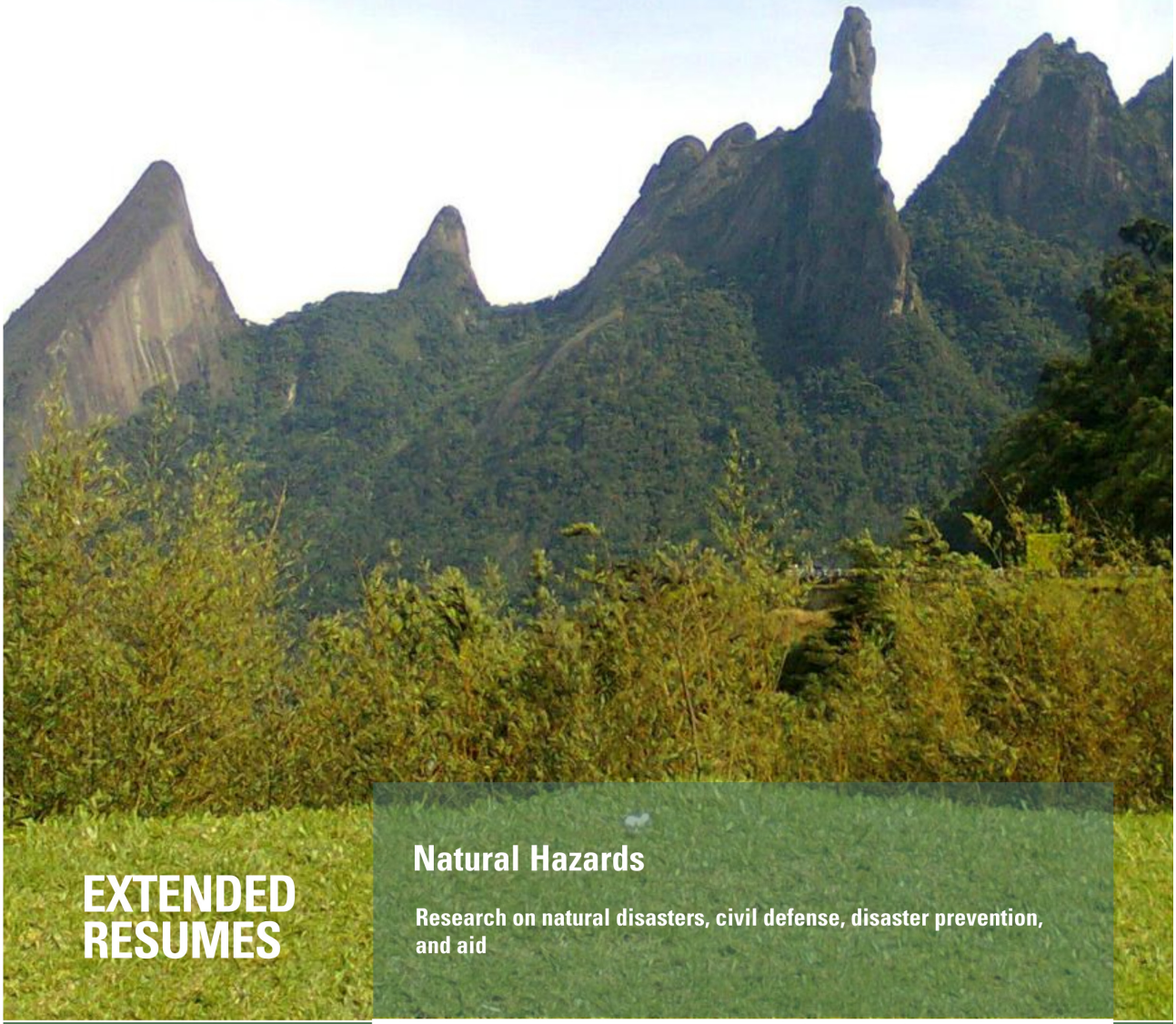
ALUMNI SEMINAR

Teresópolis
June 15th to 17th, 2012



EXTENDED RESUMES

Natural Hazards

Research on natural disasters, civil defense, disaster prevention, and aid

DAAD Deutscher Akademischer Austausch Dienst
Serviço Alemão de Intercâmbio Acadêmico

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EXTENDED RESUMES

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The German Academic Exchange Service (DAAD) organizes the seminar "Natural Hazards – Research on natural disasters, civil defense, disaster prevention, and aid" in Teresópolis, Rio de Janeiro State, on June 15th-17th.

The continuous disaster events in the last years, as the tragedy occurred in the mountain region from Rio de Janeiro State in 2011, touched us as we were deciding on the next theme for a DAAD's Alumni Seminar.

The DAAD office in Rio de Janeiro was first opened in 1972, and the Teresópolis seminar is meant to be part of the official program to celebrate its 40th anniversary this year. We are celebrating, as well, 25 years of the DAAD-program "Postgraduate Courses with Relevance to Developing Countries", which has qualified a large number of Brazilian graduates within the group of 250 students per year coming from many countries in the world.

In our seminar, we are pleased to have with us professors and students from four of these postgraduate programs. They are from the universities of Göttingen and Weimar and from the technological universities of Dresden and Munich. With this, we intend to gather the knowledge and experiences of our brazilian alumni and connect them to the teachers and students from the postgraduate courses in Germany.

Furthermore, we wish to relate the Teresópolis Seminar with the large United Nations Conference on Sustainable Development Rio + 20, which is taking place in Rio de Janeiro from 13th to 22nd of June and has also a subtopic on Disaster Risk Reduction and Resilience Building.

Our aim was to integrate a broad range of scientific areas concerning the complex and challenging question of natural hazards. We had an immediate and highly qualified return on our first call for participation. The reader of this e-book will easily identify the broad diversity of scientific approaches to the subject, presented by at least 50 Alumni from different DAAD programs, researchers from different areas and universities and institutions of all brazilian regions, as well as by professors and students from german universities. Among the participants, we are very happy to count young professionals from other countries such as Bangladesh, Zimbabwe, Peru, Bolivia, Chile, and Guatemala.

This e-book shall be widely distributed and its content made available on the homepage of DAAD Brazil in order to make it accessible to a greater audience.

We wish to thank all the participants who sent us their contributions as well as Rafaela Giordano for having organized the material and prepared the e-book.

Good read!

Christian Müller
Director DAAD Brazil

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SUMMARY

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Aspects of Movement of Coluvium in the Mountain Areas in Tropical Region

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Abstract
This article presents a study of movements of natural slopes coluvium, taking as example the situation of “Coroa Grande” in the state of Rio de Janeiro. The analysis considered results of instrumentation with inclinometers and piezometers in the area between 1986 and 2004. It was observed that the slope is moving slowly by “creeping” with displacement speed strongly influenced by rainfall.

Keywords: Natural Slopes; Creeping; Instrumentation; Displacement

Introdution

The natural slope, object of this work, is located in the coastal part of Serra do Mar in Coroa Grande, municipality of Itaguaí, state of Rio de Janeiro. At the foot of the hill is the BR-101 highway. A PETROBRAS oil pipeline lies on that area, which carries oil from a terminal located near the city of Angra dos Reis-RJ to a terminal located in Guanabara Bay, as shown in Figure 1. Thus, knowing and monitoring the hillside movements with a view of taking appropriate measures in case of impending landslides that could endanger people who live or travel in the region and harm the environment is of crucial importance.
The average inclination of the instrumented slope area is approximately 17%, being the subsoil consisted of two soil layers over rock: the first and most superficial layer is colluvial, consisting of clayey sand with gravel. The second layer of residual soil is silty clay and sandy with the presence of gravel. The deep bedrock is composed of sound gneiss rock, being altered in some nearby parts of the residual soil.
This article brings an analysis of the slope displacement from instrumentation data obtained between 1986 and 2004.

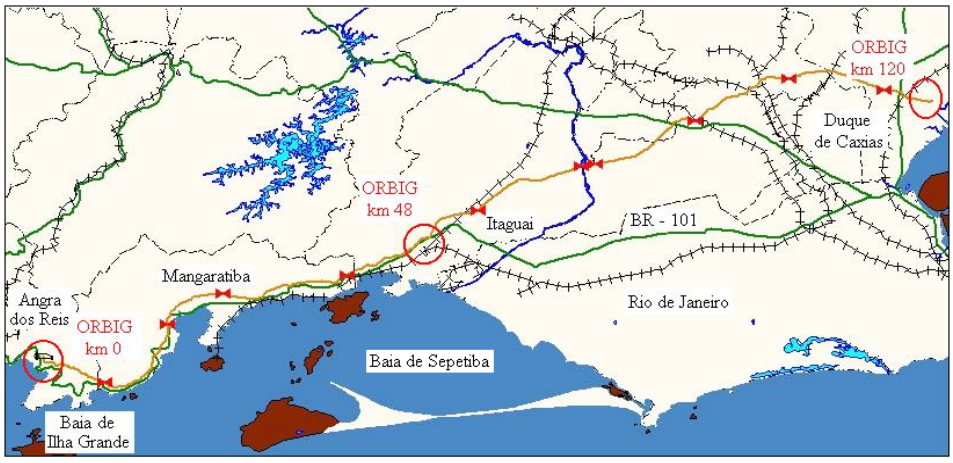

Fig. 1 - Location of the study area, Rio-Baía Pipeline at Ilha Grande - ORBIG and the BR – 101 highway.

Materials & Methods

An observational analysis of movements was conducted in the "Coroa Grande" hillside through instrumentation performed from 1986 to 1999 and from 2000 to 2004. The instrumentation considered in the study, from 1986 to 1999, was composed of 7 inclinometers, 1 Casagrande-type piezometer and 1 water level meter. The rainfall data used here were provided by the State Superintendent of Rivers and Lakes of the State of Rio de Janeiro, SERLA-RJ, for the rain gauge stations of Mendanha and Santa Cruz, the closest to the instrumented area and located about 50 km away.

The influence of rainfalls in variations of water level meters and piezometers was verified. Similarly to that reported by [1] also for slopes from the "Serra do Mar" mountain, there is a relationship between rainfalls, piezometric and water table levels, as well as horizontal displacement speed on the slope. It was also verified, in most situations, that the piezometric load and water levels values increased with increasing the amount of rain. It can be considered through relationships verified by [4] and [3] that in "Coroa Grande", the amount of rainfall is 50% higher than that in "Mendanha".

When considering the relations between the results of the displacement speed of inclinometers and the amounts of rainfall recorded at "Mendanha" and "Santa Cruz" stations, it could be verified that the rainfall peaks are close to the displacement speed peaks on the slope, as will be shown in the analysis of the results of inclinometers.

With the instrumentation results obtained with inclinometers, the sliding surface was identified and through the displacement speed, it was possible to classify the movement and analyze the stability of the "Coroa Grande" slope.

To reach the critical sliding surface, the depth equivalent to the maximum distortion was identified from the results of inclinometers for each inclinometer profile. According to the instrumentation results in the region, throughout the monitoring period, it appears that the critical or sliding surface was verified at different depths, ranging from 4.5 m to 11.5 m in relation to the ground surface level. Although several critical depths at different inclinometers were found, there is no evidence of two sliding surfaces in the same horizontal displacement profile. We assume, then, that this is the same surface, and it was possible viewing it through graphical representation in three dimensions or in topographic plant, by drawing the contour lines based on results obtained from the inclinometers. The sliding surface, recorded in the period, is located in the saturated soil even in the dry period, and very close to the contact of the colluvial soil layer with residual soil layer.

The study on the displacement speed in the period from November 1986 to August 1999 showed that the movement occurred in the study region ranges from very slow to extremely slow [2]. Analyzing each interval between measurements individually, it was observed, even in the worst situation, that the soil mass movement is by creep [6]. However, considering the entire observation period, there are variations in the horizontal displacement speed, which according to what was presented here, are influenced by rainfall, then, it is concluded that the soil mass moves by "creeping". Significant accelerations were recorded for the water table levels observed in a water level meter, above 97.05 m

Despite changes verified in horizontal displacement speeds, in the situations studied, the behavior of "horizontal displacement speed x time" curves and the speed levels achieved indicated no trends of rupture. The speeds had small oscillation around average equivalent to 0.05 mm / day. Accelerations of the displacement speeds are checked only during rainy seasons, reaching a maximum of 0.66 mm / day in November 1998.

The movement observed in the case shown is considered its worst situation, of low destructive power [2]. Some permanent structures may remain intact during the movement. Proven cases show situations of movements within the same speed range and without significant damage [7]. According to [5], for cases of residual and coluvionar soils, speeds from 2 to 5 cm / day during periods of heavy rain indicate imminent collapse.

Results & Discussion

According to the results of inclinometers, throughout the monitoring period, one could observe that the sliding surface was predominantly verified on the contact surface of the colluvial with the residual soil. Considering the results of the water level meter in the study period, it was found that the sliding surface is located in saturated soil, even in the dry season.

The study of the displacement speed proved that the movement occurred in the studied region is by "creeping". The increase in the amount of rain, according to what was observed in inclinometers, piezometers and water level meters in the period from June 1988 to June 1991, seemed to cause increases in piezometric hydraulic loads and horizontal displacement speeds, as well as elevation on water table. Despite changes in the horizontal displacement speeds, in the situations studied, the trends in the behavior of "horizontal displacement speed x time" curves did not indicate rupture.

Acknowledgement
The authors would like to thank FINEP / CTPetro for their support in the initial phase of this research, TRANSPETRO-PETROBRAS for providing data for instrumentation, to the general financial support provided by Pronex / MCT, Faperj and CAPES for the scholarship awarded to the first author.

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The protection of architectural heritage against natural hazards

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Abstract
This paper discuss about the experience that is being developed at the Laboratory of Computer Graphics applied to Architecture and Design (LCAD), at the Architecture School of the Federal University of Bahia (FAUFBA). The research aims documenting architectural heritage in the Bahia state, in Brazil, using a set of digital technologies, in order to protect them against the all kind of risks, even natural hazards, preserving the memory of Bahia's Cultural Heritage. The research is being helded in several historic sites of the state since 2004, using several technologies like digital photogrammetry, digital Cartography, spatial databank, Geographic Information Systems, three-dimensional geometric modeling, CAD technology and 3D Laser scanning technology. The documentation project creates a digital iconographic databank of orthophotos, satellite images, terrestrial and aerial photographs, drawings and all kinds of three-dimensional geometric models, including urban cadastral plans, topographic surveys of the buildings and their historic sites, and their metadata. At the end of this project, it is expected that all this data and information will be available at the project website on the Internet: <www.arqdoc.ufba.br>. Finally, divulgating this architectural heritage to the public, we hope to contribute for its preservation and call attention for the urgency of a heritage protection policy.

Keywords: Natural hazards; Cultural Heritage; Architectural heritage; Architectural Documentation; Digital Technologies

Introduction

The state of Bahia, and more specially, the city of Salvador, are known internationally for the beauty and richness of its historical and cultural heritage, and also for the wideness and importance of its architectural heritage. The colonial group of houses of Pelourinho area, the palaces, churches, convents, monasteries, fortifications, the sugarcane factories and Cachoeira city on the Recôncavo Baiano, the historic cities of seaboard, like Porto Seguro or still the cities in the heart of the state, like Lençóis and Rio de Contas, are incontestable examples of this cultural heritage.

Therefore, Bahia was a pioneer in large initiative on documenting its cultural heritage. In 1974, it was created the Inventory of Protection of the Cultural Collection of Bahia, called IPAC (Inventário de Proteção do Acervo Cultural da Bahia), which divides the state in five regions, for inventory purpose. This work was sponsored by the Bahia State Government and it was published in six books, printed in black & white. The first one was finished in 1975 [1].

Another pioneer initiative in 1970s, was the surveying with short range photogrammetry of the ruins of the Garcia D'Ávila castle [2], also known as Casa da Torre (House of the Tower). This construction gives name to one of the most famous place in Bahia, the Praia do Forte beach. It is unnecessary to say that these works were made using traditional techniques and without computer aids. Despite of this important efforts in documenting this heritage, the IPAC has a comprehensive collection, it only represents the first step towards a systemic knowledge of this heritage and, it is insufficient for its studying and effective protection [3].

In spite of the recognized importance of this architectural collection, still unique and significative, this fact, alone, has proven to be insufficient to guarantee its preservation, its wideness, and in some cases, due to the abandonment they were submitted during many years, except for some rare exceptions. So, it is important to perform an extensive documentation of this architectural heritage, not only to preserve its memory, but also as a safeguard in case of any kind of accidents.

Every year Salvador loses several buildings by the intensive rains, some of them having historic importance. For hundred years Cachoeira city was flooded by the Paraguaçu river, and a lot of important monuments were destroyed and completely lost. Many others areas of the country suffered significative destruction like Goiás Velho city in Goiás state, in 2001, or São Luis do Paraitinga city, in São Paulo State, in 2010, both caused by intensive rains and floods.
This documentation project with digital technologies was proposed as a project that aims documenting meaningful buildings and sets of buildings in some of Bahia's historic cities, and make this database available for research and others applications.
It is important to point out that this is a pioneer work in Brazil, and these kinds of data are inexistent for historic brazilian cities, even for the famous ones, like Ouro Preto, in the state of Minas Gerais or Parati, in the state of Rio de Janeiro. The cities of Lençóis, Salvador, Rio de Contas e Cachoeira were chosen to start this project.
The Architecture School of the UFBA has tradition and a precursor work in this field, in conservation and restoration of monuments and historic sites, through enterprises like the Center of Studies of Architecture of Bahia (CEAB), since the 1960s and the Course in Conservation and Restoration of Monuments and Historic Sites (CECRE), which is supported by UNESCO. For instance, all of the initiatives in heritage documenting in Bahia, mentioned before, were done by professionals of this institution.
Over the last decades, many conservation actions have been implemented (legal protection, recovery and restoration works), but none of them have resulted in effective conservation of such property, whether by insufficiency of human and financial resources, either by the lack of a strategic planning policy that articulates the various social actors through democratic participation. Maybe, much of the population do not recognize the importance of this heritage.
In Letellier (2007) words [4]:

> Today the world is losing its architectural and archaeological cultural heritage faster than it can be documented. Human-caused disasters, such as war and uncontrolled development, are major culprits. Natural disasters, neglect, and inappropriate conservation are also among the reasons that this heritage is vanishing. Although we should strive to preserve as much as possible of our architectural and archaeological cultural heritage, we cannot save everything. One of the options available to heritage managers and decision makers is to document this heritage before it is lost. (LETELLIER, 2007, p. vii).

Besides the more obvious applications in conservation and restoration of the buildings, the architectural documentation plays a vital role in preserving the memory of this heritage. This is a highly relevant aspect, given the impossibility of the physical preservation of all significant samples. There are several reasons for this, from the simple effect of time and weather, to more serious and dangerous causes such as heavy rains and floods, fires, earthquakes, neglect, abandonment and vandalism, among others. In Brazil, this is particularly worrying considering that except for few examples; most buildings from the colonial period were composed of raw earth and wood, materials that are completely destroyed by water and fire.

Materials & Methods

The project of architectural documentation of historical sites and monuments can be understood as a complex process of systematic and comprehensive planning, acquisition, processing, indexing, storage, retrieval, dissemination and delivery of data and information about single buildings or sets of them, including graphical and non-graphical information and their metadata for various uses [5].
As explained before, by their nature and extent, the documentation of architectural heritage in Brazil is a strategic issue and involves a great effort for its accomplishment. The actions proposed aim to safeguard these monuments.
All steps in this process involve the comprehensive and intensive use of digital technologies. Thus, the methodology proposed comprehends five main parts summarized here [6]:

- The overall planning stage, that consider all aspects of the work and the objective conditions for it, as well as the financial support and other resources;
- Data acquisition and field work, when the primary or raw data are captured from in situ

studies or compiled from secondary sources, which also involves some other technologies;

- Data processing and analysis, including handling or manipulation, when the data (primary or secondary) collected are processed to generate the desired products or information and their metadata;
- Management of data including indexing, storage, retrieval, data security, access, dissemination and publication of the data and information produced for concerned public and, finally,
- Control and documentation of the project, in which should be analyzed the various aspects involved in the project implementation, as well as the assessment procedures used, and product quality grades, and also indicators of income, essentials to assist in the planning of future works.

This set of phases represents a scientific methodological approach for a documentation project in order to achieve best results and the best practices. Thus in the development of these activities it is required a set of digital technologies in every related step. So, for the urban and architectural documentation purpose several digital technologies have been tested and used in this research, like: Topographic Automated Survey; Digital Cartography; Digital Terrain Modeling; Digital Photogrammetry; Spatial Databank; Geographic Information Systems; Three-dimensional Geometric Modeling; CAD technology, 3D Laser Scanning and others technologies.

Results & Discussion

Regardless of immediate applications that led to the execution of the survey, once data is produced, it needs to be indexed, stored and preserved for later use. And to ensure that these data can be used effectively they must be disclosed, published and retrieved. This procedure closes the cycle that encompasses planning, gathering, processing, indexing, storage, publication, dissemination, retrieval and use of data and information on buildings and architectural ensembles. Information which in turn will influence the conservation and interventions on these sites by generating a new cycle of documentation, to be repeated indefinitely throughout the lifetime of the building and sometimes even after their destruction.

As a result of the documentation project, it is generated a huge multimedia database containing information of buildings such as photographs, photographic panoramas, rectified photographs, orthophotos, technical drawings, various types of 3D geometric models, including point clouds, and other kind of data such as videos, audio tapes, interviews, reports, pictures and historical texts, among others.

The produced data was published in the web and at the present moment we have released two sites: Lençóis <www.lencois.ufba.br> and Rio de Contas <www.acervoriodecontas.ufba.br>. For the next sites it will be provided in a near future a robust website called Arq.Doc – Architectural Documentation at: <www.arqdoc.ufba.br>, where it is expected to publish all data produced.

Conclusions

As explained here, the documentation process for architectural and urban sites, because the amount of variables involved and resources allocated is a complex and multidisciplinary activity, involving traditional disciplines such as architecture, design, survey methods, history and art history and strongly combining digital microelectronics, computer science and information science, involving significant technological, financial and human resources.

The documentation can't protect the physically the buildings, but can provide information for their restoration in case of any accident. However, in case of the building being completely wracked, the multimedia database could preserve its memory for the future generations and educational purposes.

Finally, with this public divulgation of this architectural heritage database, we hope to contribute for historical sites preservation by promoting the knowledge about them and the valorization of these urban sets, and also calling attention for the urgency of a heritage protection policy and the risk they are submitted continuously.

Acknowledgement

We want to register our acknowledgments to everyone who has contributed in any way for the works here related. We would like to thank specially to the Brazilian agencies CNPq and CAPES for their support to the

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Rainfalls and natural disasters: the 2011- 2012 events in Minas Gerais State Brazil

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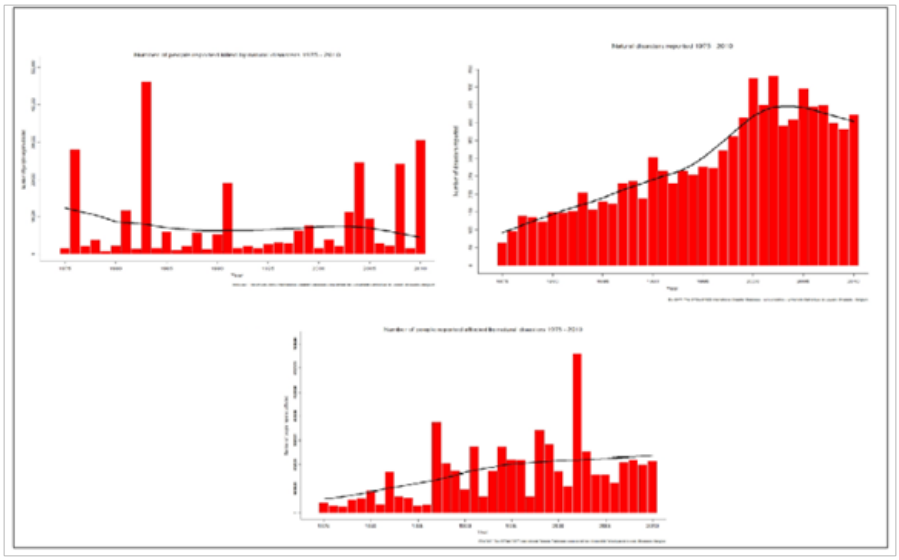
Abstract
This brief communication was compiled from recent data on the latest events of natural disasters 2011/2012 in Minas Gerais State. This is not a scientific article, but a communication on the scene, where a succession of catastrophic events took place. Natural disasters were responsible for killing about 4 million people in the world throughout the twentieth century, according to an estimate made by the Committee on Disaster Research Science Council of Japan, in 1989. The damage caused by natural disasters concentrated in the last two decades, when about 3 million people died and another 800 million were adversely affected by having spent more than US$ 23 billions. Brazilian problems associated with natural disasters are almost exclusively associated with geological processes on the external dynamics of the planet, which include landslides and related processes, flooding, erosion, sedimentation subsidence/collapse. In Brazil, the risk associated with accidents and geological processes are purely exogenous, with landslides and related processes which cause more loss of life. These natural phenomena are often conditioned by atmospheric general circulation systems operating in the region of Brazil, especially in summer, and use variables in geological order, geomorphological, topographical, pedological, hydrological and land use. The summer of 2011/2012 began catastrophically, it was characterized by one of Brazil's worst ever natural disaster, the scene of the tragedy was the Minas Gerais state, were several municipalities in Minas Gerais - 62% were affected by disasters related to severe rainfall events. In the first seven days of January 2012, it rained in Belo Horizonte 334 mm of rain, what corresponds to 22% above the expected average for the month, causing flooding in various parts of urban areas, floods and gravitational mass movements. the total number of homeless and displaced in Minas Gerais due to the floods which hit several cities doubled after the update data made by the State Civil Defense, and exceeds 2.495 people, number of homeless rose to 25.514 and 15 people have died and 3 were missing.

Keywords: Minas Gerais; Rainfall; Natural Disasters; Tragedy

Introduction

Natural disasters are a theme more and more present in everyday's people lives, independently weather they live or not in areas of risk. Although at first the term leads us to associate it with earthquakes, tsunamis, volcanic eruptions, cyclones and hurricanes, Natural Disasters also include processes and more localized phenomena such as landslides, flooding, subsidence and erosion, which may occur naturally or induced by man. Worldwide, according to data EM-DAT (2009) there was an increase in the records of the occurrence of natural disasters, increased from 50 per year in the 70 to 500 in 2005 and the material damage reached the figure 1 of 180 billion in 2008 and the number of people who lost their lives was estimated at more than 300.000 between 2009 and 2010 (Graphic 1).



SOURCE: EM-DAT, (2009). Org: Baggio, (2012).

Brazil is among the countries most affected by floods and disasters of the world, having recorded 94 registers in the period from 1960 to 2008, with 5.720 deaths and more than 15 million people affected (homeless/displaced) most natural disasters is associated with severe weather events that are responsible for triggering floods, windstorms, hail and landslides. Over 60% of these events occur in the south-southeast, in those regions atmospheric instability are common due to cold fronts in the winter, occurrences of mesoscale convective complexes in the spring (MCC) and the formation of convective systems in the summer, especially The South Atlantic Convergence Zone, or SACZ, these systems achieve a wide range of central Brazil (INSTITUTO GEOLÓGICO, 2009).

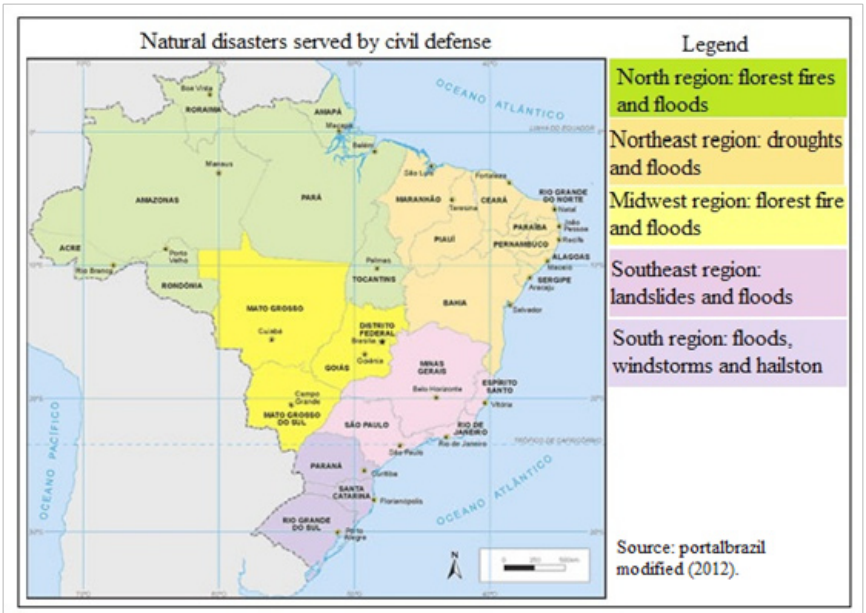


Figure 1 - Types of natural disasters occurring most in Brazil. Source: portalbrasil, modified Baggio, (2012).

The summer of 2011/2012 began catastrophically, it was characterized by one of Brazil's worst ever natural disaster, the scene of the tragedy was Minas Gerais State, where several municipalities - 62% were affected by disasters related to severe rainfall events. In the first seven days of January 2012, it rained

in Belo Horizonte corresponding to 22% above the expected average for all the month, 334 mm of rain, causing flooding in various parts of urban areas, floods and gravitational mass movements - landslides. The total number of homeless and displaced in Minas Gerais due to floods that hit several cities doubled after the update data made by the State Civil Defense – CEDEC/MG, and exceeds 2.495 people, number of homeless rose to 25.514 and 15 people have died and 3 were missing (CEDEC-MG, 2011).

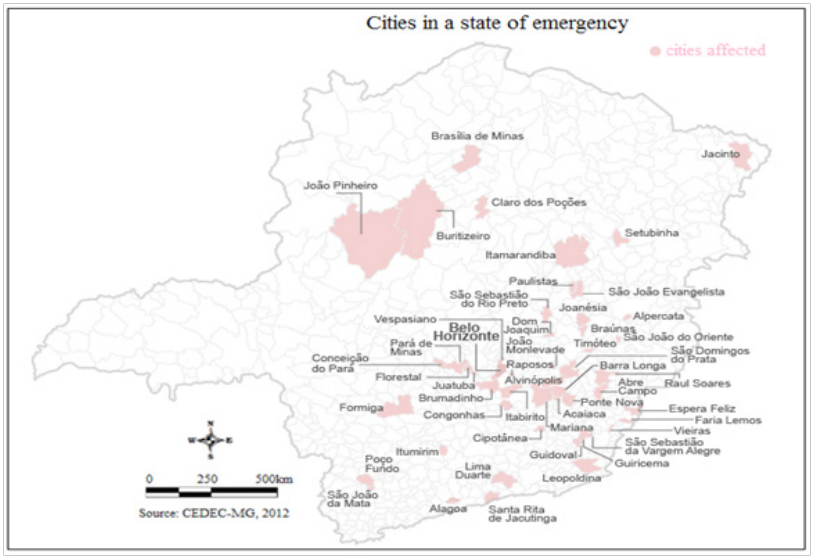


Figure 2 – Cities most affected by natural disasters (floods, flooding and landslides). Source: CEDEC-MG, (2011). Org: Baggio, (2012).

Location and physiographic features

Minas Gerais is one of 27 states of Brazil, located in southeastern being the fourth largest in area – 586.528 km² - the state is the second most populous in Brazil, with almost 20 million habitants. The state capital is Belo Horizonte, with about 5.5 millions habitants, and thus, the third largest urban agglomeration in the country. The state of Minas Gerais is located between parallels 14°13'58'' and 22°54'00'' south latitude and meridians 39°51'32'' and 51°02'35'' W-Gr. Altimetrically the altitude ranges from 450 to 1.700 meters. The relief of Minas Gerais is compartmented in 5 relief units: Cristalline plateaus, Espinhaço Range, San Franciscana depression, São Francisco Plateau, Paraná Plateau, resulting from an alternation processes:, morphoclimatic, morphostructural, morphosculptural and morphotectonic (CETEC, 1983).

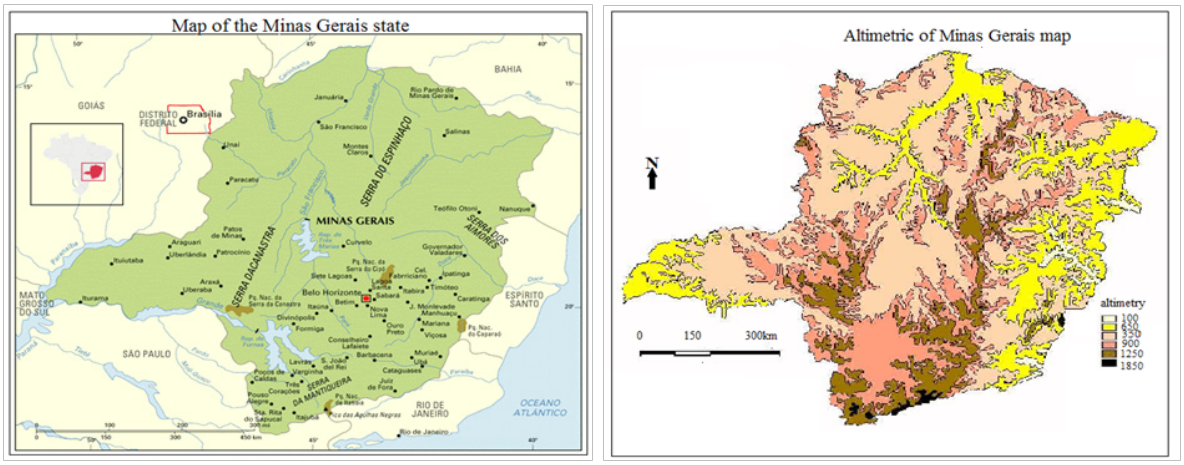


Figure 3 – (a) location map of Minas Gerais and (b) altimetric map. Source: Guianet.com.br (access, 2012); CETEC-MG, (1983). Org: Baggio, (2012).

Reis (2001) according to Köppen's classification, defined the climate for Minas Gerais: Aw-Tropical rain; Cwa hot tempered; Cwb cold tempered. Average annual rainfall in Minas Gerais varies from 900mm to 1.800mm. Temperatures vary from 23°C to 24°C. Rainfalls in summer months are intensified, causing floods and landslides in several municipalities of the state, due to the occurrence of the Convergence Zone of the South Atlantic (SACZ). The SACZ is usually oriented northwest-southeast direction and is associated with a convergence zone in the lower troposphere, which extends from the south of the Amazon to the Atlantic Center, a few thousand kilometers (Diaz, 1995).

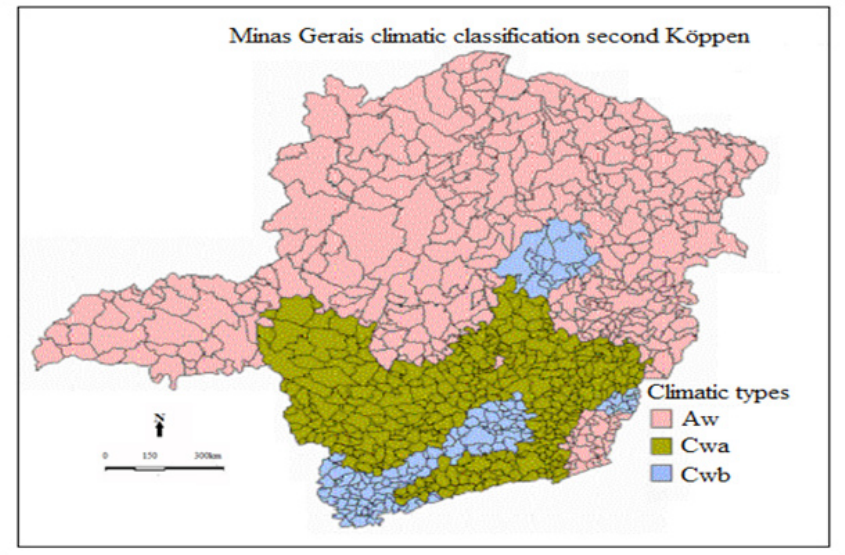


Figure 4 - Climatic classification of Minas Gerais. Source: Reis, (2001). Org: Baggio, (2012).

Originally the vegetal coverage of Minas Gerais is made up of four major biomes: Cerrado, Atlantic forest, Originally the vegetal coverage of Minas Gerais is made up of four major biomes: Cerrado, Atlantic forest, Dry forest and Rupestris fields. The Cerrado occupies about half the territory of the state, occurring in Central portion of Minas, West, Northwest and North. The second largest area of coverage is represented by the Atlantic forest, in the portions South, Southeast, Central and Eastern Minas Gerais, having been severely deforested and currently limited to small areas. The main Hydrographic basins have their heads in Minas Gerais: São Francisco Basin, Paraná Basin and East basins. (CETEC,1983).

Methods

As this is a brief communication, a compilation of recent data on the latest events of natural disasters 2011/2012 in Minas Gerais State, the work had a qualitative character. Some activities are considered of paramount importance in planning the project methodology, among them: bibliographic and cartographic research, which consisted in a comprehensive survey and review of surveys as well as studies in risk areas, environments and also aspects of the physical, economic, social and environmental context of regional and local area surveyed. All data were tabuled and maps generated using software Corel Draw X3.

Results and discussion

Analysis of scenarios of disasters caused by heavy rains in Minas Gerais

Irregular occupation of risk areas without soil use planning, associated to climate changes, have caused disasters in the world, with such intensity that forces us to reflect on the occupation of the planet and the need of changing attitude. In the last rainy season, Brazilian media showed several disasters. Among them, we highlight the floods and landslides that occurred in the mountainous region of the State of Rio de Janeiro, where there were recorded 919 deaths, 4.563 injured and 252.680 people affected. It shows that the result of the disaster magnitude presents significant numbers of human damage, without considering the environmental, economic and social damage. In the State of Minas Gerais, 25.32% of the cities were hit by rain-related disasters in the period 2010/2011and 2012, the south and the Zona da Mata together

accounted for 40.05% of total disaster and were the most affected (CEDEC-MG,2011).

Evolution of rain-related disasters in the State of Minas Gerais

During the last rainy season (2010/2011), an increase of 0.47% in the number of municipalities affected by disasters caused by heavy rains in Minas Gerais State, compared to the historic average of the last nine years, which was 215 municipalities in this period. Regarding the number of processes homologated, there is an increase of 12.79% compared to the historical average of 86 cases (Table 1).

Disaster	2001/02	2002/03	2003/04	2004/05	2005/06
Municipalities affecte	239	261	218	234	152
Processes homologated	169	136	105	50	20

2006/07	2007/08	2008/09	2009/10	2010/11
316	121	276	210	216
158	7	100	29	97

Source: CEDEC-MG, (2010).

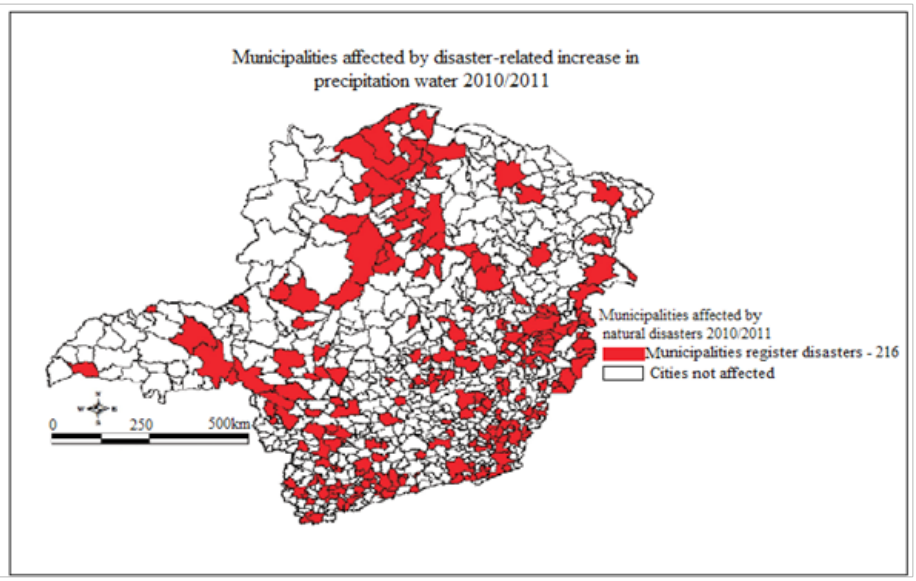
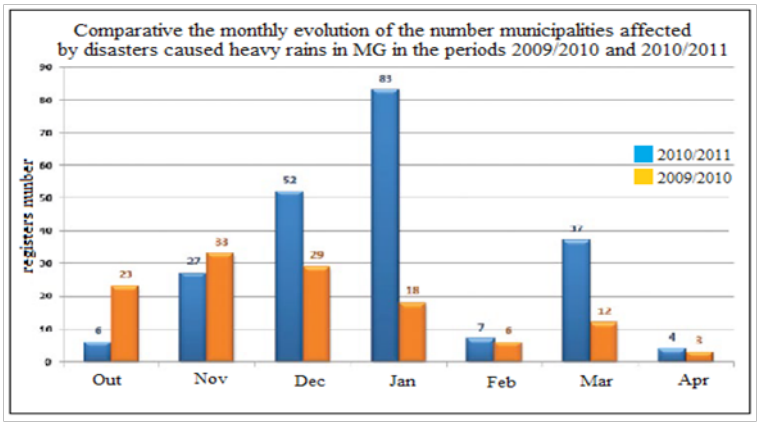


Figure 5 - Cities most affected by natural disasters (floods, flooding and landslides).
Source: CEDEC-MG, (2011).

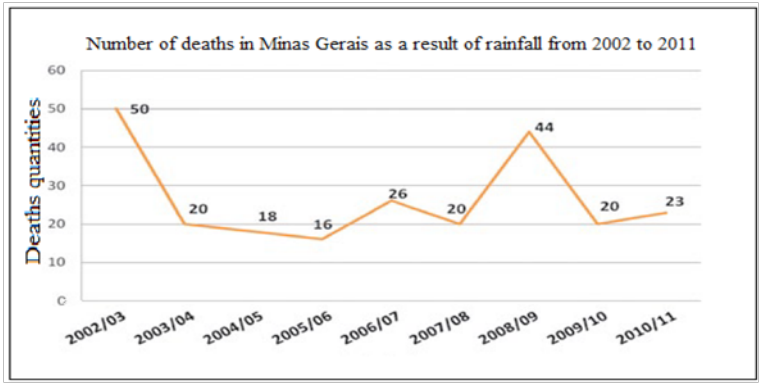
Graphic 2- Comparison of the monthly evolution of the number of municipalities affected by disasters caused by heavy rains in Minas Gerais in the periods 2009/2010 and 2010/2011.



Source: CEDEC-MG, (2011), modified by Baggio, 2012.

Graph 1 shows that in the period 2009/2010, the highest incidence of rain-related disasters occurred in November and December, the largest volume of rainfall recorded. During the period (2010/2011), the highest incidence was in January, which recorded 38.43% of the municipalities affected, followed by the month of December with 24.07%. It was registered during the two months together 62.5% of total disasters. It shows that the rainfall had been above the historical average in the period occurring various temporal from 1st to 14th of January, 2011. It shows the relationship between the numbers of municipalities affected in the period with the precipitation observed. Through the evaluation form of damage (Avadan) the human damage, environmental and economic and social losses of the municipalities affected by rains were measured in the period 2010/2011. The losses were in the order of US$ 515.635.198. In comparison with the average of the three previous periods (2007-2010) US$ 196.612.161, comparing to the average of the last three periods - 2007- 2010 US$ 196.612.161 millions there was an increase of 162.26% in the total measured by Avadan (CEDEC-MG, 2011).

Graphic 3 - Number of deaths in Minas Gerais as a result of rainfall from 2002 to 2011



Source: CEDEC-MG, (2010) modified by BAGGIO, (2012).

Graphic 3 points that in the last rainy season (2010/2011) there was a reduction of 14.81% of obits comparing to the historical average of the last eight cycles of rainfall which is 27 records. The major cause of deaths related to disasters caused by heavy rains is the burial, with 52% of cases. The disaster has its origin in the vulnerability of homes built in areas subject to landslide risk.

Consequences of natural disasters

In the weeks of the disaster Minas Gerais was under the influence of the convective system called The South Atlantic Convergence Zone - SACZ, characterized by a intense channel of moisture which extends from the North region to the Southeast region (Figure 5). According to the National Institute of Meteorology, INMET, on the first seven days of January 2012, it rained in Belo Horizonte the total of 22% above the average previewed for the month. According to the Meteorological Institute of the Energy Company of Minas Gerais – CEMIG, it rained 334mm when the expected was 274 for the whole month.

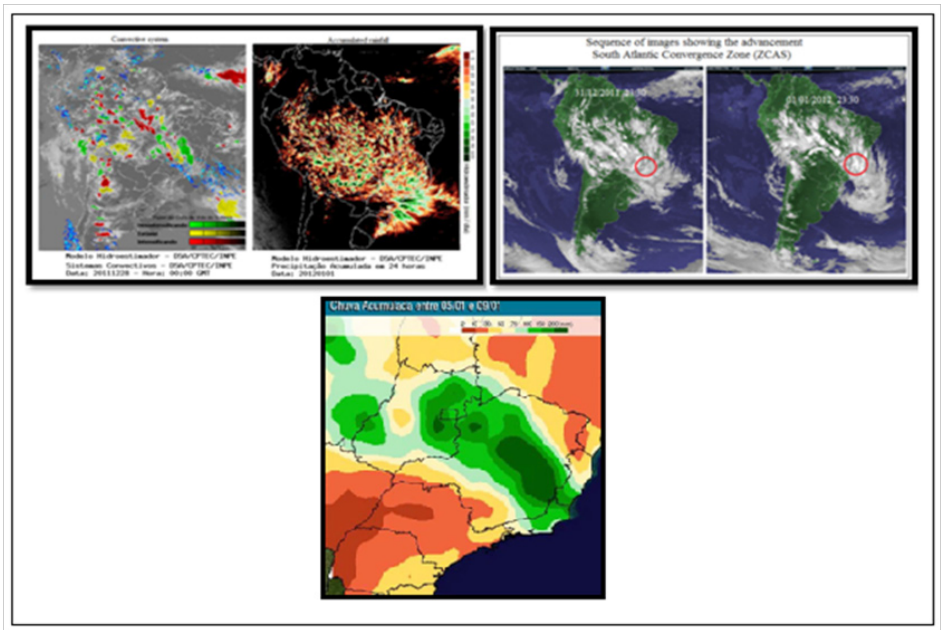


Figure 5: Climatic situation on the tragic event. Source: INPE and Climatempo, (2011). Org: Baggio (2012).

Figure 6 - Different rainfall aspects, physical structures damages in towns in Minas Gerais State. Org: Baggio (2012).

Figure 7 – images of the flood victims rescue and assistance in towns of Minas Gerais State. Org: Baggio (2012).

Considerations

Every year history repeats itself, when summer comes and with it the rainy season, there comes the suffering of the underprivileged class, who normally lives in risk areas, the hillsides that surround the major cities in the Southeast. Natural disasters in Brazil and in Minas Gerais state are a foretold tragedy: authorities fail to provide safe housing outside risk areas for low-income populations, therefore they occupy risk areas. The disaster is announced by geoscientists, it is just a matter of time. The municipal and state authorities are fully aware of the fact. Hundreds of lives were and will be lost, physical structures were and will be destroyed, in addition to a large amount of biological and animals losses. The occupation of risk areas should be strictly forbidden; however, most families are not able to afford adequate housing and occupy the hillsides. How long will the country witness this kind of tragedy? Actions must be taken immediately, before the next summer, to prevent the repetition of these tragic incidents.

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Natural Hazards – Research on natural disasters, civil defense, disaster prevention, and aid
Teresópolis / Rio de Janeiro - Brazil, June 15th to 17th, 2012

The relevance of studying the structural vulnerability of buildings in natural hazards

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Abstract
One of the most effective ways to minimize losses and damages caused by natural hazards is prevention through a preliminary survey of the hazards areas and the structural quality of buildings in this area. In this work is presented the example of evaluation of risk of different natural hazards. The study cases of earthquakes evaluation according to the European Macroseismic Scale and floods according EDAC (Earthquake Damage Analysis Center – Bauhaus-Universität Weimar) are extended to Brazilian scenario. A proposal of evaluation of structures vulnerability against landslides is also presented.

Keywords: Natural Hazards; Structural Analysis; Brazilian Code

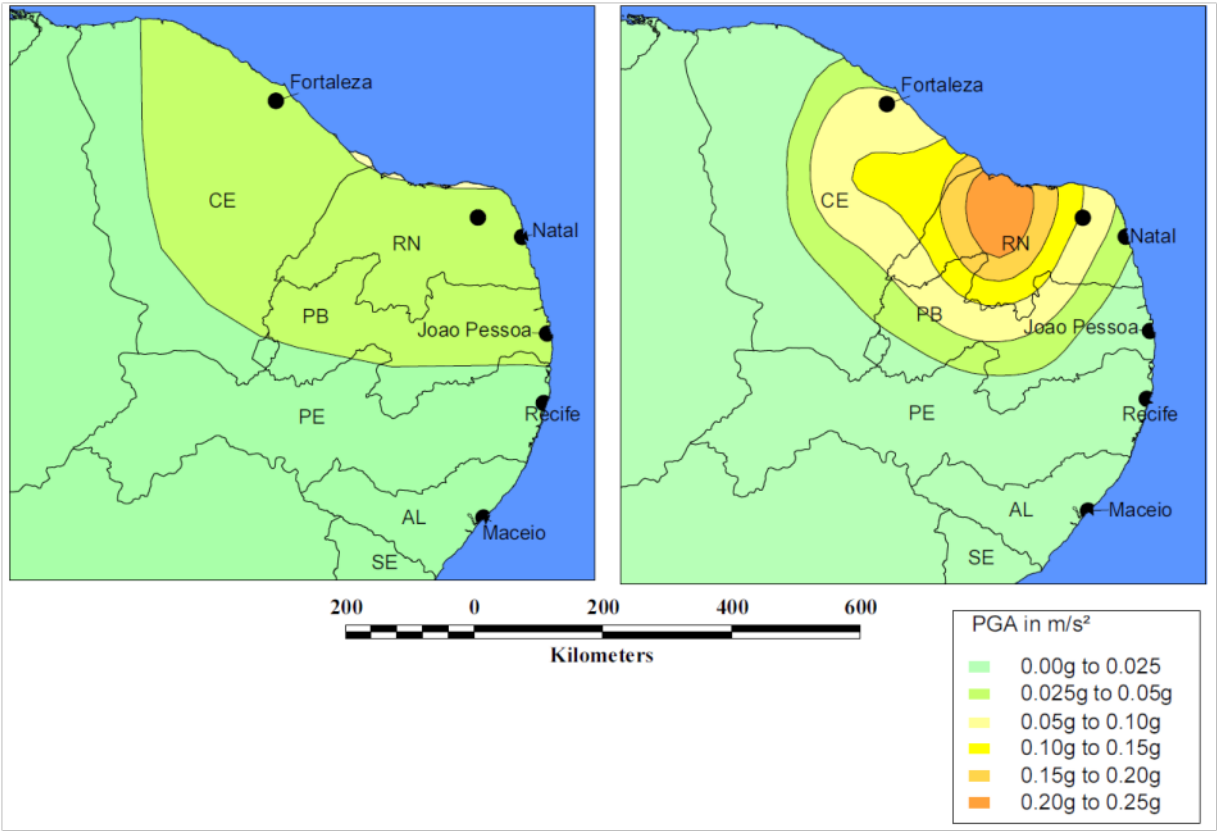
Introduction
Among the Brazilian natural hazards, floods and landslides are the most deadly [1], and up to now there was only one death due to earthquake. However in opposite direction many research has been developed around the world to structures support the extremely load from earthquakes in comparison with the others natural hazards.
The present work gives an overview of the risk evaluation of natural hazards: earthquakes, floods and landslides in Brazil. For the first natural hazard, earthquake, a new zoning map according to U.S.G.S. data base is proposed to Brazilian Code of seismic action. Also an evaluation of building vulnerability according to European Macroseismic[5] is presented.
For flood natural hazard an evaluation of building vulnerability is presented according to EDAC Flood Model by Schwarz & Maiwald [6]. Finally it is proposed to expand the approach to the evaluation of buildings and contained walls against landslides hazards.

Materials
The based materials used in this work present are the European approach against natural hazards, in special the developed in EDAC, and how it has been applied in different conditionals around the world. Also is part of the material the Brazilian date base, such as the earthquake catalog, the Brazilian seismic code and risks map developed from DRM-RJ [8].
The main approach against natural hazards losses presented here, is the previous development of risk maps based in the hazards information and also in the land use and building vulnerability.

Results & Discussion

Earthquake evaluation
The hazards evaluation of earthquake in Brazil is given by the zoning map in seismic code NBR-15421[2]. Although the Brazilian map and the data base from U.S.G.S (U.S. Geological Survey) [3] have almost the same hazard zoning for the all the country, there are particular regions where the Brazilian zoning has lower values when compared to U.S.G.S hazard studies, especially in the North-east area of the country (see maps in Figure 1). As an example, the city of Fortaleza, has 0.04g (4 % of gravity) according to NBR 15.421, and 0.06g (6% of gravity) according the data from USGS. Moreover the Brazilian Code allows using just 1% of the weight of building's floor as horizontal loading for structural design for area where the ground acceleration values are under 5% of gravity, but for any value over it not. It is necessary to apply others

approaches, such as statically equivalent horizontal forces or a complete dynamic analysis. It is not only a quantity different, but also a difference in the methodological approach.



Figures 1: Peak Ground Acceleration for according to the NBR code (left) and USGS (right).

For risk evaluation, up to now, there is no study for the whole country which can be used as a basis for the vulner-ability analysis of the building stock and the predominant structural types. Also there isn't any approach to classify their resistance under seismic action.
Subsequently, the author is focusing on the European Macroseismic Scale (EMS-98) as reference approach. In its classification each building type is defined with different vulnerability, based in strength of the structure, and also other relevant factors for seismic resistance.
Although Brazil and Europe have not the exactly same building types, the European Macroseismic has a broad structural group evaluated, which can be used in a preliminary evaluation. Also some building types are quite common in Brazil and not in Europe, such as mud or straw, which needs a particular study. An assignment of the (most) probable ranges of vulnerability classes has to be built for all Brazilian building types [5].

Table 1: Classification of the Brazilian building type using the Vulnerability Table of the European Macroseismic Scale 98 (EMS-98) [5] and the Brazilian housing type distribution [7]

	Brazilian Housing type distribution [7]	Type of Structure	Vunerability Class A	B	C	D	E	F
MASONRY	80.3%	rubble stone, fieldstone *	○					
		adobe (earth brick)						
		simple stone *	⊢○	○				
		massive stone *		⊢○⊣	○	⊣		
		unreinforced, with manufactured stone units	⊢	○	⊣			
		unreinforced, with RC floors		⊢	○	⊣		
		reinforced or confined			⊢	○	⊣	
		soil cement bricks (not include in EMS)						
REINFORCED CONCRETE (RC)	10.4%	frame without earthquake-resistant design (ERD)	⊢	- -	○	⊣		
		frame with moderate level of ERD **		⊢	- -	○	⊣	
		frame with high level of ERD **			⊢	- -	○	⊣
		wall without ERD		⊢	○	⊣		
		walls with moderate level of ERD **			⊢	○	⊣	
		walls with high level of ERD **				⊢	○	⊣
STEEL	> 1%	stell structures			⊢	- -	○	⊣
WOOD	6.4 %	timber structures		⊢	- -	○	⊣	
EARTH	1.6 %	mud (not include in EMS)	○					
OTHER	1.3 %	straw (not include in EMS)	⊢	○	⊣			
		reclaimed materials (not include in EMS)	○	⊢				

○ most likely vulnerability class;
— probable range;
--- range of less probable, expectional cases
* rare structure in Brazil
** unique structure in Brazil

Flood evaluation

Materials developed concerning flood hazard in Brazil are a quite large. IBGE. (Instuto Brasileiro de Geografia e Estatistica) has topography maps, in scale 1:50,000 in almost populated Brazilian areas. These maps can be used in a macro scale analysis.

But in a micro scale, 1:2,000 as instance, there is still much material to be developed in urban areas. The survey in these cases is a subject for the city halls, which usually have the data only in particular areas in the cities.

For risk evaluation there isn't any data, even an approach to develop a prognostic of building vulnerability under the flood scenario. Following the same criteria used in seismic hazard assessment, the use of the vulnerability classification according to EDAC-Flood Model [6] is proposed. Although this classification can be applied in Brazilian building, it must be expanded to different building types, such as confined masonry, adobe and reinforced concrete, more typical building stock.

Landslide evaluation

In last years the focus in Brazil is to developed hazard maps of landslide. Considerable progress was reached by DRM-RJ [8]. Evaluation of many urban areas, in special in the area of the towns of Teresópolis and Petrópolis could be performed.

For risk analysis, here is proposed to develop an aligned building vulnerability evaluation, following the same method as shown by the European Macroseismic Scale [5] for seismic and by EDAC [6] for flood scenarios, respectively. In the case of landslides relevant factors such as foundation type can be added as a vulnerability criterion; in the same approach the horizontal and vertical regularity are applied in seismic evaluation.
Finally a classification of contained walls, buttress and others soil contained can be developed. The final outcome will be a risk map based on the developed (multi-)hazard maps and the proposed vulnerability classification.

Possible outcomes

The main approach to reduce the losses in natural hazards present in this work is the previously prognostic of hazard and risks of a studied area. Geographical Information System (G.I.S) is the main tool in this approach. With aligned method to study different hazards it is possible to build a multi- hazard and risk evaluation, where not only a single particular hazard can be studied, but also a sequence of them, such as, floods followed by landslides or earthquakes followed by landslide or even earthquakes followed by floods (Tsunamis).

Acknowledgement

I would to thank DAAD – Deutscher Akademischer Austausch Dienst for the support of my studies at Bauhaus-Universität Weimar and for financial support for the Natural Hazards Risk in Structural Engineering. Special thanks to Dr.-Ing. Jochen Schwarz and Dipl.-Ing. Lars Abrahamczyk, Supervisor and Lecturers in the Master Course “Natural Hazards and Risks in Structural engineering” for orientation in present work.

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Climate change and land use and occupation: strategic factors for urban planning and urban flood management - Teresópolis

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Abstract
Climate change, growing and unplanned urbanization make cities potentially vulnerable for flood risk. Not only is it necessary to understand the climate system but the hydrological cycle as well how they have changed. Climate changes must be fitted into the concept of development and this point reveals the importance of urban flood management as part of urban planning. In whole world, urban floodings are expected to happen more often and causes are various. Continuing urban development and climate changes increase risks and impacts if no policy changes are made. An integrated approach is needed; it involves planning procedures, building measures, governance (liabilities and responsibilities), society and her importance on local participatory decision-making. On January 2011, floodings, mudslides and landslides killed more than 900 people, 300 people disappeared and several areas were completely devastated in five cities of "Região Serrana"- a mountainous area in the Rio de Janeiro State, Brazil. On April 2012, new floodings and landslides occurred. This study of case, using Teresopolis City as an example of the affected cities, intends to contribute to the debate by contrasting local reality, land use and occupation, environmental impacts and climate changes.

Keywords: Climate Change; Urbanization; Land Use; Floodings

Introduction

Climate change affects all, but it does not affect us equally. It is necessary to understand the reality of each region to guarantee the sustainable development which is strongly linked to the capacity to respond to the challenges and opportunities associated with climate change.
The consequence of these changes potentially affects human´s life, health indicators, economic growth, water availability, food production, ecosystems and much more.
Brazil plays an important and unique role in climate change. It is one of the ten largest economies in the world and — most importantly for climate change — home to one of the greatest ecosystems and forests of the planet: the Amazon. Brazil is the eighth largest emitter of greenhouse gases, and the third largest emitter in the developing world after China and India, according to 2000 World Resources Institute figures. Unlike most developed and many developing countries, Brazil's energy sector contributes little to the country's greenhouse gas emissions. Unsustainable land use and forestry contribute most. (La Rovere, E.L., Pereira A.S, 2007)
New climate scenarios for South America for the 21st century under different greenhouse gas concentrations suggest that climate change and its related impacts have regional variability: northern areas of the continent are projected to experience rainfall deficiency, while in southeastern South America rainfall is projected to increase. Projections also indicate widespread increase of intense precipitation events and extreme droughts for some regions. (INCT[2], 2010).
Urbanization has brought a number of advantages to the national economies and opportunities to improve people's well-being, to reduce poverty and to promote sustainable development, but it is also a great challenge in many countries. Information and analysis are essential to understand these challenges and to assist policy-makers define, formulate and evaluate policies and programmes that address them.
Brazil is a tropical country with a heavy rainy season and each year's floodings brings lost, death and destruction that could be avoided with adequate planning and management.
Listed as one of the biggest sets of natural disasters in the country, the mountainous region of Rio de Janeiro is victimizing thousands of people due to the occurrence of extreme hydrometeorological events. The flash floodings, described as the flow of water with high kinetic energy, are considered a threat to

[2]National Institute of Science and Technology for Climate Change

people when they occur in vulnerable areas.
In the last two years, 2011 and 2012, Teresópolis suffered with two floodings events and the objective of this study of case is to find some answers for these occurrences and list some solutions in the field of land use and occupation resulting in a better structure for flood management.

Material & Methods
This research is based on bibliographical resources about climate change and floodings, field research, as well as cartographic and climatological statements published by the main social-economics and environmental monitoring organizations.[3]
The methodology used is the analysis and comparison of collected data in order to draw a simplified geographic profile, geological and climatological area of Teresópolis. Added to this information, the intention is to analyze the territorial occupation in the city, the social vulnerability (using census data) and to identify the areas more vulnerable to climate change and its related risks. Once social vulnerabilities and their variables are identified, it may be possible to establish the main strategies of urban planning and land use and occupation.
The relative influence of land use and climate change on environmental conditions was examined using analysis of similarity and principal components analysis.

Results & Discussion
Climate Changes: Emissions profile
According to INTC (2007), it is important to observe that climate changes can be explained by natural climate variability or human induced changes in the form of land use for urbanization and/or increase in the greenhouse gases GHG concentration.
The Brazilian emissions profile differs from developed countries, where burning fossil fuels for energy and transportation contribute most to overall emissions. In 1994, only 17 per cent of Brazil's total emissions came from energy production. (La Rovere, E.L., Pereira A.S, 2007). Emissions from agriculture, land use and forestry, however, were together responsible for 81 per cent (see Table 1).
These data are relevant to understand the importance of land use strategies in Brazil.

Table 1 – Brazilian Emissions

Emissions in carbon dioxide equivalents	Energy	Industrial processes	Agriculture	LULUCF*	Waste	Total
Carbon dioxide	236.51	16.87	–	776.33	–	1,029.71
Methane	9.22	0.07	233.70	41.52	18.47	302.98
Nitrous oxide	2.66	4.14	148.89	3.55	3.55	162.80
Total	248.39	21.08	382.59	821.40	22.02	1,495.49
Total %	**16.61**	**1.41**	**25.58**	**54.93**	**1.47**	**100.00**

* Land Use, Land Use Change, and Forestry Units are megatons of carbon dioxide equivalent
Font: INCT

Factors for Floodings
According to DRM-RJ (2011) there are different factors for floodings that occurred in Teresópolis

1. Predisposing Factors Geology and Geomorphology; Hydrologic Surface and Hydrogeology; Climate and Climatology
2. Effective Factors: Use and land use - cuts and embankments; Rainfall history; Rain and river erosion.
3. Triggering Factor: Intensive rainfall in 15 minutes and Hourly

[3]IBGE, INEA, DRM, INCT, INPE

Soil Dynamics and Soil Water Dynamics

The slopes and hillsides of the Região Serrana are of high inclination and bring, in itself, great instability. The relief of the city is also characterized by the presence of floodplains that, theoretically, serve as water drains into the aquifer.

The areas formed by the slope of rock masses (granite) are covered with a thin layer of soil. In summer, the frequency of daily rain increases. The soil is saturated with water and heavy rains could destabilize the ground that relieves the internal pressure through the slip. Water creates paths in a bare ground and gain speed, aggravating the situation. As a result, the soils of the mountains became saturated and then some mudslides have taken place.

A continuous and strong heavy rain is enough to sweep this thin layer of soil that, in general, consists of lots of organic material that makes the soil more porous and susceptible to landslides.

According to INPE (2012) the Região Serrana usually has rainfall average of 290 mm of rain per month. On January 12, 2011 the average in Teresópolis was 124 mm in about 2 hours. On April,6 2012 it was 220 mm in 4 hours. This triggered flash floodings in series. The Região Serrana also has a large geological feature walls, this uniqueness makes the air of the lower area rise the walls, forming more clouds and more rain.

The landslides are natural and integral part of this kind of geology. However the man's action in these unstable areas - deforestation, cut and fills, inappropriate sanitary landfills, and inappropriate disposal from sanitary sewers - enhances this instability and human presence in these places turns s this instability into tragic events.

Hydrology

The municipality has peculiar hydrography: the direction of the river flow is determined by each of the six major river basin: Paquequer, Santa Rita, Rio Preto, Bengalas, Frades, Córrego Sujo, Formiga and Água Quente. The modeling work the land, from the action of rain, propitiated by the controls associated with complex geology, topography marked by determining faulty lineaments, fractures in varying directions, without regional homogeneity within the water catchment area of the Rio Paraiba do Sul Basin.

The anthropic ecosystem does not operate satisfactorily: the increasing events of floodings, droughts, reduced quality and quantity of water, points of weakness in water catchment areas or any problem in some of the sub-systems that compose it affect the entire basin.

Convergence Zones

Convergence zones are weather systems that have strong influence on weather and climate and are characterized by an interaction between weather events mid-latitude and tropical.

The South Atlantic Convergence Zone (SACZ) is defined as a persistent band of clouds extending from the Central South Atlantic south of the Amazon. It is associated with a convergence zone in the lower troposphere and is oriented northwest-southeast direction, specially characterized in the summer. It is responsible for periods of floodings in the southeast and periods of time during autumn called "short summer" (drought, accompanied by intense heat in the middle of cold season, low humidity and strong insolation, during four days at least) in southern of Brazil.

According to INPE (2011) storms that occurred in Teresopolis, Petrópolis, Nova Friburgo are part of this phenomenon that happens every summer. The convergence zone carries a corridor of humidity from south of the Amazon to the Southeast, where the mountainous areas propitiate heavy rains.

The environmental impacts of misusing and occupation

According to the IBGE (2010) Teresópolis has the second highest rate of slums in Rio de Janeiro State (the first is the municipality of Rio das Ostras). From 163.805 inhabitants, it is correct to affirm that more than 25% of residences live in risk areas in steep sided terrains (FGV, 2006). Risky territories are equally occupied by poor class, but also occupied by the middle and upper class, because of geology of the city.

The city has only 40% of flat buildable areas. The other 60% is located in the hilly area occupied indistinctively by different social classes.

Land use in urban or rural areas, expands to the fountainheads. Besides the pollution there is the silting up, causing changes in drainage, providing a higher frequency of floodings and changes physic-chemical

in water and soil.
Deforestation causes imbalances and soil exposure, rapid siltation of nearby rivers, increased evaporation of soil humidity and surface water, causing downgrades of water table in the phreatic zone. The balance of the water resource is affected. The intensity of the winds is also affected.

Other impacts could be listed below:

- The construction in risk areas and lack of sanitation, allied to growing speculation, affects the environment in different intensities of use and occupation.
- Urban expansion increases the degraded areas, with increasing deforestation, uncontrolled land occupation, movements of land (earthworks, embankments, cuts, etc.), causing landslides, siltation of rivers and soil compaction.
- Buildings and urban pavement areas that reduce the permeability of the soil, leaving little space for water drainage, causing floodings.
- Systematic withdrawals of sediments for use in landfills and in construction.
- Increased speed and intensity of climate change.

Conclusions

Although there is no certainty on future projections, it is understood that the vulnerability of cities to the occurrence of extreme events such as rainstorms, requires mitigation and adaptation, in order to minimize the damage caused by weather and climate phenomena. It must be a long-term planning.
Studies show that in a warmer atmosphere the extreme events of precipitation can increase even more than the average. As consequence of the greater amount of rainfall, more landslides, mudslides and flooding, and damages may happen in various sectors. These factors must be decisive for urban planning.
Exacerbation of current climate variability already poses substantial challenges to society, and further changes in climate are now unavoidable, even assuming effective implementation of ambitious mitigation policies. This makes the development of adaptation strategies imperative, and also demands attention to be given to issues related to ethics and justice.
The vulnerability of Teresópolis has natural elements (climate, geology, and hydrography) that are potentially dangerous without urban planning and risk control. Adaptation and management are the guarantees of ecosystems survival.

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Technologies and tools for risk communication, risk assessment, and risk management for water related hazards: Flood modelling and risk maps, experiences from the Center for Disaster Management and Risk Reduction Technology (CEDIM)

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Abstract
This article describes the Center for Disaster Management and Risk Reduction Technology (CEDIM) in Germany and summarizes its activities in research and practice. Two example projects are introduced in more detail, both related to water related hazards focussing on flooding events. The first example describes hydrodynamic modeling tools which are combined to allow computing water levels and flood wave propagation for extreme events. Such models are helpful to understand the flood event itself, and to undertake scenario runs to assess impact mitigation measures, such as dams, dikes, polders, etc. The second example describes the integration of these results into a risk map concept providing regions of distinct flood risk levels. These maps improve the management of help forces during the events, but also in the city planning process.

Keywords: Flood Modeling; Risk Map; Assessment

Introduction

“The Center for Disaster Management and Risk Reduction Technology (CEDIM) is an interdisciplinary research center in the field of disaster management founded by the Helmholtz Centre Potsdam - German Research Centre for Geosciences (GFZ) and the Karlsruhe Institute of Technology (KIT). The goal of CEDIM is to advance our scientific understanding of natural and man-made hazards, and to develop disaster management solutions for the early detection and reduction of the related risks. CEDIM is dedicated to developing technologies and tools in the areas of risk assessment, communication and management in a world with of increasing population, rapid urbanization and the growing threat associated with climate change. To achieve this, CEDIM employs interdisciplinary competence and synergies between its affiliated institutions and cooperates with emergency management at the international, national, state and community levels.” (cited from the official flyer of CEDIM, www.cedim.de)

The author has not been associated with CEDIM, but worked more than ten years at the KIT in close cooperation with CEDIM associates, especially Dr. Peter Oberle from the Institute of Water and River Basin Management (IWG) of the KIT, who provided most of the here presented information.

Former CEDIM research pojects were related to i) analysis of consequences of earthquakes in large urban aeras (Megacity Instanbul), ii) quantification of hazards into risks and visualization as maps identifying regions of highest damage (Riskmap Germany), iii) development of a modelling system to quantify risks of extreme flooding in large river basins (Modelling of extreme flooding), iv) analysis of climate change on flood, and hail hazard.

The presentations will describe parts of the flood modelling system and its integration into the risk map concept.

Materials and Methods

1) Flood Modelling for risk communication

Hydrodynamic models compute water levels and velocities for given bathymetrical and topographical data, and hydrological (flow curve from rainfall) boundary conditions. Major difficulties often arise due to missing

data. Thus, in situations where field data is missing, even the best model cannot provide reasonable results. Nowadays laser-scanning data provides an interesting method to obtain topographic information for large regions in high resolutions (see Fig. 2). This data is used to run the hydrodynamic models (e.g. Harlacher et al., 2011, Oberle et al., 2008, Bleninger et al., 2006, Bleninger and Richter, 2001), which then can be merged with the topographical data or images from airplanes or satellites (Fig. 1). Furthermore, geo-information systems can be used to visualize all data in a 3D graphical computer model (Fig. 3).

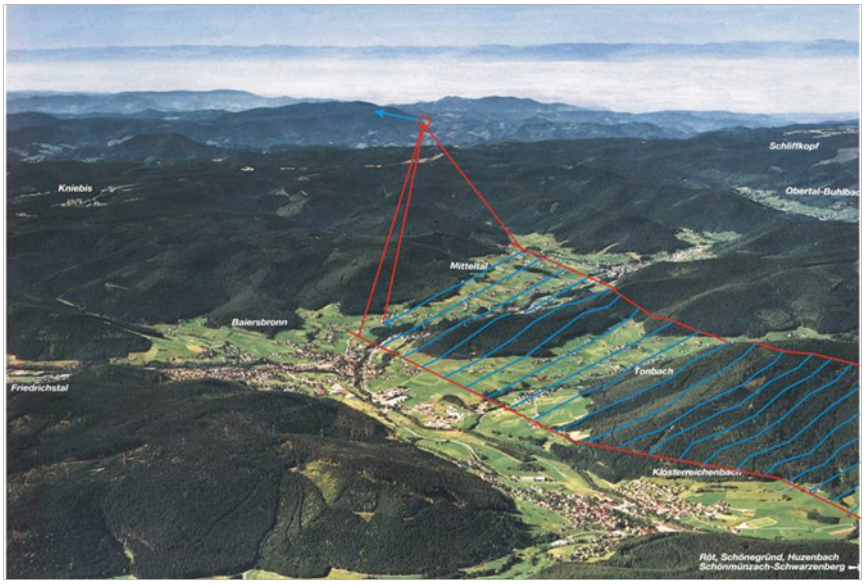

Fig. 1: Laser scanning methods to obtain high resolved spatial topographical information. (Source: Theobald et al., 2004)

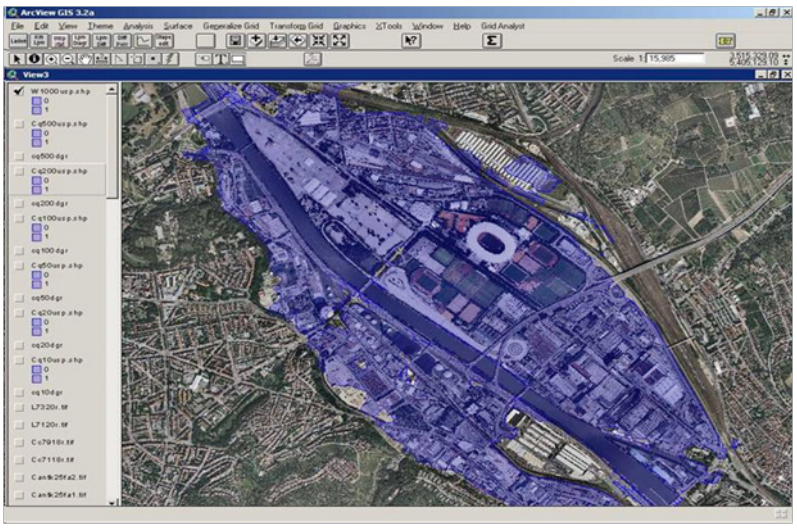

Fig. 2: Simulation of a flooding event, industrial área of Cannstatt/Stuttgart (Neckar), (Source: Theobald et al., 2004)

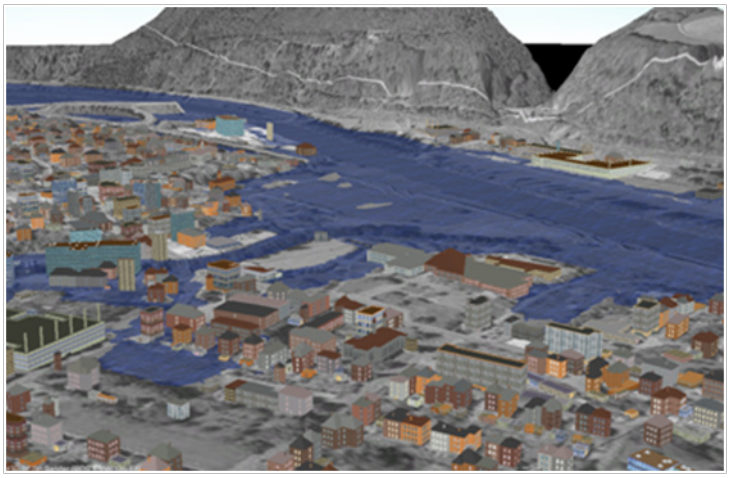

Fig. 3: Graphical 3D visualization of modeled flood event (Source: Theobald et al., 2004)

2) Risk map concept for risk assessment

The geo-information-systems are furthermore used to compute maps of flooded regions, indicating water level ranges for a certain flood event (left in Fig. 4). This information can then be processed with typical flood risk approaches (e.g. 100 year flood) to determine regions of distinct flood risks (right in Fig. 4). Finally, if available, vulnerability maps (regions with high value, e.g. right, below in Fig. 4) can be used to determine regions with high demand for protection.

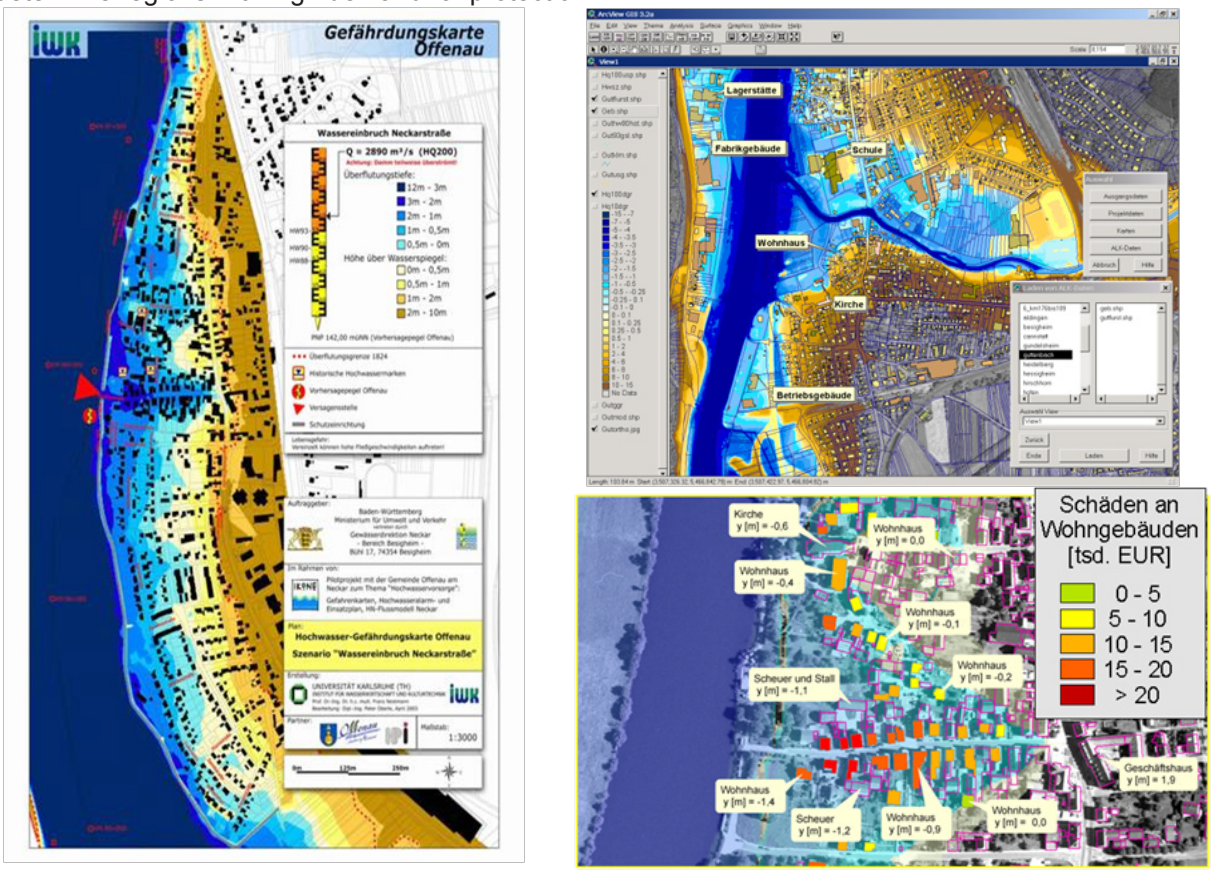

Fig. 4: Development of maps for flooded áreas and determination of áreas with a certain flood risk with final comparison/association with vulnerability maps (Source: Theobald et al., 2004)

To improve flood protection measures and flood risk management the German government funded numerous modeling studies for the major German river systems. The results are summerized by CEDIM, and published on an internet based “Risk Explorer” (Fig. 5). Users can easily access their living regions and assess the flood risk.

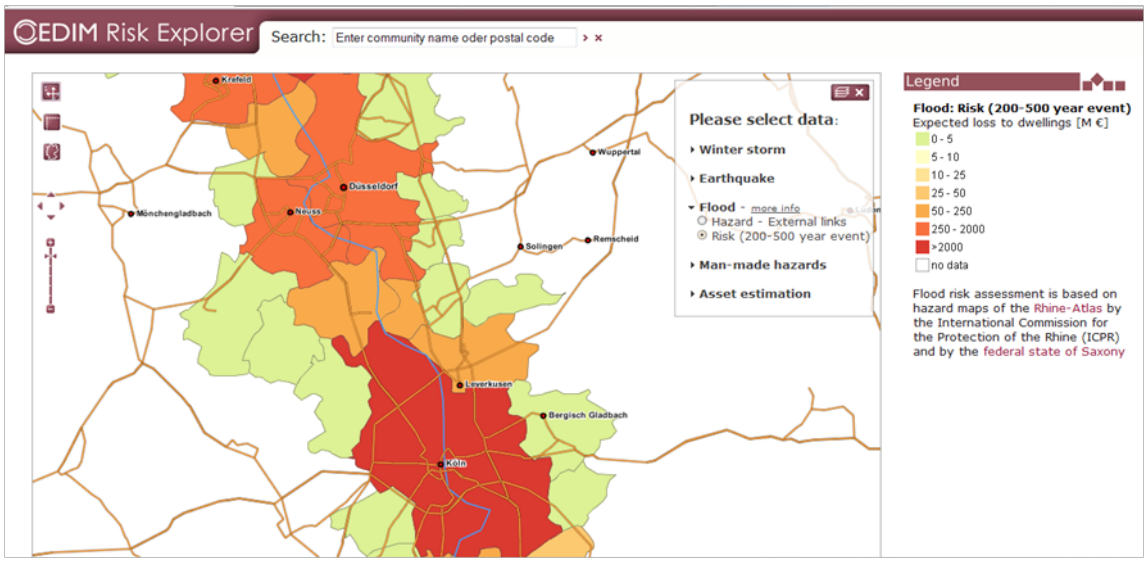

Fig. 5: Image of the Risk Explorer (www.cedim.de/riskexplorer.php)

3) Risk management

The obtained results in form of risk maps can be used by emergency services to detect regions of high vulnerability and/or importance, such as schools, factories, hospitals, etc (Fig. 6). Thus, protection and evacuation measures can be based on a quantified and more organized basis. Evacuation plans can be developed in advance according to predicted flood levels.

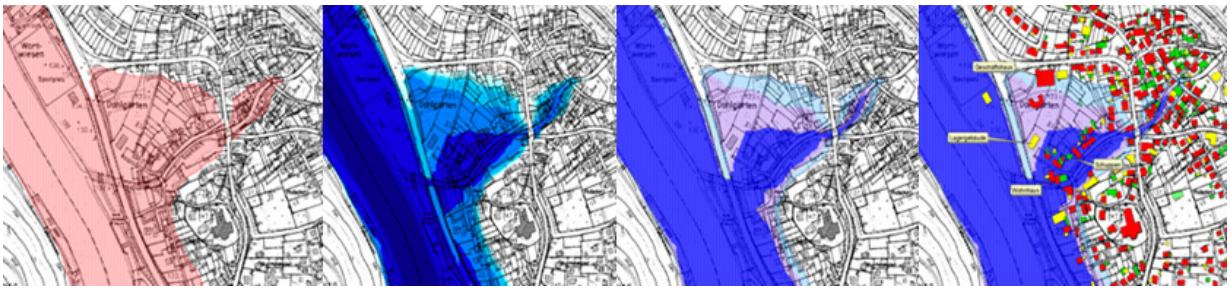

Fig. 6: Maps visualizing (from left to right): region of flood hazard, quantified flood hazard in flow depth, flood hazard depending on average river flowrate, risk map indicating important and critical locations (e.g. schools or factories) to improve evacuation or protection measures (Source: Theobald et al., 2004).

And finally these tools can be used to identify the source of the hazard (natural, man-made) to understand the risk potential and to plan mitigation measures. These range from changes of the land-use in the watershed, dikes or dams, river restoration, and other measures.

Conclusion

There are sophisticated tools to communicate, to assess, and to manage flood events in watersheds. These tools require a good data basis, which however, nowadays, can be obtained by laser-scanning methods providing an enourmous treasure of data for management purposes. The data serves to run flood simulation models predicting water levels and flow velocities. This data will then be put together in a geo-

information-system providing helpful information on flooded regions.
Running several scenarios and adding information on vulnerable áreas allows to establish valueable tools for emergency plans or long-term planning.

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Natural Hazards: The long-term perspective from Paleoclimatology – A case study from the Amazon basin

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Abstract
The combination of deforestation, land use and climate change in the last decades resulted in significant increase in natural hazards frequency and magnitude in the Amazon basin. As climate extremes in the Amazon basin are predicted to increase in the coming decades, the risks to extreme climatic events are also expected to rise at a significant pace. Here we will show how Paleoclimatology is able to significantly contribute to this discussion by providing long-term climatic time-series that extend far beyond the instrumental records. The perspective from Paleoclimatology allow us to put modern instrumental records of extreme events/natural hazards in a broader temporal context, as well as support the development of appropriate mitigation and adaptation policies.

Keywords: Paleoclimate; Amazon Basin; Last Millennium; Flood; Drought

Introduction

With an area of about 5.4 million km² the Amazon represents about half of the world's rainforest and is home to about a quarter of Earth's terrestrial species. The Amazon rainforest plays a vital role for global climate through its influence on the water cycle and atmospheric circulation (e.g., Gedney and Valdes 2000, Werth and Avissar 2002) and its carbon storage (e.g., Malhi et al. 1999). At present, the Amazon rainforest is threatened by deforestation and climate change (e.g., Malhi et al. 2008). So far, about 20% of the original extent has been cleared (Davidson et al. 2012).
Record-breaking high (e.g., 2009, 2012) and low (e.g., 2005, 2010) levels in the Amazon basin were experienced during the last decade (e.g., Zeng et al. 2006, Cox et al. 2008, Marengo et al. 2008). The impact of such extreme floods and droughts generated pronounced hazards not only to local population but also to full ecosystems (e.g., Aragão et al. 2008, Boyd 2008). Among the most affected sectors were agriculture, transport, hydropower and public health. As climate extremes in the Amazon basin are predicted to increase in the coming decades, the risks to extreme climatic events are also expected to rise at a significant pace (IPCC 2012).
Informed decisions on mitigation and adaptation policies are urgently needed in order to avoid at least part of the damages associated to these extreme events. Effective measures would greatly benefit from a sound knowledge of the complex functioning of the forest-climate system in the Amazon basin (IPCC 2012).
Here we will show how Paleoclimatology is able to significantly contribute to this discussion by providing long-term climatic time-series that extend far beyond the instrumental records.

Materials & Methods

Between February and March 2012 we performed a research cruise (Response of Amazon sedimentation to deforestation, land use and climate variability - AMADEUS) between Recife (Brazil) and Bridgetown (Barbados) with the German research vessel M.S. Merian. The main aim of the cruise was to explore the Holocene and Pleistocene climate history of the Amazon basin in relation to changes in ocean circulation on millennial to decadal time scales as well as the Holocene development of the Amazon submarine delta. The cruise took place in the framework of a German-Brazilian scientific cooperation.
During the cruise we sampled sediments and the water column on the continental slope and shelf off

northeastern and northern Brazil and French Guiana with gravity-corer, multi-corer, Rosette/CTD, in-situ and shipboard pump systems. Seismoacoustic data was also gathered with a multichannel seismic system and the ship-mounted echosounder systems.
The following methods will be applied to the sampled material: (1) inorganic geochemistry (e.g., major, minor and trace elements in bulk sediments); (2) organic geochemistry (e.g., compound specific fluxes); (3) isotopic geochemistry (e.g., marine carbonate oxygen and carbon isotopes); (4) micropaleontology (e.g., pollen and foraminiferal assemblages); (5) environmental magnetism; (6) 210Pb and 14C dating; and (6) geophysical data processing tools (e.g., NMO-correction, despiking, correction of residual statics and stacking).

Results & Discussion
During the cruise we successfully deployed the gravity-corer 15 times and the multi-corer 16 times. The water column was sampled in 15 stations, and we occupied more than 30 seismic/echosounder lines.
After applying the methods described above, our samples/data will be used to: (1) document the effect of deforestation on the composition and deposition of Amazon sediments; (2) reconstruct the Holocene history of precipitation over the Amazon basin on sub-decadal time scales; (3) understand the Holocene architecture and development of the Amazon submarine delta in relation to the climate history of Amazonia; and (4) to investigate the relationship between variations in ocean circulation and tropical precipitation on millennial time scales. Of particular interest here is our ability to reconstruct the frequency and magnitude of Amazon River extreme floods and droughts (e.g., the ones with potential to generate natural hazards) during the last millennia. This will allow us to put modern instrumental records of extreme events/natural hazards in a broader temporal context, as well as support the development of mitigation and adaptation policies.
In our presentation, we will show the outstanding preliminary results of the cruise and correlate them to other available studies.

Acknowledgements
We thank the Deutsche Forschungsgemeinschaft and the Interdisciplinary Climate Investigation Center from the University of São Paulo for financial support. The Brazilian Navy, the Brazilian Ministries of Science, Technology and Innovation, of External Relations, and of the Environment are thanked for providing all necessary authorizations for performing the cruise. We thank the captain and crew of RV M.S. Merian for the supportive work onboard.

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El Nino Southern Oscillation (ENSO) induced disasters: Challenges for Zimbabwean agriculture and forestry

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Abstract
El Nino Southern Oscillation (ENSO) warming events in the eastern Pacific are responsible for the interannual variations of climate in the tropics and subtropics through teleconnections. ENSO occurs irregularly every 2-7 years and lasts about 12-18 months. However, the physical drivers of El Nino are not yet understood. Teleconnections are perceived as a statistical correlation rather than a process-based perspective. Sea surface temperature (SST), a proxy for ENSO, was correlated to rainfall and maize yield in Zimbabwe. SST accounted for 64% of the variation in rainfall and 78% of variation in maize yield. During El Nino years, the likelihood of drought increased particularly in the southern regions of Zimbabwe around Gutu and Bulawayo. Remote sensing was used to infer vegetation status over Southern Africa during the 1997/98 and previous ENSO events. Advanced Very High Resolution Radiometer (AHVRR) instruments aboard the NOAA polar-orbiting satellite series were used to calculate the vegetation and temperature condition index (VT) as a surrogate for vegetation conditions during ENSO in Southern Africa. Vegetation stress was observed during El Nino (VT 10-20%), notably during the months November and December. La Nina years were associated with good vegetation conditions with VT values above 60%. There is an urgent need to determine the impacts of ENSO on agriculture and forestry at finer spatial scales, such as eco-region or forest type. For the forestry sector it is suggested to set up drought simulation experiments, and to determine the vegetation response before and after ENSO events.

Keywords: El Nino Southern Oscillation; Zimbabwe; Forestry; Vegetation and temperature condition index; Agriculture

Introduction

El Nino Southern Oscillation (ENSO) describes the full range of the Southern Oscillation that includes both sea surface temperature (SST) increases (warming) as well as SST decreases (cooling) when compared to a long-term average (Phillips et al 1998). The warming event is called El Nino and the cooling event is called La Nina. The warming and cooling occurs in the central and equatorial Pacific Ocean. ENSO consists of the oceanic component (El Nino) and the atmospheric switch in pressure in the Southern Pacific, i.e. the Southern Oscillation. ENSO occurs irregularly every 2-7years lasting for about 12-18months (WMO 1995, Kovats et al 2003).

Teleconnections, are linkages over great distance of seemingly disconnected weather anomalies (Plisnier,et al., 2000).ENSO events in the distant Pacific are a strong determinant of interannual climate variability in many countries in Africa, Asia, and North and South America. The teleconnections are understood as a statistical correlation rather than from a process-based perspective (Orlove and Tosteson 1999). During ENSO events, the atmospheric circulation and precipitation patterns are strongly disturbed for several months worldwide and more particularly in the tropics (Phillipon et al 2012). The effects usually include regional land and sea surface warming, changes in storm tracks, and changes in precipitation patterns (Plisnier et al., 2000). During the warm period of El Nino, Southern Africa and Australia experience dry and warm conditions, whereas the western margin of South America is characterized by warm and wet conditions. In Southern Africa the warm and dry conditions occur during the growing season and affect vegetation and crop production. During the La Nina phase southern Africa and northern Australia experience wet and cool weather conditions, whereas coastal Peru has dry and cool weather conditions (http://www.wrh.noaa.gov/fgz/science/elnino.php?wfo=fgz).

The aim of the present paper is to present research results on the impact of previous ENSO events on agriculture and forestry in Zimbabwe.

Materials & Methods
This paper is based on a literature review of research findings on ENSO related impacts on the agriculture and forestry sector in Zimbabwe.

Results & Discussion
ENSO patterns in Nino 3 region (5oN - 5oS; 90oW - 150oW) have a correlation between 0.70 - 0.85, depending on the lead time with precipitation in Southern Africa (Cane et al 1994). El Niño events begin during the first half of the year, and have a strong relationship to below-normal rainfall in most of Zimbabwe during the rainy season. The most affected areas are rather in the South than in the North, but the likelihood of dryness is also strong in areas clustering around Harare, Gutu and Bulawayo (http://reliefweb.int). Sea surface temperature anomalies in the Nino3 region are a good predictor of maize yields at a national-level in Zimbabwe. Years in which the SST anomaly is strongly positive are associated with below average precipitation. As such SST at Niño3 index can account for 64% of the interannual variation in precipitation and 78% of the variation in maize yields (Cane et al. 1994). Thus the temperature and rainfall distribution is affected due to El Nino and in turn affects the growth of most cereals, particularly maize. The critical shortage of rainfall is experienced from January to March, when crops are about to tassel and fill the grain. During the 1992 El Nino drought, about 100 million people in Southern Africa were affected and agricultural productivity was reduced by 60% in Zimbabwe (Cane et al. 1994). During this period rainfall was reduced by about 80% below the normal and Zimbabwe produced only 13 000 tonnes of grain which was just enough for 2 days' consumption. More than one million head of cattle died of starvation during that year (Maphosa, 1994).
During past El Nino events, two coherent patterns developed in the course of the vegetation cycle. From week 3-12, the differences between El Nino and La Nina years were minimal and random (Kogan 1998). From November-December (weeks 22-26) vegetation conditions deteriorated considerably and quickly in El Nino years. At both locations it took only 5-6weeks for the VT to drop to the level that indicated severe vegetation stress (VT is 10-20), which is normally associated with a strong drought impact. The condition remained very unfavourable for a period of 10-14 weeks. Opposite to that, vegetation in La Nina years remained in good condition (VT above 60) throughout the cycle (Kogan 1998). In Southern Africa, the warm El Nino phase was more intense than in other areas, especially in week 38, as almost all of Botswana, Namibia and Zimbabwe were affected with a VT index around 18%. In comparison to other ENSO events (1986/87, 1991/92), vegetation stress reached up to 85%.

Conclusions
ENSO affects rainfall availability in Zimbabwe during the growing season. Maize yields are correlated with sea surface temperature thus maize yield declined during warm ENSO events. There was a lag response by vegetation during El Nino and La Nino years. Vegetation deteriorated due to moisture stress and previous ENSO events (1986/87, 1991/92) caused much more stress than the 1997/98 El Nino event.

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M.Sc. student in NHRE (Natural Hazards and Risks in Structural Engineering). The occurrence of an increasing number of natural hazards all over the world and their various effects on individuals, societies and modern economies is one of the major challenges for future decades. The master course in “Natural Hazards and Risks in Structural Engineering” faces this challenge by providing indispensable tools for taking into account those phenomena in the different design processes in civil engineering. Thereby, the master course aims at combining practical structural engineering with state-of-the-art concepts regarding computational mechanics, dynamics and probability theory/stochastic analysis. Consequently, the master course provides key qualifications for innovative work in the field of earthquake, flood and wind engineering and offers an international setting in which students will achieve both technical success and personal advancement.

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Application of Modern Engineering Tools in Risk Analysis and Assessment in aspect of Bangladesh

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Abstract
In recent years, growing population and expansion of settlements and life-lines over hazardous areas have largely increased the impact of natural disasters both in industrialized and developing countries. Third world countries have difficulty meeting the high costs of controlling natural hazards through major engineering works and rational land-use planning. Industrialized societies are increasingly reluctant to invest money in structural measures that can reduce natural risks. Hence, the new issue is to implement warning systems and land utilization regulations aimed at minimizing the loss of lives and property without investing in long-term costly projects. Several different methods for assessing natural hazards were proposed or implemented by Government and research institutions through worldwide . The reliability of produced maps and the criteria behind these hazard evaluations are ill formalized or poorly documented. Within this framework, Geographical Information Systems (GIS) and small scale testing may play a renewed role in assessing areas prone to natural hazards, and helping mitigate the associated risk.

Keywords: Risk and Hazard assessment; Engineering Tools; GIS; Small scale testing

Introduction

The main focus of this study is to introduce the utilization of current available tools for risk assessment and mitigation. Applications of these tools have been trained to the students in NHRE faculty of Bauhaus University in a frame of several project works. In order to make the students familiar with these tools, each student had to work for their own country to reach the desired goal thorough micro-zonation of the urban areas in the forefront of any damaging hazardous event that has to be conducted including the identification of the local building stock's vulnerability and social preparedness. T

Materials & Methods

1. Geographic Information Systems (GIS):

The use of GIS offers a number of advantages:

- It can be surprisingly cheap; very expensive equipment and highly specialized technicians can be avoided by proper selection of a system and its application. The main constraint is not typically a lack of funds but rather a lack of trained personnel.
- It can multiply the productivity of a technician.
- It can give higher quality results than can be obtained manually, regardless of the costs involved. It can facilitate decision-making and improve coordination among agencies when efficiency is at a premium.

Below Figure 1.1 refers to earthquake catalogue and Figure 1.2 refers to peak ground acceleration map of Bangladesh, which are produced with the help of MAPinfo; a software based on GIS. These two maps clearly gives an overview of highly seismic vulnerable places in Bangladesh and they are well comparable to each other.

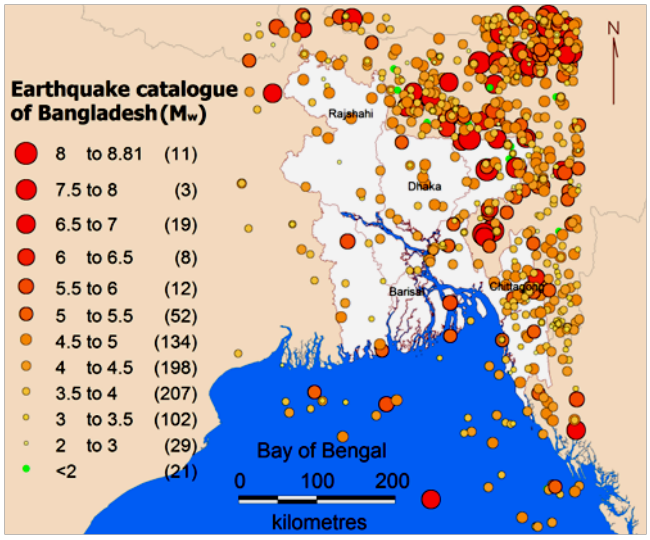

Figure 1.1: Earthquake Catalogue of Bangladesh [1*]

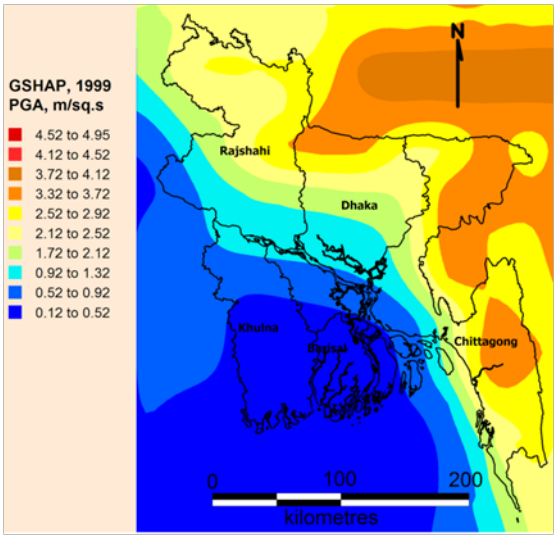

Figure 1.2: PGA (Peak Ground Acceleration) map of Bangladesh [1*]

2. Multiple Hazards Mapping

Hazards mapping is the process of identifying and displaying the spatial variation of hazard events or physical conditions (e.g. potential ground shaking, steep slopes, flood plains, hazardous materials sites, climate zones, etc). Important variables involved in mapping hazards and interpreting hazard maps include the size (scale) of the area to be mapped, the availability and completeness of data, the cost of collecting and mapping data, etc.

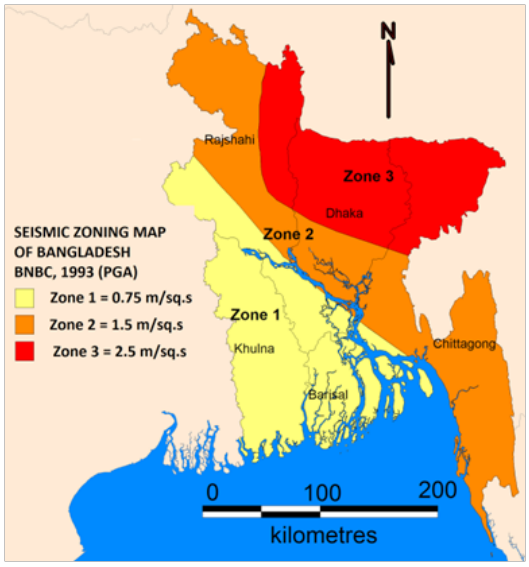

Figure 2.1: Seismic zoning map of Bangladesh [1*]

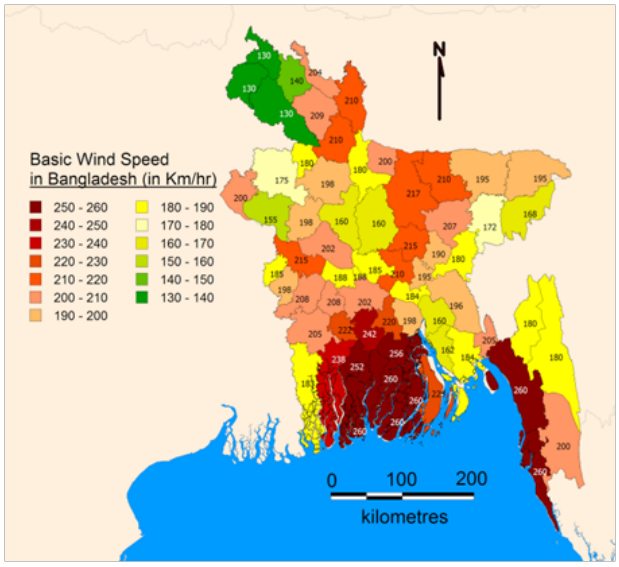

Figure 2.2: Basic wind speed (in km/hr) map of Bangladesh [1*]

The multiple hazards map is an excellent tool for fomenting an awareness of natural hazards and for analyzing vulnerability and risks, especially when combined with the mapping of critical facilities.

3. Vulnerability Assessment

In theoretical basis, engineers are trained to study and work with analytical approaches. But in reality, to make a prognosis for the expected damages, several tests have to be performed which are in need of calibration to reflect the original responses of the structures. Hence researchers in these areas are highly motivated to work with different scale testing and the crucial task is to select the right scale for a given structure under certain boundary conditions (e.g. structure type, hazard types, soil parameters, etc.)

There are several kinds of testing depending on their scale which are briefly described here.

Figure 3: The shake table demonstration (at the National Press Club, Dhaka) in one UNDP project for safer Bangladesh [2]

a) 1:1 scale testing: Originality of the main structure is maintained and hence it gives the perfect result with respect to field behavior. But this method is not cost effective and often creates problems to create the original structure in the lab because of lab limitation.

b) Medium scale testing: This test is performed under the situation when the structure is so important that nonlinear response of the structure cannot be visualized in small scale testing but the 1:1 scale test will lead to a very high expenditure.

c) Small scale testing: In recent years small scale testing is being a strong medium of easy visualization of hazardous effects; especially for peoples who are in lack of engineering knowledge. This method is cost effective but often becomes complex to represent the real scale behavior in it; especially in the calculation of nonlinear response (see Figure 3).

d) Very small testing: This type of testing is useful for testing one structure under several conditions. It has two folded advantages – it is very cost and time effective; and it helps to visualize the behavior of one particular system under different condition. The results obtained from this kind of tests can be used both for research purpose and also for awareness purpose for indigenous people.

Results & Discussion

In this context, the analytical investigation of buildings or derived structural systems being representative for the local building stock becomes an essential part of the study. As the increasing natural disasters are giving birth of environmental refugees in particular areas in the world, hence this is peak time to work for people rather than to limit the outcomes in research papers. The ultimate aim is to production of useful and handy engineering tools which can be easily accessible and understandable to people.

Acknowledgement

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*Above references papers are projects conducted in Master course of Natural Hazards and Risks in Structural Engineering (NHRE) at Bauhaus-Universität Weimar under supervision of Dr. Jochen Schwarz; Head of Earthquake Damage Analysis Center (EDAC)

[2] Gender in Urbanization and Community Based Disaster Management - United Nations Centre for Regional Development (UNCRD)

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Status of Land Tenure Security in rural and urban Brazil

DAMASCENO, I. G.

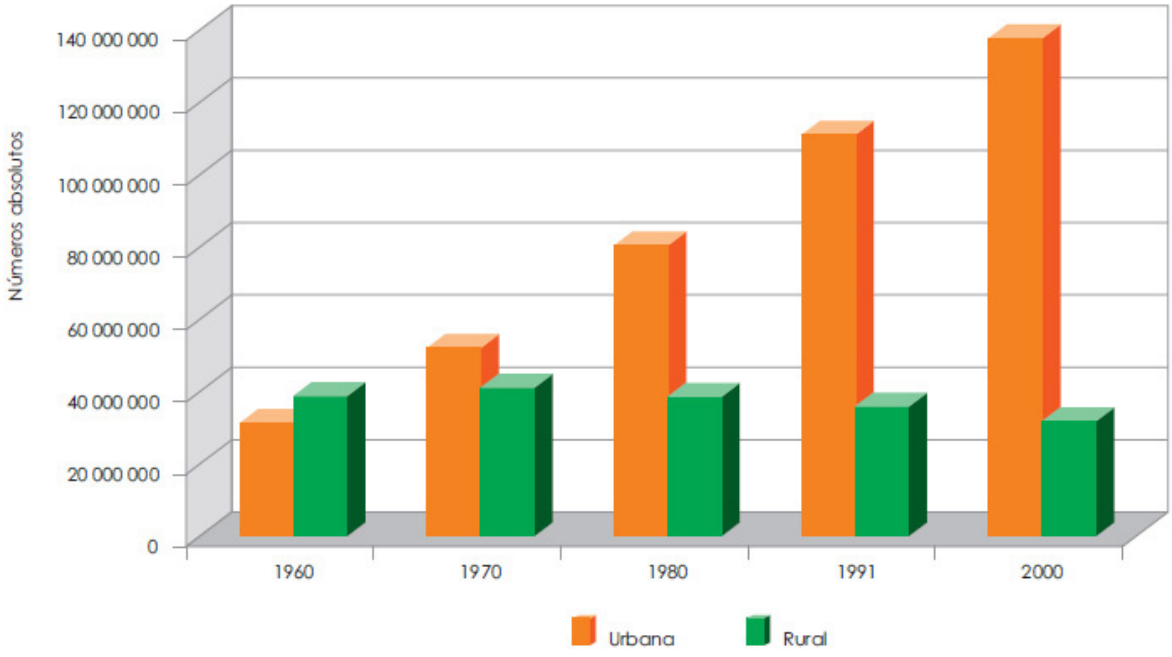
Abstract
Access to land and the associated tenure security have significant implications for development. Good governance in land tenure and natural resource can help to reduce hunger and poverty and to support social and economic development in rural and urban areas.
Brazil is a country of big contrasts: land of rich and poor; abundance of water and drought; first producer of food and high level of hunger. Country of black, white, mestizo and Indians as well Catholics, Protestants, Spirits and Afro religions.
Brazil has 8,51 million km² of area and 190 million inhabitants, numbers which confers it a position of the fifth biggest country of the world and the fifth more populated. Achieve good governance and guarantee good living conditions for its citizens in rural and urban areas are the main challenges of this huge country.
Since 50's Brazilian changed from rural country to urban one. The economy has accelerated grown and the country has diversified its economy sectors in agriculture, industry and a multiplicity of services. Nowadays Brazil supplies the world with many of its products like: meat, soya, steel, airplanes, alcohol, electrical equipments, automobile, etc. The country is an influent economic agent at regional and global level.
Although the flourishing economy, the social is burden with deep and old problems, consequence of centuries of social exclusion and unequal distribution of wealth, income and opportunity, a society of very rich and very poor. Contrast that can be clear perceived in urban and rural areas. Mega cities like Sao Paulo and Rio de Janeiro with 11 and 6,1 million inhabitants showing nice quarters and skyscrapers beside slums and informal settlements erected on slopes over risk areas and recording every day the high indices of violence, misery and criminality.
On the other hand the rural areas attesting the unequal distribution of land where productive and unproductive "latifundios" contrasts with poor rural settlements in mini miserable rural areas without any sort of infrastructure.
Brazil has an archaic system of property (i.e. land) rights that supports one of the world's most iniquitous and inefficient land distribution system.
The land tenure system in Brazil is characterized for large numbers of informal property holders in rural and urban areas; insecure property rights; complicated and obsolete land administration system; disorderly data on property; lack of adequate sources of information on land tenure for risk assessment, resource management and good governance, conflicts over land and lack of adequate land dispute resolution mechanisms.
The Brazilian government has a lot of projects going on to diminish the social problems and improve security of tenure for rural and urban areas but these initiatives are characteristically long term projects which require commitment, funding and implementation of subsequent governments. Unfortunately many of the elected representatives don't have any interest to continue the projects initiated because they don't bring visibility and the result is many projects remain uncompleted or unfinished.

1. General information about Brazil

Brazil has 8,51 million km² of area which is equivalent to 47% of South-America territory. It is the only Portuguese speaking country of America and one of the most multi-cultural nations of the world, result of the strong immigration from a variety of countries. Most part of the population is catholic, religion which had deep influence in the historical development of the country even though great religion syncretism.
Brazil was a colony of the Portuguese Empire from 1500 to 1815, when it turned a kingdom united with Portugal. In 1822 it passed to be independent from Portugal establishing the Brazilian Empire. In 1889 the country proclaimed the Republic.
According Brazilian Institute for Geography and Statistic (IBGE), Brazilian has currently 190 million inhabitants. The Brazilian census of 2000 proved that the Brazilian population has experienced successive increase of its contingent, having arising almost 10 times during the XX century. Although the geometric

average index of annual grown of 1,63% from 1991-2000 was the lowest already observed which reflect the decrease of the birth rate during 90's years. Brazil is progressively reaching the stabilization rate.
According the Demographic Census of 2000 the urban population is 4,3 times higher than the rural population, confirming in the whole Brazil a tendency initiated during the 60's years, when the percentage of urban population had exceeded the rural one. This reduction of rural population was caused by the attraction of urban areas and migration in every Brazilian region.

Table 1.1: Resident population by domicile Brazil – 1960/2000



Fontes: Censo demográfico 1960-1970. Rio de Janeiro: IBGE, 1968-1973; IBGE, Censo demográfico 1980-2000.

Source: IBGE, Brazilian Census, 2000

1.1 Social Aspects

Socioeconomic transformation took place rapidly after the World War II when Brazil had two of the world's largest metropolitan centers – São Paulo and Rio de Janeiro that showed high indices of economic growth but also attracted all excluded population of rural areas. Urban Growth and structural change haven't altered the extreme unequal distribution of wealth, income, and opportunity and the urban areas have inherited all problems of rural areas. Discrimination, informal settlements, violence and criminality.
According the Getulio Vargas Foundation, in June of 2006 the misery rate based in income generated through Labor was 18,57% of the population with a fall of 19,8% compared to 4 preceding years. The misery rate is partially attributed to the economical inequality of the country which according the Gini Coefficient[1] is one of the highest in the world 49,3 even thought the Human Development Index (HDI) is considered high 0,813[2].
The poorest region of Brazil is the North-east which has big areas with high indices of misery and un-nourishment. The reason why the North-east is so poor is the fragile socio-economic structure, characterized by high level of social inequality and occasionally intensified by the periodic drought of the region which have been used for electoral and opportunist purposes.

[1] *The Gini coefficient is utilized to measure the land concentration. This index goes from 0 to 1. The closer to 1the higher is the land concentration.*
[2] *Source: UNDP, 2009:.Human Development Index (HDI)*

In general the poverty is common of every Brazilian big city in a form of suburbs, slums, poor communities. The cities have disorderly grown up. The government has failed in establishing an urban plan for the increasing cities as well to delivery the necessary infra-structure for all.

1.2 Economical aspects

In 1993 Brazil has stabilized its economy with the so called "Plano Real"[3]. With this measure almost three decades of high inflation were extinguished. A strong currency Real has substituted the old Cruzeiro and gave place for a favorable economic environment.

The Brazilian economy (recently classified as investment level) is diversified comprising agriculture, industry and a multiplicity of services. Currently Brazil has been successful and influent at regional and global market grace to the development of its economy. The economic power that Brazil has demonstrated is due in part to the global boom of the commodities prices and the export products.

Brazil commercialize regularly with more than hundred countries in the world. 74% of the export goods are manufactured or semi-manufactured. The bigger partners are European Union (26%), Mercosul and Latin America countries (25%), Asia (17%) and USA (15%). The more dynamic sector is the agro business which keeps Brazil more than two decades among the countries with more rural productivity.

Brazil is the higher national economy of Latin America and the tenth bigger economy in the world. The market rates and currency are the ninety bigger in buying power according the International Monetary Fund - FMI and World Bank. Its GDP[4] per capita is 10.296 dollars which keeps Brazil as the 70° position.

The main export products include soya, meat, coffee, orange, steel, iron, airplanes, electrical equipments, automobile, alcohol, textile, shoes, etc.

Brazil takes part of a variety of economical groups like: Mercosul, G-22, Grupo de Cairns and BRIC Group, the four emergent economies: Brazil, Russia, India and China.

2. Aspects of land in BrazilAspects of land in Brazil

Sustainable economic development is intimately connected with the issue of land distribution. This oversight is symptomatic of the conservative nature of the development process in Brazil.

Brazil has an archaic system of property (i.e. land) rights that supports one of the world's most iniquitous and inefficient land distribution system.

The land tenure system in Brazil is characterized for:

- High level of tenure insecurity
- Large numbers of informal property holders in rural and urban areas
- Insecure property rights.
- Complicated and obsolete land administration systems.
- Disorderly data on property and lack of adequate sources of information on land tenure for risk assessment, resource management and good governance.
- Decentralization of authority.
- Absence of mechanisms to access credit using land as collateral.
- Conflicts over land and lack of adequate land dispute resolution mechanisms.
- Resistance by political and economic interest groups.

The current land tenure system is intrinsic related with the use and politics of land in the past.

In the next lines the research will briefly present historical reasons why the land tenure system in Brazil is so unequal.

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[3] The Real Plan "Plano Real" was a economical stabilization plan conducted by Itamar Franco government and developed by the economic equip of Treasury Ministry, during the management of Fernando Henrique Cardoso, that subsequently was elected Brazilian President in 1994. The objective of Real Plan was to control the mega-inflation, the cyclic problem of Brazil. Politic, Historical and Economic conditions were combined to permit the Brazilian Government to launch at the end of 1993, the bases of a long term program. Established in phases, the plan resulted in the end of almost three decades of high inflation and the substitution of the old currency for Real, up July 1° 1994. Source: http://pt.wikipedia.org/wiki/Plano_Real

[4] Gross Domestic Product (GDP)

2.1 Land relations in the past

After the Brazilian discovery in 1500, the Portuguese kingdom started to fear the foreigner invasion in Brazilian land. This threat was real as British, French and Hollander pirates have been oft plundered the wealth of the new land. It was urgent starts a colony and administrates it in an efficient way.

For this reason between 1534 and 1536 the Portuguese King D. Joao III decided to split the land of the discovered territory in strips which started from coast until the imaginary line assigned in "Tordesilhas Treaty"[5]. These huge strips of land were designated as "Capitanias Hereditárias", big plots of land, the first "latifundios" of Brazil.

These lands were donated to nobles and trustful lords of the King. The landowners were called "donatários" and have the mission to administrate, colonize, protect and develop the region. The landowners had also the task to combat the Indians who tried to resist the land occupation. In contra part, beside the land, the landowners have permission of the king to explore mineral and vegetal resources of the region. These lands have obeyed the hereditary system, which meant that they had to pass from father to son. Many "Capitanias Hereditárias" have failed because the land owners were not capable to administrate and invest in such big plot of land.

Table 2.1: Brazilian "Capitanias Hereditárias"

Luis Teixeira, *Litoral Brasileiro com as Capitanias Hereditárias*, Portugal, Biblioteca da Ajuda, 1574

Source: Wikipedia

Since the Brazilian discovery in 1500 until its independency in 1822, the economy was characterized essentially as agrarian, monoculture, adopting slavery labor, guided to export and characterized by big properties called "latifúndios".

[5] *In June 7th of 1494 the Spanish kings of Castilla and Aragon, Isabel and Fernando and the Portuguese king Juan II assigned the Tordesilha Treaty which divided the lands of the new world between the two kingdoms though an imaginary line located 370 miles from west of Cabo Verde.*

The three centuries of land controlled by one small group of landowners were determinant to define the land tenure system of Brazil until nowadays. (Prado Junior, 1970)
After the independency, there was a small period of 28 years when freemen's occupied "terras devolutas[6]". These occupations have not caused big changes in the land tenure system of Brazil. In 1850 was approved the law 601 of empire called Land Law "Lei das Terras" which has favored the consolidation of "latifundios" guided to exportation in Brazil. The law allowed the land acquisition through purchase, but with high prices (Silva, 1996).
During XIX century it starts the concern to extend the land access for the citizens spread by Politicians and important people of the epoch like: José Bonifácio de Andrada e Silva. The objective was to stimulate the economy and social growth. (Dolhnikoff, 1998).
The period known as Old Republic "República Velha" (1898-1930) was controlled by coffee landowners "Oligarquia do Café" with workmanship turned to be made mainly by European and Japanese immigrants. In this period the number of properties and landowners have increased but with slight changes in land tenure system of Brazil.
The power of coffee landowners group was declined with 1930 revolution, which between other changes, promoted the industrialization process and has introduced the work legislation, but has not intervened in the Brazilian land tenure structure.

2.2 Property regimes

Since the Brazilian Discovery, Brazil had three different systems to acquire property: "sesmarial", "senhorial" and modern property. Benatti (2003, p 34).
The "Sesmarial" system was established in 1504 and lasted until 1822. The "sesmaria" property consisted in a confirmation by the Portuguese king of a concession of land plot to someone who cultivate and demark it. The beneficiaries generally were nobles and friends of the king and the plots were generally huge. The kingdom recognized right of individual property to whom possess the original title of concession and confirmation of donation by Portuguese kingdom. The access to property was regulated by the "sesmarial" system, by ordinations and sparse legislation emanated from Portugal. After the king confirmation, the plot acquired the status close to what today is conferred for absolute private property.
The "senhorial" property derives from primary occupations of the land and not from official transfer of the public wealth to private patrimony like "sesmarial" system. It was through local customs and juridical conception of this epoch that such occupations gained recognition as rural private property. Afterwards, the nation recognized and legitimated it because the pressure of "senhorial" owners. In fact a lot of private appropriation has occurred in open areas. The legitimating of the rights to own a land plot was based in cultivation of the land and the legalization occurred through prescription acquisition, buying and selling negotiations and testament which were accomplished in private documents and officialized by public notary and testament judge. The fact that the "senhorial" property had its legitimating in occupations does not mean that it was an illegal property; it was in fact a property which had its fundaments in the jurisprudence of the XVII and XVIII centuries. The pressure to turn these occupations into legal private property gained political and juridical power of the landowners "senhores de terra".
Important remark is that the "senhorial" property is related exclusively with big plots of land, which also means that who did not had power in that epoch like „quilombolas"[7], "caboclos"[8], river population and Indians were apart of the land acquisition process. The "senhorial" property turned to be illegal at the

[6]"Terras Devolutas" at that time were synonym of open access. Nowadays in Brazilian Constitution "terras devolutas" are public lands without a defined public destination, it means land which still do not have passed though discrimination process.
The Brazilian Constitution of 1988 dispose in it article 20, II that "terras devolutas" are Federal land, since it is indispensable for boundaries protection, or area reserved for fortress and military areas, for federal highways and area reserved for environmental protection.
The article 26, IV of Federal Constitution of 1988 disposes that in other cases the public land belongs to State.
[7] Quilombolas are the descendents of slaves that escaped from slave plantations that existed in Brazil until abolition in 1888. Source: http://en.wikipedia.org/wiki/Quilombola It was mainly in the Federal Constitution of 1988 that the Quilombola issues passed to be treat as a public policy, as a result of Black Movement. The article 68 of "Ato das Disposicoes Transitórias" (ADCT) says: "the reminiscent of Quilombolas Communities which still have been occupying their lands is recognized the definitive land property. The State shall provide the respective title" . Source: http://www.cpisp.org.br/comunidades/html/i_oque.html
[8] Caboclo (or caboco, from Tupi kaa'boc, 'who came from forest') is a term used in Brazil describing a person of mixed Brazilian Amerindian and European descent. In Brazil, a caboclo is a specific type of mestiço.

beginning of XX century with the strength of the modern conception of property.
The Brazilian modern land property is demarked and registered in the notary, mechanism utilized by public power to transfer its patrimony for private dominium.
While the "sesmarial" and "senhorial" property had developed during XV until XIX century, the modern property was established only at the end of XIX century, but only gained hegemony between 1930 and 1960, depending on Brazilian region.
The "sesmarial" and "senhorial" property have one aspect in common: During the colonial times they were the centre of economic and political unities, absorbing all the life in the surrounds. For this reason few or almost no space were given for development of small and middle rural properties.
Another characteristic of this time was the wasteful use of land: soil, forest, etc. There was no concern about the necessity to preserve environment with a rational land use.

Table 2.2: Brainstorm of property regimes in Brazil

Type of Property	How to acquire	Proof of Acquisition	Landowner power	Land use and management of natural resources
Sesmarial	Concession / Possession and Concession	Letter of sesmaria concession / Letter of confirmation	Absolute and exclusive	Predatory and wasteful
Senhorial	Possession	Land improvements and political and economical power.	Absolute and exclusive	Predatory and wasteful
Modern	Official public title	Land title	Absolute and exclusive	Predatory and wasteful

Source: Benatti, Direito de Propriedade e Proteção Ambiental no Brasil: apropriação e o uso dos recursos naturais no imóvel rural, Belém, 2003, p. 36.

3. Current rural land tenure system in Brazil

According the historical analysis it is easier to comprehend why the land inequality in Brazil is very high. Since 1930 the government is adjusting the sector in order to make it clearer and fair for Brazilian population, but it evolves important decisions which breaks the roots of the antique rural relations and privileges of many important landowners and politicians in Brazil. The rural lobby is powerful and has many representatives in local, state and federal level of government who avoids radical changes. The current scenery of land exclusion and unclear land data can be profitable for many of them. Make changes in the current system can be dangerous and for this reason the land sector in Brazil has showed slight changes. It has improved a little bit but the kern of problem still exists: unfair distribution of land, poor land reform policy, which distributes land in remote areas without deliver basic infrastructure and provide access to credit to support the new incoming landowners.
Another big problem to point out are the inefficiency of land institutes with old paper based procedures, lack of human, technical and financial resources. The land information system is also unreliable and unclear which affects the security of tenure; difficult land management prevents correct land use and generates conflicts in rural and urban areas.
Brazil also has a weak mechanism of conflict resolution. The justice system is expensive and slow.
The land distribution inequality measured by the Gini coefficient[9] have slightly declined from 0,836 in 1967 to 0,802 in 2000 but it still is very high.
Land Tenure patterns throughout Brazil reflect that the majority of desirable lands are controlled either by the national government or the economic elite and are concentrated into large holdings known as "latifundio", were land is left idle or reserved for plantations, while poor rural farmers are pushed into subsistence farming or share cropping on "minifundio", small holdings often with marginal soils.

[9] *It is an indicator of inequality commonly used to identify the rate of land and wealth concentration. The score vary from an interval of 0 and 1, meaning, the more close to 1, the more unequal is the land distribution. The more close to 0 the lesser unequal is the land distribution. The full numbers 0 and 1 represents also the maxima equality and maxima inequality respectively.*

The tables below show the distribution of land plots in Brazil with its respective areas in hectares.

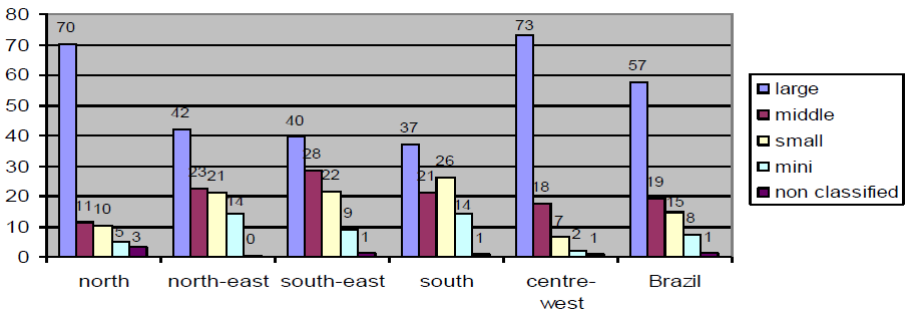
Table 3.1: Distribution of land plots in Brazil

Distribution of land plots in Brazil (2003)					
Total area in hectares (ha)	Rural Plots		Total area		Average area in hectares
	N° of plots	%	Hectares (ha)	%	
Up to 10	1.338.771	31,6	7.616.113	1,8	5,70
From 10 to 25	1.102.999	26	18.985.869	4,5	17,20
From 25 to 50	684.237	16,1	24.141.638	5,7	35,30
From 50 to 100	485.482	11,5	33.630.240	8	69,30
From 100 to 500	482.677	11,4	100.216.200	23,8	207,60
From 500 to 1000	75.158	1,8	52.191.003	12,4	694,40
From 1000 to 2000	36.859	0,9	50.932.790	12,1	1381,80
More than 2000	32.264	0,8	132.631.509	31,6	4110,80
Total	**4.238.447**	**100**	**420.345.362**	**100**	**99,20**

Source: MDA/Incra; Produced: DIEESE

According to INCRA (National Institute for Colonization and Land Reform), 31,6% of rural plots have an area of up to 10 ha, but hold a total area of only 1,8%. On the other hand, the plots of up to 2000 ha represent only 0,8% of the total number of plots, but hold a total area of 31,6%.
Approximately 3% of Brazilian total rural plots have an area of more than 1000 ha and hold an area of 56,7% of agriculture lands. Much of this area is not used productively. This means that an area equivalent the sum of the two Brazilian States of Sao Paulo and Paraná belongs to the 300 biggest landowners of Brazil.
According to Pastoral Land Commission (CPT) it means that less than 3% of the land owners have more than half of the agricultural lands. On the other hand more than 4 million rural families do not have access to land and live in extreme poverty[10].
At the table 3 is showed the size of the land plots in different regions of Brazil: north, northeast, southeast, south and mid-west.
It is easily perceived that in all Brazilian regions the big properties are majority. 57,4% of rural land plots are “latifundios”
Another remark from the table is that the more developed regions of Brazil: south and southeast presents a more equal land distribution between big, middle, small and mini land plots.

Table 3.2: Distribution of total area of land plots by category – Brazil and its regions 1998 (%)



Source: INCRA, Estatísticas Cadastrais; Produced: DIEESE

[10] *www.cptnac.com.br 18/11/2003 Campanha Global pela Reforma Agraria no Brasil*

Remark: As large rural land plots were considered the plots with area superior of 15 fiscal modules[11]; As middle rural land plots were considered the ones with area superior to 4 and inferior to 15 fiscal modules; As small rural land plots were considered the ones with area superior to 1 and inferior to 4 fiscal modules; As mini rural land plots were considered the plots inferior to 1 fiscal module. The definition non classified comprises 149.548 rural land plots with inconsistent data.

4. Real problem analysis and recent country efforts in improving land tenure security in rural areas

On the rural perspective since 1930 the government is adjusting land policies for rural areas in order to make it clear and fair for Brazilian society, but it evolves important decisions which breaks the roots of the antique rural relations and privileges of many important landowners and politicians in Brazil. The rural lobby is powerful and has many representatives in local, state and federal level of government who avoids radical changes in rural structure. The current scenery of land exclusion and unclear land data can be profitable for many of them. Make changes in the current system can be dangerous and for this reason the rural sector in Brazil has showed slight changes.

Up 2007 the presidency of republic affirmed the necessity to accelerate and strength efforts to regularize land, improve cadastre and emission of environmental licenses especially for Amazon region which has the rights of land completely unclear. A favourable wave of change is going on to improve security of tenure in many Brazilian states.

4.1 Initiatives of government to acknowledge the rural land tenure system of Brazil and regularize land

According the ex - President of Incra Rolf Rackbart in his article about 40 years of Land Statute (INCRA, 2006) Brazil has a total area of 850 million hectares. From this number only 418 million hectares are recorded by INCRA.

The sustainable and peaceful development of the rural areas in Brazil depends on clear definition of who has use and property rights over its lands. Even though many efforts of federal land Institute INCRA since 1999 to re-record the rural plots through cadastre campaigns the rural indefinition is still very high, especially in Amazon region where many rights over land are confusing or unknown.

Three re-cadastre campaigns were executed by INCRA in order to clarify the land tenure system of Brazil: the first one in 1999 covering the records of properties bigger or equivalent to 10 thousand hectares. The second one was accomplished in 2001 to cover properties between 5 thousand and 9,99 thousand hectares in some selected Brazilian municipals and 2008 in municipals with highest level of deforestation in Amazon region. The results of the re-cadastre campaign were in part satisfactory. The first initiative accomplished in 1999 for rural plots ($x \geq 10.000$ ha) covered circa 3.579 rural plots which is equivalent to circa 120 million hectares of Brazil (14% of the Brazilian territory). The campaign of 2001 ($5.000 \text{ ha} \leq x \leq 9.999$ ha) reached 743 rural plots covering a bit more than 5 million hectares. The third campaign is still in progress.

The main advances of such campaign were:

- The cancellation of the records of circa 20 million irregular hectares land which were transferred to establishment of unit conservations;
- The legitimating of the land documentation of 20 million hectares in 663 land plots;
- The prohibition of INCRA to emit declarations of land possession which were common practice in the past and, in reality, were precarious documents which always gave the occupant expectation to

[11] *Fiscal Module: is a unit measured in hectares fixed for each Brazilian municipal district established by law n° 6.746 at 10th December of 1979.*
The law takes into account: type of land use of municipal district
The income obtained with rural activities Other land uses existent at the municipal district, which even though not predominant are still expressive because the generated income or utilized area.
Concept of familiar property
The fiscal module serves also to classify rural plots concerning its dimension according the art. 4 of the Law n° 8.629/93:
Mini rural plot: inferior to 1 fiscal module
Small rural plot: area between 1 and 4 fiscal module
Middle rural plot: area between 4 and 15 fiscal module
Large rural plot: area superior to 15 fiscal module.

have the land plot regularized by law. This sort of declaration also allowed the access to credit for small and middle landowners (x ≤ 450 ha) as well the informal public land transaction.

- The cancelation of the records in INCRA rural cadastre "Certificado de Cadastro de Imóveis Rurais" (CCIR) of approximately 66 thousand possessions, measure which hinder the informal commercialization of public lands.
- The launching by the federal government of a program to establish a unique national rural cadastre: "Cadastro Nacional de Imóveis Rurais" (CNIR) in order to organize the current data in a logical and practical way and raise the security of cadastre system.

According the Imazon publication "Quem é o dono da Amazônia?" (Barreto, 2008, p.53) the cadastre campaigns were very important to acknowledge the Brazilian land tenure system but they also left many pendency's unsolved because the insufficient budget, inconsistencies of the legislation to define the rights of the occupants or to define how to proceed in order to cancel the illegal records acknowledged by real state, or how to regularize the legitimized possessions found.

Evidences of these deficiencies are reported by Imazon: seven years after the first campaign (1999), 56 million hectares lands continued to appear as land plots with documentation in process or without information; after three years of the campaign more than 40 million hectares of occupations continued to appear as irregular.

Therefore transparency and agility to deal with land tenure issues is missing. The land regularization campaigns will only be successful if these issues and procedures can be clearly defined and the actions quickly implemented.

4.2 Land regularization project in Amazon region: Legal Land Project "Projeto Terra Legal"

From 2003 to 2008, 81 million hectares lands, what is equivalent to 10% of the territory of Amazon Region, were designated to settlement projects, conservation areas, Indian areas and state lands. There are still 67,4 million hectares of public land without destination in Amazon region, what means 13,42% of the total area of the region which is favorable to start a policy of land regularization. Under control of the states government, there are more than 100 million hectares lands in condition to be regularized.

In January of 2009 the Ministry of Agrarian Development (MDA) launched the program Legal Land "Terra Legal", which intends to regularize 67,4 million hectares land in Legal Amazon[12].

The program intends to give land titles to people who has land plots until 15 fiscal modules (maximal 1.500 ha) invested in occupation older than December 2004. The project will be guided by Ministry of Agrarian Development (MDA) with the partnership of states and municipals of the Amazon region. The strategy is to set up a join up work groups between the land institutes of federal, state and municipal level to record thought geo-reference measurements the land plots in the cadastre system.

In order to gain efficiency, the regularization process will be simplified especially concerning the legislation and procedures to get a land title. Under the normal rules the whole process would take 5 years.

The intention of the project is regularize land in a following way:

- Plots until 1 fiscal module (average area of 76 hectares) the title process will be free of charge and will take between 60 and 120 days up the land record of the occupation in the cadastre system.
- Plots between 1 and 4 fiscal modules will be sold with prices under the land market value with 20 years for payment with 3 years of amortization. The procedure to get a title is the same as the one designed for plots until 1 fiscal module.
- Plots between 4 and 15 fiscal modules will be sold according land market prices discounted the improvements of the property. The title procedures will be preceded by survey analyses in order to identify the improvements, age of the property and deficiencies of the plot. The procedure of payment will follow the similar rules set up in the case of plots (1 ≤ x ≤ 4) fiscal modules.
- Plots bigger than 15 fiscal modules (until 2.500 ha) have to obey the normal legislation.

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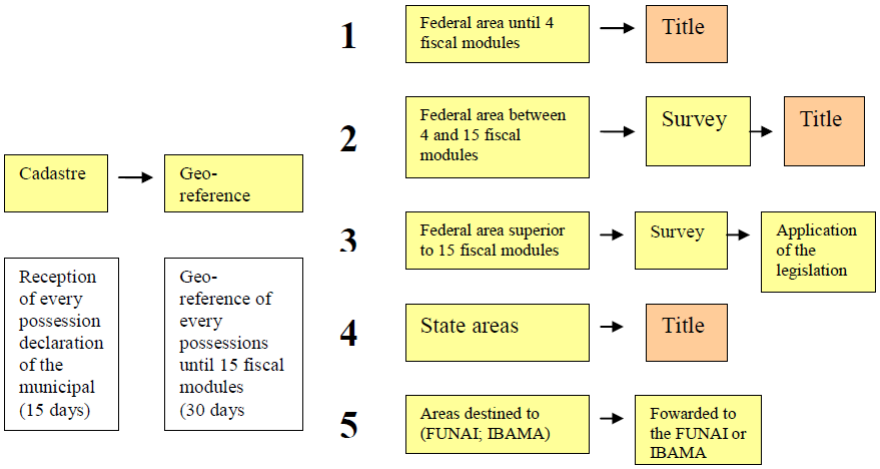
[12] The legal Amazon comprise the north estates of Brazil (Acre, Amazonas, Amapá, Pará, Rondonia, Roraima, Tocantins, Mato Grosso and part of Maranhao (44° longitude west) and a small territorial portion of Goias (up 13° of latitude south).
The concept of Brazilian Legal Amazon was determined in Jan 6th 1953 by the Law 1.806. At that time the Mato Grosso Estate took part with only the north part of its territory (16° of latitude). The Mato Grosso Estate took part of Legal Amazon in its integrity by the complementary law n° 31 in Oct, 11th 1977.
Source: (Lentini at al. (2005): Amazon Forest Facts 2005, Imazon, Belém-PA.

- Plots bigger than 2.500 ha have to have authorization of National Congress to be sold.

The procedure of the regularization process will follow the schedule below:

Table 4.1: Rural areas: Steps of regularization process



Source: INCRA: “MDA vai regularizar 67,4 milhoes de hectares na Amazonia legal”, 23/01/2009.

In all the cases it is required the alignment with the environmental legislation which in Amazon region claims that 80% of the land plots should be covered with native vegetation.

Another rule is that the plots in process of get land titles can’t be sold during the time of ten years, but they can be used as mortgage by financial institutions.

4.3 Combat land forgery „Grilagem de Terras“ in Amazon region

According the history the expression “grilo” or “grilagem”, which is commonly used in Brazil to express the lands illegally occupied and recorded, originates from an artifice of giving documents the appearance of old.

With this purpose, the forgers inserted the forger document in one metal or wood box with a lot of crickets and closed it. After some weeks, the document presented light yellow-dull-rust color arisen by dejects of the insects. Everything was made with the purpose of supposing an action of the time in the paper.

Certainly, it was an artifice of the past overcame by sophisticated technological artifices. But the history of “grilagem” serves as an example to demonstrate how old the practice of forger land title documents in Brazil is. The land forgery has colonial roots. Since XIX century, through different ways and frequently with the participation of public power, forgers advance to public lands, forging land titles with the participation of land institutes and Real State Offices. They use also violence to expel rural and Indians communities

The forgery has the connivance of governmental institutions with through bribe indicate and permit the forgery of land titles in public areas to powerful agents, sometimes behind the names of inexistent persons in order to execute the forgery in Real State. After having succeeded the forgery in Real State, the forger replied the same procedure in the State land institution, Federal land institute and Federal Patrimony. The objective is to link the records in order to give the forgery an appearance of legal action.

The forgery was historically facilitated by institutional lacks as an example the inexistence of a common cadastre, the data of federal and state cadastre are not joined up. The federal cadastre is merely declaratory. The supervision over the Real State is poor.

The forgery of land titles is the most powerful mechanism of land concentration in rural Brazil. In the whole country the total area with suspicion of land forgery is around 100 million hectares, what means four times the area of Sao Paulo State or the area of Central America plus Mexico.

In the north region of Brazil the situation is critical: from the total area of Amazonas State what is equal to 157 million hectares, 55 million are suspected to be land forgery, what is equivalent to three times the

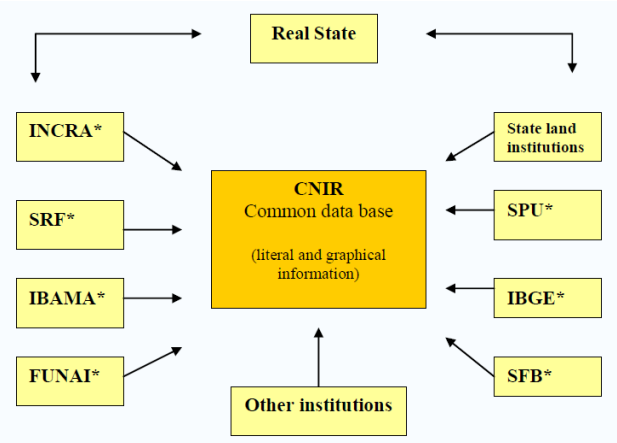
Paraná State.
In Pará State for example, an inexistent person sold to ten other people approximately 9 million hectares of public land.
Great part of the Real State Offices, not only in Amazonas State but also in Pará, Acre, Goiás, Paraná, Amapá and Roraima States, present mistake and vice of registration process.
The Ministry of Land Policy and Agrarian Development (MDA) plus the National Institute for Settlement and Land Reform (INCRA) are trying to revert for public patrimony many ten million hectares of irregularly land occupied by private individuals.
The first step of this operation consists on the cancelation of the registry of big properties, all of then previously analyzed. The objective of government is requiring the cancellation by State and Federal Justice of the registry in real state of such illegal properties.
With this action the government intends to revert for public patrimony the forgery private areas and with them support policies of land reform, environmental conservation and others. With this measure the government aims to combat the social exclusion of rural Brazil.

5. Trends and development of rural land administration system in Brazil

5.1 Establishment of a unique rural cadastre system

The fragility of the rural cadastre system is acknowledged at least since 1992 when the Federal Treasure Secretary (SRF) has launched a cadastre separated of the National Institute for Settlement and Land Reform (INCRA) federal rural cadastre especially for the purpose of collecting the rural duty (ITR). From this time on, the idea to establish a unique registry and cadastre system arose. In 1998 an auditing executed by Union Count Tribunal (TCU) emphasized again the necessity to establish a unique cadastre. But only the Law n° 10.267 of 2001 has consolidated juridically the proposal to create a national unique geo-referenced rural cadastre.
The current proposal of National Rural Cadastre (CNIR) aims: to bring together and facilitate the access to the land related rural data; raise the reliability of the data to fiscal, environmental, rural development and land reform purposes and increase the efficiency of human and financial resources.
According the legislation, the structure of the national rural cadastre CNIR should be like that:
- The data base will consist in a common land information system conjoined by INCRA and SRF, produced and shared with a diversity of federal and state land related institutions which will be able to provide data and use the data base.
- The joined data base will adopt a unique code to be established by INCRA and STR to allow de identification and sharing of the data with other public land related institutions.
- The national rural cadaster (CNIR) will integrate the produced data bases of each institution participant which can be shared between each other, respecting the rules of each institution.

Table 5.1: Land information system of the national rural cadastre (CNIR)



Source Barreto, Paulo: Quem é o dono da Amazônia?, Belém 2008, p.51.
INCRA: National institute for Settlements and Land Reform, SRF: Federal Treasure Secretary, IBAMA: Brazilian Institute for Environment and Renewable Natural Resources, FUNAI: National Indian Foundation, SPU: National Patrimony Secretary, IBGE: Brazilian Institute for Geography and Statistics, SFB: Brazilian Forest Secretary.

6. The urban Brazil

Less than a century ago Brazilian cities were inhabited by 10% of the total national population. Today 82% of the country's citizens live in cities. This change took place in cities and together with it a process of social exclusion which further aggravated existing social inequalities. Past policies aimed at correcting the situation proved non effective, either due to a lack of focus on the population segments that suffer the most from the effects of disorganized urbanization or due to the lack of continuity, a problem that worsened during the peak of the nationwide economic crisis.

Brazil suffers of a variety of urban problems: lack of water and sanitation, chaotic and noisy transit in big cities, poor delivery of public transport services with regularity and quality for its citizens, home facilities for all. The urbanization models used in Brazil during the last decades have created cities that suffer from fragmentation, scarcity and social exclusion as well as to the rampant and disorganized growth of city suburbs. The most significant indicators are the increase in the number of slum dwellers, showing an increase that is much higher than the national average; the continued proliferation of informal and illegal settlements; and the degradation of environmentally protected areas.

On March 2010, Rio de Janeiro was the stage of the 5 World Urban Forum where a variety of urban topics were discussed. The Brazilian government has impressed presenting the results of the Growth Acceleration Program (PAC), a strategic four-year investment plan for building infrastructure in different fields of development in whole Brazil.

In the field of sanitation and slum urbanization the amount of resources allocated for it, according the last financial statement presented in June of 2009, was: R$ 56.34 billion Reais for the housing sector, R$ 20.8 billion Reais for sanitation sector. 41% of the contracted housing projects were under way and 31% of sanitation projects had initiated. (Ministry of Cities, 2008 p.7).

Three weeks after the 5 World Urban Forum, Rio de Janeiro suffered the strongest storming rain of its history which caused flood and land slides in 105 localities of the state which resulted in more than 220 deaths and urban chaos. The losers of the natural catastrophe were mainly the urban poor. Many informal settlements in slum areas over the slopes slid down. In Niteroi, the community of Bumba was completely destroyed. The Bumba was an antique hill of garbage turned inoperative since 1981. Since then the hill was completely settled by the urban poor. Some specialists have warned about the danger of settle a garbage hill because the unstable soil, the contaminate water, the toxic elements of the area like methane gas with explosive components, but the warning had no effect. The community continued to grown and the Prefecture of Rio started to invest in urban infrastructure for the area. A road was constructed until the top of the hill to facilitate the access to the area. This measure has intensified even more the occupation in a vulnerable area. Result of the rains and public negligence, the slope slid down.

Catastrophe like that reveals the fragility of building conceptions and good sense of the decision makers. How could they invest in urban planning in a settlement over a garbage hill?

6.1 Recent country efforts to improve urban areas

Measures to reverse the above mentioned trends have been characterized by some historical landmarks such as the 1988 Federal Constitution, which includes provisions related to urban policies, to the social function of property and the right to housing (arts. 182 and 183); and the institution of the City Statutes (Federal Law 10.257/2001 and Temporary Order 2.220/2001).

The Ministry of Cities has been a party, together with social organizations, of this historical context. The Ministry was created in 2003 and its main objective was the creation of a National Urban Development Policy which could combat social exclusion and segregation within Brazilian cities through integration of regional housing, sanitation and transportation policies.

The Brazilian government also has set alliances to improve know how in urban issues and has done a lot of adjustments in the legal framework to better define and implement issues in different subjects of urban planning. Brazil is the first developing nation to join the Cities Alliance, an organization that counts amongst its members the G7 countries and other international organizations. This Alliance of Cities provides financing for urbanization programs directed at precarious settlements in developing countries and also provides and defines strategies for urban policies.

The regulatory code for sanitation has been approved and the regulatory code for the urban transportation

and mobility sector has been forwarded to the National Congress. The Law 11.445 of 05/01/2007 which sets the national directives for basic sanitation and for federal sanitation policies was sanctioned. In the housing sector it was created referential works for the National Housing Policy (PNH) in 2004, followed by the creation through Law 11.124 of June 16th 2005, of the National System and the National Fund for Social interest Housing (SNHIS/FNHIS) and its Managing Council; the creation of the National Habitat Plan (PlanHab); and the inclusion of actions for the housing sector in the Growth Acceleration Program (PAC). Every state of the Brazilian Federation and more than five thousand municipalities joined the National Social Interest Housing System (SNHIS). The system has become one of the most valuable instruments for the re-start of planning, the creation of an environment presenting new institutional conditions and the capacity to influence the executive branch on federal, state and municipal levels.

The results of Growth Acceleration Program (PAC)

The Brazilian program, PAC - Slum urbanization was praised by Willian Cobbett, coordinator of the city Alliance Program, which globally acts to improve urban planning in order to diminish poverty. According Cobbett, currently, Brazil is well known as international leader of slum urbanization. He mentioned, although many things still have to be done, Brazil shows political will to change the way of living of the inhabitants of slums. The country did some changes in the City Statute in order to regularize the access to land, he also added: Brazil has hit when established the Cities Ministry to manage the issues related to urban planning, initiative existent in few countries. The Indian Jockin Arputhan, president of the International Association of slum settlers was also admired with the Brazilian initiative. “This is a good model to be adopted everywhere in the world”. Ministério das cidades, (2010)[13].

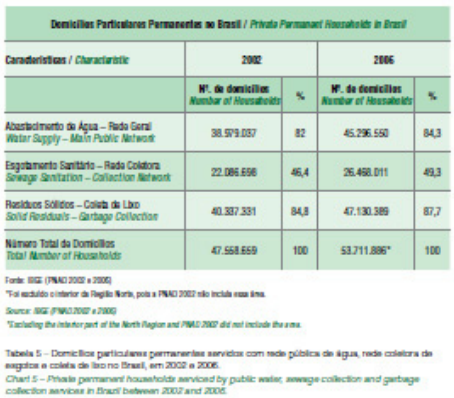
In fact the Brazilian government is investing in a series of infrastructure projects to improve the urban areas with especial focus on the urban poor.

The results of the first Growth Acceleration Program (PAC), a strategic four-year investment plan for building infrastructure in different fields of development in whole Brazil showed the following results: R$ 56.34 billion Reais was designed for the housing sector, R$ 20.8 billion Reais for sanitation sector. 41% of the contracted housing projects were under way, 50% were in the bidding stage and 9% in the preparatory stage. The figures for sanitation projects showed that 31% were initiated, 63% were in the bidding state and 6% were in the preparatory stage. (Ministério das Cidades, 2008 p.7).

The table n° 6.1 shows the number of domiciles benefited with sanitation from 2002 to 2006.

The table n° 6.2 shows the percentage of housing investment by income levels, and the table n° 6.3 shows the evolution of investments in habitation.

Table 6.1: Number of domiciles benefited with sanitation from 2002 to 2006



Domicílios Particulares Permanentes no Brasil / *Private Permanent Households in Brazil*				
Características / *Characteristic*	2002		2006	
	Nº. de domicílios *Number of Households*	%	Nº. de domicílios *Number of Households*	%
Abastecimento de Água – Rede Geral *Water Supply – Main Public Network*	38.979.037	82	45.296.550	84,3
Esgotamento Sanitário – Rede Coletora *Sewage Sanitation – Collection Network*	22.086.696	46,4	26.468.011	49,3
Resíduos Sólidos – Coleta de Lixo *Solid Residuals – Garbage Collection*	40.337.331	84,8	47.130.389	87,7
Número Total de Domicílios *Total Number of Households*	47.558.659	100	53.711.886*	100

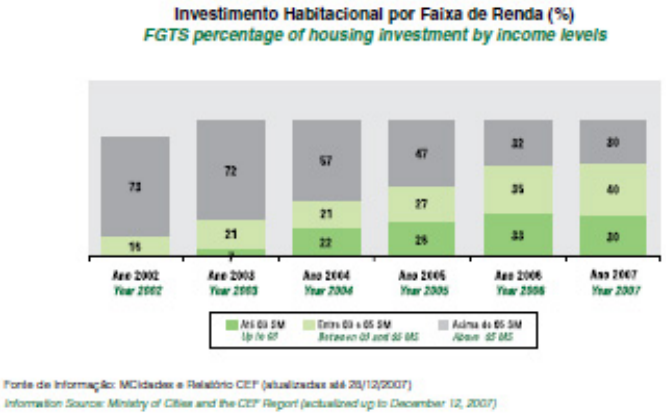
Fonte: IBGE (PNAD 2002 e 2006)
*Foi excluído o interior da Região Norte, pois a PNAD 2007 não incluiu essa área.
Source: IBGE (PNAD 2002 e 2006)
Excluding the interior part of the North Region and PNAD 2007 did not include the area.

Tabela 5 – Domicílios particulares permanentes servidos com rede pública de água, rede coletora de esgotos e coleta de lixo no Brasil, em 2002 e 2006.
Chart 5 – Private permanent households serviced by public water, sewage collection and garbage collection services in Brazil between 2002 and 2006.

Source: Ministério das Cidades, Resultados, Projecoes, Acoes, 2008. p. 23.

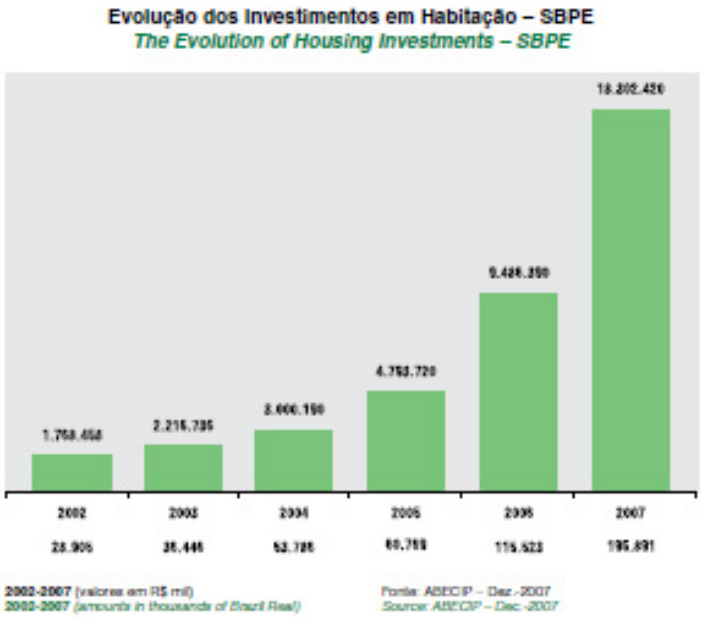
[13]*Source: Ministério das Cidades.: “PAC Urbanizacao de Favelas obtém reconhecimento internacional no FUM 5”. At: http://www.cidades.gov.br/ (status 26/03/2010).*

Table 6.2: Percentage of housing investment by income levels



Source: Ministério das Cidades, Resultados, Projeções, Ações, 2008. p. 38

Table 6.3: The evolution of housing investments



Source: Ministério das Cidades, Resultados, Projeções, Ações, 2008. p. 42

In order to continue the previous plan, the Brazilian government has launched the PAC 2 with an estimated investment of R$ 1,59 trillion which will be divided in six new focus which cover infrastructure projects in whole Brazil: PAC Better cities, PAC citizen community, PAC My home, my life, PAC Water and Light for all, PAC Transport and PAC Energy.

6.2 Trends and development of land administration system

The responsibility for the production and administration of cadastre system in Brazil is fragmented between INCRA in rural areas and Municipals in urban areas. In urban areas, while the Real State is responsible to record immobile transactions according the registered number of the property, the city hall remains the tasks to approve land parcels, concedes building licenses, charge the taxes and secure land rights of the property owners. The State Judiciary through Real State and the Municipal

Executive like the Fiscal Secretary, Building Secretary, Urban and planning Secretary sharing attributions related to land records. They use to record a unit, fraction or building and constructions of a specific land plot.
In Brazil there isn't a unique, multifunctional, modern public cadastre system related to immobile data which comprise the registry of technical, legal and graphical data related to terrain and edification. (Souza,2001 apud Philips, 1996). One of the main problems of the Brazilian urban cadastre is related to the narrow use of this tool. Generally the municipal administration uses the urban cadastre mainly for the taxation purpose, to charge the, IPTU "Imposto sobre propriedades territoriais urbanas", urban taxes, services and in less scale for urban planning.
To turn the cadastre multifunctional is a necessity of the modern world.
The Ministry of cities is promoting a Seminar in all Brazilian regions to present and discuss a regulatory code to define contents, institution and up dating of Multifunctional technical cadastre (CTM) to be adopted by the Brazilian municipalities.
The cadastre is a fundamental tool to support the municipal actions because it consolidates and integrates a series of information: physical, social, economical, juridical and environmental about the territory. It is essential to support urban planning, urban management and support the execution of urban policy as well the obligation to fulfill the social function of property, to charge the tax over urban property (IPTU), to execute land regularization; to mediate urban transactions, to concede and charge the license over the right to building, to charge for the use of a public place (urban infrastructure network).
Every urban and rural institutions recognize the necessity to change the old fashioned paper based data to a computer based with GIS technology. This is a tendency to be admitted in whole Brazil. Seminars, discussions, adjustments in the legislations have been made in order to build place for a new and modern system.

7. SWOT Analysis of the current land tenure system in rural and urban areas of Brazil

In order to better visualize Strengths, Weaknesses, Opportunities and Threats of the current land tenure system in Brazil in rural and urban areas; SWOT[14] strategic models were designed and presented below:

Table 7.1: SWOT Analysis of land tenure system in rural Brazil

RURAL	Positive	Negative
Internal	**Strengths**	**Weaknesses**
Factors	Existence of financial resources to be bound for institutional improvement, land regularization, technology acquisition and capacity building.	Confusing legal framework which gives space for delays and impunity.
	The federal, state and municipal rural land institutions have been working more close in a previously agreed priority policy.	Slowness of Judiciary to sentence a case.
	A modern multifunctional cadastre with geo-referenced information system is in progress. The system will comprise land information from the government land related institutions.	Absence of governance in remote areas, like for example some areas in Amazon region, where the law is made by powerful agents. As a result land conflicts and environmental degradation are high.
	Efforts to combat land forgery have been made.	Resistance of rural lobby to clarify the rural system
		Absence of effective mechanism to delivery infra-structure for the rural poor.
External	**Opportunities**	**Threats**
Factors	Pressure of international market for clear tenure and clean production.	Presidential elections: discontinuity of actions.
	Pressure of landless movement to access land	Corruption

Source: Proper source

Table 7.2: SWOT Analysis of land tenure system in urban Brazil

URBAN	Positive	Negative
Internal	Strengths	Weaknesses
Factors	Existence of financial resources to be converted in urban benefits.	Poor land information system. The urban cadastre isn't geo-referenced or multifunctional.
	Existence of a ministry especially to deal with urban issues: the Cities Ministry which in partnership with states and municipals are defining policies and projects to improve urban areas.	It is necessary to stick more in the quality of the creating urban infrastructure not only the quantity.
		The articulation between federal, state and municipal levels is still weak.
		It is necessary to invest in human capacity building in the municipal level.
		Absence of technology and human capacity to prevent natural catastrophes.
External	Opportunities	Threats
Factors	5° World Urban Forum accomplished in Rio de Janeiro has emphasized the importance to guarantee equal, universal, fair and democratic distribution of urban resources in order to give opportunities for all.	Natural Catastrophes which have been affecting the Brazilian cities like storming rains, and land slides.
	After the strong damages caused by natural catastrophes, the Urban planners and policy makers are more aware to the quality of the building constructions and are bond to invest in technology to monitor the weather changes.	Corruption of the founds designed to build urban infra-structure
		Presidential elections: discontinuity of actions.

Source: Proper source

8. Conclusions on land tenure security in rural Brazil

Brazil, the giant country has grown economically. Strong investments have been made to improve infrastructure, integration of the country, combat social inequality and support sustainable development in urban and rural areas. Financial resources have been allocated for a variety of development purposes in rural and urban areas like: land regularization, rural settlements, rural cadastre system, capacity building, institutional improvement, sanitation, transport, urbanization of slums, habitation projects, etc. Even though the reasonable financial resources and a favorable will of change, the development policies encounter great difficulty to be implemented because the unclear tenure system, slow procedures and decisions of judiciary and public administration. Break the archaic roots of the system aren't an easy task and needs time and commitment to change.

Resources exist, but commitment of subsequent governments doesn't, because such long term projects don't bring immediate visibility. The result is, many projects remain uncompleted or unfinished.

On the rural perspective, the government is adjusting land policies for rural areas in order to make it clear and fair for Brazilian society. Maybe with a renew of the rural structure turning it more attractive for part of

[14] *Source Wikipedia: SWOT analysis is a strategic planning method used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project or in a business venture. The technique is credited to Albert Humphrey, who led a convention at Stanford University in the 1960s and 1970s using data from Fortune 500 companies. http://en.wikipedia.org/wiki/SWOT_analysis*
A SWOT analysis must first start with defining a desired end state or objective. A SWOT analysis may be incorporated into the strategic planning model.
- Strengths: attributes of the person or company that are helpful to achieving the objective(s).
- Weaknesses: attributes of the person or company that are harmful to achieving the objective(s).
- Opportunities: external conditions that are helpful to achieving the objective(s).
- Threats: external conditions which could do damage to the objective(s).

the population which live and work there, the urban problems would be diminished, but it evolves important decisions which breaks the roots of the antique rural relations and privileges of many important landowners and politicians in Brazil. The rural lobby is powerful and has many representatives in local, state and federal level of government who avoids radical changes in rural structure. On the urban perspective the cities have also inherited the social inequality and grew up disorderly, in many areas completely apart of urban planning and build laws. The urban poor have been struggling to live in the city. They have settled slopes and vulnerable areas of the city. Urban policies to offer the urban poor access to home and infrastructure have been weak and punctual. Brazil recognizes its strengths and weaknesses. The government is trying to change the archaic system to support the growth of a giant modern land and reduce the contrast between rich and poor in rural and urban areas.

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Collaborative Information Systems for Disaster Management: Building Resilience against Disasters by Combining Participatory Environmental Monitoring and Vulnerability Communication

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Abstract
Recent years have seen increasing attention given to environmental hazards and their potential impact in terms of natural disasters, especially as the frequency of disasters has steadily grown recently. Furthermore, projected climate change is expected to accentuate this tendency even more. Consequently, in addition to measures for climate change adaptation at the national and international levels, such as disaster preparedness and response, it will be important to develop community-based, bottom-up approaches to improve community resilience, i.e. to improve the capacity of communities to resist, change or adapt to get a new level of functioning or structure in the occurrence of disasters and such extreme events. This abstract describes an ongoing research project to address this challenge by developing an adaptation strategy that relies upon collaborative geospatial information systems to implement two different and complementary strategies: a) participatory environmental monitoring; and b) communication about long term changes and associated vulnerability and risks.

Keywords: Geographic Information Systems; Disaster Management; Collaborative Systems; Resilience; Climate Change

Introduction

Recent years have seen increasing attention given to environmental hazards and their potential impact in terms of natural disasters, especially as the frequency of these disasters has steadily grown recently. Furthermore, projected climate change is expected to accentuate this tendency even more. Consequently, in addition to top-down measures for climate change adaptation, such as disaster preparedness and response, it will be important to develop community-based, bottom-up approaches to improve community resilience, i.e. to improve the capacity of communities to resist, change or adapt to get a new level of functioning or structure in the occurrence of disasters and such extreme events [3].

In order to achieve resilience, it is important to have accurate, timely and complete information on the current status of environmental variables, as well as on the scientific prognoses about the upcoming changes and their associated impacts. Such information is valuable not only for decision making about public policies, but also for improving public awareness on the challenges imposed on our society by climate change. Furthermore, information is one of the most important assets for managing disasters, and may be of great help in reducing the impacts of such extreme events in terms of human, material, economic or environmental losses. In these contexts, geospatial information is of particular importance, since information on both environmental change and disasters are always related to a specific geographic context or region.

In this manner, the research challenge that is posed in this context is how to manage and make available all the information needed for building resilience to climate change risks in vulnerable communities, so as to support effective local decision-making both for individuals that live in vulnerable areas, as also for the respective local public policy decision makers.

This project is aimed at addressing this challenge by developing and deploying a collaborative information system as an adaptation strategy to climate change in vulnerable communities, i.e. for improving the resilience of communities in face of climate-change related risks. Adaptation is to be pursued towards two different and complementary strategies:

1) Participatory environmental monitoring: in order to build community resilience against disasters or extreme events a collaborative SDI geoportal and an associated alert system are being developed, so as to manage and concentrate different types of information: a) official information (governmental sources), b) real-time status of environmental variables (sensors), and c) community-generated information (VGI, crowdsourcing). Additionally, the geoportal will be used to share information about consequences of floods (e.g. flooded streets, traffic jams, etc.), workaround strategies, infrastructure improvement etc.
2) Communication about long term changes and associated vulnerability and risks: by enabling the visualisation in maps of the local effects that are consequent of the projected changes, as well as allowing information exchange about associated vulnerabilities and strategies for risk management both from the governmental side (public policies), as well as private and third-sector initiatives.

Materials & Methods

The general objective of this project is to research a transdisciplinary approach [1] for improving resilience of vulnerable communities to climate by the following steps:

1) Participatory development of a SDI geoportal for community-based, participatory environmental monitoring that integrates real-time information (sensors and volunteers), early-warning alerts (nowcasting), and projected long term impacts (climate change models), providing governments and citzens with an observatory for environmental information in three different time scales.
2) Developing a research framework to study the particular problems, information needs, risk perception and motivation factors of the community about water-related climate change risks by analysing the usage of the geoportal and ethnographic fieldwork.
3) Developing quality strategies and metrics based both on interaction metrics ISO criteria (19113:2002, 19114:2003) and community-based evaluation of the geoinformation, as well as developing ways of effective processing, analysing and communicating (e.g. by means of spatio-temporal visualisations) these indicators for improving understanding and fostering community participation.

Furthermore, the proposed platform will interface with two other ongoing research projects:

1) Assessment of Impacts and Vulnerability to Climate Change in Brazil and Strategies for Adaptation Options. Principal Investigator and Coordinator: Dr. Jose Antonio Marengo Orsini (CCST-INPE). This is a large-scale project funded by the Brazilian funding agency FAPESP, which involves a multidisciplinary group of researchers of the best institutions in Brazil with the goal of establishing the base for studies and assessments for impact, vulnerability and adaptation to climate change in Brazil, using a combination of regional climate change projections and vulnerability indices based on environmental, geographical-geophysical and social information, to identify areas under risk to climate stress, and to map vulnerability of population nation and in the state of Sao Paulo. I take part of the Component 6: Mitigation and adaptation measures of vulnerable communities to cope with water-related risks derived from climate change scenarios at river basins of Sao Carlos [3], coordinated by Prof. Dr. Eduardo Mendiondo (EESC-USP). This project will construct a prototype Spatial Data Infrastructure for the interchange of information between the different researchers in this project, as well to provide data for a web geoportal to publicize the results of the project to the broader Brazilian population.
2) E-Noe: Wireless Sensor Network for Urban River Monitoring. Principal Investigator: Prof. Dr. Jo Ueyama (ICMC-USP). Prof. Ueyama is developing a sensor network platform to monitor variables like pollution and floods of urban risks, which will provide us with real-time data.

Expected Results and Contributions

This project seeks to achieve two major scientific contributions:

1. Contributing to the understanding of the role of collaborative geospatial information systems in improving the adaptive capacities of vulnerable populations against disasters, and in social learning about climate change, by means of evaluating behaviour change, engagement and participation, as

well as empowerment and action within populations that are potentially impacted by climate change. Currently, the evidence for a positive linkage between ICTs and climate change resilience is mostly anecdotal, so that further research in this topic is still required [5]. Furthermore, this research proposal will advance knowledge about how to integrate technological, sociological, and organizational issues, what is seen as critical to the improvement of disaster response [6] and also for the management of volunteer geographic information [2].

2. Advancing knowledge on how to assure the quality and effectiveness of volunteered geographic information for improving adaptive capacity to disasters and climate change impacts, both by developing techniques/methods for addressing well-known quality assurance problems of VGI and by evaluating these in a practical and concrete usage scenario.

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Accelerated degradation of 14C-atrazine in Brazilian soils under no-tillage

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Abstract
The main goal of our project is to evaluate the degradation pattern of atrazine in different Brazilian agricultural soils under no-tillage and its relation with history of ATZ application and soil type, employing 14C-ATZ. Two main studies are involved in this project. In the first one, the pattern of atrazine degradation in two Brazilian Oxisols that have received repeated atrazine applications over years was investigated. The results were compared with those obtained from soils of the same type without a history of atrazine application. In the second one, soil samples form a South Brazilian Acrisol and their respective cover straw were examined in respect to the ATZ degradation pattern. Our results demonstrate an accelerated ATZ degradation in a previously ATZ-treated soil due to an ATZ-adapted soil microbial population being able to rapidly mineralize this herbicide. This fact occurred regardless the soil class. In the native soils, ATZ tend to occur in a less mobile form (ASE-extractable) but this compartment is still liable to be mineralized or mobilized back to the soil solution. Cover straw tend to decrease the ATZ mineralization.

Keywords: Labeled ATZ; Cover Straw; Adapted Microorganism; Sorption

Introduction
Atrazine [2-chloro-4-(ethylamine)-6-(isopropylamine)-s-triazine] (ATZ) is a widely used herbicide though it was banned by several countries many years ago. In Brazil, ATZ is still widely applied for broadleaf control in maize, soybean and sugar cane crops, which are the most important and profitable Brazilian agricultural products. Due to changing of agricultural management systems to conservative systems, information on the environmental fate and behavior of ATZ is needed when this herbicide gets in contact with the soil and with the straw cover in no-tillage systems. The main goal of our project is to evaluate the degradation pattern of ATZ in different Brazilian agricultural soils under no-tillage and its relation with history of ATZ application and soil type. Two main studies are involved in this project. In the first one, the pattern of atrazine degradation in two Brazilian Oxisols that have received repeated atrazine applications over years was investigated. The results were compared with those obtained from soils of the same type without a history of atrazine application. In the second one, soil samples form a South Brazilian Acrisol and their respective cover straw were examined in respect to the ATZ degradation pattern.

Materials and Methods
For the first study soils samples were collected from the upper 10 cm of a Rhodic Hapludox (RS) and from a Xantic Hapludox (BA), that were under no-tillage for 20 and 10 years, respectively. For the second study an Acrisol (RS) kept under no-tillage for the last 10 years was employed and samples from soil (10 cm) and oat straw were examined. In all areas soil samples from a neighboring area without ATZ application history were used as references. The incubation experiments with 14C-ATZ were conducted for 85 days in order to compare the mineralization, formation of metabolites and nonextractable residues of ATZ. The amount of mineralized 14C- ATZ and that of 14C-residues were determined liquid scintillation counter (LSC, 2500 TR, Tri-Carb, Packard Liquid Scintillation Analyzer).

Results and Discussion
Study 1. Samples from the agriculturally used sites showed a high degradation potential for atrazine.

After 15 days of incubation, about 75 % of the initially applied 14C-atrazine was mineralized in the Rhodic Hapludox, while in the Xantic Hapludox it did not exceed 15 % (Figure 1). After 85 days, the mineralized amount reached up to 82 % in the Rhodic Hapludox and up to 74 % in the Xantic Hapludox. The cumulative evolution of 14CO2 from ring-labeled atrazine observed in the untreated soils was low. After 85 days, the average cumulative 14CO2 evolution in the untreated soils was only 5.0 % and 0.4 % of the initially applied 14C-atrazine in Rhodic and Xantic Hapludox, respectively (Figure 1). The behavior of atrazine degradation observed in the cultivated soils can be attributed to the presence of microorganisms capable to metabolize atrazine after repeated applications under field conditions, as control samples showed only small mineralization values. The low mineralization observed in both soils under native vegetation, was assigned to the absence of adapted microorganisms during the incubation time. The amount of water-extractable atrazine retrieved directly after its application (day 0) was similar among the same soil type, regardless of the soil use, but was higher in the Xantic Hapludox (Figure 2). The comparatively higher sorption of atrazine in the Rhodic Hapludoxs can be related to its higher organic matter content. After 8 days of incubation, the amount of water-extractable atrazine in the previously atrazine treated soils decreased due to the mineralization of the herbicide. On the other hand, the decrease in water-extractable atrazine in the non-cultivated soils can be attributed to the formation of stronlgy sorbed atrazine as indicated by the gradual increase over the time of the fraction obtained via accelerated solvent extraction. In addition, a gradual increase of the bound residues fraction during the incubation time was observed as well.

Study 2. First results showed a higher 14C-ATZ mineralization in the cultivated soil (around 86% of the total applied amount of 14C activity) in comparison to the native soil (around 8% of the applied amount) after 68 days of incubation (Figure 4). In both soils, the water-extractable amount of 14C-ATZ directly after its application was greater than 60%(Figure 6). In the cultivated soil it decreased drastically with time and reached values lower than 5 % after the 9th day of incubation. In the native soil, the decrease of water-extractable ATZ was smoother and reached 20% at the 85th day. The water-extractable metabolites detected were hydroxyatrazine and deethylatrazine. The water-extractable amount of deethylatrazine was higher than the amount of hydroxyatrazine for the native soil. The ASE-extracted ATZ in the cultivated soil was around 40% just after application and decreased with time as already observed with the water-extractable ATZ (Figure 6). In the native soil, the amount of ASE-extracted ATZ varied around 40%. The mineralization fo ATZ in the soil+straw system was always lower that than the naked soil (Figure 5).

Conclusions

Our results demonstrate an accelerated ATZ degradation in a previously ATZ-treated soil due to an ATZ-adapted soil microbial population being able to rapidly mineralize this herbicide. This fact occurred regardless the soil class. In the native soils, ATZ tend to occur in a less mobile form (ASE-extractable) but this compartment is still liable to be mineralized or mobilized back to the soil solution. Cover straw tend to decrease the ATZ mineralization.

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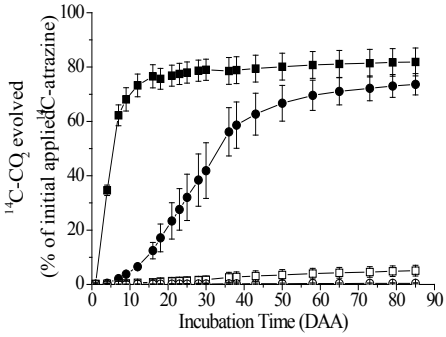

Figure 1. Cumulative 14CO2 of 14C-atrazine mineralization during 84 days incubation of the cultivated and non-cultivated Rhodic Hapludox and Xantic Haplustox.

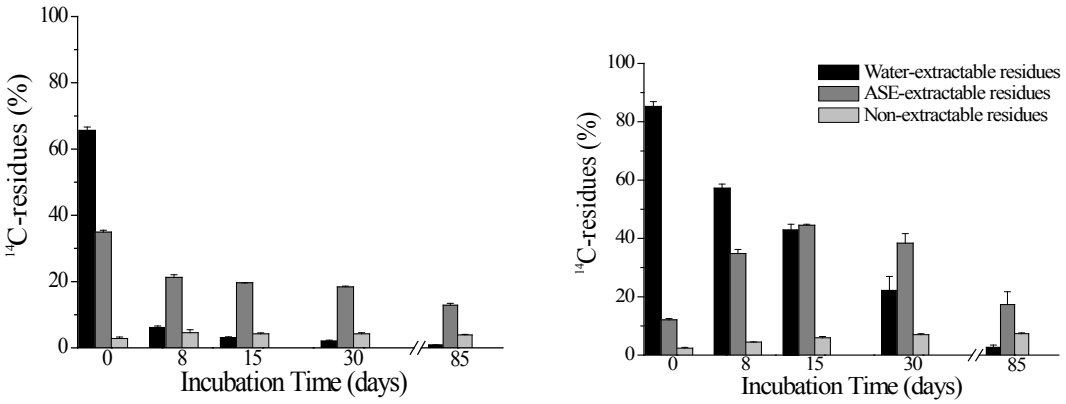

Figure 2. Extractable and non-extractable 14C-residues in the cultivated Rhodic Hapludox (a) and Xantic Haplustox (b).

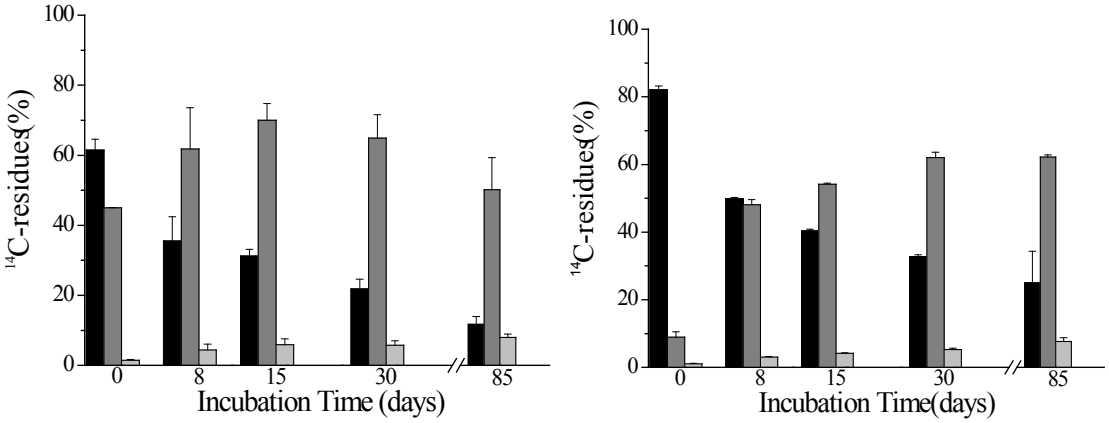

Figure 3. Extractable and nonextractable 14C-residues in the non-cultivated Rhodic Hapludox (a) and Xantic(b).

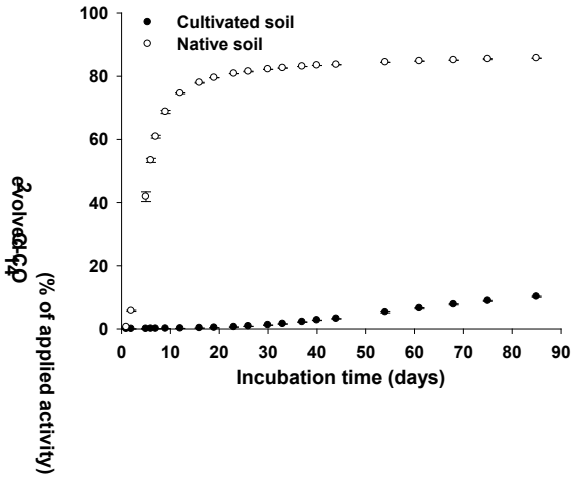

Figure 4. Cumulative 14CO2 during laboratory incubations in cultivated and native Acrisol. Values are reported as percentage of total 14C applied activity as a function of time.

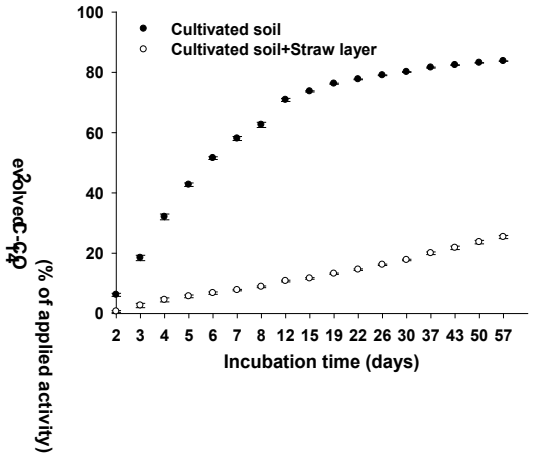

Figure 5. Cumulative 14CO2 during laboratory incubations in cultivated Acrisol with and without straw layer. Values are reported as percentage of total 14C applied activity as a function of time.

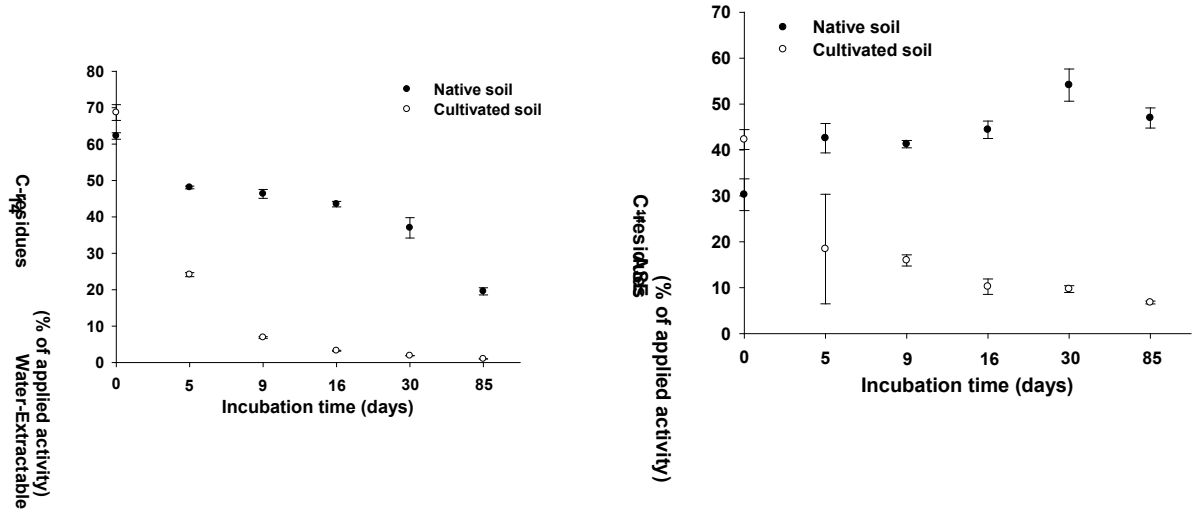

Figure 6. Water-extractable (a) and Accelerated Solvent Extractable 14C residues in cultivated and native Acrisol. Values are reported as percentage of total 14C applied activity as a function of time

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No-tillage as a strategy to promote Carbon sequestration in a subtropical agricultural Oxisol

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Abstract
Recent studies showed that conservative soil management may preserve biochemically labile soil organic matter (SOM) and increase C stocks in surface soil layers. This study aimed to investigate the influence of soil management system on the SOM quality and stocks of a subtropical Brown Oxisol. Samples were collected in soil profiles (0-100 cm) cultivated for 30 years under no-tillage (NT) and conventional tillage (CT), and from a neighboring area under native forest (NF). After removal of particulate organic matter (POM), the suspension (< 53 µm) was sonicated and silt and clay fractions were separated according to Stokes' law. Carbon content of the whole soil and of the fractions was determined by dry combustion and SOM composition was investigated by means of FTIR spectroscopy employing multi-component analysis. The SOM of fine and coarse silt and of clay from the 0-2.5 cm layer was characterized by means of 13C-NMR. Soil subsurface (20 to 100 cm) stored about 70 % of the whole stock of the 0-100 cm layer. The silt fraction under NF showed a higher capacity of C retention than its clay fraction. The estimated Cclay decreased in the order NT > NF > CT, whereas light fraction free Csilt decreased in the order NF > NT > CT. The SOM under NT showed the highest polarity index and the lowest aromaticity in comparison to CT. Both organo-mineral interactions and SOM self-assemblage seems to be the main mechanisms for C sequestration.

Keywords: Saturation; No-tillage; Conventional Tillage; Granulometric Fractionation; Carbon Sink; Recalcitrance

Introduction

In the last decades, studies about the influence of no-tillage system on the increase of soil C stocks have been conducted mostly within the first 5 to 20 cm soil layers. In general, these studies verified that each soil has a certain capacity to retain C, and this behavior is related mainly to soil texture and to the reactivity of mineral surfaces1,2,3. Based on this concept, the capacity of soil to sequestrate C would be solely related the formation of organo-mineral complexes. Nevertheless, other mechanisms like self-assemblage of organic molecular moieties and the accumulation of C in deeper layers have been also proposed to explain the potential of soil as a C sink4,5. The mechanism of self-assemblage foresees that the SOM chemical composition plays an important role in the C-retention by soil. Therefore the scope of this study was to investigate the influence of soil management system on the C retention capacity of silt and clay fractions and on their SOM chemical composition of a subtropical Brown Oxisol from a long term experiment.

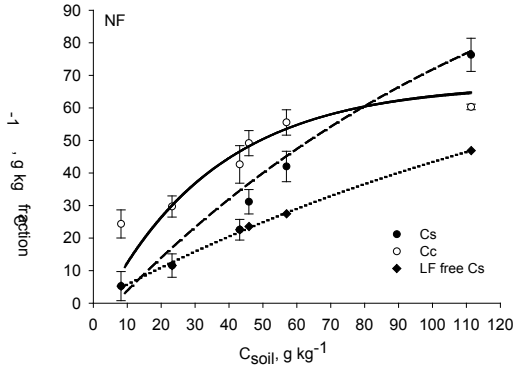
Materials and Methods

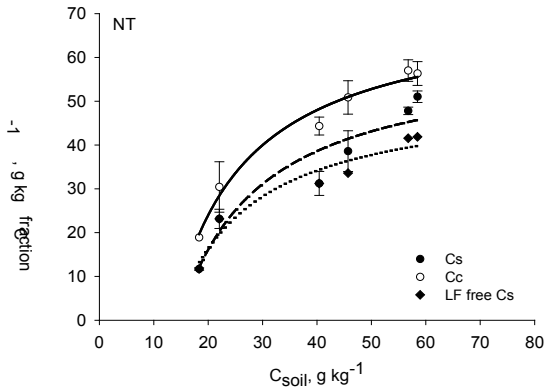
Samples (three field replicates) were collected from a Brown Oxisol cultivated for 30 years in Paraná State under no-tillage (NT) and conventional tillage (CT) in the following depths: 0-2.5; 2.5-5; 5-10; 10-20; 40-60 and 80-100 cm. Samples from native forest (NF) were collected and used as reference of the indigenous vegetation. For the determination of C retention capacity the particulate organic matter (POM) was removed by sieving, and the suspension (<53 µm) was sonicated (1500 J mL-1). Silt and clay fractions were separated according to Stokes' law. The silt fraction was further submitted to density fractionation with sodium polytungstate solution (ρ= 2.0 g cm-3) for the removal of the light fraction (LF), resulting in a LF-free

silt. The C and N contents of the whole soil and of the fractions were determined by dry combustion. The maximal C retention capacity was estimated from the mathematical models fitted to the plot between the C content in each fraction and Csoil (Cfraction= a-b/Csoil or Cfraction = a+b*[1-e(-c*Csoil)]). The chemical composition of the SOM in each fraction was investigated by FTIR spectroscopy, after treating the samples with HF 10% solution, and the data were analysed by Principal Component Analysis (PCA). The SOM of the coarse and fine silt and of the clay fraction from the 0-2.5 cm was further examined by 13C-NMR CP/ MAS in a Bruker DSX 200 (50.3 MHz), using zirconium rotors of 7 mm OD with Kel-F caps (6.8 kHz). The measures were performed with a contact time of 1 ms, a 90° 1H-pulse width of 6.6 □s and a pulse delay between 200 to 300 ms. Depending on the signal-to-noise ratio, between 4,800 to 11,500 scans were accumulated with a line broadening of 100 Hz. 13C Chemical shifts were assigned as follows: 0-45 ppm, alkyl C; 45-60 ppm, methoxyl and N-alkyl C; 60-110 ppm, O-alkyl C; 110-140 ppm, aromatic C; 140-160 ppm, phenol C; 160-185 ppm, carboxyl C and 185-220 ppm, carbonyl C. The total signal intensity and the relative intensity (proportion) of each functional group were obtained by integrating the spectral regions with the integration routine of the spectrometer.

Results and Discussion

The soil under NT showed higher soil C stocks until 5 cm depth in comparison to CT. Regardless the management system only 30% of the total soil C stock of the 0-100 cm depth was accumulated in the first the 0-20 cm layer. The C saturation level estimated for the silt fraction under forest exceeded that of the clay fraction in about 50% (Figure 1). After removal of the light fraction (LF), C saturation of silt fraction in NF decreased but still remained higher than that in the clay fraction (Table 1). This result was unexpected since the specific surface of silt is much smaller than clay particles. In the agricultural soils Cclay was > LF free Csilt (Table 1), but the values were always greater under NT indicating that the C retention did not depend only on the mineral surface sorption sites. The SOM in the fine silt under NF presented the highest C alquil/ C-O alquil ratio and the lowest polarity index of all fractions. The resulting hydrophobic interactions may promote the SOM self association and thus increase the C sequestration by this fraction under NF. The SOM under NT presented a higher polarity index in all three fractions than CT (Table 1) and this might enhance the organo-mineral association. The higher C alquil/C-Ó alquil ratio in the fine silt fraction under NT may also promote the SOM self-assemblage in this fraction.





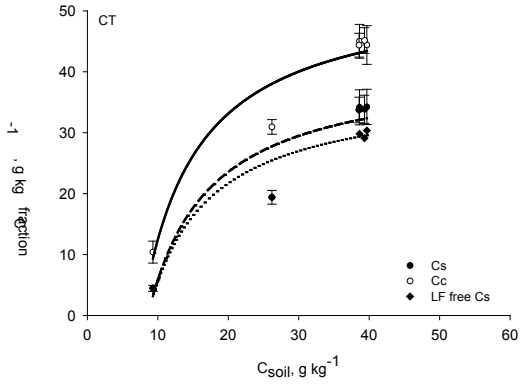


Figure 1. Relation between Cfraction and Csoil for the clay (Cc), silt (Cs) and silt fraction free of LF (LF free Cs) of the Brown Oxisol under NF, NT and CT.

Conclusions

The retention of SOM in the Brown Oxisol seems to be explained by two main processes: the sorption of organic compounds directly on the mineral surface sites and a sorption of SOM on previously sorbed organic coating, leading to a self-association micelle-like structure. In both mechanisms the SOM chemical composition plays an important role on C sequestration. The non-revolvement of soil under NT enables the occurrence of both mechanisms.

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Table 1. Estimated maximal C retention capacity and chemical composition of the SOM from under native forest, no-tillage and conventional tillage for the Brown Oxisol

SOIL	Maximal C retention capacity (g kg^{-1})								
	Native forest			No-Tillage			Conventional Tillage		
	C_{clay}	C_{silt}	LF free Cs	C_{clay}	C_{silt}	LF free Cs	C_{clay}	C_{silt}	LF free Cs
Brown Oxisol	66	139	99	72	61	52	54	41	38
	C groups (%) of the SOM from 0-2.5 cm layer								
Fraction	C alquil	C-O alquil	C aromatic	C carboxilic		C alquil/ C-O alquil	Polarity index		C aromatic/ C-O alquil
NF									
Coarse Silt	28	40	15	17		0.70	1.59		0.38
Fine Silt	33	32	14	21		1.03	1.33		0.44
Clay	31	44	10	15		0.70	1.57		0.23
NT									
Coarse Silt	22	46	17	14		0.48	1.84		0.37
Fine Silt	25	42	17	16		0.60	1.75		0.40
Clay	23	48	14	15		0.48	1.95		0.29
CT									
Coarse Silt	21	41	20	17		0.51	1.73		0.49
Fine Silt	24	39	19	18		o.56	1.62		0.49
Clay	25	43	15	16		0.58	1.68		0.35

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How to prevente environmental damage: a case study of the composting plant from ecocitrus cooperative

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Abstract
The present study sought to deepen the work of the composting plant from Ecocitrus Cooperative, located in Montenegro, in Vale do Caí – RS, Brazil. This study aimed to demonstrate the feasibility of sustainable practices for reuse of industrial wastes, as well as the benefits for organic citrus producers in the region through the use of organic compounds. Furthermore, the plant is an option for discarding the waste of companies without harming the environment. As a methodology, we performed a case study in locus and a visit in May 2011. The results showed that the activities accomplished by the composting plant contribute significantly to sustainable development of the environment through the processing of waste into organic fertilizers.

Keywords: Composting Plant; Reuse; Environmental Responsibility; Organic Compound

Introduction

Most industries produce large amount of waste in their production processes, where only a small part is intended for treatment in appropriate facilities. While this small amount of solid and liquid waste is treated, all the rest is dumped into landfills and water sources without due care. Some of these waste residues are suitable for recycling through the process of composting, which consists in controlled, exothermic and bio-oxidation decomposition of organic materials by microorganisms. The reuse of waste in other productions is possible through composting, not polluting the environment and generating an alternative income.
In this context, this work studied the case of a composting plant from Ecocitrus Cooperative, in Montenegro, in Vale do Caí - RS. Thus, the main objective of this study is to demonstrate the work developed by the plant and the benefit brought to organic citrus producers in the region and for the environment.
It turns out that actions like those accomplished by the composting plant are of great economic and environmental importance, since the organic market is expanding. Using the concepts of both sustainability and social and environmental concerns for growing food is one way to lessen the damage to the environment and improve the quality of life for all involved in the production process, as well as provide quality food to the final consumer.

Materials & Methods

We carried out a visit in locus to the composting plant from Cooperative Ecocitrus and an interview with a staff member in May 2011. The study is qualitative, as it focused on more detailed information on the plant operation, source of materials, processing steps, by-products and final destination. Besides this, the study is exploratory and it includes a case study because it is a pioneering example in the processing and recycling of industrial waste into organic compounds.
According to literature, overall, the case study is applicable when you wish to obtain analytical and not statistical generalizations, which may contribute to some theoretical framework. A research through case studies fits the group called qualitative methods, which is characterized by a greater emphasis on understanding the facts than exactly their measurement. This way there is a contrast with quantitative methods, which are more concerned about measuring phenomena and are applied to more extensive

samples (Lazzarini, 1997).

Results & Discussion

History and work focus

The composting plant, a part from Cooperative Ecocitrus, is located in Montenegro, in Vale do Caí-RS. The activities began in 1998 through an investment of R$ 78,000.00 from the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ). With this resource, the machinery was purchased and the land on which the plant headquarters is currently installed was rented.

The plant focuses on the reuse of waste resulting from a production process, thus it creates a new cycle of life to other products in the form of organic fertilizers, bio-fertilizers and ashes. Because of this the work of the plant is considered innovative and sustainable. From the beginning of its activities, the plant has become a reference in this type of activity. On that account, the waste that comes to the plant are only those which once processed can be reused in organic agriculture. The plant is constantly seeking new markets for the commercialization of their products and by-products.

Products and by-products

Biomass is the basic raw material of the compost produced by the plant, derived from sawmills and logging companies. The prices of fertilizer compounds are different for ecological producers and producers in transition from conventional agriculture to organic agriculture.

Waste residues to be processed are obtained in a radius of 200 km away from the plant. Companies without ISO 14001 may allocate the waste to landfills or composting. A company that has the seal 14,001 must obey the rules of legislation to guarantee the most appropriate and sustainable final destination as possible. The transport of waste residues to the plant can be accomplished either by the company itself or by someone from the plant. There are contracts regulating the services and also the granting of waste between plant and companies.

From the process of converting waste into organic compound there is a reduction of the input mass by 60%. As the product is not perishable and has an aerobic digestion, the longer it stays in the plant, the lower the remaining volume and better quality fertilizer it is going to present. The entire process of transforming waste into compound fertilizer takes four months. However, this time could be reduced to 35 days in case there was a better structure. Taking into account that the biodynamic fertilizer receives biodynamic preparations, it requires a longer period, from 6 to 12 months, until whole transformation process is finished.

Commercialization

Products are sold to members of the cooperative and also others. The members do not have to pay for compound fertilizers and the logistics of these products. The properties only receive what the staff of the association analyzes as necessary and sufficient for the area to be applied. In addition to this, this staff makes constant analysis of soil and leaves in the properties of its members.

For the commercialization to others, the staff also makes the licensing and examination of the area where the product is applied. The ash is given to anyone provided that technical analysis is made; only transportation costs are charged. For the compound commercialization, technical analysis is not required, because the soil has to fit the product. For other buyers, the market price is charged.

The plant has an investment plan to improve its infrastructure to a greater process control and to reduce environmental impact. Another objective is to cover the two ponds which produce biofertilizers to capture methane gas, which is released in the aerobic process for power generation, avoiding the release of greenhouse gases.

Acknowledgement

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Climate Change and Land Conflicts: Challenges for the land sector in environmental risk management

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Abstract
The frequency of natural disasters has been steadily increasing in the last decades, putting substantial pressure on land management and land administration systems. In this context, one of the most relevant challenges is security of land rights and land tenure, for without good governance in this area, disaster prevention and mitigation actions are seriously hindered. The objective of this poster is thus to highlight the main challenges for the land sector in facing environmental risks and to point out the implications for the necessary capacity development actions in this field.

Keywords: Environmental Risk Management; Land Management; Land Administration; Capacity Building

Introduction

The land sector is a complex system composed by an extensive list of technical and legal aspects which have direct impact on economic development, environmental protection and social welfare. Land policy, as the overall guideline for the formulation of regulatory frameworks and tools with respect to land and stating the values and objectives to be followed by the land sector, sets the basis for the construction of a spatially enabled society and, of course, for the establishment of a balanced and "context-smart" rural and urban development.

Land management is a dynamic process which requires a sound land administration system that provides the technical and legal infrastructure for the implementation of the land policy and management strategies. As basis for this system, there is a need for a functional spatial data infrastructure which facilitates interoperability and access to land information and lays the necessary structure for the cadastre and for the information concerning ownership and use of every land parcel thus providing the link of the system with the society.

The backbone of this hierarchical structure should be composed by spatial planning and institutional frameworks originating from good land governance principles for the organization, implementation and proper operation of the land sector. A failure in this arrangement leads to a malfunctioning system with consequences which can be quite dramatic, for instance, unbalanced development of rural and urban areas, increasing vulnerability to natural disasters, increasing poverty and rural-urban migration (Magel, Espinoza, Klaus and Masum 2010).

Current trends around the world

In many countries there are major conflicts between governmental agencies, between sectors, between different land use activities, between different interest groups among the citizens, and between administrative levels. These conflicts are often solved for the benefit of the strongest stakeholders and/or through implementation of short term solutions. As a consequence, the territorial system is debilitated significantly by emerging problems such as unbalanced development, land conflicts and vulnerability to environmental risks.

Land management and land administration for disaster risk reduction

Land management and land administration have a key role to play in environmental risk management, both in terms of prevention and mitigation measures. Ideally, considerable efforts should be devoted to

activities leading to reduction of disaster risks and increasing preparedness to such events. In this regard, it is important to highlight the crucial role of capacity development at individual, institutional and societal levels.

Implications for capacity development actions: the need for a global academic partnership

In order for these and other activities to be carried out, there is worldwide a need for qualified professionals in the fields of land management and land administration. Considering the complexity of the conflicts at hand, there is little chance for isolated capacity development efforts to be successful. Therefore a global academic partnership should be initiated on the basis of the following targets:

Target 1. Joint research
Target 2. Exchange of knowledge on land issues.
Target 3. Exchange of teachers and students
Target 4. Mobilization of financial resources
Target 5. Exchange of partners' network
Target 6. Strengthen management capacity of partner institutions

Conclusions

One of the major challenges for land management and administration systems, particularly in developing countries, is the construction of a stronger basis (technical, social, cultural, etc) for dealing with environmental risks in a proper manner. This challenge implies considerable technical upgrade as well as a sound institutional development. Furthermore, collaboration of the civil society is crucial, for without civic engagement and support there's little chance for legal instruments to work as they should. In order to cope with these important challenges, there is a need for capacity building at all levels (individual, institutional and societal). For this to work, the establishment of a global academic partnership in the fields of land management and land administration is crucial.

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O avanço do mar e a destruição de vilas e cidades na região costeira do Pará

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Abstract
This research aim to contribute to the understanding of geological processes active during the Quaternary, especially during the Holocene in Coastal Region as well as in the Fluvial Estuarine System of the Golfão Marajoara, both in Pará, Brazil. The paleogeographic Model proposed to the area considering the Flandrian Transgression, beginning around 18,000 years BP, as a starting point for sea level rise and the drowning of rivers and formation of estuaries in North Coastal Region of Brazil. The sea level rising will tend to increase. the erosion on the Para coastal areas. The future Model to study area shows that the erosion will occur in the next 1000 years, from the today surface to the level of 7 to 10m, which will mean a strong erosion in the coastal areas and an opening of the mouth of the Dendê river approximately 50m more each margin.

Keywords: Environmetal Geology; Sea erosion; Salinópolis; Dendê river; Pará/Brasil

Introduction

This research aim to contribute to the understanding of geological processes, active during the Quaternary, especially in the Holocene, in the Coastal Region as well as in the Fluvial Estuarine System of the Golfão Marajoara, both in Pará, Brazil.
The gradual rising in sea level of the Atlantic Ocean, associated with the Flandrian Transgression, begin around 18,000 years BP (Pinheiro, 1987), and according to evidences in the Brazilian coastal region, has undergone slight variations up and down from current levels, since the last 7000 years (Suguio et al, 1985).
Considering Milankovitch (apud Faria Jr, 2010), it is assumed that such variations were due primarily Astronomical Cycles, with thousands of years duration, which led to global climate change culminating in the current warming of the lower layers of Earth's atmosphere after a long glacial period.
Should be considered, also for the submersion of coastal regions of Brazil and Continental Shelf of South America, tectonic processes resulting from distension of the passive margin of the South American Plate.
In the Coastal Region of Northern Brazil, which covers the states of Maranhão, Pará and Amapá, the advancement of ocean waters on the continent is clearly portrayed in its physiography, composed of "golfões", "rias", "reentrâncias", "furos", islands, bays and large river valleys "drowned."
The rivers, in the Coastal Region of the NE of Pará State, which empty into the Atlantic, have common characteristics which are: a wide mouth with shallow waters and inland narrowing valleys, that extended along more than tens of kilometers offshore. All have a strong influence of macrotidals (average of 5 meters on the coast), defining a set of fluvial-estuarine systems very important, both from the standpoint of economic partner for the populations of cities and towns situated on the coast and inland, either in the perspective of their ecosystems.
Within the South American Plate, in the Amazon region, setting the Amazon River Basin and its tributaries, particularly in meeting with the Xingu and Tapajós rivers, along the right, and the rivers Trombetas and Nhamundá, the left margin, show the "drowning" of these large river systems, similar to the major estuaries of the coastal region, especially the Para river, in Golfão Marajoara (Fig.1) (Faria Jr, 2010).

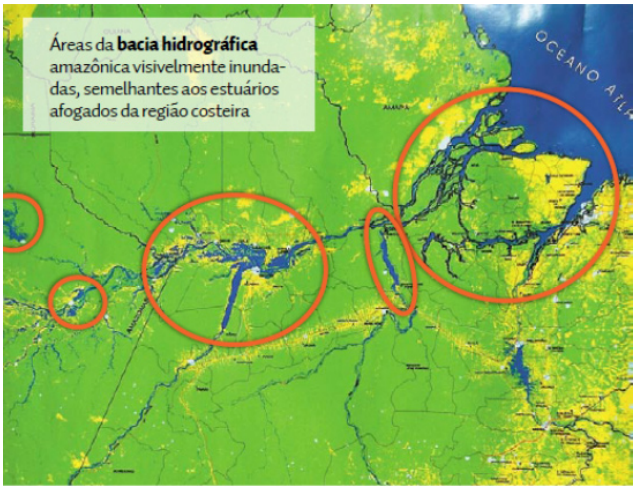

Figure 1 - Satellite image composite. Observe in circles, the configuration of the drowned valleys of the rivers within the river basin of the Amazon River and the coastal region of Pará. Source: Faria Junior (2010)

In the Northeastern of Pará, old fishing villages, located in the coastal zone and on the margins of the river estuaries, inland, gave way, in recent decades, to cities as a result of urban expansion and occupation coastal and estuarine ecosystems.
In this paper two areas are considered to demonstrated the advance of the sea level and the consequent erosion of cities and villages on continental areas (Fig. 2).
The Salinopólis city, on the coast of Pará, originally built on top of the Coast Plain (Barreirras Group), expanded into lower areas, subject to tidal flooding. Although located in higher areas, many homes undergo from the sea rising and the consequent advancement of marine erosion, slumping along with the edges of cliffs (Faria Jr, 2012).

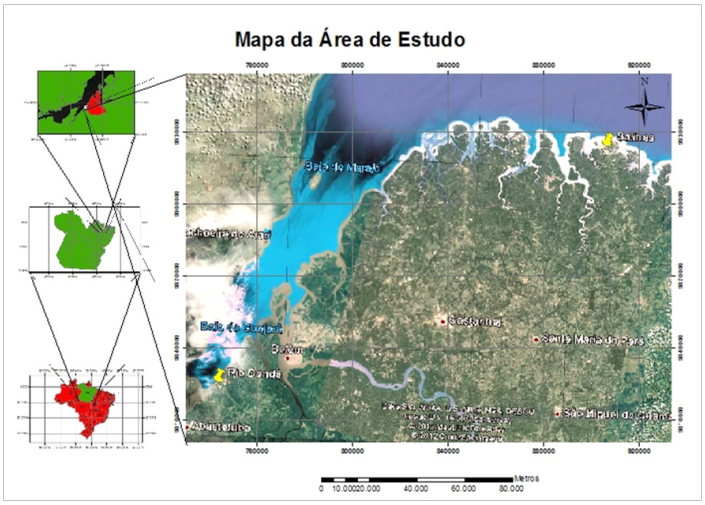

Figure 2 - Study area map. Source: Faria Junior

The Dendê River, a small tributary of the right margin of the Para river, situated about 70 km from the Atlantic Ocean, strongly influenced by macrotidals in its estuary (average of 3 meters wide), undergo the consequences of “drowning” process, in scale of its size and location, with the erosion of many settlements, especially the Vila do Conde, located at its mouth (Alves, 2012)

Materials & Methods

To carry out this research, were developed that involved a literature review and surveys of secondary data relating to geographical and thematic areas, in particular satellite images, basic steps for implementing the field and collecting physical and chemical parameters of water (temperature, pH, conductivity, turbidity and dissolved oxygen), in situ, and samples of sediments, mainly sandy, analyzed in the laboratory and the mineral content and textural properties.

Studies of the mineralogy and textural properties of sediments (grain size, roundness, etc.) and observations of sedimentary structures (metric sandy bars or "sandwaves"), a consequence of the tidal wave, the action of winds and other geological processes operating in the study area, made possible also to understand the resulting currents and / or predominant in the erosion of cliffs and margins of the estuary, transport and deposition of sediments.

Results & Discussion

The Geological Evolution of estuarine and coastal regions of northeastern Pará is directly related to variations in sea level in the Atlantic Ocean during the Quaternary, the main caused main by crustal movements, sediment compaction and glacio-eustatic process, which were the most important.

The paleogeographic Model to the estuary evolution of the Dendê river considers these steps outstanding of the geological evolution of the Coastal Region of Pará (Alves e Faria Jr 2012) (Fig. 3).

Around 17,000 years BP, the study area would be represented by a wide fluvial meandering system, which flowed 300 km beyond the present coast line, covering the entire region that now constitutes the Brazilian Continental Shelf.

The marine transgression, especially in the last 5,000 years, is main responsible for the erosion and retreat of the coastline in Salinopólis. This transgression process caused, too, a wide erosion in the Dendê river mouth and the establishment of the increasing of the estuary inland.

As it was possible to establish the paleogeography of the Dendê river estuary, it is present here a future Model to that area to the coming 1,000 years.

This Model is based on forecasts that indicates that the sea level rising in the Brazilian coastal areas, should be constant over thousands of years, with speeds ranging from 75 cm to 1 m per century, which will mean an opening of the mouth of the Dendê River approximately more than 50 meters on the both margins, causing the partial destruction in the Vila do Conde.

Figura 3 - Modelo de Evolução do rio Dendê, a) 5.000 anos antes, b) Atualmente e c) 1.000 depois do presente
Source: Faria Junior

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Vulnerability Analysis of Coastal Erosion Based on the Prediction of Backshore width: Application for the Central Coast of Pernambuco

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Abstract
The central coast of Pernambuco presents various critical points of erosion, even though it counts with the presence of innumerous coastal protection structures. The problem becomes even more serious due to population density and real estate pressure in the region. This increasingly motivates the search for understanding the conditioning phenomena subjected to coastal erosion, as well as the urban occupation process and anthropic interventions in the area, with the purpose of guiding public policies for coastal management. In this context, the vulnerability analysis of erosion permits getting to know the risks and identifying high-priority areas for coastal management. Spatial analysis was performed using specific software, and resulted in shoreline and interest zone displacement rates for the period between 1974 and 2010. The results were applied to equations that relate to both the variables and the width of the backshore, and permits evaluation of the degree of vulnerability. Around 82% of the beaches studied fall into the category of very high vulnerability, while only 5% present low vulnerability. The remaining ones were put into the following categories: 6% high vulnerability, 3% moderate vulnerability, and 5% conditional. Adding up the very high and the high categories, we arrive at a value of 90%, which shows how critical the area is regarding vulnerability to coastal erosion. Establishing coastal segments that are priority for management plans is possible through studies such as the one presented here and establishes methodologies that are very interesting support tools for coastal management, especially if combined with management arrangements that ensures the reestablishment of the beaches along the coast.

Keywords: Vulnerability; Coastal erosion; Urban occupation

Introduction
The coastal zone of Brazil presents various sectors with registers of marine erosion. In the central coast of Pernambuco coastal erosion varies from moderate to severe, even with the presence of coastal erosion protection features (Manso et al., 1996). Coastal engineering structures were built over the years, that didn't bring the desired effect and burdened public funds.
The problem of coastal erosion becomes more severe in the region due to its demographic characteristics and real estate pressure in the coastal zone. Currently there is a search for understanding the phenomena affecting coastal erosion in this area, as well as the processes of urban occupation and anthropic interventions over the years, to enable orientation to public policies in coastal management.
The tools available to achieve these goals lie in the scientific sphere, with the current knowledge of coastal processes, and in the legislative sphere, serving as a subsidy to public management.
One of the methodologies used in scientific circles, as a support to coastal management, is the assessment of coastal vulnerability to erosion. The definition and quantification of coastal vulnerability to erosion permits the knowledge of risks and identification of priority areas for concentration of studies, as well as for carrying out management actions (Capobianco et al., 1999).

Materials & Methods
The area was divided into 80 segments over the municipalities of Itamaracá, Igarassu, Paulista, Recife, Jaboatão dos Guararapes, Cabo de Sanro Agostinho and Ipojuca (Figure 1), using a pattern of environment homogeneity between sectors, considering physical, biological and anthropic aspects of the coastal region.

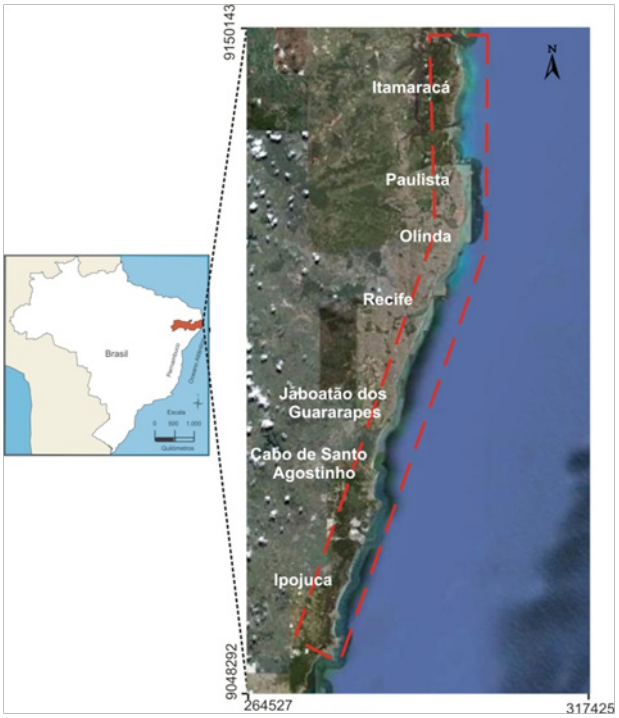

Figure 1 – Municipalities of the central coast of Pernambuco

For this study we used aerial photographs of the years 1974, 1981, 1997 and 1997 as well as the coastline for the year 2010, totaling a period of 36 years. The position of the coastline in 2010 was accomplished through footwork, using a GPS Trimble R3 equipment (Global Positioning System) in its kinematic relative mode.

The images were geo-processed through the ArcGis software on a map scale of 1:25000, geo-referenced in UTM (Universal Transverse Mercator) and Datum SAD-69 (South American Datum - SAD-69), that served as a base map. The coastline was defined as the line of the last tide, and the zone of interest as the anthropic occupation in each segment.

To quantify the degree of vulnerability of the area under study the methodology proposed by the MAI project (FINEP/UFPE, 2009) was employed. Through specific software the evolution rates of the displacement of the coastline was calculated, as well as the zone of interest.

For a better understanding, all data was grouped into a statistical program, calculating the mean, median, minimum and maximum values of the transects, both for the coastline and for the zone of interest. Subsequently, the levels of vulnerability were represented on maps, using the traffic light color code.

Results & Discussion

The calculated values for the displacement of the boundaries of the zone of interest were, in almost all totality, positive. This means that for the period analyzed, there was a considerable advance of the zone of interest towards the sea. These data are related to the advance of buildings on the beach system, i.e., the advance at the expense of protection, which often includes the dunes. The beach environment acts as a buffer zone for marine storms in the coastal zones. Therefore, at the time that it is suppressed, its protective function stops working.

The width of a beach can be changed by the rate at which the zone of interest advances on the beach system, even if there is no displacement of the coastline. This aspect should serve as a warning for public managers, because in general, even on beaches that should be in protection, problems of coastal erosion are observed.

According to data collected in the coast of the studied area there is a very serious situation regarding coastal erosion, because approximately 82% of the area presents high vulnerability to erosion. This percentage

considers both the displacement of the coastline and the displacement of the zone of interest.
In relation to the displacement of the coastline, the averages found for the segments analyzed are mostly positive. This means that for the period analyzed, there was a retraction in the coastline towards the sea, i.e. the beaches should be protected, without presenting problems of coastal erosion.
While analyzing the averages of the displacements of the zone of interest positive values were also found. This means that for the period analyzed, there was a considerable advance in the zone of interest into the sea, often at rates higher than the displacement of the coastline.
Considering the nearest approach to environmental reality, which considers the displacement of the boundary of the zone of interest, this indicates that about 82% of the beaches studied fall into the category of very high vulnerability, while only 5% present low vulnerability. The rest were in the following categories: 6% high vulnerability, 3% moderate vulnerability and 5% conditional. Adding up the very high and the high categories, we arrive at a value of 90%, which shows how critical the area is, regarding vulnerability to coastal erosion.
The possibility of highlighting the regional variability of the vulnerability, as well as the variability among its determinants is essential in guiding policies and initiatives for mitigation in each site. The establishment of priority coastal sections in management plans, possible from studies such as the one presented here, makes this methodology a very interesting support tool for coastal management.

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Disasters in Brazilian urban areas: an analysis from the perspective of the ideas of risk and catastrophe

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In contemporary societies, we have been experiencing a collective and intense feeling of anxiety. Such an anxiety is intimately connected to the modern condition, to its technological acceleration and to the endless process of social corrosion that it entails and, as such, it should be considered as a byproduct of the so called "creative destruction" (see MARX, BERMAN, SENNETT, VIRILIO, for instance). Though this is not a feeling connected particularly to modern life only, in no other social context the future of humankind can be seen from such a gloomy perspective as from our contemporary culture. The perception of dangerous swords hovering over our heads testifies not only this anxiety, but also certain pessimism: the atomic threat, global warming, international economic crisis, international terrorism, all these events have contributed to lead, for instance, Habermas (1988) put into question the success of the modern project. In no other social context, our collective capacity to anticipate, to be ready for an uncertain future is so visibly undermined as when we face these catastrophes. Thus, in recent sociological production, ideas such as dilution, disorientation, disaster, catastrophe, risk, became very popular – being this production itself an index of the anxiety of our technological culture. The feeling of imminent catastrophe reports a paradoxical situation. According to Jean-Pierre Dupuy, we are constantly confronted by the perspective of the impossible, of an inconceivable reality that, in an ex-post facto analysis, shows itself to be in fact inevitable. Let us think a while about classical examples of this paradox: two world wars, the extermination of hundreds of thousands of human beings in the explosion of the atomic bombs of Hiroshima and Nagasaki. It all seems unimaginable from the perspective of a foreseeing and enlightened reason. However, as the horror of these facts became reality, a reality with no power of building experience (as Walter Benjamin would say), they seem a very logical consequence of a given political, economic and technological configuration. Impossible and, nonetheless, inevitable.

The substantiation of this paradox, of this absurdity against which reason seems too feeble an opponent, should not impose a tragic fatalism upon us, the feeling of acedia, but commitment to investigate why reason seems so badly equipped to attend to the demands of a "time of catastrophes", an era of colossal disasters. Dupuy aligns his philosophical contribution with that of Max Weber, Ivan Illich, Hans Jonas, Jacques Ellul and so many other authors for whom, once the technical reason has become hegemonic in modern societies, a certain automatism in human action follows. What Weber calls "unintended consequences" of rational action, and Ivan Illich calls "counterproductivity", testify this very automatism, which in the last instance simply installs irrationality at the very core of our world. The logic that governs rational, technical action, Illich remarks, is that of a detour, of a postponement of a given satisfaction. The danger of a highly technical civilization is the possibility that we lose ourselves in the detours of technicality without being able to ask about the meaning of the tools we have helped to created. About one hundred years ago, Weber already questioned the real possibilities of fulfilling our moral responsibilities in a society in which instrumental reason has become a logical imperative. The implications of the remarks which Dupuy, following Illich, makes on this subject might become more explicit if we take the results of comparative study that both authors produced about the use of bicycles and cars as means of transportation (DUPUY, 2011, p. 30). The conclusion to which they arrive, once more, drives us into a kind of paradox. If our intention is to save time when choosing a means of transportation, we should choose bikes rather than cars, even when we consider the locomotion between two distant places. Taking into account the costs implied in driving a car and transforming these costs into time of work, that we should pay in order to have access to this kind of transportation, the outcome of the study is that there is more time implied in driving a car than riding a bicycle. Thus, if this seems so clear, why do we use the first rather than the second means, when we all know that the later are environment friendlier and healthier? Because the speed of capitalism, the speed

of its technology which in principle should be considered as a means to an end, converts itself into an end: spend, squander, deplete resources, are presented as inevitable actions, necessary to maintain the inner dynamics of capitalism. Would it be the case that we should start to be critical of such a dynamics? But how?

Let us take another point of view. Broadly, it is possible to say that the sociology of disaster is marked by the following proposition: the occurrence of natural catastrophes in our society can no longer be conceived exclusively as a natural phenomenon. This assertion can be formulated in a more radical way. In the book Hominescências, Michel Serres warned us to the fact that civilized life – let us consider the consumption of electric power in metropolis such as Paris, for instance – turn out to be a natural phenomenon. Given the scale of this consumption, the impact it presents over the planet is not only a cultural, but also a natural phenomenon. In this case, it is not enough to say that events become disasters "when its damaging potential has an impact over a vulnerable human community" (KROLL-SMITH apud FONTES, 2008, p. 118), that is, when human communities somehow undergo a process of collapse. Obviously, an environmental disaster, such as that occurred in the Mexican Gulf in 2010, has a direct impact on human populations in Southeast United States. However, the idea of vulnerability should be extended to the fauna and flora affected by that disaster.

One thing is to be aware that the consequences of a disaster, of a catastrophe, have impacts beyond the sphere of culture, that is, beyond human populations. Something completely different is to realize that human action plays a fundamental role in the production of "natural" catastrophes. In this case, these disasters are a typical modern phenomenon that should be understood as a specific technological, economic, political and cultural context. If we admit that such elements of sociability are key variables for understanding the production of disasters, concepts such as risk, vulnerability, human settlement handling become very important instruments to propose an empirical action that could help to deal with these phenomena. Even when we realize that these concepts are far from sufficient for analyzing and dealing with disaster such as those occurred in Teresópolis in 2011, or those that devastated part of Pernambuco in 2010, we cannot help to formulate this type of question from a moral instrumental perspective. To what extent, however, this kind of analysis can sufficiently identify the problem it faces is something that we shall keep asking.

Risk and vulnerability are expressions that refer to the same order of phenomena: the possibility of disasters to happen. Risk refers to the probability that something harmful, noxious affects a population (and its material structures, productive systems etc.), or a segment of it (FONTES, 2008 p. 121). Vulnerability refers to the other side of the same coin, namely, to the elements that result in a greater susceptibility to the effects of disasters in a given social structure – but also to the way a group deals with risky situations given a particular form of social organization. The idea of vulnerability, therefore, entails that of environmental sustainability. Social practices are sustainable when they ensure their reproductibility for future generations. This insurance is only possible when we take into consideration that a significant part of natural resources is not renewable, that is, the time of nature is not necessarily coincident with the time of culture.

The urban space, an outstanding example of human intervention over the natural environment, is the quintessence of modernity. Although cities exist for a long time, no other social system is as clearly urban as the modern one. And being urban means to belong to a civilization that, in spite of its capability to create wealth, is marked by destruction and, in the last instance, by putting into risk the existence, or the well being, of humankind and of nature alike. The daily life in great cities offers a good illustration of this contradiction: gigantic traffic jams, air pollution, floods, and degraded landscapes, people living in unhealthy or inadequate places (palafitte, hillside). The question we should pose now is: from the point of view of the preservation of today's capitalist pattern of consumption, how could we avoid the "counterproductivity" that results in disasters? More to the point: taking into consideration the reality of a predatory capitalism, how could we question and act productively against environmental disasters such as those associated with the destruction of huge areas of the Amazonian rain forest for raising livestock? But this process is intimately tied to urbanization. Given the pressures of capitalist development in Brazil, how can we conceive of a political action that could accept the financial costs of an urban occupation that would be ordered and sustainable?

The fight against chaos should take into consideration the fact that, although often in conflict, in the last instance, people share a common space as well as, most of the time, the destructive effects of predatory

action over the environment. What seems so obvious, however, is not understood as such for a very simple reason: in the short run, the outcomes of predatory action are not equally distributed among a given population. In the short run, it is undeniable that the results of agglomeration economies are asymmetrically distributed: some people bear the expenses more than others of this curious civilization where collective interest is denied, giving way to private, selfish search for advantages. The occupation of areas of environmental protection, or of risk, such as hillsides, should be understood from the perspective of this reality. Governed by the interests of construction companies and by the need of those without access to the market created by those companies, the lack of control of urban processes cannot produce a collective logic that would care about water heads or hillsides.

Often interpreted as the sociologist of risk, Ulrich Beck might more adequately be understood as a heavy critic of this idea that is often used as a means to deal with the perspective of disasters and catastrophes – those ghosts that always haunt our deeply technological relationship with the environing world. If we analyze his remarks on risk, as they are exposed in Sociedade de Risco, for instance, in fact we would not have a formulation too distinct from the insights of Dupuy on the same theme. Risk calculation always supposes the possibility of adopting the cost and benefit analysis for guiding our action over the natural world, without taking into account, for instance, the fact that negligible costs could sum up into an environmental nightmare (FERREIRA, 2010). The risk perspective seems to depart from the presupposition that a technical solution would always be available to deal with a problem technically generated. In fact, we believe that a political and deeper discussion on the cultural constitution of a “time of catastrophes” should be undertaken. And this has to be a starting point for any development project that could claim to be sustainable.

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Evolution of the Coastal Zone and its Relation to the Risks of Erosion of the City of Recife (PE) - Northeast Brazil

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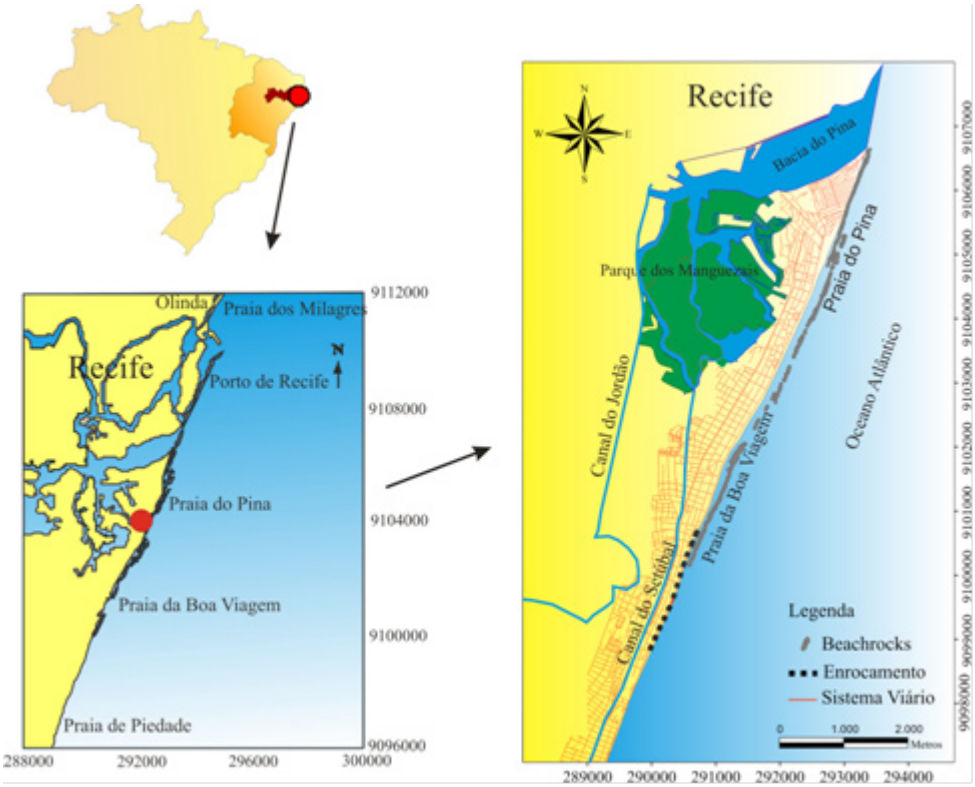
Abstract
The city of Recife is located in the northeast region of Brazil. Its beaches (Pina and Boa Viagem) are urban beaches with great economic and socio-cultural value. The coast is characterized by an intense erosion process to the south. It presents coastal contention structures and there is no backshore or beach during high tide. In the offshore direction, it possesses a line of emerged beachrocks during low tide, a channel, and a second continuous line of submerged beachrocks. To understand the erosion process, studies were carried out on the beach and inner continental platform: sedimentology, morphology, dislocation of the coastline (1960-2008), and 14C dating of the first line of beachrocks. The line of submerged beachrocks forms a barrier for the transfer of sediments from the beach environment and the inner continental platform, and this one does not constitute a source of sediments for itself; there is a relation between the erosion process and the morphology of the beach environment from north to south, and with the dislocation of the coastline, that receded to the south during the last 48 years. The first line of beachrocks present ages between 4482 – 6652 years cal.AP. The beachrocks cause direct impacts on the evolution of the coast, and its association with the retraction of the coast suggests that the largest part of the coastline is in retrogradation.

Keywords: Erosion; Morphology; Beachrocks; Northeast of Brazil

Introduction

The shoreline, or simply shore, is the strait fringe of land in contact with the sea in which the action of the coastal processes is felt in a more severe and potentially more critical way, as the erosion or constitutional effects can sensibly alter the configuration of the coastline (Muehe, 2001). The configuration of the Brazilian coast, both in relation to its geographical position and orientation of the coastline, resulted, greatly, from the origin of the sedimentary basins and the Atlantic Ocean (Tessler & Goya, 2005).The evolution of the coast has natural and human causes, and is linked to factors in temporal and spatial scales. The current sedimentary dynamic answers for the variations in the coastline, being either of momentary character, or a sedimentary tendency of a coastal segment.

In the coastline of Brazil, many places present evidences of marine erosion. In Pernambuco, there are signs of erosion that vary from moderate to severe, however there still isn't a precise diagnoses for the comprehension of local and regional causes (Manso et al. 1995). The city of Recife is located in the Brazilian northeast (Figure 1), its beaches (Pina and Boa Viagem), are urban beaches with great economic and socio-cultural value. They present, towards the south, an intense erosive process, with the presence of contention structures. We can observe a narrowing of the beach environment or the inexistence of a backshore; towards offshore, along the area, the presence of a line of emerged beachrocks during low tide, a channel, and a second continuous line of submerged beachrocks. Currently there is a study to contain the erosion process in all the metropolitan area of Recife being executed by a coastal engineering firm.



Methodology

For a better understanding of the erosive process in the area, a study on various parameters was carried through. Among them: the data analysis of the morphological and volumetric variations (beach profile), for the identification of points of erosion, the evolution of the coastline, at medium term, between the years of 1960 and 2008. Also, an analysis of the sedimenthological characteristics of the beach environment and internal continental platform was done, in conjunction with the completion of the topo-bathymetric profiles. For the beachrocks, located in the area nearest to the coastline, a study was carried through on thin layers and their respective 14C dating at the University of Kiel (Germany), in order to supply subsidies for understanding these features in the evolution of the coast.

Results and Considerations

To the north of the area the beach profiles presented the greatest morphological variations. These variations are related to the months of greater deposition and sediment accretion. The months with higher and lower sediment volumes occurred in different times of the year, independent on seasonality. To the center the profiles remained balanced in relation to the other profiles. To the south they also presented morphological variations in the whole beach environment, and sediment accretion for all the analyzed period, except for the last profile, that presented at the end of the monitoring period a positive volume. The profiles located to the north are more developed.

The profiles did not present their morphological and volumetric variations, according to variation cited in conventional literature. Their values for biggest and smallest volume were independent on the period being raining or dry. The study of the topographic profiles presented a relation between the morphological variations and the study of the dislocation of the coast between 1960 and 2008.

The progradation index diminishes from north to south, presenting an increase in the retraction rates and in the distances of transects in the direction of the continent, especially in the area where there a contention structure of the jetty type. Where the topographic profiles present themselves in a smaller extension, whether with a total loss of the upper part of the beach environment. Despite the presence of a contention structure in the southern part of the study area, the erosive processes are still active, with dislocation and

expansion of this structure to the central and northern part of the area, with constant maintenance.
No direct relation was observed between the line of emerged beachrocks during low tide and the displacement of the coastline. In front of the more continuous line of emerged beachrocks erosive processes can be present or not. Where there is an opening in the line of beachrocks, a tendency for deposition can be observed. But the occurrence of progradation or retraction of the coastline related to the presence of the line of beachrocks, does not correspond to the whole area of study.
The analysis of the topobathymetric profiles presented similar results, in relation to its distribution from north to south, just like the beach profiles analyzed and the displacement of the coastline. The beach environment also presents itself more developed to the north of the area, presenting more mellow profiles and dissipative beaches, and concave profiles or reflective beaches more to the center. In the southern direction the profiles presented changes in these features, for more convex profiles. In the southern direction the profiles present changes in these features, for more convex profiles. To the south the beach environment presents itself planer, with no expressive feature, almost in a straight line (where the contention feature is located). To offshore, there is the presence of a channel between the line of emerged beachrocks during low tide and a line of submerged beachrocks that follows along the entire coastline in the area, which is distributed to longshore, and is apparently in parallel to the coastline. These two features present themselves closer to the coastline to the north and in the southern direction, going farther and larger in the onshore direction where there is a bigger erosion process.
The surface of the line of beachrock presents irregular and dissected features due to erosion processes, probably working in a relative level of the sea lower than the present one. The canal presents a mean depth of 6.40 m and a mean width of 437.15 m. The line of beachrock is at a mean depth of 7.37 m, at the beginning of the base, and 11.32 m at the end, with a mean width of 1285.56 m.
Considering the topographic profiles and the submerged features of the bathymetric profiles, the erosion processes observed in the first do not present a direct relation with the depth at the top of the submerged beachrock. In some profiles these are shallower, in the central part, as observed in the submerged profiles, more elevated tops and lowered tops by erosion processes. What could be more emphatic is the fact that where a higher rate of erosion occurs (in the location of the jetties), the distance from the line of beachrock in relation to the coastline, there is a bigger proximity of the channel, in relation to the north of the area. This can probable mean that the erosion process has been acting for a longer period of time in the south sector, where there is a great sediment accretion. Also the lack of sediment has been going on for a long period, for the line of beachrock to be more distant and the channel wider.
The characteristics of these sediments differ in the offshore direction, mainly after the submerged beachrock. The sediments observed in the beach environment, in the area of the internal continental shelf before the line of beachrock, and the sediments located after these, present different characteristics as to their statistical parameters. The line of submerged beachrock serves as a divider between the sedimentary characteristics. Between the environments a void can be observed, demonstrating in this way, that there is no interaction between the sediments from the upper level of the profile and the submerged part. Therefore the internal continental platform adjacent to the city of Recife is not a source of sedimentary supply for the beach environment.
Beachrocks are commonly found in tropical and subtropical regions, but also are formed in environments with high latitude. Dating on the clam shells found in the beach were done with the 14C method. These varied from 4482-6652 cal years AP, which confirms its formation during the period of the Medium Holocene, which means that some studies on the relative level of the sea in the state of Pernambuco, dates approximately to the Maximum of the Last Transgression (5200 years AP) and indicated marine levels superior to 2.5 m.
Various studies confirm that the exposition of the beachrock is associated with the retraction process of the coast. The formation of the beachrocks causes direct impacts in the evolution of the coast, which include: reduction in the volume of sediment and changes in its morphology, differential erosion, altering the transversal and longitudinal transport of the sediments, which at long range can reduce the sedimentary supply to longshore. The association of the beachrocks with the retraction of the coast suggests that the biggest part of the coastline is retreating to the interior of the continent.

Acknowlegments
Acknowledgments to Dr. Karl Stattegger and to Dr. Maximiliano Michelli, from Geologisch-Paläontologisches Institut, da Christian-Albrechts-Universität zu Kiel; to DAAD, to FACEPE and CAPES for the scholarship.

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Natural Hazards – Research on natural disasters, civil defense, disaster prevention, and aid
Teresópolis / Rio de Janeiro - Brazil, June 15th to 17th, 2012

The influence of trees and agroforestry systems in risk reduction and adaptation measures from climate change in rural areas of the Peruvian Andes

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Abstract
Weather hazards are affecting the small-scale farmers in Andean regions of Peru, increasing food insecurity and poverty levels. Agricultural droughts are one of the events which affect crops most directly. Small-scale farmers depending on agriculture can adapt their systems, to prevent natural hazards and reduce vulnerability, by increasing the trees and forestry share in their farm household system. This research identifies the local strategies used to cope with the agricultural droughts and assesses the influence of trees in the farmer's livelihood, in order to provide evidence for a trade-off between the different production alternatives enhancing food and income functions together with ecosystem functions.

Keywords: Climate Change; Agroforestry; Adaptation; Livelihood; Vulnerability

Introduction

Climate change as a long-term hazard is already affecting the small-scale farmers in Andean regions of Peru through extreme weather events. Weather hazards like frosts, hailstorms, droughts and floods are which are directly affecting crops, livestock, biodiversity and increasing food insecurity and poverty levels1-3.
Risk reduction and adaptation measures are one of the most urgent aspects for local small-scale farmers depending on agriculture. Although they have reduced, in some extent, the impacts of these hazards by adapting farming techniques, varying their crops and altering their planting season, so far not much is known about the related local knowledge, behavior and action.
The Achamayo river basin is a typical inter-Andean valley of Peru's central highlands ranging from 4500 m.a.s.l. down to 3262 m.a.s.l., where agriculture remain one of the main economic activities and traditional agricultural practices are still in use. Here, droughts, more precisely, agricultural droughts during the midsummer ("veranillos") are one of the events which affect crops most directly and thus the livelihoods of the small-scale farmers in the region. Even if the mean annual rainfall has not changed significantly, there is a loss in the yield production due to agricultural droughts, and their incidence is increasing in the last years4.
By increasing the trees and forest share in the area i.e. through agroforestry systems, small-scale farmers can adapt their systems to prevent natural hazards (locally mitigating their negative effects) and simultaneously contribute to climate change mitigation (increasing the storage of carbon in the system), linking both adaptation and mitigation strategies.
The main objective of the research is to analyze the use of trees and forests as a measure of adaptation to agricultural droughts in the rural areas of the tropical Andes. The main focus is put on the relation between the presence of trees in the crops (agroforestry systems) and their influence on agricultural droughts (analyzing their effects in the yield) and consequently in the farmer´s livelihood (with emphasis on food security).
Therefore, local strategies used by farmers to cope with this hazard are being assessed together with the farm household systems. The implications of agricultural droughts and the yield variations in staple crops between the different production systems (agricultural and agroforestry systems) together with the food security (risk reduction) are being analyzed. In addition, vulnerabilities in the study area will be identified. Finally, following the small-scale farmers' interests and attitude towards this adaptation measure a trade-off analysis between the different production systems will be carried out.

Materials & Methods

The case study areas are located within the Mantaro Watershed in the tropical Andean region of Peru. The selection criteria considers the following: (1) settlement of traditional cultures carrying out ancient practices for natural resource management; (2) existing strategies and practices for adaptation and mitigation of climate change and (3) level of climate change impact in the area.

The Mantaro watershed, and more specifically the Achamayo river basin, was also selected because of the experience in climate change in the area. Many studies and climatic measurements (the most extensive series carried out in Peru) take place in this area. The Achamayo river basin is a typical inter-Andean valley of Peru's central highlands. It is located in the province of Concepción, region of Junín. Dryland agriculture there (potato, oca, fava beans, barley) is complemented by irrigation using water from springs and wetlands.

Different methods and tools are being applied, such as participatory rural appraisals5 (i.e. round tables incl. agro-climate calendars; past, present and future mapping; rankings; trends), participant observation, direct measurements, semi-structured interviews, and direct observation. These methods which cover a set of participatory, flexible and variable approaches stress the importance of taking local farmers' perspectives into account and give them a greater say in the survey of scientific information.

Results & Discussion

A specific description of agricultural droughts in the farm household systems (agroforestry systems and crops) was conducted primarily through semi-structured interviews in order to infer their damage pattern, severity (also in comparison with other extreme events), its relation with irrigation systems, the derived consequences, as well as the reaction and adaptation measures taken by farmers. Preliminary results indicate that farmers acknowledge the presence of agricultural droughts but usually they do not treat them as a separated weather event. They relate their origin to temperature and rainfall changes. Moreover, there is low social capital resources used to address this issue (lack of organization and technical support). The Physical and Financial limitations could be overcome with a good organization in the community. In addition the lack of training and knowledge to face agricultural droughts (human capital) is also affecting the reaction and adaptation measures of the farmers.

After identifying the main production systems, agroforestry systems and agricultural systems were selected in pairs within the farm household systems. In these plots, an analysis on the influence of the trees and forest component on the soil moisture and yield are being conducted with the use of semi-structured interviews, participant observation (for the harvest) and soil moisture measurements. There were no statistically significant differences in the yields, in relation to the distance to trees, found in the preliminary evaluations.

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Report on experiences from DAAD-funded workshops along a large international congress

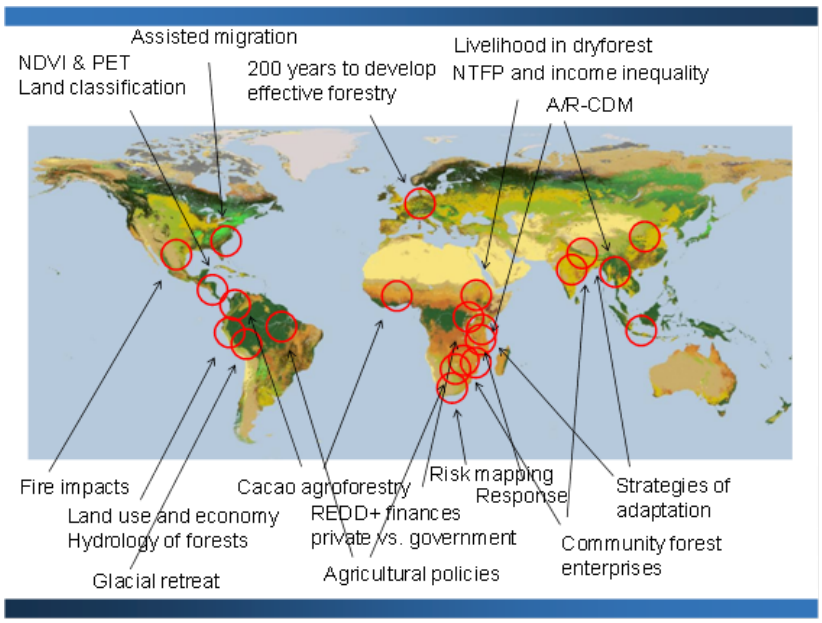
This paper presents background, implementation and experiences from a DAAD funded workshop initiative in the field of “forests and climate” that brings together students and alumni and prepares these researchers for a better understanding of the complex field of scientific research and policy processes in the context of the UN-FCCC.

The need for intensive and intelligent integration of international networking and capacity building in the field of “forests and climate” arises from the fact that the related processes having become so complex that hardly anybody can follow it in all details. It is deemed important that students start getting involved and prepared and it appears efficient to link this capacity building with input of professionals from all over the world in order to foster both scientific education and the building of international networks.

For that reason, the Chair of Forest Inventory and Remote Sensing at Universität Göttingen has implemented two workshops so far, the third is in preparation. And this paper reports on implementation and experiences from the last workshop in Durban in December 2011.

A group of 45 participants (from 22 countries), half students half lecturers and scientists met in Durban for a one week workshop entitled “Forests in climate change research and policy: The role of forest management and conservation in a complex international setting” discussing topics in the wide filed of “forests and climate”. This workshop was funded and accompanied by DAAD. Among the participants were students and lecturers from DAAD funded study programs in Germany and alumni from universities and institutions all over the world; these alumni were asked to bring along 1-2 good and motivated students.

In a series of introductory talks in Göttingen, to which high ranking speakers were invited, the group was prepared for that workshop; participants who were not in Göttingen had the chance to join in via video-conferencing. The group travelled then to Durban and held the workshop there; both students (in groups of 2) and lecturers made presentations in that workshop. The wide range of topics and geographical references is depicted in the following figure:



The entire group went then to Forest Day 5 on 05. December 2011, a large international conference organized by the CPF, the Collaborative Partnership of Forests. This is the place where scientistis, politicians and negotiators meet and it was an excellent experience for our participants to get into contact with all these groups.

As a result of this measure, a proceedings volume was produced with full papers from all workshop

presentations; there, the participating lecturers supported the students in crafting their paper. For many students in this workshop, it was the first serious experience in writing a scientific paper.
Altogether, we see this workshop as an excellent success; the opportunity of international networking and capacity building has been fully achieved. Contrary to most capacity measures in the context of UN-FCCC projects and activities, which have the character of short-term actions, we believe that such workshop contributes truly and significantly to develop country capacities on the long run, by starting stressing the challenging and exciting science-policy interface in the field of “forests and climate” already during the university studies.

For more information you may also refer to the AWF Wiki:
http://wiki.awf.forst.uni-goettingen.de/wiki/index.php/DAAD_FD5_Workshop

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Extreme flood events simulated by hydrometeorological systems: a Brazilian and a German experience

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Abstract
Reliable hydrometeorological forecasts are necessary to help reducing damages caused by extreme events. Coupling atmospheric and hydrological models can help improving those forecasts. Therefore the main objective of this work is to present a German and a Brazilian experience about this theme. One German study was coupling GESIMA (GEesthacht's Simulation Model of the Atmosphere) and NASMO (Niederschlag-Abflul3-Simulations-MOdell, i.e., precipitation runoff model). In a cooperative research, GESIMA model was applied to the Ubatuba watershed region (São Paulo state, Brazil) and the model precipitation forecasts were evaluated. The model results show a good agreement with the observations. One Brazilian experience was coupling the Eta atmospheric model, and the Distributed Hydrology Soil Vegetation Model (DHSVM), applied to Bocaina watershed (São Paulo state, Brazil). The lack of fluviometric data in Ubatuba watershed shifted the study area to Bocaina. The results showed that the hydrological model DHSVM simulated basin outflow coherent to the observations in the study area. The atmospheric Eta model exhibited large spatial variability of the prognostic variables which was sensitive to model's resolution. This proposed Brazilian coupled system produced satisfactory outflow forecasts although the simulated outflow that was obtained with the models' coupling presented strong dependence on the precipitation forecast quality.

Keywords: Hydrometeorological Forecasts; Extreme Events; Hydrological Models; Atmospheric Models

Introduction

Heavy rainfall can cause floods and landslides and, consequently, many negative social problems. Reliable forecasts are necessary to help diminish the damages produced by such extreme events.
The understanding and accurate representation of the hydrological cycle in a region can provide useful information for water resources managers. However, lateral flow, which plays an important role in the water cycle, is not adequately represented in the atmospheric models.
Coupling atmospheric and hydrological models seems to be more appropriate methodology for describing more accurately the hydrological cycle. The coupled system can be applied to manage reservoirs, conduct flood forecasts, and other applications. Some international research centers are working with one-way coupling, aiming at creating two-way coupling ([1], [5], [10] and [12]).
Model linkage is a challenging task due to model designs and problems of incompatible units, spatial scales, and temporal scales [11]. While atmospheric models work from few to hundreds of kilometers, hydrological models work with small scales, from a few meters to hundreds of meters.
The Institute of Meteorology – University Leipzig – carried out a study within framework of coupling a mesoscale atmospheric model with a hydrological grid point model for closed description of water cycle.
A two-way-coupling of a meso-β-scale meteorological model with a runoff model was developed and tested in short time scale. The hydrological processes of river catchment are considered in the atmospheric model, which itself drives the hydrological model [9]. It means that precipitation and evapotranspiration predicted by meteorological model serve as input for hydrological model, while runoff and lateral water flows determined by hydrological model are considered in calculation of soil wetness by the meteorological model.
They worked with the Leipzig's version of non-hydrostatic model GESIMA (Geesthacht's Simulation Model of the Atmosphere) and the hydrological model NASMO (Niederschlag-Abfluβ-Simulations-Modell, i.e., precipitation runoff model), that is a physically based model. It distinguishes surface runoff from subsurface

flow and groundwater flow. Further details can be seen at [9].
One Brazilian coupling system was showed in [6]. One-way-coupling with the Eta atmospheric model and the Distributed Hydrology Soil Vegetation Model (DHSVM) was applied to Bocaina watershed (São Paulo state, Brazil). Simulations of streamflow from hydrological model driven by observed precipitation are compared against observed streamflow.

Materials & Methods
This section describes GESIMA model that was applied to Ubatuba watershed, in cooperation with Brazilian researchers [6], for an 150–200 mm heavy precipitation event occurred in July 2004. A short basin description is showed.
The Eta atmospheric and DHSVM hydrological models are also described. They were applied by [7] to Bocaina watershed. The lack of fluviometric data in Ubatuba watershed shifted the study area to Bocaina. The coupling was tested for three heavy rainfall events: two South Atlantic Convergence Zone (SACZ) events which occurred in February 2004 and in March 2008, and one cold front event which occurred in July 2004. The considered coupling is unidirectional; the atmospheric model outputs (2- and 10-km resolutions) were used as inputs in the hydrological model. Bocaina watershed is also shortly described.
The GESIMA model is developed by [3] to study regional weather phenomena like the baltic heat cyclone or orographic precipitation in the mesoscale. After the heavy rainfall event (~300 mm/d) in august 2002 caused by a quasi steady flow of saturated air against the „Erzgebirge“ (~1000 m) in east Germany are meteorological models used to simulate such precipitation events. Further details see [3] and [4].
Ubatuba catchment is part of Serra do Mar and covers an area of around 64 km2 in northeast São Paulo state, Brazil. This region presents a complex orography and frequently is reached by extreme events like intensive rainfall, floods and torrents, landslides that result serious economical and social damages. Its area is predominantly covered by tropical forest, called Mata Atlântica, and presents a significant human interference.
Eta ([2] and [8]) is an atmospheric model that has the advantage of the vertical coordinate which is approximately horizontal even around mountain regions. Therefore, in the Eta Model the increase of horizontal resolution does not cause numerical problems. The model has complete physics processes. This model is used operationally to daily forecasts by the National Institute for Space Research, Center for Weather Forecasts and Climate Studies, CPTEC-INPE, Brazil.
The DHSVM is a physically based model that represents the topography, vegetation and soil effects on the water flows in a watershed. It can be applied to watersheds of up to 10.000 km2 at sub-daily timescales for multi-year simulations [11]. Further details see [11].
The Bocaina watershed located at São Paulo State - Brazil, has a drainage area of about 251 km2. The length of the Bocaina River is approximately 30 km. Due to the complex topography, the size of the drainage area, and in particular, the availability of observed long time series of hydrometeorological data, the Bocaina watershed was selected in the study carried out by [7].

Results & Discussion
The results are separated by two topics, the GESIMA rain simulations and DHSVM-Eta coupling simulations.

GESIMA applied to Ubatuba watershed
[6] studied an orographic rain event in Brazil. There are rain observations of 150–200 mm during 3 days in July 2004 at the Ubatuba watershed region. From NCEP/NCAR global reanalyzis data and soundings data of Rio de Janeiro, the synoptic situation was established and the mesoscale model was initialized.
Figure 1 depicts results obtained by [6] with 3D GESIMA simulation, for 17.07.2004 to 20.07.2004 case, as vertical cross section in parameters of positive and negative vertical velocity, cloud water and cloud ice above 273 K isotherm line. The real topography is overlaid and the arrows indicate the stream direction. The second plot shows the horizontal rain distribution produced by the Jacob cloud module. On 20.07.2004, the stream direction southeast is normal to the mountain ridge. Simulations are carried out on an idealized and real topography. Rain rates of 3 mm/h were attained for Ubatuba region. That is, for a quasi steady

duration of 72 h, a total value of about 216 mm, thus. The model results show a good agreement with the observations.

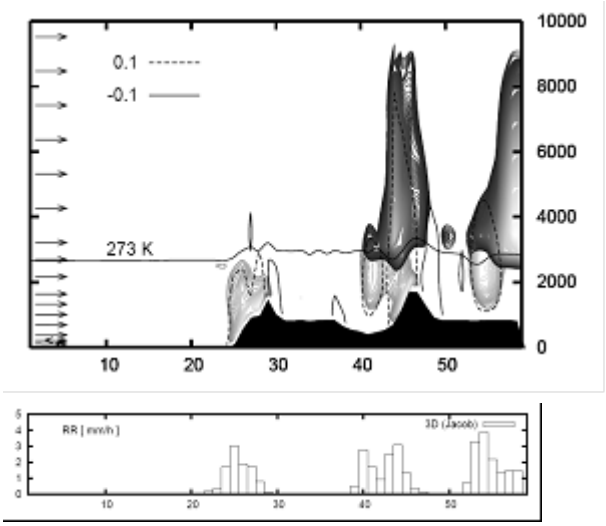

Figure 1: Results with real topography: Upper, the vertical cross section of the 3D GESIMA (Jacob) with topography (filled), 0°C line (horizontial, solid), upward (solid) and downward (dashed) directed velocity as well as cloud water and cloud ice (gray scaled). Downer, the horizontal rain rate [mm/h] distribution for a 3d-simulation (boxes). Source: [6]

Brazilian coupling system applied to Bocaina watershed

Although three extreme precipitation events were studied by [7], only July 2004 results were chosen to be showed, because of the same period analyzed by Gesima model.

For July 2004, according to Figure 2, the simulated outflow that was closest to the observed data was the one that had, as input, the Eta 10-km results. The simulated outflow that had as input the observed data exhibited somewhat worse results but showed a higher correlation with the observed data. The simulation with the Eta 2-km input data had the worst result.

Figure 2 shows that the accuracy of the simulated outflow is directly proportional to accuracy of the precipitation forecast. The 10-km Eta precipitation was closer to the observations than the 2-km, although it did not simulate the precipitation peak that occurred on the 19th July 2004.

Discussion

Coupling atmospheric and hydrological models is a very important tool to help diminishing damages produced by extreme events.

German and Brazilian researchers were and are working to improve hydrometeorological forecasts. Achieved results showed good agreement with observed data, but there are still many scientific challenges to be transposed.

Local studies are very important to understand and solve specific problems.

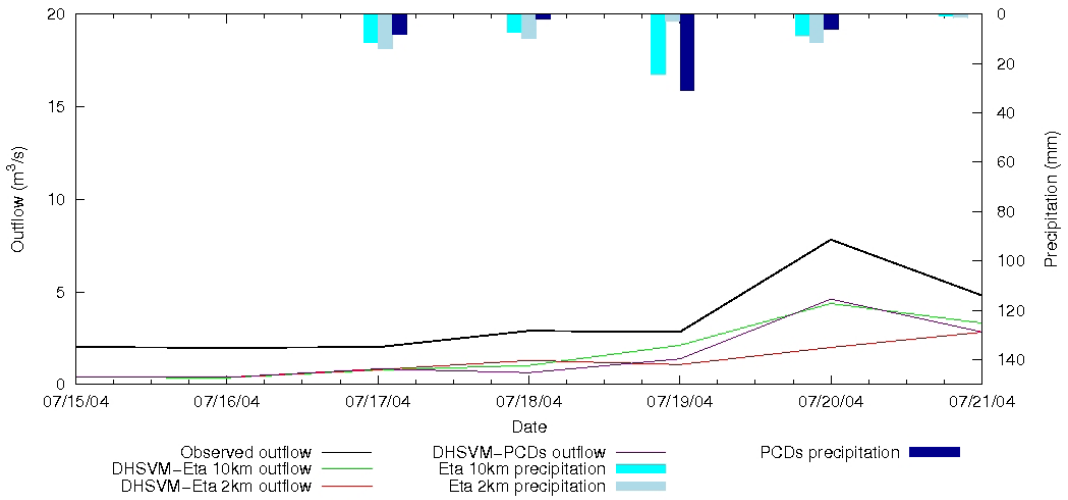

Figure 2. Daily outflow (curves) from observation (black), and calculated from DHSVM driven by Eta-10km variables (green), Eta-2km variables (red) and station observations (purple). Daily accumulated precipitation (bars) from observations (dark blue), Eta-10km (cyan) and Eta-2km (grey) averaged over the watershed. Units are m3s-1 for outflow and mm for precipitation. The simulation period was from 15 until 21 of July 2004.

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Announced Tragedies: Victims that could be avoided

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Abstract
In 2011 there was an exceptional rainfall in the Mountains Region of the state of Rio de Janeiro that carries off more then 800 deaths. Nevertheless, instead the big consequences from 2011, people died in each summer. The effects of the summer rain could be minimized if same actions have been considered and implemented to prevent constructions in risk areas. This is what this work will deal to.

Keywords: Announced Tragedies; Victims of rainfalls; Mountain Region, Rio de Janeiro State

Introduction

This work concentrate in how avoid problems, that is, how to prevent people from dying and losing their homes and possessions, because of the rains. The focus is the Mountains Region of the state Rio de Janeiro. However, this also applies to other regions of Brazil.

Figure 1: Location[1]

Although in 2011 occurs exceptional amount of rainfall in the Mountains Region from the State of Rio de Janeiro, the probability to have accidents again because of rain continuous to be so high that it can be affirmed: people will die next summer in Teresópolis, Petrópolis and Friburgo because of the rain. I make this statement in my classes, and whenever I can. This is not a prophesy. This is a warning based on data and observation. Among the data, the following, from different sources:

- 2007: Rains caused 29 dead. Once more de city of Friburgo was the most affected"[2]
- 2008: "Rain in Petrópolis in February let 1881 people homeless, 16 wounded and 9 dead."[3]
- 2009: Rains caused 29 dead in Petrópolis.[4]
- 2010: "Torrential rain make 200 deaths in the cities of Rio de Janeiro, Niterói, Nilópolis, São Gonçalo, Petrópolis, Maricá and Macaé."[5]
- 2011: "A survey of the Civil Defense registers 5.980 homeless, 15.479 displaced and 812 deaths caused by rain in the Mountain Region."[6]
- 2012: "Rain and landslides kill 3 in the Mountain Region von Rio de Janeiro."[7]

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[1]Available at: http://www1.folha.uol.com.br/cotidiano/859711-numero-de-mortes-em-nova-friburgo-e-teresopolis-sobe-chuvas-matam-245-no-rio.shtml). Accessed on: May 26, 2012.

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[4]Available at: <http://noticias.uol.com.br/ultnot/agencia/2009/10/10/ult4469u47229.jhtm>. Accessed on: May 26, 2012.

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There are areas where it can't be constructed, because they offer a big risk off natural events consequence off intensive rain.

The risk areas

Particularly they are from two types: areas with risk from hillside slide and area with risk from flooding. In this grounds can not be construct any kind of buildings.

Figure 2 shows the flood in consequence of recurrence of the rain from 2, 10, 50 and 100 years. It demonstrate how dangerous is to construct on the banks of rivers and in wetlands.

The odder situation of dangerous is the hillside with high inclination. The probability of slide is higher when the angle is bigger. In Mountain Region of the state of Rio de Janeiro are founded frequently rocks covered by thin layer of soil. This increases the probability of slide occurrences caused by rain. Figure 3 illustrate the slide process. If stat only soil there is a rock under de soil layer, the water flows between rock and soil and turns the probability off slide higher.

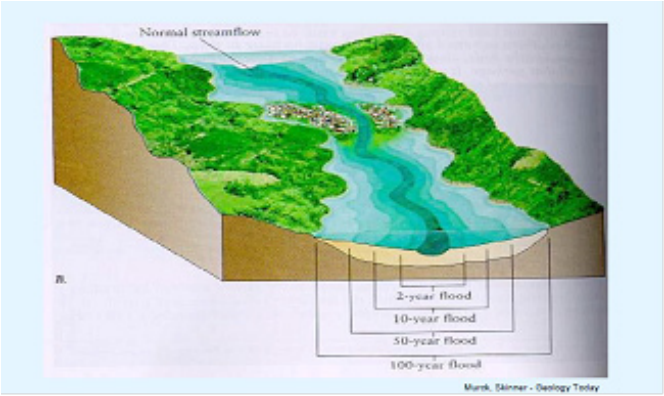

Figure 2: Recurrence of flood (MURK, SKINNER, 1999)

Figure 3: Slide process[8]

The regenfall in year 2011 in the mountain region

The big tragedy that happens in the Mountain Region of the state of Rio de Janeiro was caused principally by the occupation of risk areas. Figure 4 shows two examples of the situation off occupation of areas with high probability of flood, that are recurrent in a space of time.

Figure 4: Petrópolis, O Globo, Jan 13 and 23 2011

Figure 5: Petrópolis, O GLOBO, Jan 13 2011

[8] Available at: <http://3.bp.blogspot.com/_DCNHHCCpn5c/S8JTVoPIIEI/AAAAAAAAAQ0/fkL27eAF9DE/s1600/talude+1.png>. Acessesd on: May 26, 2012.

Figure 6: Friburgo's downtown. O Globo Jan 14, 2011

Figure 7: Teresópolis. O Globo Jan 13, 2011

Procedures

To avoid that people dies and have a material losses, it is necessary to prevent construction in risk areas. To this, these locations can be identified. Figure 8 show a map with the identification and classification of the risk of flood in the municipality of São José do Vale do Rio Preto, neighbor to Petrópolis and Teresópolis, made from de Geoinformation Laboratory of the Geosciences Faculty of the Federal University of Rio de Janeiro, Prof. Dr. Sc Jorge Xavier da Silva. It is part of an Urban an Environmental Diagnosis (MICHALKA, XAVIER-DA-SILVA, 2011).

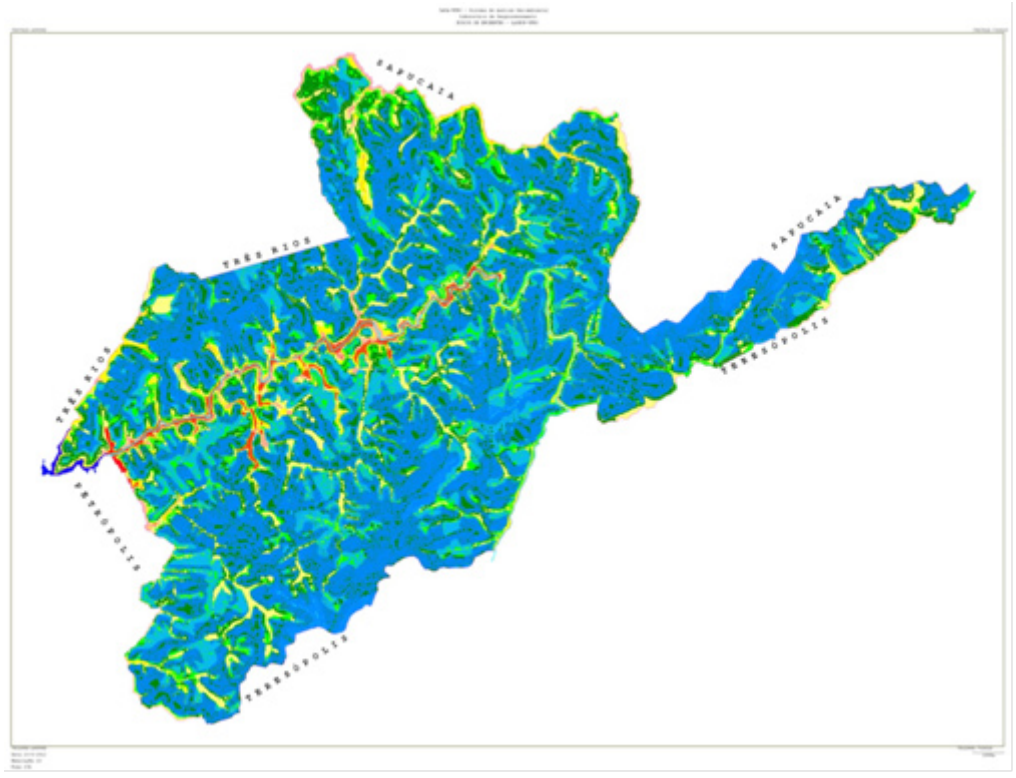

Figure 8: Map of risks of flood in the Municipality of São José do Vale do Rio Preto - RJ

Similarly, figure 9 shows the map of risk of slide. It can be noted that the risk of slide is bigger than of flood because of the location of the municipality in the Mountains Region.

With both information it is possible to define areas where must have a construction prohibition. If this has been made, many lives could have been preserved as the material possession too.

There is the responsibility from many actors: the people that constructs in risk areas, the city hall administration that let it, the city council that don't make lows to prohibit it, the professionals that construct without the necessary observation of the risk conditions and the Board of Engineering that does not inspect, especially the irregular self buildings.

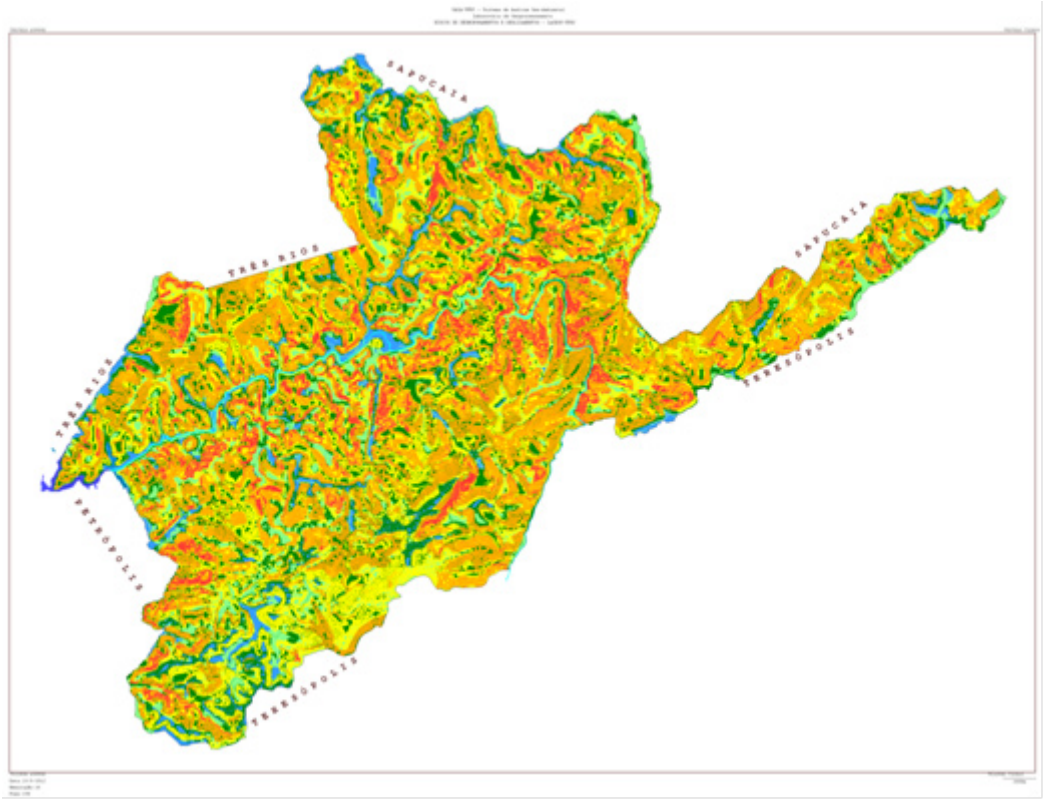

Figure 9: Map of risk of slide in the municipality of São José do Vale do Rio Preto – RJ

Conclusions

Each year the rain brings death and a lot of damages in the Mountain Region of the state of Rio de Janeiro. This happens most of all due to the occupation of risk areas. They are areas from hillside with risk of slide and flooding areas. This happens not only in this case of study, but in the same way in many other Brazilian municipalities.

It is imperative to change this reality. The planning of the municipality, that includes the urban planning, has to be reversed. It becomes necessary to be implemented a new planning paradigm. It means to plan in a systemic way. To look the municipality as a whole, where there is an interconnection of al factors. As an orientation two points can be taken in account do control the quality of the planning: environment and life quality. If both get better, the actions are going in the correct direction.

This is a change that will happen only if all the people take part. This is an initiative in which all sectors of society have to be engaged.

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What is the value of Mangroves in reducing hurricane disasters costs?

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Abstract
Mangrove habitats are quickly decreasing all over the world so there is an urgent need to protect this environment in an effective and sustainable way. This study seeks to calculate the benefits for the stakeholders, also known as demanders, of the protection against hurricanes' ecosystem service provided by the mangrove area in East portion of Great Abaco Island, The Bahamas. The study results show that the calculated values of benefits, in the form of costs avoided, for both demander groups, per km2 of mangrove area, per year, were $ 1 137.77 and $ 1 348.98 for the local population and the government, respectively. The main conclusion of this study, however, is the inclusion of the government as a demander group is of critical need to better understand the cost and benefit sharing among demanders and to allow an improved comprehension of the factors that may play important roles in conserving natural areas.

Keywords: Mangrove; Valuation; Ecosystem Services; Benefit and Cost Sharing

Introduction

Several studies have shown how important mangroves habitats are for providing several different ecosystem services such as fuelwood provision, natural flood, erosion and hurricane protection, and nursery habitats in tropical regions1-5. Moreover, most of these studies not only recognize this importance but also calculate a monetary value for these services, generally suggesting that those areas are worth preserving.
One of the most important ecosystem service provided by mangroves in the East portion of Great Abaco Island, The Bahamas is the protection against disturbance. The mangrove acts as a physical barrier that slows down the wind speed and absorbs the storm and hurricane energy, and also reduces the wave strength of tsunamis2, 6. The Bahamas archipelago, however, has never been hit by a tsunami. Considering this, the only actual protection function of the mangrove of Great Abaco Island is against hurricanes.
Therefore, this study seeks to calculate the monetary benefit that a mangrove area may provide for the local stakeholders (local community and government) by reducing the damage caused by hurricanes in the East portion of Great Abaco Island, The Bahamas.

Materials & Methods

Regarding the valuation of mangrove area for the protection against cyclones or hurricanes, Badola and Hussain7 used the damage-cost avoided approach to calculate the loss incurred per household with the 1999 cyclone in India. The study showed that on average, households on a village that had their mangrove area intact had 22% less expenses to repair their properties than in a village that had replaced their mangroves by an embankment - US$ 44.02 and US$ 153.74, respectively.
In another study, Costanza8, using a regression model relating the natural log of damage per unit gross domestic product (dependent variable) and natural logs of wind speed and wetland area (independent variables), calculated the average annual value of the wetlands on the United States per state. As an example, the value calculated for Florida was U$7,879.50/ha, one of the highest values found mainly due to its susceptibility to hurricanes.
The model used in this study followed the damage-cost avoided assumption and was divided in two equations, one for the local community and one for the government. For the local community group the following model was used: V_Lc=Vf*p_d*GDP_d*f_P, where VLC = net value of the mangrove for the local community; Vf = value of mangrove forest km2 calculated for Florida State; p_d= ratio in hurricane

strike probability between Florida and The Bahamas; GDP_d = ratio in GDP per km2 between Florida and The Bahamas; f_P = factor for population. The model defined for the government follows the model above mentioned just replacing the population factor (f_P) for the factor for government (f_G). The first three variables of the model were defined by Constanza et al. (1997) while f_P is a factor that indicates the percentage of total costs the population has to assimilate itself (without the financial support of the government) after a major hurricane strike. In this case, the data used is derived from hurricane Katrina (USA, 2006), as this type of data is not available for The Bahamas.

Results & Discussion

As a result, this study showed that the calculated values of benefits, in the form of costs avoided, for both demander groups, per km2 of mangrove area, per year, were $ 1 137.77 and $ 1 348.98 for the local population and the government, respectively. Although the monetary value of keeping mangroves are positive for both groups, when considering the costs avoided when of a hurricane catastrophe, the hidden costs of keeping this mangrove area are usually much higher. These costs are exclusively paid by the government in most situations in the form of lacking revenues from developments' taxes (i.e. hotels) and have to be kept in mind in order to understand the reason why these forests still lack protection. It is, however, imperative that the government also understands the higher population needs in emergency situations that could be avoided by protection measures. It is usually a matter of weighting population and government's needs and conditions to cope with natural disasters' costs.

Acknowledgement

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Climate change adaptation through sustainable resource management: a case of study from mountain areas of Colombia

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Abstract
Colombian high mountain ecosystems are key ecosystems that provide basic services to a significant portion of the population. Unfortunately the lack of planning and the unsustainable use of the natural resources reduced the resilience of this ecosystem and increased its vulnerability towards natural disasters. Additionally, impacts to be expected from climate change will further increase its vulnerability. The Rio Blanco basin is located in a high mountain area, and has about 15.000 inhabitants. It is an important water supplier to the aqueduct and sewerage of Bogota (capital city of Colombia), providing water for a population of 8 million. Climate change predictions show a reduction in precipitation compared to the present situation for this ecosystem. This implies an increased occurrence of droughts, placing at risk the water supply for the population. Therefore, the Colombian government along with other institutions set-up the Integrated National Adaptation Plan (INAP) to address impacts of climate change. The Rio Blanco Basis is one of the areas where it has been implemented as a pilot plan. This plan consist of four main steps: (i) definition of an ecological adaptive structure, (ii) construction of a restoration plan, (iii) promotion of participative ecological restoration actions, and (iv) classification of agroforestry systems. It has been found that through developing an integrated vision of the ecosystem that is based on fundamental ecological processes, it is possible to reduce the vulnerability to climate change and the risk of natural disasters.

Introduction
In Colombia climate change is affecting high mountain ecosystems and paramos, leading to a reduction in water retaining capacity and soil carbon stocks as a result of increased temperature and decreased rainfalls, and losses of biodiversity and ecosystem services. High mountain ecosystems provide a wide range of ecosystem services, such as slope stability, drinking water supply, hydroelectric power and flood control (Körner 2000). The root system of plants in high mountain areas is more extensive than that of lowland plants, and tends to prevent soil and scree loosening and erosion. Substantial below-ground structures are important for ecosystem functioning at high elevations (Körner 2000). Soil conservation is a key factor for a sustainable land use in high mountain ecosystems. This can only be achieved by a complete vegetation cover with high biological diversity, which is not necessarily in conflict with land use options (Körner 2000). The present study is based on a literature review. Itsmain objective is to understand the importance of ecosystem functions and services towards human welfare, and to provide an example of the initiatives that the Colombian government and other institutions are implementing to adapt such a complex system to global change and to reduce and prevent the risks of natural disasters.

High mountain ecosystems in Colombia
In Colombia the mountainous areas are mainly located along the Andes that stretch through the national territory, and the mountain system of the Sierra Nevada de Santa Marta. In Colombia every land located above 2.740 meters is considered a high mountain ecosystem, covering in total 4’210.000 hectares. 70% of the Colombian population (45’508.205 inhabitants) depends on environmental services provided by high mountain ecosystems (IDEAM 2011).
The country will face multiple impacts through climate change on the biophysical environment, such as costal zones, glacier masses, soils, vegetation cover and water resources. These will increase the occurrence of flooding, melting of glacier masses, drought, desertification, degradation of soils and fires, especially in higher mountain areas (IDEAM 2011). Studies conducted by IDEAM (Institute of Hydrology, Meteorology

and Environmental Studies) predict an average rainfall decrease of 10-30% and a temperature increase of 2,4º C, showing an increase of the driest periods in comparison to the present situation. This would imply an increase in dry areas of more than 4 million hectares for the period 2071-2100 in an optimistic scenario.
High mountain areas have become a priority conservation area due to the potential impacts of climate change and the associated losses of natural ecosystems and production systems in the region. Information about climate changes is applied to consolidate adaptive planning models at a local basis so it can be used for risk prevention by local people (IDEAM 2011).

Vulnerability of the Rio Blanco basin in Chingaza National Park, Colombia
The Rio Blanco Watershed is located within the National Park Chingaza, which is the second largest paramo of the country (40.528 ha). 60% of the total basin is located in higher mountain ecosystems above 2.740 meters, and located 70 km away from the Capital District Bogota. The river basin has about 15.000 inhabitants and is an important water supplier to the aqueduct and sewerage of the capital city, providing water for a population of 8 million. The predominant land cover in the basin is pasture, fragmented forest and secondary vegetation (IDEAM 2011).
IDEAM (Institute of Hydrology, Meteorology and Environmental Studies) carried out a vulnerability assessment for the Rio Blanco Basin, including social and ecological aspects affecting the study area. It was necessary to identify the relationship between the sensibility factors found in the area and the threats affecting the region by different levels of exposure. Available information shoes that the greatest changes in land cover and land use are a reduction of dense forest areas and an increase of fragmented forest areas, pasturelands and croplands; these changes along with an increase in temperature and changes in precipitation regimes will increase the vulnerability to climate change of local communities and the ecosystems in which they live. .

Ecosystem based adaptation in the Rio Blanco Basin
Governmental authorities and institutions along with nongovernmental and international organizations are developing the Integrated National Adaptation Plan (INAP) to address impacts of climate change. The objective is to implement specific pilot adaptation measures and policy interventions (IDEAM 2011). Under this plan it is assumed that a decrease of the level of threats will allow natural ecosystems to become more resilient to climate change. The incorporation of ecosystem-based adaptation approaches into planning efforts will be the best way to ensure that local authorities take into account climate change. The adaptation of high mountain farming systems will decrease the pressure on natural ecosystems, the vulnerability will be furthermore reduced through an increase in available information on the impacts of climate variations. Four steps were constructed to achieve an ecosystem based management in the Rio Blanco Basin: (i) definition of an ecological adaptive structure, (ii) construction of a restoration plan, (iii) promotion of participative ecological restoration actions, and (iv) classification of agroforestry systems.

Preliminary results of the pilot project
Restoration actions were implemented in nine local communities and restoration agreements were signed (6.440 planted trees, of 50 native species). 204 ecological restoration processes were implemented and silvopastoral and agroforestry systems were established on 121 farms. Eight home-gardens were established in different localities to promote propagation of native species and production of organic fertilizer along with one nursery for producing high quality plants for distribution among local communities. Capacity building was carried out in local communities on restoration, agroforestry systems and efficient use of water (800 families benefitted). Nine adaptive land use plans were compiled at the local level for the management of goods, and restoration actions were included into educational and cultural activities.

Conclusions
An integrated vulnerability assessment is the first step to address the impacts of climate change on mountain areas. As the vulnerability increases with non-sustainable land management practices, development activities will require a cultural change in terms of how the land is used. Restoration of ecosystem services is a measure to increase the resilience to climate change; this is a matter of social and economic development and depends on the participation of local communities and the recognition of traditional knowledge. The

valuation of restoration approaches has to be improved, including social, ecological and cultural costs. Public policies, planning, and participation of institutions are key factors to improve the resilience.

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The impacts of the Climate Change and the El Niño Events are creating many problems in the Bolivian society. The last 6 years those events were magnified and many people were affected Bolivia wide. Some were affected by drought and wild fire others had problems with floods and also with the increase of diseases like Dengue Fever. This study was focused in the Autonomous Departmental Government of Santa Cruz and the description on how this department is working in two main areas, identification of risk prone areas and the issuance of norms and also primary. Also primary and secondary sources of information were consulted in order to elaborate a data base for the elaboration of the risk prone areas maps.

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The impact of Natural Hazards on Land Uses in Santa Cruz Bolivia Prevention Activities

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Abstract
The impacts of the Climate Change and the El Niño Events are creating many problems in the Bolivian society. The last 6 years those events were magnified and many people were affected Bolivia wide. Some were affected by drought and wild fire others had problems with floods and also with the increase of diseases like Dengue Fever. There are some initiatives that the Autonomous Department of Santa Cruz is doing in order to reduce the economic losses; one is increasing the resilient of society by training them in attention and prevention measures. The different Administrative levels have created the Environment Risk Management Unit and this unit is trying to solve one part of the problem, the attention, but also there are many projects within the Autonomous Department of Santa Cruz that have been working to try to increase resilient in the society, For instance, productive projects are developing new seed varieties that can adapt better to the variation of the climate. Others are identifying the risk prone areas. There is also some efforts made regarding the issuance of norm to regulate or prohibit settlements in certain risk prone areas; others are more focus prioritizing the works and investment that the Administrative level should carry out in order to attend the most affected areas, like those that are within the Pirai and RioGrande river basin.

Keywords: Flooding; Drought; Wild Fire; Prevention Measures; Legal Framework

Introduction

Bolivia is suffering many impacts due to the Climate Change and the “El Niño” events. The governments in the different administrative levels are more focused in the attention of the disasters than in their prevention. The Prevention measures should be strengthened because this is the only way to develop social and economic resilience to the impact caused mainly by El Niño. But nevertheless there are some efforts to strengthen the resilience of the Bolivian society by reducing vulnerability. In general Bolivia is suffering more than 300 natural disasters per year. Generally speaking the Bolivian society is not well prepared to address Natural disasters. The impact of the Natural hazards is a big issue in the Autonomous Departmental Government of Santa Cruz.

Since some years ago the Autonomous Departmental Government has been facing the attention of the Natural disasters mainly Flood, Drought and diseases like Dengue Fever. The number of cases of Dengue fever had increased due to the presence of water bodies which create the natural conditions to reproduce the principal vector of transmission, the mosquitoes, principally the mosquito Aedes Aegypti.

The environmental problem has created food insecurity in some sectors, mostly in the industry of cattle and poultry. But the biggest problem is that the resilience of the society is not well developed and some natives were suffering starvation, the Bolivian Government in the different administrative levels has been trying to reduce this problem by implementing better production practice, eg. the crops of better seed species that can support more extreme climate conditions. But also in the administrative level some Departments and municipalities created an Environmental Risk Unit.

Materials & Methods

Primary and secondary sources of information were consulted and collected. From meteorology data, official reports of the Departmental Operation Emergency Center to reports or news published in the media.

ArcGIS 9 Software was used for the generation of the layout, identifying mainly flood, drought and landslides prompt areas within the Department of Santa Cruz. Also the anthropogenic thread was identified (e.g.

Agrochemical pollution threats) and vulnerability that exist within the department.
The Departmental legal framework was analyzed in order to identify which one were the initiatives that the Departmental Government was carrying out in order to address legal loopholes within the topic of natural hazards e.g. the issuance of the departmental decree which prohibited the settlement and any investment in the flood prompt are identified as a buffer zone in the “Rio Grande” River.

Results & Discussion

After collecting the information from primary and secondary sources the elaboration of an Environmental risk assessment database was possible, with this data it was possible to categorize and identify the current risk prompt areas and the possible areas which could suffer natural disasters within the near future. It was also observed, that the areas within the north-east of Santa Cruz will be the ones with biggest environmental problems, because of the new settlements and the migration in the future.
The analysis of the data base was done using ArcGIS 9 software by the GIS unit under the Sustainable Environmental Development Secretary. Seven risk prone areas where identified as a result of the analysis, these areas were visualized in maps or layouts, those Departmental risk prone areas are named as followed:

- Flood prone areas
- Drought prone areas
- Landslides prone areas
- Frost prone areas
- Anthropogenic Threats
- Agrochemical pollution threats areas
- Areas with wild fire.

There are some initiatives that the legal unit of Departmental Government of Santa Cruz is carrying out to regulate the settlements in some risk prone areas. For instance the Departmental Administrative Resolution 086/2007 was issued, this norm basically prohibited the settlement and any investments in an buffer area around the “Rio Grande” River. But there is a lack of reinforcement to implement what is said within this Administrative Resolution and also there is a small or any budget assignation to reinforce or implement it.
Another initiative was the issuance of the Administrative Resolution 03/2006 which basically prioritizes the mitigation works in the biggest prone flood areas in Santa Cruz, those are the river basin of Pirai and Rio Grande. The main objective was to put more effort in areas which have been affected by floods mostly due to the El Niño events. These areas are where the soy beans and sugar cane industry. The alluvial formation of these lands had created a fertile soil and one of the best soil for agricultural business.
The creation of the Environment Risk Management Unit was also one initiative that tried to improve the articulation of the natural disaster attention, because in the past the department of Santa Cruz, did not have any unit or direction in charge of the attention of the disasters. Under this unit is the Emergency Operation Center, which is the arm that acts when there is the need to attend any case, like rescue missions or provide food and water to the affected populations.

Acknowledgement

The creation of this information was possible because of the efforts that Autonomous Departmental Government of Santa Cruz is doing trying to create a resilient society. In particular, the technicians who were working in the Control and Monitoring of Watersheds Project and the Prevention and Mitigation of Environmental risks Program.

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Climate and Land Use Change: Modeling Sustainability Scenarios for the Amazon Region in 2020

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Abstract
The present article summarizes the results of 50 months of research performed by the LUPIS Project – Land Use Policies and Sustainable Development in Developing Countries - in Brazil, one of the seven developing countries involved in this EU-funded research project. Seeking to render the concept of sustainable development operational, the main question addressed by the research project was: "How can the sustainability of land use-related public policies be assessed in developing countries"? In order to answer this question, the LUPIS Brazil team developed LUSMAPA, a model with a strong regional identity allowing the construction of future scenarios taking into account the side effects of land-use policies such as the paving of the BR-163 highway in the states of Mato Grosso and Para and the reform of the Forest Code. The ineffective presence of the State institutions and an economic context (national and international) that favours the expansion of the agricultural frontier results in a close correlation between deforestation and regional economic growth. Pavement of several highways that cut the Amazon biome causes an increase in the rates of deforestation and opens new fronts for occupation. Pavement of road BR-163 was subject of an EU funded integrated research program called LUPIS (Land Use policies and sustainable development in developing countries) comprising the study of eleven municipalities in both states, Mato Grosso and Pará. In this paper the role of land use policies is illustrated to reduce greenhouse gases in Brazil and suggestions for a transition towards a low carbon economy and green growth are given.

Introduction
The study area comprises the area along the road BR-163, where land use policies for the North of Mato Grosso and southeast of Para are centred on agricultural development which, in turn, coexists with conservation policies (Rodrigues-Filho et al., 2010). The national policy on climate change (Law 12.187/2009) became an important instrument, as it establishes clear targets to reduce Brazilian GGEs between 36.1% and 38.9% in relation to the emissions projected to 2020. At the same time more than 80% of the targets will be realized through the reduction of deforestation in the Amazonia and Cerrado, as well as by the intensification of agribusiness.
Uncontrolled land use changes and various land use policies that affect these changes are the main issues in the case study area. Therefore, a model that describes such land use conversions is most appropriate. Modelling land use changes can be carried out with a wide array of model types. For example, in the spatially explicit CLUE model land use conversions are dealt with as transition chances using various matrices. The proposed model for the Brazil case examines land use changes in a mechanistic way; land use changes are modelled using ordinary differential equations (ODE) in which specific mathematical equations describe various processes and functions.
The developed model is not spatially explicit; it assumes 'containers' of land use types, called state variables, which can change from on land use type to the next. The choice of a non-spatially explicit model type was based on the limited amount of spatially explicit data (GIS maps etc.) that were not available for the project. Therefore, some spatially explicit mechanisms are 'mimicked' using non spatial relationships.

Material and Methods
The model assumes land use conversions from one land use type to the next in which those conversions are affected by various (external) drivers. Since the model is a full ODE, a general equilibrium could be calculated; the design of the model is such that a final equilibrium of final land use types exists. The model

is constructed using three sub models that represent the three regions in the case study areas; north, central and south. These regions are functionally connected through land demand for various agricultural productions.
Basically, three types of drivers affect land use change; prices of agricultural products, land use conversion caused by local people (migration effects) and the effects of road pavement on the distribution of agricultural production amongst the three regions.
Changes in the state variables of the model are assumed to be caused by various drivers; market prices for commodities, population developments and road construction and development. Therefore, a description is given on how data from these drivers are derived from statistics and how these drivers are implemented in the model. The conceptual model includes an ex post analysis and model calibration, where several simulations are run from 1990 to 2007 and model results are compared to the statistics that describe changes in the same time period. Based on these calibration runs some model adjustments were made in such way that the simulated values of model parameters are in line with the collected statistical data. Finally, an ex ante analysis (IMPACT 2020) is carried out. Here the parameterisation of the scenarios and policies that are assessed are introduced and the model runs are carried out for the period 2007-2020, with the last year as focal point. Based on the model results of that year the post modelling phase starts.
The LUSMAPA (land use simulator Mato Grosso- Pará) model is based on ordinary differential equations of various land use types and simulates changes in the area within each land use. The model is split up into the three sub-regions; the consolidated agricultural area “South’, the intermediate agricultural area ’Central’ and the pioneer area ‘North’.
Through a time series analysis of data between 1995 and 2008 we defined different land uses in the three regions and the conversion routes of land use types. Each region includes natural vegetation, defined as a mixture of Cerrado and Mesophyll (dry) forest forest in South (CM forest), Mesophyll forest in Central and Rainforest in North. Since the forest area protected under the Forest Code depends on deforestation rates, this forest type was included as a separate land use. Agricultural area in the three regions is divided into pasture, soya and other crops. In the North region a land use type ‘cleared land’ was introduced. This land use is intermediate between forest and pasture – other crops. Based on Figure 2 we can define land use changes using a series of differential equations.
Many scenario studies use storylines (Leemans et al., 2002; Strengers et al., 2004) to depict possible directions of development. Among those, the SRES scenarios of IPCC are widely used (e.g. Grübler et al., 2007; Parry et al., 2004). Parameterization of such scenarios depends on estimations of demographic and GDP development. Based on those, extensive macro-economic is usually needed to calculate supply and demand of commodities. These calculations usually result in gradual and linear increases of output and prices. Therefore such scenario designs are useful for long term projections but less suitable for the short term as the case in our study. Historical price developments of beef and soy between 1995 and 2007, based on FAO data, show high variation, ranging from -1% to +33% for world annual beef price increments and -27% to +41% for soy (FAO price database). Average annual increase was found 4.36% in world beef prices and 3.89% in world soy prices. To construct distinctive prices scenarios we assumed one scenario in which the historical trend more or less continues up to 2020; for both beef and soy we assume a yearly 3% increase in price. In contrast a high price scenario was assumed in such way that from the historical trends we took only the years with high prices, leading to approximately a yearly increase of 8% for both commodities.

Results and Discussion

Increased demand for cattle and soy production in the case study area due to increased (future) prices of commodities will boost deforestation, but deforestation differences between the high and low price scenario are relatively small. This is due to two factors: first, forest areas in the consolidated South and intermediate Central areas are rather small in 2008. The price scenarios differ in the rate of deforestation, but mainly up to 2011, when unprotected forest area is practically vanished. Second, the largest deforestation rates occur in the pioneer North area, since unprotected forest is still abundant. But deforestation rate in this region is assumed to be caused by migration rates mainly. Although we assume an additional 3% yearly increase in migration rate in the high price scenario, deforestation rates only minor differ amongst the price scenarios.

THE LUSMAPA model simulated the impact of the Forest Code reform on land-use in Northern Mato Grosso and Southern Para, both intertwined by the controversial BR-163 highway. Modeling proved that if the Brazilian Forest Policy Code was reformed in such a way, to expand the agricultural frontier over forests in those states, the estimated increase in deforestation would be of 47% until 2020.
The law project that alters the Brazilian Forest Code - target of a strong debate in the Brazilian National Congress in 2011 and 2012 – displays the difficulties to overcome the dilemma between development and environment in developing countries such as Brazil.
There is a consensus between environmentalists and “ruralists” about the need to update the Forest Code, currently suffering from certain anachronisms that no longer reflect Brazil’s agrarian reality and potentialities. Nevertheless, the reform proposal steered by the ruralist lobby at the National Congress is a clear setback that can result in an augmentation of the already alarming deforestation levels in the Amazon and Cerrado biomes.
The LUSMAPA model has included the possibility of the Code´s reform into its governance scenarios. As a result, the projections to 2020 evidence the substantial increase of deforestation rates - in case the Forest Code reform is performed in relation to the baseline scenario - even with high governance levels. However, the result also suggests that deeper discussions overcoming the old dilemma between development and the environment are necessary, opening the door for creative debates about the transition from extensive towards intensive agricultural practices.

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Civil Defense X Social Assistance

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Introduction

This paper aims to present a situation that just replacing a corporate social responsibility and a municipal civil defense policy for social assistance.

The study area is the Mata Sul of the state of Pernambuco, involving several municipalities, which were hit by a major flood in 2010. The area was almost completely destroyed by the tragedy.

In 2010 the state of Pernambuco experienced a major flood, with 49 municipalities affected, 14,394 homeless, 15,319 displaced people and 13 municipalities with a declaration of emergency.

According to the Institute of Social Technology Social responsibility is the recognition in this citizens, individually and together, their duties to the community they live and society in general. This concept is based on the principle that a greater or lesser extent, individual actions always have an impact (positive or negative) in the life of other citizens and their community. Thus, social responsibility is realized by making attitudes, behaviors and practices positive and constructive, contributing to preserve and improve the common good and improve the quality of life for all. When applied to companies, the term is also synonymous with Corporate Social Responsibility.

As stated Shommer (2000) and Shommer, Rock, Fischer (1999), the concept of corporate social responsibility assumes that business activity includes commitments with complete production chain, such as: customers, employees and suppliers and communities, the environment and society. This concept relates to the theory of stakeholders - individuals or groups who depend on the organization to achieve its goals and of which the company depends on to function.

Social assistance is already a practice rejected because preaches charity and helps palliative, which solves nothing in the situation that person you need. Who is in a less favored not need charity, but they need social rights guaranteed by law to take effect.

In the case studied the affected area was the area of Mata Sul of the state of Pernambuco, where floods occur frequently. In 2010 there was a heavy rain that flooded the following cities: Palmares, Catende, Black Water, Bethlehem, Mary and Barreiros. In addition to flooding, landslides were barriers and slopes with this population had to flee their homes located in risk areas, especially in Palmares. The Una river runs through these cities and the level it currently is controlled by the State Department of water resources through sensors, but in 2010 there was not a level of monitoring, alarms being very precarious, even bells were used. Therefore, a large proportion of the population entirely by surprise. Besides the problem of increasing the level of the river, there are aggravating to the flood as the macro-urban poor drainage and garbage is not collected properly and that piles up in the streets.

The cities were almost totally destroyed, homes, hospitals and schools were unable to work and people have died by the floods. Companies located near the affected areas joined a stream of aid to cities. Some companies, located near the affected areas, donated machinery, food, blankets, clothes, among other needs of the population and cities. Also put manpower available.

Materials and Methods

Data were gathered from Internet research and interviews with a Human Resources manager of one of the companies involved in helping victims of the tragedy.

In the interview were lifted information about social actions were taken. Initially, the municipal authorities sent the demands of the population and the city to the companies, was held after a meeting with business leaders and defined the actions that each one would be responsible.

During the early days, which were the most critical, the shares were intensive and many donations were collected including with the work-force.

Results and Discussion
It is concluded that this attitude of companies is not systematic, it can not be classified as social responsibility, but of welfare, because all efforts were made to minimize the tragedy, but with corrective actions, there is no planning with preventive actions, a civil defense plan set with municipal governments don't exist.
Efforts were made at the time of crisis, companies and municipalities are not prepared to meet the victims of a tragedy of natural disasters.

Acknowledgement
Efforts by companies to help the victims were intense and brought many benefits in the crisis period.

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Monitoring desertification process in Seridó Region (NE Brazil)

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Abstract
This study presents a analyze and map desertification processes in the semi-arid Seridó region. Based on the Geosystem theory, this research shows the detection of desertification areas using environmental indices and products from remote sensing techniques, digital image processing in multispectral analysis and Geographic Information System (GIS). In a first step were treated the rainfall data and NDVI satellite Modis, aiming at identifying areas which do not present vegetation cover, even during the rainy seasons. In a second step, we work on a regional scale using Landsat ETM + images (2000-2005) and data collected in the field, as the evaluations of exposed surfaces, that together with MDT / SRTM-NASA (2003) allowed classify the altitude and slope of the relief, soils type, different morphologies and correlate them with the areas susceptible to desertification process. The integration of the georeferenced data, related to these indicators, allowed the identification of five different levels of susceptibility to desertification (very high, high, moderate, low and very low), and the geographic domain of each class. Based on the analysis of the dynamics of the vegetation cover, we can establish that the main results refer that there is a decrease of the biomass at the region, associated either with the dense caatinga vegetation areas, but more important, with the scrub and degraded areas.

Keywords: Desertification; Land Change; MODIS; Landsat; NDVI; Seridó; Brazil

Introduction

The United Nations Conference on Environment and Development, (Rio-92), officially defined "Desertification", [chapter 12 of Agenda 21], as "land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities." It was pointed out the failure of international programs to combat desertification and the need for a "Convention of Desertification", aiming at greater involvement of nations, particularly rich countries. The susceptibility to desertification process according the Agenda 21 (UNO, 1994), affects about one third of the Earth surface (about 36 million km2), or 70% of the dry lands of the world (arid, semi-arid and dry sub-humid), excluding hyper-arid areas and deserts. The affected area according to the German Federal Ministry for Economic Cooperation and Development - BMZ (1999) correspond an area 3.5 times larger than Europe and one sixth of world population. Many developing countries suffer from problems soil degradation and destruction of natural resources, including Brazil, where the area most vulnerable is located in the NE semi-arid region. This area exceeds 900,000 km2, and a 20 million population, corresponding 44% of the Northeast and nearly 10% of the population of Brazil (Census 2010). This region is characterized by high evapotranspiration, the occurrence of periods of drought, narrow soils and reduced water retention capacity, thus limiting their productive potential. All these combined elements lead to very fragile ecosystem, which is worsening mainly due to degradation of vegetation cover and mismanagement of land, due to the predatory exploitation of the particular biomass known as Caatinga , deforestation and burning.

The state of Rio Grande do Norte (RN) is the 4th northeastern state (on eleven) with number of municipalities included in the semi-arid desertification susceptibility area. About 50% of these municipalities belongs to the Seridó region, located in the most vulnerable area to desertification, with an area of 2,341 km2 and concentrating the largest number of inhabitants (260.000) of this region.

In this context, the objective of this study is to identify and map areas of Seridó Region showing advanced process of desertification, using Remote Sensing and Geographic Information Systems (GIS) to quantify

and evaluate its impacts and influences on the regional environment.

Materials & Methods

The Modis NDVI were used to identify areas that do not show vegetation cover, even during the rainy seasons. In a second step, the Landsat ETM+ images (2000-2004) were worked on a regional scale and checked with data collected in the field, as the evaluations of exposed surfaces.

A model of MDT/SRTM-NASA (2003) (Shuttle Radar Topographic Mission) refined at a resolution of 30 meters using the Bicubic Spline interpolation and prepared with the software SPRING, has allowed classify the altitude and slope of the relief, different morphologies and correlate them with the areas susceptible to environmental degradation.

A 16-day composite Terra/MODIS obtained image during Feb. 2000 to May 2005 (121 full scenes of MOD13Q1 data) was downloaded from NASA's DAAC web site (http://daac.gsfc.nasa.gov/data/). The MODIS image was firstly geo-rectified and resized into 30 m resolution to match the TM image, and then, a relatively atmospheric correction was applied to minimize the effect of atmospheric conditions difference between these images.

All procedures were performed using the GIS and image processing, ENVI and ArcGis. To compose the database, three sets of data were used: (1) the available data in systematic mapping (1:100.000): altimetry - landforms, settlements, roads, hydrography, (2) the thematic mappings on regional scale (between 1:100.000 and 1:500.000), such as hydrogeological potential, geology, lithological resistance, soil types, class of land use, underground water wells, mineral occurrence, (3) data obtained from digital processing of remote sensing data, such as levels of vegetation cover classes and fragmentation of vegetation cover.

NDVI MODIS images

Vegetation change has been successfully observed at scales ranging from local to global using the Normalized Difference Vegetation Index (NDVI), derived from satellite data. The NDVI minimizes the effects of topography and atmosphere, requires no prior knowledge of ground conditions, and is sensitive to the amount of photosynthetically active vegetation present. The change in the value of the NDVI between 2000 and 2005 obtained from imagery acquired by the MODIS satellite was used for this indicator.

Due to the fact of the satellite MODIS present a constant imaging we could process a complete series of images month to month. First they are processed and analyzed the MODIS images with the purpose of evaluate areas with vegetation deficit in the dry and on rainy periods, selecting witch areas would be analyzed in a second moment with the Landsat images.

The stages of treatment of the MODIS images were the following:

(1) Acquisition of MODIS original data (MOD13Q1, 250 m) from USGS site; (2) Batch import and subsetting of NDVI, EVI and QA channels. Using the script (PCI Geomatica easi script) performs a batch import and subsetting of the original MODIS HDF files to creates a subset for NE-Brazil; (3) Cloud masking of MODIS data. Use the PCI Geomatica Modeler models script for cloud flagging. This script creates masks for cloudy and shadowed areas within the images. Cloud and shadow values are taken from the QA bit mask. This script applies the masks that have been created in (3.) to the VI channels. The output is stored in separate files for EVI and NDVI; (4) Export data to IMG format (convert_PIX_IMG.mod) and Import of data to ENVI / save as meta file,; (5) Conversion of map projection from Siunosuidal to UTM24S_SAD69 - For further visualization and analysis in ENVI and GIS software, desired subsets of the files can be reprojected to UTM projection (6) Visualization of time profiles and Filtering of time series data (preliminary stage).

First results of the cloud flagging attempts with 5 masks (3 cloud + 2 shadow) produce large masked areas. Further Investigations have to be carried out using only 3 cloud + 1 shadow mask (shadow2) or using only the cloud masks. Despite of the large coverage of masked areas, these 5 mask cover the cloudy and shadowed areas fits good results.

After repeat this same procedure with all the set of five years images and filtering of time series data, we have the overview of this period and the different season of dryness and rain. In this series of 121 Modis images from 2000 to 2005, it is possible to identify very clearly the positive peaks that mark the rainy seasons and negative peaks that identify the dry seasons.

The integration of data generated from the processing of MODIS images allowed to identify which areas

of the Region Seridó showed lack of vegetation even during the rainy seasons and thus these areas were selected for the next step which was centered on the processing of Landsat images to map and quantify the areas in the process of desertification.

Landsat 5-TM and Landsat 7 ETM+ digital analysis

For mapping the desertification level of the Seridó Region, on the selected areas establish in the anterior images processing, were used images of the sensor LANDSAT-7 ETM+, cut according to the coordinates of the study area. These images were taken between September of 1999 and in the consecutive years, more precisely in March and Setember/2001, April and October/2002, September/2003 May and September/2004 and April 2005. This aspect of multiple temporalities of the images is important, because it allows the comparison of the spectral response of the land features in conditions of different humidity, as well as the monitoring of the evolution of the patterns of anthropogenic activity in the area.

The digital analysis was processed directly in the software ENVI, version 4.0. Initially, the images were corrected geometrically, through extracted control points from the plane-altimetry maps of Superintendence of NE Brazil Developing (SUDENE) in the 1:100.000 scale. Primary information for this study was gathered from a 1:100.000 false color composite image made from bands 4, 7 and 3 (R, G, B). The color composite was geometrically rectified using 30 ground control points whose ground coordinates were read from the topographic map of the same scale. Accuracy of geometric correction was achieved within one pixel. Through techniques of emphases analysis and transformations were obtained improvements in the visual quality of the images, which it served as base for several themes, as extraction of drainages, structural lineaments, updating of the road net and other several interpretations (using the module ArcGIS Image Analysis).

After the selection of the more representatives ETM bands, a classification was establishes using the ecosystem map of the Seridó Area as a mask for classification. Classification routine was separately applied for each type of ecosystems. Such customized routine was used because the classification related to projective cover as a main indicator, and could indicate different levels of desertification in different ecosystems. For Landsat supervised classification routine on ENVI the color image was classified using the Maximum Likelihood Classifier with about 30 training sites used to classify desertification levels of the area with acceptance probability equal to 0,5 (and also tested other acceptance probabilities). The coefficients of correlation between the original and transformed images and vegetation cover were calculated for 1999 and 2004. The purpose for the ratio transformations was to increase the correlation of the image data with vegetation cover by reducing the redundant information due to high correlation between the images and by increasing variation of the image data.

Was applied a post-classification techniques in the intention of improving the result of the supervised classification, where the Clump and Sieve functions were used to agglutinate and to separate pixels badly classified in the images, being also applied the filter of median, with a 7x7 raster uniform. Finally, the mapped classes were transformed of the format raster for the vectorial format (using Envi 4.0), being after exported for the software ArcGIS where it was made the last adjustments (in the mapped classes) in the intention of obtaining the physiographic maps of Geology, Geomorphology, Vegetation and Soils for this region and evaluate the areas in desertification process.

The normalized vegetation index (NDVI) was used to identify unvegetated regions and generate the Desertification Map. The field evaluations combine with the low values of this index were used to represent in this map the areas with stronger process of desertification. Comparisons were made with composite images to derive the threshold, and then unvegetated areas were identified. In addition, to consider seasonaling in vegetation, autumn and spring data and common areas were identified. From exploratory analysis of spectral data for the different land cover units, and from the analysis of evolution of land use, it has been concluded that: vegetation has to be assessed by the ratio TM4/TM3 (a vegetation index), considering the natural vegetation areas, namely dense and scrub vegetation; and soil can be studied based on the ratio TM3/TM7, considering scarce vegetation areas, where the soil spectral reflectance dominate. Finally, the desertified areas identified based on data from different years were superimposed to obtain yearly changes. A land cover analysis was first carried, being selected the natural vegetation areas (dense, and scrub vegetation units) to study the spatial structure of vegetation issues (TM4/TM3 spectral data) and only

scarce vegetation areas (TM3/TM7 spectral data) to assess the heterogeneity of soil characteristics.

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Growth and yield models of Tectona grandis L. f. (Teak) Plantations

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Abstract
This study aimed to construct site index curves and fit a growth and yield model for a teak plantation located in the State of Mato Grosso - Brazil. The classification of productive capacity was made with the guide-curve method, using the logistic model. The growth and yield model was adjusted using the Clutter model in its usual form. Both models resulted in precise and non-biased estimatives, demonstrating the quality of the adjustment and adaptation of the model to the data used. Based on the simulations, the results obtained can be used for the prognosis of yield for that population.

Keywords: Growth and yield models, Clutter, teak.

Introduction

Despite the significant advances in studies of growth and yield modeling, historically estimated production of Tectona grandis (teak) were made empirically. (Nogueira et al., 2006) Thus, is still justified scientific research involving the development of models of growth and yield for populations of this species.
The patterns of tree growth and yield were, mostly, proposed by Schumacher (1939), Buckman (1962) and clutter (1963). These can be classified, as their flexibility in empirical models, semiempirical and biological, the latter being the one that best describe growth trends (Pienaar, 1965). All of them include effects such as age, site index, basal area and frequency. The choice of model depends on the type of information, the level of detail required, the stand characteristics and the type of data available(Leite, 2009). In the case of stands subjected to thining, we indicate models of varying density, such as Clutter (1963) and Buckman (1962), individual tree models or distribution of diameters.

Materials & Methods

The data used in this study came from 89 permanent plots of continuous forest inventory stands mesured between 1998 and 2009, in stands of Tectona grandis.
The plots were measured at approximately 31, 41, 52, 65, 79, 89, 100, 117, 130, 142, 155 and 168 months. The thinning applied in the population was always selective. Some plots with higher productivity, suffered three thinnings, while others only two. The weight of thinning was 30% of the basal area in all cases.
To adjust the guide curve and subsequent classification of yield capacity, we used an index age of 72 months and the logistic model:

$$Hd=\alpha(1+\beta e^{-\gamma I})^{-1}+\varepsilon$$

In which:
Hd = dominant height in m;
I = age in months;
α, β, and γ = parameters, and
ε = random error, ε ~ NID (0, σ^2)
The growth and yield model was carried out employing the Clutter model (1963), in the usual way:

$$LnB_2=LnB_1 (I_1 I_2^{-1})+\alpha_0 (1-I_1 I_2^{-1})+\alpha_1 (1-I_1 I_2^{-1}) S_1+\varepsilon$$

$$LnV_2=\beta_0+\beta_1 I_2^{-1}+\beta_2 S+\beta_3 LnB_2+\varepsilon$$

In which:
V_2= volume at age projection I_2, in m³.ha-¹;
I_2= projection age in months;
I_1= current age in months;
S_1= site index in the present age, in m;
B_1= basal area at current age I_1, in m².ha-¹;
B_2= basal area at age projection I_2, in m².ha-¹;
α_i and β_i= parameters;
Ln = natural logarithm, and
ε = random error, ε ~ NID (0, σ²).
The model adjustment was made by the method of least squares in two stages, using the software Eviews 6.0. To assess the quality of the adjustment, the analysis was combined with the residue value of the correlation coefficient between the observed and estimated values of basal area and volume.

Results & Discussion
Based on the concept of site index it was obtained:
$Hd=S_1\ (1+3{,}0262801e^{-0{,}018245818(6)})(1+3{,}0262801e^{-0{,}018245818.I})^{-1}$

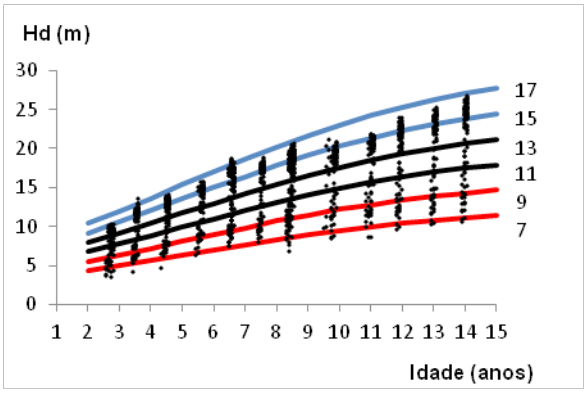

Figure 1. Site index curves obtained by the method of the guide curve using a sigmoidal model for a stand of Tectona grandis in the State of Mato Grosso, index-age 72 years.

The adjusted Clutter model with data from 89 plots was:
$LnB_2=LnB_1\ (I_1 I_2^{-1})+2{,}871416(1-I_1 I_2^{-1})+0{,}068164\ (1-I_1 I_2^{-1})\ S_1$; $\bar{r}^2=0{,}94$

$LnV_2=1{,}219921-14{,}37804 I_2^{-1}+0{,}038616S+1{,}110919LnB_2$; $\bar{r}^2=0{,}99$

The values obtained for the models described well the reality of the population when compared with data obtained in the field (Figure 5). The residues of both models (basal area and volume) were well distributed with a range between -20 and 20%, showing no trends.

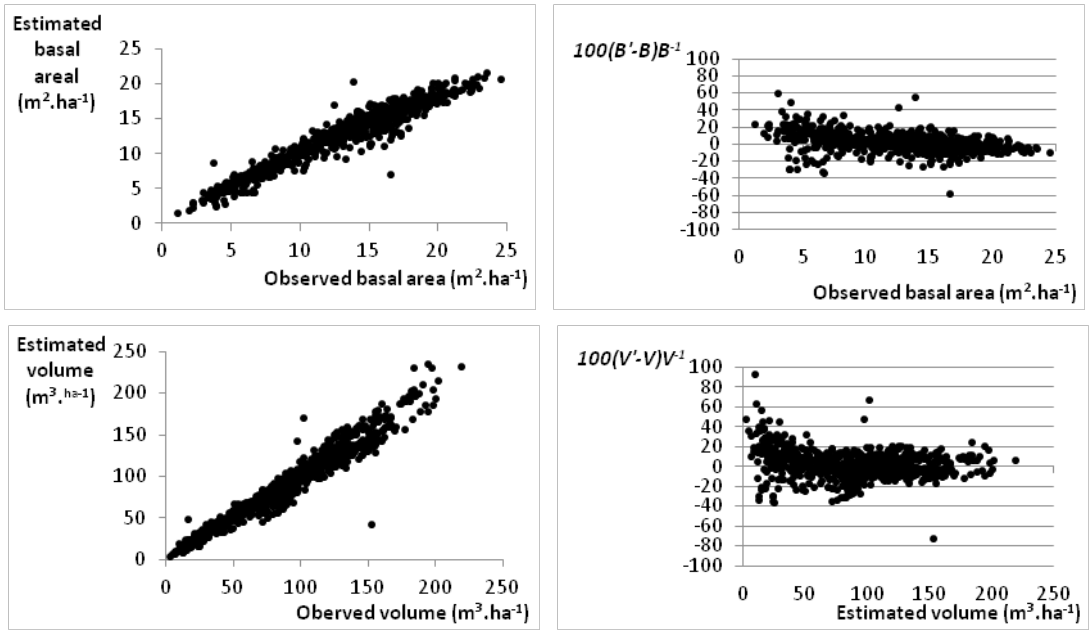

Figure 2. Relations between the observed and predicted values of the variables basal area and volume, using the Clutter model and the distribution of the error.

Acknowledgement
The logistic sigmoid model represented the dominant height data efficiently and can be used to classify the productive capacity of teak stands.
The Clutter model in its usual form is efficient for modeling the growth and yield of the stand.

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Land use change and natural resources in the Guapi-Macacu watershed, RJ – the German-Brazilian Research Project DINARIO

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Abstract
The DINARIO research project addresses the objectives of methodological advancement and applicability of results in decision-making at the interface of environmental management and economic progress in the Mata Atlântica region of Rio de Janeiro. The principal focus of this project is derived from the considerations of the actual causes and processes of landscape change under the influence of global change, in particular of future climate conditions. The research approach is structured into five interdisciplinary modules comprising land use systems analysis, Forest systems and bio-indicators assessment, soil and water resources management, participative research on rural development and integrated hydrological modelling including database management for Decision Support System development. The main products of this project are beneficial both for Brazil and Germany. Brazilian institutions and stakeholders will receive planning and decision support based on recent research considering all the three aspects of sustainability to optimize landscape planning, agricultural production systems, nature conservation and natural hazards risk management. Within the course of the DINARIO project, the partners have improved basic, applied and transferable research on the assessment of the status and the dynamics of the actual land use systems, the analysis of forest fragmentation, forests succession dynamics and carbon storage capacity and the assessment of landscape history based on integrated analyses of soils and fluvial archives. Most of the research data will be used for an integrated hydrological modelling approach. Furthermore, the strengthening of international and multidisciplinary networks in the respective fields of research is an essential output for the partners of both countries as well as a strong benefit for the human resources development within an academically challenging international research project.

Keywords: Atlantic Forest, land use change, landscape degradation

The Projects Scope and Methods

The Atlantic Forest region of Rio de Janeiro is famous for its extraordinarily rich biodiversity, hosted by a heterogeneously structured landscape which ranges from the lowland mangrove regions of the Guanabara Bay up to more than 2000m a.s.l. in the Serra dos Órgãos mountain range (Galindo-Leal and de Gusmão Câmara 2003). This landscape, originally covered by forests which show nowadays only about 7–16% of its original extent (Tabarelli et al. 2005, Ribeiro et al. 2009), is facing tremendous man made changes in land use and climate conditions. Within the framework of the interdisciplinary Brazilian-German research project DINARIO we addresses the actual causes and processes of land use change and landscape degradation by applying a wide range of field research methods, both from life and social sciences, to back up the development of strategies for climate change mitigation and nature conservation at a local level with databank- and scenario based decision support (see Fig.1). Even though the projects research area as a whole comprises six municipalities in the Atlantic Forest region of Rio de Janeiro (Petropolis, Guapimirim, Teresópolis, Cachoeiras de Macacu, Nova Friburgo and Bom Jardim), the main research has been carried out in the 1265 km² watersheds of the rivers Macacu and Guapiaçu.

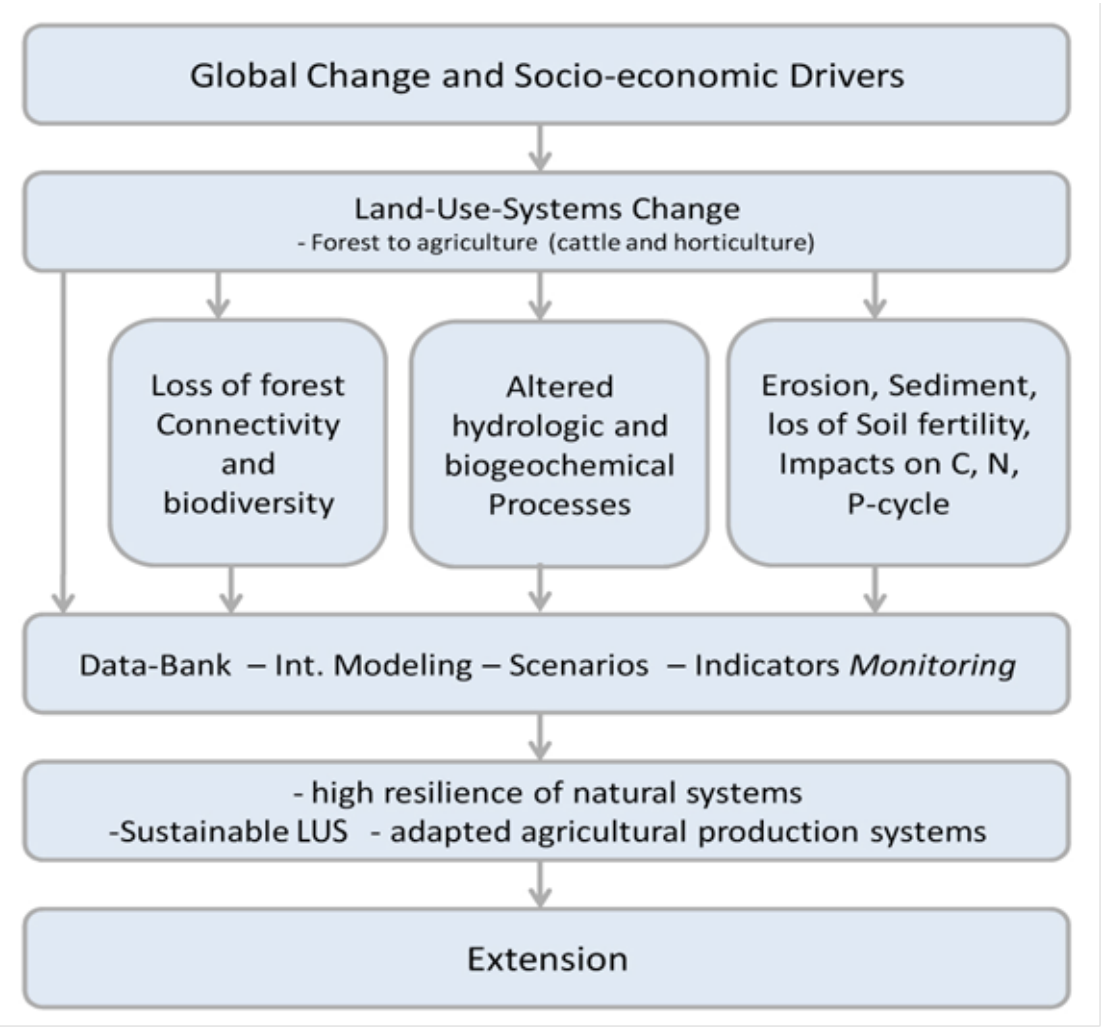

Fig.1. Integrated logical framework of the DINARIO projects research fields with regard to scenario modeling.

Within the municipalities of Bom Jardim, Nova Friburgo and Cachoeiras de Macacu the agricultural production systems have been analyzed and a cost-benefit analysis of the most important production systems has been carried out. Along with these studies, participatory questionnaires regarding the local actor's awareness for the significance of forests for water quality and quantity and other ecosystem services were conducted. To support the general understanding of the forest's floristic composition, fragmentation and succession stage, continuous forests and forest fragments have been botanically investigated with plot- and transect based research approaches, both in the lowland region and along the entire altitudinal gradient of the mountain range. By means of geostatistical methods (GIS), spatial patterns of landscape- and forest fragmentation have been revealed. Furthermore, the carbon storage capacity of these forests has been analyzed with special regard to the forests succession stage and disturbance history (Lindner & Sattler 2011). The soils of all important, non agricultural land use types of the region (pasture in various stages of degradation, initial forest succession, forest fragments and continuous forests) have been extensively sampled to provide both basic knowledge on the soils physico-chemical quality and the input into the hydrological modelling. In addition, the fluvial morphodynamics of the most important tributaries in the upper catchment of the Guapi-Macacu river system have been reconstructed by analyzing the river sediments physical and chemical constitution (e.g. grain sizes, clay mineral composition, CNS-ratio etc.) and age (radiocarbon- and OSL-dating). A hydro-climatic monitoring network was designed and put into place in the Guapi-Macacu basin. Three sub-watersheds with different land use distributions were selected as test areas where meteorological

variables (precipitation, temperature, air humidity), water level together with water quality parameters are being measured. The collected data will be used to model the hydrology and the water quality using the J2000 and J2000-S models respectively (Penedo et al. 2011). Finally, all thematic layers of information gained from the various field research results will be compiled in the Jena Adaptable Modelling System (Kralisch et al. 2009) with focus on hydrological response units to get a detailed idea about resource losses, priority areas for (erosion) risk management and suitable nature conservation concepts before the background of IPCC climate change scenarios.
As the DINARIO Project is reaching its final phase in 2012, most of the research results are being elaborated and not published yet. Nevertheless, an overview of the numerous thesis publications being produced along the course of the project can be obtained by consulting the project's homepage:
http://dinario.fh-koeln.de/content/research_publications.html

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Coastal erosion at the Parana Coast (Brazil): sinthesis of studies and methods applied

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Abstract
This report is a synthesis of coastline variation rates (erosion and progradation) estimated at the state of Parana at the last 60 years. Studies comprised different methods, as comparison of aerial photos and satellite images from different data, and DGPS and GPS surveys. Mainly causes of the coastline variation are pointed and management purposes are suggested to stakeholders.

Keywords: Coastline; Erosion; Progradation; Parana State

Introduction

This report results from different projects concerning coastal erosion, conducted by distinct units of the Federal University of Parana (UFPR), as the Marine Studies Center (CEM), Department of Geomatics and Department of Geology, and more recently was established a cooperation with the Department of Cartography Engineering, of the Federal University of Pernambuco (UFPE). Along the last years financial support was provided by Araucaria Foundation, Brazilian Research Council (CNPq) and Harbor Administration of Paranagua and Antonina (APPA). The German Academic Exchange Service (DAAD) supplied scholarships, mainly at the post-graduation researchers exchange between Germany and cooperative with Coordination for the Improvement of Higher Level (CAPES) - Brazil.
Coastal erosion is one of the present environmental problems in many coastal regions (Souza, 2009), and Parana State, in South Brazil, is not an exception. The coastline has 105 km long (25º18´12¨ - 25º58´35¨ S), interrupted by two estuaries (Guaratuba and Paranaguá bays).
Beaches near estuarine inlets were classified as unstable, since strong variations of the coastline can be observed, instead few variations occur inside these protected areas, considered stables. Oceanic beaches are moderately stables (Angulo, 1993).
The determination of the coastline variation was surveyed by different methods, mainly comparison of aerial photos and satellite images from different dates, and field surveys with GPS (Global Positioning System). All of them were used in the different studies developed along the years at the Parana coast, and a synthesis and the most important results were published by the Brazilian Ministry of the Environment, at a book called “Erosion and progradation of the Brazilian coast” (MMA, 2006).

Results and discussion

Ararapira channel, the border between Parana and São Paulo states, shows a southwest migration, with strong coastline erosion. Rates calculated indicates 43 m/year between 1953 and 1980, or 1.200 m (Mihály and Angulo, 2002). As the migration occurs, houses and other structures of the small village of Ararapira are reallocated by their inhabitants.
South Superagui and Peças islands also have strong coastline variation, both located at the Paranaguá inlet. In Superagui, Angulo (1993), using aerial photos, estimated a progradation of 7 m/year between 1952 and 1980, and APPA/CEM (2000, 2002) measured a retreat of 84 m (1999-2000) and 96 m of progradation (2000-2001), with GPS surveys. At the Peças Island, Angulo (op. cit) identified a coastline retreat of 200 m/year (between 1952 and 1955) and 28 m/year (1955-1980). APPA/CEM (2000, 2002) estimated to the same region a retreat of 90 m (1999-2000). Instead the variation of the coastline is significative, the region

is located at a National Park (Superagui), where no population exists.
Ilha do Mel (Mel island) it is an important touristic site along the Brazilian coast, and most part of the area is protected by law (different types of Conservation Units). As the island is located at the Paranagua inlet, coastline erosion and progradation are common. Rate estimation is of 4 m/year of retreat at the Saco do Limoeiro and Conchas beach (1954-1992), both located at the isthmus of the island (MMA, 2006). In recent years, a sandy spit developed near the lighthouse (progradation of 100 m/year, 1993-2001), conditioning the coastline variation at the region.
At the Ponta do Poço region the rates of erosion calculated were 6 m/year between 1954 and 1996 (Krueger et al., 1996), and 30 m/year between 1999 and 2000 (APPA/CEM, 2000; 2002). This coastline retreat is consequence of human intervention, since an artificial channel (DNOS) was excavated in 1950´s, disturbing the local dynamics. A small by-pass dredging system could be used in this region, to normalize sediment deficit at the erosional area.
Pontal do Sul Resort region showed periods of progradation (12 m/year between 1954 and 1980; 15 m/year between 1980 and 1993) and retreat (115 m/year between 1997 and 1999; 160 m/year between 1999 and 2001). The cause of this strong coastline variation was attributed to the blockage of sediment transport (locally from south to north) in association with the ebb tidal currents of Paranaguá Estuarine Complex. These rates were estimated in many different studies at the region with different methods, as Angulo (1993, op. cit.), Soares et al. (1994) and Lamour (2007).
Matinhos region, near Guabatuba´s bay inlet, is the more problematic situation concerning marine erosion, where different beaches exist. In 1980´s, a serious erosive problem destroyed Mansa´s beach, when streets, houses and buildings were threatened. Dykes, seawalls and beach face revetments were applied and beach became stable along the following years. Instead, erosion became a problem at Brava beach and resorts located at north of Matinhos, which problem persists up to today. Even with low rates of coastline retreat (0,7 m/year, 1954 -1980), many buildings and streets were constructed very near the coastline, changing the sinuosity of the beach. Since this, seawalls, dykes and other civil engineering structures adopted to contain the erosion have been destroyed, mainly during storm surges, and the problem and investments persists. A more detailed study applying GPS and DGPA at the region was performed by Krueger et al. (2003).
Rates of coastline variation at the Guaratuba municipality are more recent then the other regions above described, existing estimative of 1 m/year (both erosion and progradation, 1999-2001) at the Brejatuba´s beach, and no erosional problems were detected, since residences are far (more than 100 m in general) from the beach.
More recently, experiments involving the coastline variation using Artificial Neural Networks (ANN) and Fuzzy Logic (FL) have been developed (Gonçalves, 2010). ANN contemplates a temporal database of shoreline positioning extracted by remote sensing and GPS, trying to predict behavior of erosion or progradation, mainly in Matinhos region. FL is a modeling system integrating different linguistic variables like social, and economical aspects (Boruff et al., 2005), as well as physical parameters), producing maps of vulnerability, instead not yet widely used by scientists and policy coastal makers.
Despite all information provided by the studies above described, erosion stills a problem in some areas of the coastline of Paraná, mainly in Matinhos municipality. Natural oceanic dynamics was not respected during the urbanization process, as beach length, as an example. There is a necessity of a reevaluation of the urban plan, and actions looking to the touristic potentiality and recreational uses, instead summer emergency actions involving hard civil engineering structures.

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Adaptation and mitigation measures for flood control in Pernambuco State, Brazil

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Introduction

Facing the serious disaster by flooding in June 2010, over taking dozens of municipalities of South Forest and the Metropolitan Region, the Government of Pernambuco, through the Department of Water and Energy Resources (SRHE), signed an agreement with the Technology Institute of Pernambuco (ITEP) through the Project Management Unit Dams for the purpose of coordinating the study of environmental impacts of dam projects on rivers Una, Jaboatão and Sirinhaém for flood control in this region.

The recurrence of disasters in South Forest of Pernambuco has caused major social and economic losses with deaths, destruction of homes, public facilities, infrastructure, agricultural areas, strongly impacting the economy of the municipalities affected by flooding.

The dams to be built has as main purpose to reduce the flood disaster. However, the reservoirs may also be used for other purposes, in view of the multiple-use desired. These functions provide a better quality of life of the people directly affected, allowing the stimulation of economic activity and increased employment and income, and offers a pleasant area of great scenic beauty.

This paper presents the main results of environmental studies conducted for the physical, biotic, and socioeconomic status, with regard to the environmental diagnosis of the current situation of the areas where the dams are built, the likely environmental impacts and ways to mitigate and control them.

According to the Department of Water and Energy Resources of Pernambuco, the region of South Forest has suffered by frequent floods, as shown in Figure 1. In the years 2000, 2005, 2010 and 2011 rains caused extensive damage in the region, besides causing loss of life, damage to property to the population. In 2010, 21 people died, 26,966 were left homeless, 55,643 were displaced, 14,136 homes were destroyed and 142 bridges were damaged.

Figure 1 - Flooding and losses in the municipalities of Catende and Palmares

The floods were caused by climate change that has led to more intense rains, the characteristics of the topography of the watersheds and the occupation of inappropriate areas of the riverbed for residential and commercial.

After the flood of 2010, SRHE / APAC contracted mapping services of digital laser with high precision to topographic survey in areas of the river basin of Una, Mundaú and Sirinhaém. The survey was made using modern equipment that recorded aerial images in a range of 850 meters on each side of the river, in a finer-scale, was also studied the topographic mapping of the cities, especially those affected by floods.

The service has allowed us to generate three-dimensional digital models, highly accurate and dense, that support the development of engineering solutions. Besides allowing the details of the wetlands flood simulation system to be operated by APAC, the work is also enabling more rapid development of projects of dams to contain floods. The services received investment of $1.2 million and were carried out within seven months.
The Integrated System of Flood Containment in the South Forest should control flooding in the catchment areas of rivers Una and Sirinhaém.

Construction of dams for floods retention
To minimize the problems faced by people during the floods, will be built 5 (five) dams, which will stop the rivers Una and Sirinhaém in the region of the South Forest of Pernambuco: Barra de Guabiraba, Serro Azul, Gatos, Panelas II and Igarapeba (Table 1). The construction of five containment dams has estimated investment of R$ 650 million from the Government of Pernambuco and the Federal Government. These works will benefit about 150,000 people in eight municipalities of the Una River basin and approximately 11,000 in the Sirinhaém river basin. Besides the protection of cities against floods, dams can help to supply rural and urban population, the irrigated production of vegetables and provide leisure conditions.

Table 1: Characterization of the dams to be built in the basins of the rivers Una and Sirinhaém

Barragem	Municipality	Watercourse barred	Watershed basin	Accumulation capacity (m³)	Finality
Igarapeba	São Benedito do Sul	Pirangi River	Una River	42.500.000	supply / flood control
Serro Azul	Palmares	Una River	Una River	303.000.000	supply / flood control
Panelas II	Cupira	Panelas River	Una River	17.000.000	supply / flood control
Gatos	Lagoa dos Gatos	Riacho dos Gatos	Una River	6.300.000	supply / flood control
Barra de Guabiraba	Barra de Guabiraba	Sirinhaém River	Sirinhaém River	16.000.000	flood control

Source: SRHE, 2011

The dams will protect against flood an area of the watershed of the Una of 2060.23 km² (30.58% of total area), corresponding to the middle and lower watercourses, where are located areas of 28 municipalities, ten municipal centers (Belém de Maria, Catende, Cupira, Jaqueira, Lagoa dos Gatos, Maraial, Palmares, São Benedito do Sul, Água Preta e Barreiros). The Dam of Barra de Guabiraba, in the Sirinhaém river basin occupies an area of 300.16 km² of the upper river basin Sirinhaém (Figure 2).

Figure 2: Schematic of the dams to be built to contain floods in the state of Pernambuco.

To minimize the impact of this change and help the population is being carried out the registration of households in areas that will be expropriated for the construction of dams. A team of 30 technicians, coordinated by the ITEP, is visiting the homes located in areas to be used for the construction of dams.
The technicians are applying socioeconomic questionnaires to the characterization of families to be relocated and transferred to similar homes in other areas. To collect the data is being used for Territorial Information System (SIT), a mobile device like a small computer, which enables mapping the area, taking pictures, among other functions and speeds the transmission of information collected for the ITEP.

Main results of the studies of environmental impact
In this region, the water is used for public and industrial supply, irrigation, fish farming, and recreation. The dumping of sewage into the rivers is the main cause of water pollution. The rivers Una and Sirinhaém receive large amounts of untreated sewage from cities that cross them, and there are reports of endemic diseases such as schistosomiasis.
The main economic activity in the area is agriculture, especially monoculture of sugar cane and family farming (cultivation of fruit trees). During the off-season, are registered high unemployment rates, exceeding 45%. The extensive livestock activity of cattle and goats is also part of the region's economy, which has grown below the average for the State of Pernambuco.
The municipalities show a high rate of infant mortality, with predominance of young people (10-24 years), a low birth rate and life expectancy is increasing. Visits were conducted in the field where it was possible to describe the main impacts from the construction of dams, below divided into negative and positive for each source studied.

Main Negative Impacts

Socioeconomics
- removal of people and productive activities.
- indemnity of properties.
- flooding of the railway line.

Biota (vegetation and animals)
- removal of vegetation and loss of habitat for animals.
- reduction of the biodiversity.

Physical
- changes in the water regime.
- changes in the regional landscape.

Main Positive Impacts

Socioeconomics
- improvement of the living conditions in nearby communities.
- dynamization of municipal economies.
- Possibilities of uses of water for human supply, tourism, fishing and recreation.

Physical
- flood control avoiding disasters with materials and lives losses.

The main mitigative measures

After identifying the impacts, mitigation measures were proposed in order to reduce the negative effects that may appear with the construction of dams.

Physical
- control of soil erosion and landslides.
- recovery of damaged areas.
- environmental recommendations for the implementation of the work.
- control of land use (river banks and slopes).
- control of water quality in the basin.

Biota
- seedling plantation in the remaining fragments.
- implantation of ecological corridors.
- replacement and maintenance of riparian areas with native species that can provide refuge for wildlife.
- escape, rescue and translocation of animals from the area that will be flooded.
- creation of nurseries for reproduction and artificial propagation for native species.

Socioeconomics
- indemnity of buildings and improvements.
- relocation of affected families.
- implementation of actions of rural resettlement and support to family agriculture.
- cooperation with agencies to hire workers in the region.
- training for productive activities.
- rebuilding of houses and roads.
- preservation of cultural patrimony.

Final considerations

The Environmental Impact Study was developed to evaluate the different types of environmental impacts associated with different stages of planning, implementation and operation of dams, it was made a diagnosis of the environment that will be affected by the project, obtaining several primary data, considering the environmental elements of physical, biotic and socioeconomic sources.

The probable impacts were identified and analyzed, showing that the most highly impacted shall be at vegetation, terrestrial fauna and particularly to aquatic fauna and flora. To mitigate, control and even neutralize the effect of these impacts were proposed mitigation measures and, Control & Environmental Monitoring Programs were designed, to support the development of environmental management area.

The analysis of positive and negative impacts and the conviction of the need for structuring works associated

with effective public policies to reduce recurring flood disasters in the region of South Forest, showed that it is important, the construction of dams in the shortest time possible, before other extreme weather events, with concentrated and intense rains come to re-produce the scenes of destruction that occurred in 2010 and 2011.
Finally, considering the dynamic nature and specificity to build dams, it is possible that, over time, it will be required to adopt additional measures. Therefore, it is relevant the systematic monitoring of all phases of operation of the enterprise, so as to enable the adoption, in a pro-active form, of complementary measures that could be necessary. From a technical standpoint, may be considered that the previous environmental care, and the mitigation and control measures, when properly implemented, will contribute effectively to the environmental viability of the activity described and evaluated in this document.
In a synthesis of the results, are listed below the main aspects of environmental quality from the perspective analyzed with or without the construction of dams.

(i) Environmental quality without the dams:

- Floods will continue to cause more disasters.
- Expectations of heavy rain likely at risk of flooding.
- Jobs maintaining the trend of low growth.
- Loss of public and private property caused by flooding.
- Deaths continue to occur as a result of flooding.

(ii) Environmental quality with the dams

- Installation of flood control system and protection of the municipalities.
- Possibility of use water for public supply.
- Stimulation of economic activities.
- New perspectives of socioeconomic growth for the population.
- Improve the quality of life of the population.

In this context, the implementation of these dams is environmentally viable and socially necessary, contributing to improve the quality of life for people in the area of influence of the project.

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Natural disasters management in the Brazilian Amazon

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For a long time, both inside and outside of Brazil, the Amazon region has been considered as a territory without strong natural hazard impacts. However, in recent years, extreme natural events, increasingly more recurrent and intense, have manifested both in rural and urban areas in the region. Consequently, these events expose this territory to the impacts of various technological and natural hazards, most of them associated with droughts, floods, soil, fluvial, and coastal erosion, and fires.

A disaster associates frequency, recurrence, and magnitude of the natural hazardous phenomena with the exposed population and infrastructures' vulnerability. These disasters impact negatively on the region, whose development already presents many unresolved problems, in particular regarding the economic and environmental activities of the most vulnerable people (e.g., poor in urban areas, subsistence farming communities). It is expected that the situation will worsen, considering the forecast scenarios of bigger and more intense use of the forests and occupation of the cities, as well as intensification of climate change in the Amazon region. In this sense, a big challenge to respond to these scenarios is to develop and implement risk management policies, strategies, and measures that can address the regional peculiarities.

In Brazil, the vast majority of the natural disaster historical record, the academic researches, and the risk management strategies and measures' implementation is focused on the most populated and developed regions of the country - Northeast, South, and Southeast. The scarce studies associated with this issue in the Amazon region are neither integrated nor systematic and are poorly disseminated within and outside of Brazil.

In this sense, this article chapter aims to describe and analyze the particularities of the risk management in the Amazon region considering, with special emphasis, the issues of spatial planning, sustainable development, water resources, and climate change. In this way, considering the possibility to understand how far the natural risk management really integrates the governmental policies, this research seeks answers to the following key aspects:

- The identification of the major disasters, locale, and frequency of the events.
- The description and analysis of the legal and regulatory framework, institutional organization, and availability of financial resources governing risk management in Brazil and particularly in the Amazon region.

The research activities focus on (i) survey of existing information in the free available Internet databases of the State and federal Governments, (ii) construction and spatialization of a historical record of the natural disaster events between 2000 and 2010 using GIS (Arcgis 9.2). The data are originated in the emergency and state of calamity official decrees, and (iii) semi-structured interviews with managers and qualified technical staff from various secretaries and institutions at federal and State levels (e.g., Environmental Secretary and Institute, Department of Planning, military firefighters' corporations, civil defense coordination). The partially structured interviews are compounded by the following four main questions:

- Considering the point of view of your institution, how are the risk management actions developed in the State evaluated?
- What is your institution's participation in the risk management activities, at the State level, particularly considering the prevention, response, and mitigation steps?
- What are the main obstacles (e.g., institutional, technical, budgetary, and regulatory) of the State and your institution preventing a better performance in risk management?
- Which is the importance that you assign to the territorial planning, water resources management, and climate change aspects in the natural risk management? How are they implemented by your institution?

The Brazilian environmental legislation is very profuse and detailed, showing a permanent evolution since the 1980s. The state's constitutions specifically refer to the actions and responsibilities in case of calamities. However, other legal instruments do not or poorly consider risk management as a key element in the land

use classification, water resources regulation, and sustainable development context. Noteworthy is the wide range of legal instruments, which indirectly assist to mitigate the current risk impacts and/or prevent the potential ones, reducing vulnerability factors.

Successful risk management depends on the integrated action of various governmental institutions and the society. The description and analysis of the institutional framework concentrate on the direct administration ministries and secretariats in Brazil, and particularly, in the Amazon region states. At the federal level, the programs linked to risk management are implemented in the following ministries: Science and Technology (Inter-ministerial Commission of Global Climate Change), Agriculture (Agricultural Zoning for Climate Risk); Agrarian Development, National Integration (prevention, preparedness and response to emergencies and disasters), Cities (municipal master plans), Environment, Water Resources, and Amazonia (protected conservation units). At the state level, besides the Civil Defense structure, other governmental institutions analyzed are classified depending on the type of relationship with risk management – thematic (direct/indirect/non-existent), temporal (before and/or after the occurrence of the disaster) and responsibilities/activities (survey of basic information; formulation of actions; and implementation and control).

The review of the financial framework with consideration of the significance to know the financial capacity of the institutions in charge of risk management actions, describes and analyzes the proportion of resources, their availability, and mechanism procedures for the execution of the prevention, mitigation, and emergency response activities.

The answers given by the managers of the state governments' institutions are classified into 2 groups categorized as: problems faced and solutions implemented in risk management. Among the first are the lack of perception of the risk as a political issue, the incipient territorial and land use management, the role played by Civil Defense institutions in the coordination of risk management, and the lack of financial and data resources. Outlined among the solutions are the development model changes, the establishment of state climate policies, institutional changes, and establishment of partnerships.

Allowing for the results obtained, the final considerations are presented and discussed, along with the main challenges to be faced in the coming years by the risk management in the Amazon region. Among them stand out the perpetuation of the risk management issues in the society and the governments also in non-disaster periods, the increase of the role of risk prevention in the strategies and actions developed, the strengthening of the institutional framework, and the empowerment of the municipalities to undertake their risk management.

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Strategies and basic principles for comparative Earthquake-Risk Studies between Central and South America, taking the February 27th, 2010 Maule (Chile) earthquake as reference event

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Abstract
The February 27th, 2010 Maule earthquake (8.8 magnitude) was an event that caused several damage to the infrastructure in Chile. Using this earthquake as reference event to analyze and also to simulate by numerical models the damage in the building stock in Concepción (the most affected area), a comparison with a similar scenario for the infrastructure in Guatemala City is being performed to establish strategies and basic principles for the comparative Earthquake-Risk studies between South and Central America. The vulnerability of the infrastructure is analyzed in terms of vulnerability classes (empirical approach) and/or capacity curves (analytical approach).

Keywords: Maule (Chile) Earthquake 2010; Earthquake Damage; Vulnerability Classes; Capacity Curves; Comparative Earthquake-Risk Studies

1. Introduction

The countries located in the Pacific Ring of Fire are constantly in seismic hazard. Most of the countries in Latinamerica possess a high seismicity. Historically in both Chile and Guatemala the earthquakes were produced mainly by subduction. The present study is based on the analysis of the February 27th, 2010 Maule (Chile) earthquake and the interpretation of observed damage cases. The first phase of the study was a careful investigation of all the data taken in a field trip throughout Chile done just after the earthquake in the year 2010 by experts from the “Earthquake Damage Analysis Center” -EDAC- of the Bauhaus-Universität Weimar. The following phase was the hazard assessment and code situation analysis. The most important particularities from source mechanism were investigated. Finally in this phase, the development and effect of earthquake resistant regulations; the assessment of design parameters was analyzed. The next phase was a field research performed during May of 2012 in Concepción, Chile. After the identification of suitable measurement sites (taking into account particularities of observed damage cases) and the collection of available profile data for test site areas, the measurement in several locations inside the urban area of Concepción of the ambient noise using a velocity sensor was done. The analysis of the taken data was following the method of Nakamura (1989, 2000) that popularized the use of the horizontal-to-vertical component spectral ratio (HVSR) from microtremors as an effective and economic tool to estimate the fundamental vibration period of the soil. Also using the velocity sensor, the building response of representative building types was measured, in order to have reliable data for the calibration of the numerical models. The final phase (actually in process) is the interpretation of the case studies for nonlinear analysis; the re-interpretation of the seismic behavior. The numerical modeling (using the software from CSI, ETABS) of representative buildings for non-linear analysis and the elaboration of capacity curves on the basis of pushover analysis will lead to the assessment of the effectiveness of possible strengthening measures.

2. Materials & Methods

2.1 Field Research

2.1.1 Soil measurements

For obtaining the ambient noise measurements was used a velocity sensor (MR2002) from SYSCOM Inc. (Figure 1a). The measurements were done on a free accessible point not affected by the vibration of tall buildings and trees. To reduce the influence of the wind, the sensor was installed in a small hole covered by a bucket. (Figure 1b). The measurements were done trying to cover the entire area of Concepción. An

image of the measured points is shown in Figure 2.

(a) (b)

Figure 1. (a) Velocity sensor. (b) Final view of the installation of the entire system

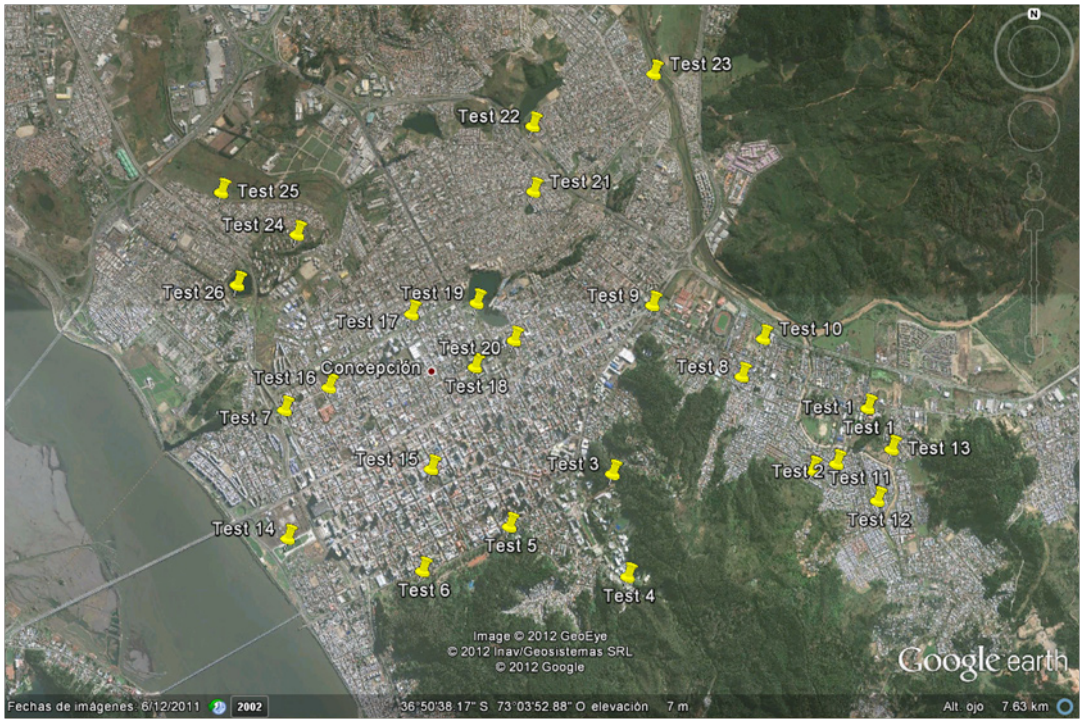
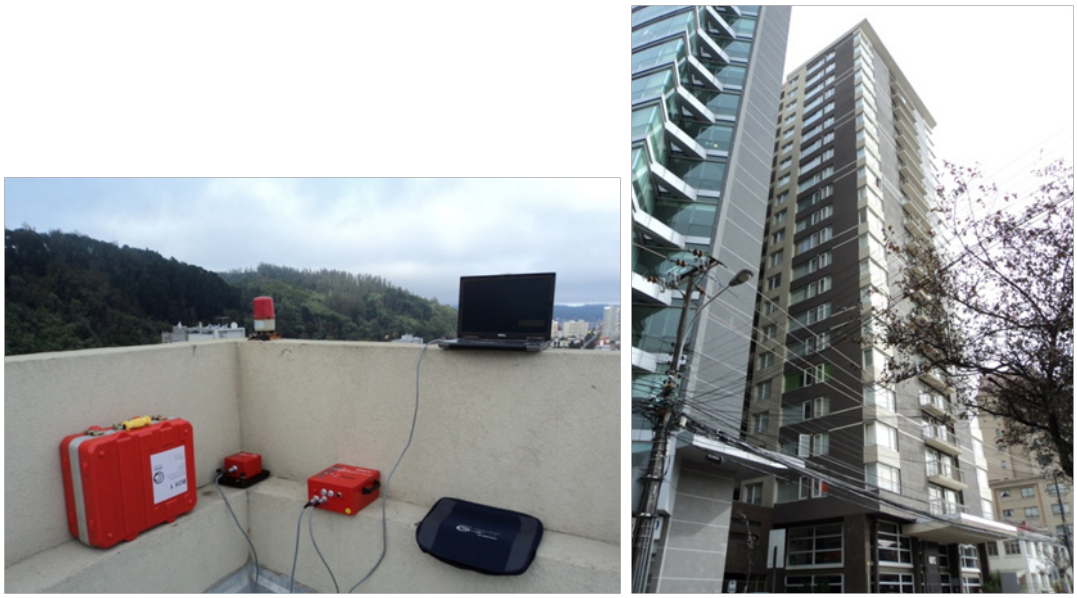


Figure 2. Measured points in the area of Concepción

2.1.2 Building measurements

The same procedure to measure the ambient noise was followed in the buildings. In order to select the reinforced concrete structures, the structural drawings were first obtained. The Figure 3a show a measurement done in one building in the center of Concepción and the Figure 3b show the building itself.

Figure 3. (a) Measurement in the top of the Concepto Urbano building. (b) Concepto Urbano building.



(a) (b)

Figure 3. (a) Measurement in the top of the Concepto Urbano building. (b) Concepto Urbano building

3. Results & Discussion

3.1 HSVR Spectrum

For obtaining the horizontal-to-vertical component spectral ratio (HVSR), the obtained data is being analyzed using a MATLAB code. The Figure 4 shows an expected result for different HVSR spectrum for the measured points. The same HSVR spectrum will be calculated for Guatemala City using available data from other researchers.

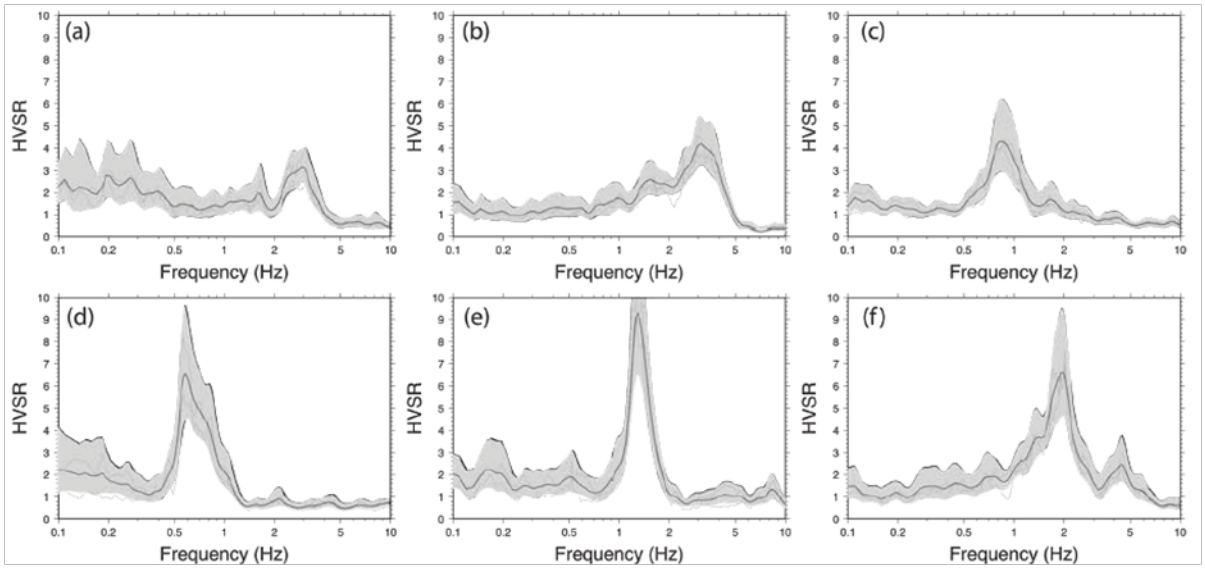
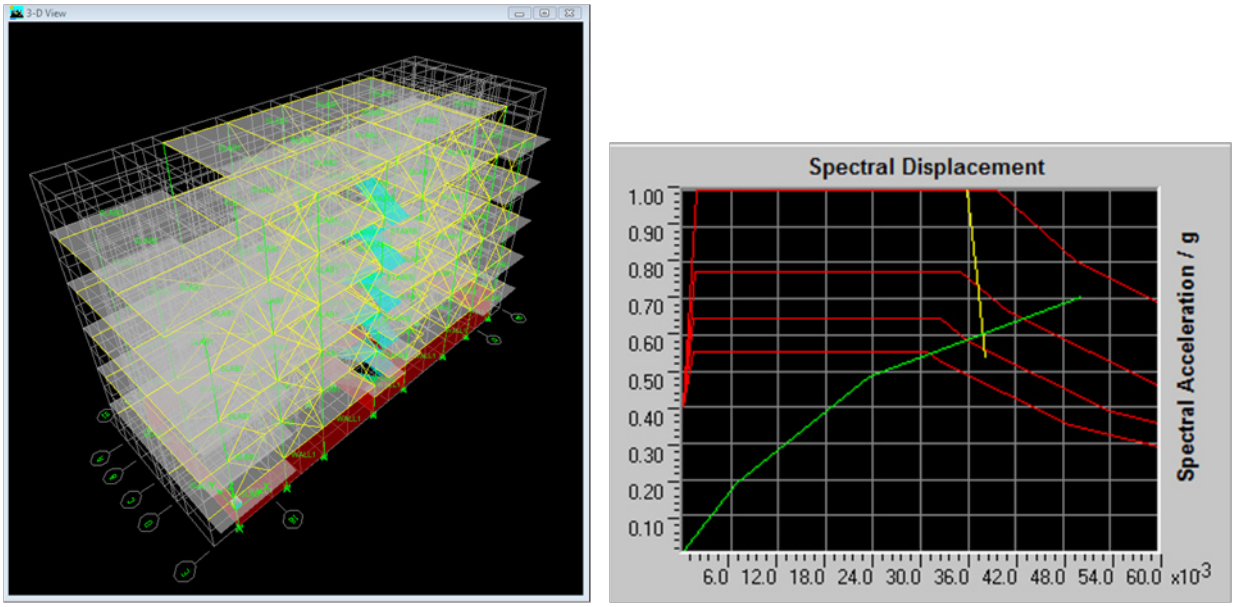


Figure 4. Expected result of the HVSR spectrum for Concepción. (Leyton, F. et ál., 2011)

3.2 Numerical modeling

The numerical modeling of the buildings in both Concepción and Guatemala City is being performed. For the non-linear analysis it is being used the CSI Software ETABS. The following step is the elaboration of the capacity curves on the basis of pushover analysis. The Figure 5a shows a finished numerical model of a random building and the Figure 5b an expected capacity curve.



(a) (b)

Figure 5. (a) Numerical model done with CSI ETABS. (b) Expected capacity curve:

Further calculations, modeling, calibration of the models and presentation of final results and conclusions, are still in progress. The final expected result of the research work is a reasonable comparison of the damage and behavior of reinforced concrete buildings, affected by different (but also comparable) seismic events in both cities Concepción and Guatemala City.

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Coastal Erosion and Sea Level Changes on the Rio Grande do Norte State

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Abstract
This paper presents a brief overview of the major results of the research developed by the Brazilian-Germany cooperation between Federal University of Rio Grande do Norte (Natal, Brazil) and Christian Albrecht University (Kiel, Germany) related to environmental impacts occurring on the northeastern coastal zone of Rio Grande do Norte, Brazil; in particular, problems of a rising sea level and their consequences for coastal environments. Relative sea-level curves show a drop in sea level for the Brazilian NE coast. A long term trend of shoreline retreat is observed on the northeastern Brazilian coast but it is more related to the negative sediment budget.

Keywords: shoreline retreat, coastal erosion, sea level rise, northeastern Brazil,

Introduction

Like other areas on the coast around the world, the beaches of Rio Grande do Norte State are essential to tourism, and growing numbers of permanent and seasonal residents choose to live at or near the ocean. Coastal erosion is a cause for concern along many RN beaches, and several erosion hot spots were already recognized (Fig. 1).

Fig 01; Examples of erosion hot spots on the Rio Grande do Norte coast. A) Caiçara Beach, E-W Sector; B) Ponta Negra beach, N-S Sector

The State of Rio Grande do Norte (RN) is situated in the northeastern part of Brazil along the Atlantic Ocean and comprises two different sectors (Fig. 2): 1) a northern N-S trending Sector or Oriental Sector, and, 2) an eastern E-W trending Sector or Setentrional Sector [1,2]. From a morphodynamic point of view, the N-S Sector is a wave-dominated coast with active sea cliffs carved into tablelands alternating with reef-or dune-barrier sections, while the E-W Sector is a mixed-energy complex of wave-dominated, and tide-dominated coast. Dunes, ebb tidal deltas, beachrock, barrier islands and spits are present along the

northern coast. This coast is drained only by small rivers, and the fluvial plain is restrict to the mouth of the most important rivers of the area (e.g. Curimatau, Potengi, Açu). A marked characteristic of this littoral is the presence of beachrocks aligned almost parallel to the coast line, which impact the beach and surf zone through their influence on wave refraction and attenuation.

Materials & Methods

An operational methodology was developed using collection and analysis of an integrated dataset (comprising remote sensing, bathymetric, oceanographic, hydroacoustic, and sedimentologic data, supported by diving). Moreover, high-precision AMS-radiocarbon dating of both, terrestrial organic material, and mollusc shells of coastal deposits permitted to comprehend the environmental changes in time and space. All data were integrated through a geographical information system database.

Results & Discussion

Sea Level Changes

The relative sea-level curves documented for the Northeastern Brazilian coast (Fig. 2), for the last 7.000 years [3,4,5,6,7] indicate that the sea level was some meters higher than the present, with a tendency to drop during the last 5.000 years. The Postglacial Marine Transgression (PMT) was at -3m at 7000 cal. yr BP, and passed the modern sea level 6500 cal. yr ago [7]. The Holocene highstand reached 1.3 m above modern sea level at 5900 cal. yr BP. After the highstand, sea level dropped to its present position. Numerical experiments suggest an actual sea-level drop between 0.2 and 0.3 mm/y for the NE Brazilian coast [8].

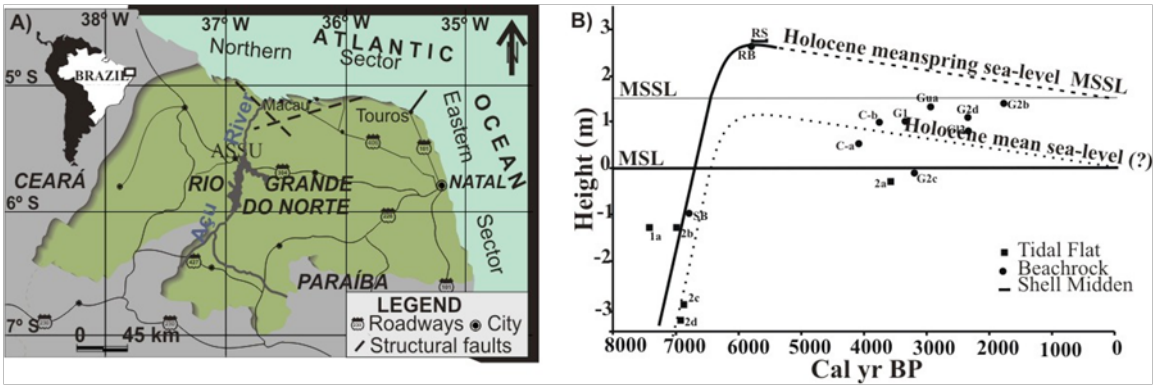

Figure 2 – A) Location of the study area; B) Sea-level curves proposed for the Northeastern Brazilian coast [6, 12]

Coastal Erosion

Coastal erosion has both natural causes and causes related to human activities. Gradual coastal erosion results naturally from the very slow rise of sea-level. The most common indicators of coastal erosional processes observed on the Rio Grande do Norte Coast are i) general and progressive landward shoreline displacement (retrogradation) trend, during the last five decades, ii) severe erosion of sandstone cliffs along the coastline (Tertiary Barreiras Formation, as well as from the Quaternary eolian and/or marine deposits), iii) destruction and burial of mangrove adjacent to the beach, iv) subaerial exposure of peat bog from ancient lagoonal or mangrove deposits on foreshore and upper shoreface surfaces, v) persistent destruction of engineering works, vi) heavy minerals concentrations on foreshore zone, The most important factors and causes of coastal erosion observed on this coast are related to: i) coastal circulation dynamics – the presence of beachrocks aligned parallel and intermittent to the beach, change the wave energy causing accentuated erosion and embayment on the beach [9, 10]. ii) Holocene evolution of the coastal plain [7, 11, 12, 13] – the intense longshore drift (from south to north on the Oriental sector and from east to west on the Setentrional sector) associated to a negative sedimentary budget and losses of sediments towards the land with dune field and spit formation. Iii) naturally inefficient sediment supply [14] – the river of the study area are small and do not contributed with significant sediment amounts. Moreover, the most expressive rivers (e.g. Açu river) are dammed, prevent the sediments to reach the ocean. iv)

Construction of hard interface structures, placed parallel to the shoreline [15] – these structures are built without background knowledge of the most important aspects of coastal erosion aggravating the coastal erosion. v) Tectonic factors [16, 17] – on this coast tectonic activity also played an important hole on the coastal erosion. On the Oriental sector the graben and horst structural architecture, resulting from intense tectonic movimentation, origins the embayment configuration, while on the Setentrional sector the shelf bottom morphology, strongly conditioned by the tectonic configuration, also contribute to coastal erosion by the sediment trapped on specific places and wave refraction. The results showed erosion areas are linked to large scale bottom morphology. The changes are mainly due to longshore drift contributions and negative sediment budget.

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Climate Change and Water Resource Management: Federal District of Brasília (Central Brazil)

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Abstract
In the context of a joint research and development project (IWAS-AGUA DF) between German and Brazilian partners, an integrated management concept is expected to be developed, in order to guarantee, both in terms of quantity and quality, the safe supply of water to the Federal District of Brazil and its surrounding urban areas, including adequate wastewater treatment and disposal.
This concept has to take into account the expected climate changes in the near future (e.g. longer dry periods and/or concentration of high precipitation in shorter periods), the fast population growth, and the trends of social and economical development and its impacts on urban areas expansion in Federal District Brasilia, with special attention to catchments with potential to be used as water supply sources, as water will get limited and demand will be increasing continuously.
The building of this joint project allows the German researchers, through the Brazilian partners, to introduce and adapt to the Brazilian reality some German innovative technology and materials in the field of water supply and sanitation systems integrated within the energy-saving and raw material conversion management concept.
In the climate change field, German and Brazilian research cooperation has to be built parallel to the main project. This parallel project aims to develop regional climate models for Brazilian central area and to simulate extreme climate change scenarios and their consequences in the region and in the water availability.

Keywords: IWAS-IWRM; German-Brazilian Cooperation; Climate Chance

Introduction

The urban region Brasilia developed in the last 50 years (Brasilia was settled 1960 in a large extension of savannah landscape) and has already approximately 2.5 millions inhabitants. The Companhia de Saneamento Ambiental do Distrito Federal (CAESB) is a public local company, which manages the water supply and sanitation in the Federal District (5,000 km2).
The problems of the competitive water use already existing are additionally strengthened by different factors:

- Development of the agricultural areas predominantly using irrigation methods in the Federal District at expense of the savannah (Cerrado) removal.
- Increasing of contamination of surface waters, soils and groundwater.
- Erosion problems in the catchments areas with consequent sediment filling of the reservoirs.
- Governmental programs which promote the cultivation of plants for the production of bio-fuels.

In this scenario, CAESB, without taking into account the impact of the probable climate changes, predicts shortage of drinking water in the near future for several parts of the Federal District, especially in the dry season.
According to data, the average monthly water household consumption in the Federal District is about 18,000 l. At high income residential areas it rises up to 44,000 l, and in poorer outlying districts it goes down to 14,000 l.

A part of the water distribution network must be renewed, considering that figures show water losses in the order of up to 30% (annual basis).
Groundwater is seldom used by CAESB in its main water supply network, but as private wells is the exclusive water source of private horizontal settlements (Condominiums).
In order to guarantee the future water supply, CAESB is planning the establishment of new water production systems. Current studies carried out by CAESB pointed out that Paranoá Lake is one of the best possibilities to increase water production.
Furthermore, it is necessary to develop new plants to the admission and treatment of the river water as well as the extension of the existing water supply network of Brasilia.

Cooperation Partners
On the Brazilian side the CAESB work together with the Geoscience's and Engineering Faculties of the University of Brasilia. For several years, a formal cooperation agreement between CAESB and UnB on water research and sanitary engineering in the region of Brasilia is already available, and numerous scientific works were developed.
Related participating institutions are INMET (Instituto Nacional de Meteorologia), NOVACAP (Companhia Urbanizadora da Nova Capital do Brasil) and EMBRAPA (Empresa Brasileira de Pesquisa Agropecuária).
The German cooperation partners are the following:
Helmholtz Center for Environmental Research (UFZ) Leipzig and the Technical University of Dresden (TU Dresden) as coordinating cooperation partner for the joint project.
Related participating institutions are KIT (Karlsruhe Institute of Technology), the Universität der Bundeswehr – München and the water supply company Sachsenwasser, Leipzig.

Materials and Methods
The following project outlines can be pointed out:
Research Points
1. Survey and analysis of the present water supply condition in the Federal District, including:
    - Regional water balance and water quality, including surface and ground water.
    - Surface and ground water monitoring (quality and quantity).
    - Detailed hydrological cycle studies including infiltration behaviour in different soils and transpiration from the various cultures.
    - Impact of human, agricultural and industrial occupation inside the water basins.
    - Evaluation of soils, groundwater and surface water pollution by agrochemicals, sewage, pharmaceuticals, nutrients, etc.
2. Development of models for the individual parts from the actual state analysis of the single projects on common database in GIS.
3. Integration of the developed regional climate models and scenario models with minimum and maximum precipitation and temperature variation.
4. Proposal of changes in current water resources management policy aiming to sustainable development and water resources use (e.g. land use, town development, cultivation of useful plants with smaller water requirement etc.).
5. Local, regional and supra-regional evaluation and examination.
6. Dissemination of the obtained results to areas with comparable climatic changes.
7. Development of decision support systems to subsidize stakeholder economical and political decisions.

Technical Points
The necessary infrastructure for the establishment of the integrated management concept to guarantee the water supply and wastewater systems at Brasilia (IWAS-AGUA DF) requires an extensive and innovative global concept. At this time, as follows, some selected examples are stated:
1. Development of a working plan for the existing drinking water treatment plants and wastewater treatment, regarding with special consideration the energy conservation and increase of the capacity. The reorganization of the existing dams operation is to be considered;

2. Development of a technical concept for an integrated supply network, specially under integration of the Paranoá Lake, as well as other possible surface water and groundwater resources;
3. Bring in from innovative techniques and materials for the drinking water and the wastewater systems aiming the improvement of resources efficiency (water, energy, materials, filter, chemicals, etc.);
4. Guarantee of high water quality, use of modern monitoring analysis technology;
5. Development of a water network management for a long-term supply and decrease of large water losses;
6. Structure the technical plants locally and thus clear possibility for German partners of being able to bring innovative technologies and materials for the overall process;
7. Development of concepts for possible water re-use (e.g. ground-water recharge) and examination concerning the economic efficiency.

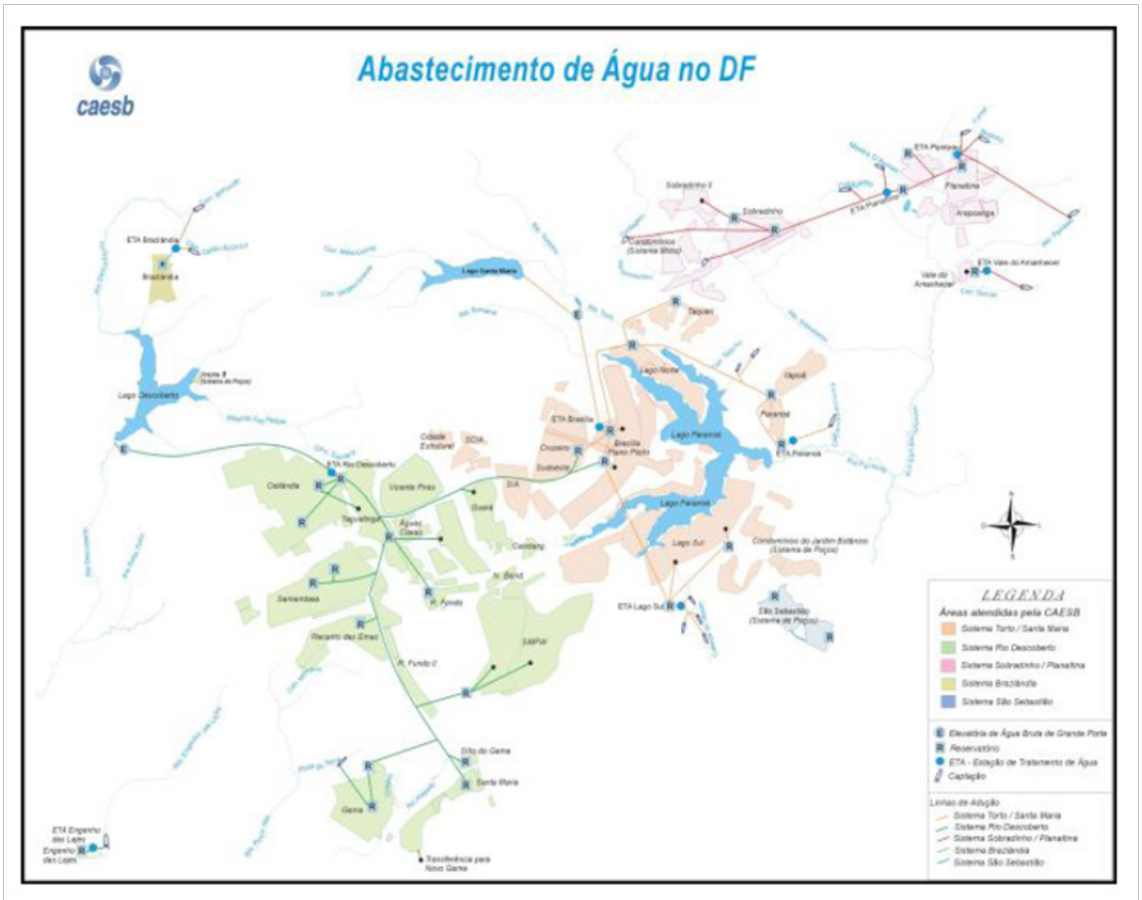

Figure 1. Water Supply in the Federal District (CAESB)

First Results

A priority of the project is to develop a general understanding of water resource system in order to establish an IWRM for the DF. To understand the system surface water-groundwater-raw water, we analyzed three aspects, water amount, water quality and sediment loads.

The effect of regional climatic changes is still in investigation. Thus, we will focus within the project on the effects of regional climate change, urbanization and soil management, crop rotation and irrigation on run off generation. (Lorz, C. et al., 2011).

The progress of the project are listed in the websites IWAS: http://www.iwas-sachsen.ufz.de/index.php?de=17427, IG: http://www.igd.unb.br

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