











Global Opportunities Fund – Climate Change and Energy Programme

Newsletter of the projects

"Using Regional Climate Change Scenarios for Studies on Vulnerability and Adaptation in Brazil and South America" and

"Dangerous Climate Change"

GOF-CPTEC

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Editorial

You probably already know that the winners of the Nobel Peace Prize of 2007 announced recently are the Intergovernmental Panel on Climate Change and Mr. Albert Gore Jr. It is clear from the Nobel Committee's press release, see:

http://nobelprize.org/nobel_prizes/peace/laureates/2007/press.html)

That this is a recognition of nearly twenty years of tireless work by the climate change science community. The Nobel Committee cited the importance of dissemination of greater knowledge in making this award, so the honor today is fundamentally to science and its value to all humankind. The IPCC's role is defined by its reports which have been the core of our efforts and the primary way in which we have informed the public. These reports are the core work of the different IPCC working groups, so, together with that of previous Lead Authors, this is very much all IPCC members prize and recognition of the untiring efforts, dedication to balance, and teamwork across the continents.

On the other hand, the work by the co-recipient Al Gore and his enormous efforts has managed to take the messages of climate change science to the public in general, worldwide.

It is worth to say that the Brazilian scientific community is well represented at the IPCC: Working Group 1: Scientific basis (Paulo ARTAXO USP; Pedro Leite da SILVA DIAS USP; Jose Antonio MARENGO -INPE); Working Group 2: Impacts assessment, adaptation and vulnerability (Ulisses Confalonieri Fiocruz; Carlos Nobre INPE); and Working Group 3: Mitigation (Emilio LaRovere UFRJ; Jose Roberto Moreira USP; Suzana Kahn Ribeiro UFRJ; Roberto Schaeffer-UFRJ).

José A. Marengo CPTEC/INPE

General information about the vulnerability and risk evaluation on climate change

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The vulnerability concept has its origins on the natural event risk studies, and may be defined as "the person or group characteristics related to its capacity in antecipating, dealing with, resisting and recovering from an natural impact or risk. It implies a combination of factors that determines the degree in which people's life way might be in risk due to an natural or social discrete event" (Blaikie et al., 1994). The concept covers different factors and processes which reflect the susceptibility, the predisposition to be affected and the conditions that make a lost or disaster easier to happen (Cardona, 2007).

According to the IPCC, "the vulnerability is the degree by which a system is susceptible or incapable of going through adverse effects on climate change, including the variability and the climatic extremes. The adaptation capacity and the sensitivity are functions of the climate change character, magnitude and fastness, and besides, of the system exposition variation" (IPCC, 2001).

Climate change plus society vulnerability is showing increments in climate-associated disasters, such as droughts and flood. Recent climate projections reported by the Intergovernamental Panel on Climate Change IPCC (IPCC AR4, 2007) show scenarios of droughts and extreme precipitation events worldwide. Even without safe information about long-term climate change consequences, in the last few decades, there have been different precipitation events, heat islands and extreme event sequence (droughts followed by intense rain), which have damaged human, economic, infrastructure and ecosystem biodiversity without precedent worldwide (epstein and McCarthy, 2004). Climate change caused by anthropogenic factors is a global threat and the poorest population will the most affected by it.

The study of population vulnerability to different kind od disaster has evolved through the years. Firstly, the analysis was focused only on the social component of a collection of disaster situations, just associated to poor populations.

However, this exclusively social focus from the "school of social vulnerability", which is characterized by the strong criticism to the capitalism, has become to be limited and insufficient to explain many vulnerability causes. This started a series of analytical proposals and models which vary in complexity levels, but converge in combination of factors both social and biophysical. The vulnerability concept has been discussed and complemented by many authors, originating a wider vision on additional elements that infer in its development, such as, public policies, which determines the power distribution and the decision making in a society; culture, economical models and development planes (Charvériat, 2000; Cardona, 2001; McEntire, 2005).

There are many methodologies to vulnerability evaluation, and all have the intention to support the adaptation policy development, the decision make and the elaboration of sensitiveness educative program. This paper aims to discuss some aspects of socioeconomical and populational vulnerability to disasters related to climate change, and some evaluation methodologies, observing possible implementation in Brazil.

Brazil: a climate change vulnerable country. According to the World Meteorological Organization (WMO), the global number of mortal victims by natural disasters has decreased by 60% between 1985 and 2005, even though this kind of disaster has been raised 4 times in the last 25 years. This is clearly a consequence of improvement in the management of antecipating warnings and alerts (figure 1).



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According to the Emergency Events Database EM-DAT (2007), 150 natural disasters have ocurred between 1948 and 2007, in Brazil (they are considered severe when resulting in dozens of deaths and thousands of unprotected and homeless people). In the las decades, it has also been observed a reasonable raise in frequency and intensity of such kind of event, as far as in consequent associated losts. Some studies indicate it is only a climate change consequence.

The 4th IPCC report, brought out in last February, shows a raise of both precipitation to southern and southeastern regions, and droughts to northern and northeastern regions of Brazil.

Floods and storms follows as frequent disasters with dramatic long-term consequences the poorest population worldwide. In Brazil, floods represent 59% of the collected dataset, followed by 12% of mudslides (figure 2). More than 80% of the disasters ocurred in Brazil may be explained by the climatic instability, which added to climate change, population growth, poverty, socio-spatial segregation (with causes house building in risk zones) raises the population vulnerability (Marcelino, 2007).



Figure 2. Natural disaster types ocurred in Brazil (1948-2007). Legend: EN Floods, DE Mudslides, TE Storms, SE Droughts, TEX Extreme temperatures, IF Forestfires, TR Earthquakes.

Source: (Emergency Events Database EM-DAT, 2007), (Marcelino, 2007).

According to article 4, item 8 of the United Nation Framework Convention on Climate Change, Brazil follows the vulnerable-country model because has "low coast, arid and semi-arid zones, forest cover exposed to drougth and desertification, high atmospheric contamination in urban zones and fragile ecosystems.

In Brazil, northeastern is the most vulnerable region to climate change, once it is the portion that presents the lowest social indicators, low incomes and low adaptation capacity. According to the *INPE's Climate* *Report 2007*, to the future, it could be expected a warmer climate and so, Northeastern region could become arid, which would affect subsistence regional agriculture, water avaiability and population health. Southern and southeastern of Brazil are also high vulnerability zones, once in these regions happen almost 60% of the natural disasters of the country (figure 3). In such zones, climate change could impact in precipitation, drought and temperature extremes, affecting agriculture, population health and energy generation.



Figure 3. Distribution of natural disasters in Brazil (1948-2006). Legend: NO Northern, CO Middle West, NE Norhteastern, SE Southeastern, SU Southern. Source: (Emergency Events Database EM-DAT, 2007), (Marcelino, 2007).

Considering the Brazil's size, to make a regional and local sudy of vulnerability and climate change risk is os great importance. Besides, future climatological patterns will influence in decision making and planning processes. Vulnerability is constructed socially and so is susceptible to changes as a result of decision making, mainly of governmental character.

In addition, economical growth is fundamental to reduce poverty and to reach social goals as the "*Development objectives of the Millenium*". All this growth will depend on the raise in the capacity of decreasing the economical development impacts on environment and in our capacity of decreasing vulnerability and minimizing losts caused by natural disasters, as floods, storms and droughts.

Vulnerability is a function of three factors: exposure, sensitivity and adaptation capacity. The more exposed and sensitive, the greater the vulnerability increment. On the other hand, the greater the adaptation capacity of a system, the lower the vulnerability. It is important to remember, however, that to have adaptation capacity does not mean necessarily the effective use of it, influencing the vulnerability determination.

This 3-factor interaction may be resumed in Table 1.

Table 1. Factors which infer in vulnerability and climate change risk.

Exposure	Sensitivity	Adaptation Capacity
It refers to both the risk to climate change and the changes that a system has to go through.	It is considered as the biophysical effect of climate change, taking into account the social and the economical contexts.	System capacity of adjusting to climate change, climate variability and extreme episodes.
What is in risk: • Population • Resources • Property, infra- structure Changes to go through: • Sea level • Temperature • Precipitation • Extreme events	 Water Agroindustry Human settlement Energy demand Forests Financial services 	 Richness Health Tecnology Education Institutions Information Infra-structure "Social capital"

Source: www.unfccc.int













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Vulnerability may be studied with different focus. Im the last decade, it has been produced plenty of scientific publication in this subject, both in theoretical and practice terms (Janssen *et al.*, 2005). It is necessary to comprehensively and intregrally describe vulnerability, recognizing that there are depedent- and independent-threat aspects, and both make the situation worse (Cardona, 2007).

All evaluation methods are based on the use of vulnerability indicators. The selection of these indicators will depend on each case study, scale analysis (individual, regional and national), information avaiable and specific characteristics of place and local of study. By this reason, many researchs are based on specific case studies. The number of analysis indicators and measures must be sufficiently wide to capture the essential elements of a study, and the same time restricted to not overload the data analysis. The election of indicators must be always considered as non-permanent, until they have been proved by use.

One restriction to vulnerability studies may be the restricted acess to the group- or individual-attribute databases, including socio-economical and environmental indicators. These data help to classify the vulnerability level of differente groups, and, by this reason, it will not be always possible to attribute quantified values to social and economical dimensions of vulnerability (WMO-EURD-UNU, 2006).

According to the United Nation Framework Convention on Climate Change, to start a vulnerability and adaptation study is necessary to make questions as:

1. What is the concern?

- Food production, water supplies, health?
- Concern could not be expressed in dimatic terms, such as, extreme temperature, but in the consequeces of climate to people.
- 2. Who could be affected?
- 3. What is the time horizon of this concerning?
- Could the concern be more based on the actual risks? (which could be worse to dimate change).
- 4. With what purpose the evaluation is used?
- Sensitiveness Educacation?
- Policy design?

5. What kind of results are necessary?

- 6. What are the avaiable resources to make the study?
- Budget
- Profissionals
- Experience

7. How much time do we have?

Source: www.unfccc.int

The results of a vulnerability evaluation will be directly related to the kind of questions formulated. Questions about how climate change may affect resources can drive to a long-term impact analysis (e.g., what will be the biodiversity effects of Amazon?; what will be the effect of sea level raise on the Brazilian coastline cities?). Besides, questions related to adaptation policies can drive to vulnerability analysis with planned horizons.

In metodologies to vulnerability evaluation is possible to identify two trends. In the first one would be the metodologies instructed to evaluate vulnerability to an specific threat, such as: floods, droughts, sea level raise, etc. In the second, there are those that analyse all threats in only one set. This kind of metodology considers variability and climate change as a threat. We can highlight metodologies that build and apply indexes or proxies, in which vulnerability is expressed with a numerical value.

Applying the same tool to different places allows to make objective spatial comparisons. Besides, to repeat the evaluation at the same place allows to visualize the vulnerability evolution in time.

Other countries have been used different metodologies to vulnerability evaluation associated to climate change. Some of them evaluate the coast vulnerability with respect to sea level raise in determined zones (Thieles and Hammar-Klose, 2000); Thumerer *et al.*, 2000). On the other hand, other studies make a vulnerability evaluation of flooding (e.g., Connor e Hiroki, 2005), or of drought impacts (Fowler et al, 2003 e Wilhelmi e Wilhite, 2002). Yet, others use the index definitions, for instance, the climate change index of Baettig *et al.* (2007) composed by annual/seasonal temperature and precipitation indicators; the climate vulnerability index proposed by the Meteorological Institute and Environmental and Energy Ministry of Costa Rica (in spanish, IMN and MINAE, 2005), which defines the vulnerability of the water system to climate change threat; the climate vunerability index developed by Sullivan and Meigh (2005) which put togheter variability/climate change and water avaiability/socioeconomic factors.

Methods and models used to evaluate vulnerability do not necessarily give answers, but may work as a guide to formulate policies and action plans.

In Brazil, only few studies about vulnerability evaluation to climate change in an specific sector have been done. A pioneer study from the electricity sector is the project "Brazilian Electricity Sector Capacitation facing Global Climate Change" (BRA/95/G31, 2000-2002), which was made between 2000 and 2002. This project analised sector themes related to the inventory of greenhouse gas emissions, the mitigation measures to reduce global climate change risks, and the climate vulnerability of the electricity sector, between others. To vulnerability, it has been made an evaluation analysis of hydrological cycle and energy supply/demand effects according to climate fenomena in Brazil.

Another importat study, concluded in 2005, is the project "Vulnerability analysis of Brazilian population to the sanitary impacts of climate change", coordinated by Ulisses Confalonieri, a researcher from the Biological Science Department of Fiocruz (DCB/ENSP/Fiocruz). It aimed to evaluate health and population vulnerability, considering three "dimensions": epidemiological, socioeconomic and climatic (Confalonieri, 2005).

Generally, vulnerability and adaptation knowledge in Brazil still needs great improvement to supply the country demand. The vulnerability studies are more common to biodiversity and some agrosystems, as corn, wheat, soybean and coffee. In sectors as health, water resources, energy, coastal zones, sustainable development of semi-arid and Amazon regions, the number of impact and vulnerability analysis is much lower, which points out to a urgent need to induce studies in this direction (Marengo, 2007).

Nowadays, the vulnerability study claims for an wider vision, a new focus that should not be limited to military questions or country economic development, but expanded to an integration and incorporation exigency of social, economical, political, tecnological, and environmental variables.

The regional climate change scenarios contribute to improve vulnerability scale analysis. In this context, the Center for Weather Forecasting and Climate Studies in portuguese, CPTEC/INPE is currently working on the development of such regional climate change scenarios to apply them in vulnerability and adaptation studies. This work has started with the project "Using Regional Climate Change Scenarios for Studies on Vulnerability and Adaptation in Brazil and South America", and now, is going on with a complemental research called "Dangerous Climate Change", which is also coordinated by Dr. José Antonio Marengo and supported by the Global Opportunities Fund (GOF) - "Climate Change and Energy". This ongoing project aims to work on climate change impacts in some Brazilian key sectors, suggesting new evaluation methods, studying the vulnerability/adaptation policies relation to prepare the "Second Brazilian Communication to UNFCCC", and improving the regional climatic forecasting. Currently, these GOF projects are actively helping

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to prepare vulnerability studies in energy, health, agirculture and mitigation sectors, aiming to understand climate change impacts until the end of this century.

The vulnerability of Brazilian society to climate risks, both current and future, needs to integrate climate change subjects on social/economical development and planning. Aiming to have a sustainable development, the decreasing of disasters in Brazil is necessary to social and economical development. Then a interest convergence from different sectors of society is need, with purpose of improving the management of climate and disaster relative risks.

According to Brazilian characteristics, it is necessary to desing own methodologies to evaluate sectorial and regional vulnerability to climate change, considering climatic, environmental, social and economical diversity of each region. Plus the fact that, it is also necessary to propose a methodology that is useful with a limited dataset, but that also allows short- and long-term regional/sectorized analysis, makes spatial representations and elaborates visualization maps.



Figure 4. Brazilian biodiversity Source: www.folhadomeio.com.br/fma/folha/2001/11/brasil.gif

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First meeting of the project "Dangerous Climate Change in Brazil" at CPTEC/INPE

In 5th October 2007, it happened at CPTEC/INPE, in Cachoeira Paulista, São Paulo, the first meeting of the project "Dangerous Climate Change in Brazil", supported by Global Opportunities Fund GOF. It has been presented Dr. José Marengo (project's coordinator), Márcia Sumirê (representative of the British Embassy in Brazil and financial-support supervisor of British government) and Dr. Mark Bramley (UK project representative).

Currently, two of the three GOF-supported projects in Brazil are developed at CPTEC/INPE. These three projects are:

- Using regional climate change scenarios for studies on vulnerability and adaptation in Brazil and South America. GOF-CPTEC, 2005-2008.
- Dangerous Climate Change in Brazil. GOF-CPTEC, 2007-2009.
- Brazil Stern Report: the costs and benefits of reducing Amazon deforestation, 2007-2008.



Left to right: Mark Bramley, Márcia Sumirê and José Marengo.

During the meeting, research advances were presented at CPTEC/INPE. It has also been discussed how climate change subject is received by decision makers and policy formulators. The outline shows that in many cases, the greatest difficulty in obtaining attention and funds to develop the topic is the government solicitation of 100% precision in forecasting. However, efforts have been made to set up a climate change work plan, focusing on mitigation, adaptation, and vulnerability. In this context, Brazilian Space Research Institute (in portuguese, INPE) is planning the creation of the Earth System Science Center (in portuguese, CCST), aiming strategically to "amplify and consolidate abilities on weather and climate forecasting and in global environmental changes", to answer both national and international challenges.

Another subject discussed at the meeting was how is media treating climate change and how Brazilian states and South and North America are concerned about current problems. In Brazil, until now, the most interested states on such researches are from Amazon region.

Finally, there is a great effort on the Met Office, CPTEC and GOF union to improve climate forecasting capacity, using climate models, and consequently minimize forecasting uncertainty, once great changes are not predicted for the next 20 years, however, great climate variations are predicted afterwards.

Representative visitors from British government were satisfied with the meeting and the commitment to reach all goals proposed was reinforced.



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