

EXTREME PRECIPITATION EVENTS AND THEIR SOCIO-SPATIAL IMPACTS ON A BRAZILIAN URBAN CENTER: CAMPINAS-SP

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(Dated: 22 August 2011)

I. INTRODUCTION

Extreme precipitation events can cause overwhelming catastrophes that affect a considerable part of the population, mainly the poorer sectors, who usually inhabit sites prone to these phenomena.

The IPCC Fourth Assessment Report (2007) places emphasis on a trend of increasing extreme rainfall events worldwide, as well as on the severity of the impacts related to these episodes, fact that would be directly related to global warming.

In Brazil floods are responsible for most of the casualties by natural events: Em-Dat database show that 196 natural hazard events took place in the country from 1900 to the beginning of August 2011, out of which 110 were floods that killed 7,464 people (www.emdat.be, access August 2011). The consequences of these natural episodes can be aggravated by anthropic actions, such as urbanization and lack of urban planning. This is the reality of most of the Brazilian urban centers, including Campinas, an important economic development pole of São Paulo State encompassing industry, agriculture and services: with 1,080,999 inhabitants (2010 census), ca. 7,527 families live in 92 risk-prone areas of the municipality (*Companhia de Habitação Popular de Campinas*, Cohab-Campinas).

II. PRESENTATION OF THE RESEARCH

The objective of this research was to investigate the impacts related to extreme rainfalls from 1958 to 2007 in Campinas city, São Paulo State – Brazil (FIG. 1), in connection with the social-spatial pattern of their distribution. Campinas is a high-tech center which attracts national and international investments, as well as migrant labor (both specialized and non-specialized). Agriculture is also an important activity in the area (fruits, coffee and sugar cane). However, the expansion of Campinas has contributed to impressive environmental changes during the last decades: the amount of forest cover remaining today corresponds to only 2% of the original cover (Nunes, 2011).

Daily data from four rainfall stations localized in Campinas were analyzed, being considered extreme the days in which rainfall probability was higher than 95.0%. Based on these data, a survey of the occurrences that caused problems in the municipality was carried out by consulting local newspapers and the Campinas Civil Defense archives. The available information was compiled, such as the exact sites of the records, time and damage caused. The data thus obtained were organized in a database with individual analysis for each decade, which were compared later.

In order to evaluate the social-spatial patterns of the calamitous occurrences, the information was analyzed on the basis of the income of the heads of the households.



FIG. 1: Campinas, São Paulo State, Brazil.

III. RESULTS AND CONCLUSIONS

The analysis of the five decades evidenced a considerable increase in types and quantities of recorded impacts. Regarding impact types, 16 different types occurred in the first two decades, increasing to 25 in the third and 31 in the last two. The increase of records of general impacts along the decades was more significant, from 129 occurrences in the first decade to 3,837 in the last. However, no significant alteration was recorded in the frequency of extreme rainfall events, emphasizing that the extreme rainfall consequences were associated not only with the magnitude of the total rainfall, but also with the vulnerability of the affected group.

The increase in the number of records through time can be the result of two factors: one is the data source used, once for the first decades only newspapers were consulted; another factor is the population increase and its recent spreading, once the population increase was 500% along the period of analysis.

FIG. 2 shows the five types of most frequent impacts in the 50 years analyzed, according to the social-economic level.

Flooding of property was the most recurrent impact along the whole period, totaling 1,450 occurrences. The social levels composed of low-income people were the most affected in the last three decades.

The second most recurrent impact was risk of property collapse, with 1,320 records. The most affected classes were of medium and low income. A considerable increase occurred mainly from the fourth decade on.

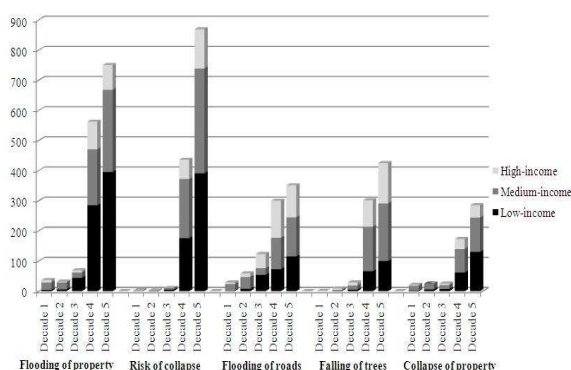


FIG 2: Quantity of records per social-economic level (flooding of property, risk of collapse, flooding of roads, falling of trees and collapse of property)

Flooding of roads totaled 862 cases. This type of impact most frequently affected medium-income areas through time; however, in the third and fourth decades the most affected areas were predominantly those of low- and high-income populations, respectively.

Falling of trees summed 766 records and the high-income population was the most affected in the first two decades, whereas the medium-income population predominates in the last three. This results from the fact that neighborhoods inhabited by the higher-income populations are more arborized.

Total or partial property collapse summed 529 records. In the first four decades the middle class was the most intensely affected. More recently, the low-income areas have been the most affected.

Considering all types of impacts surveyed and in general, in the two first decades (1958-1967 and 1967-1977) the areas inhabited by medium-income people were more impacted by extreme rainfall episodes, whereas in the last three decades (from 1978 to 2007) the low-income areas were more constantly affected. Possible explanation for these scenarios is that between 1976 and 1979 Campinas received a large population contingent from migrations caused by the drought in Northeastern Brazil, frost in Paraná State (south of São Paulo State), and the local industrial expansion. Thus, this most often unemployed population settled down in low-income areas, being exposed to several types of risk.

It is also evidenced here that the low- and medium-income populations were the most affected along the whole period of analysis: of all recorded impact types, 16 occurred more frequently in low-income areas (including flooding of property, injured, homeless, missing, landslide, collapse risk, casualties, landslide risk), 15 in medium-income areas (flooding of roads, falling of trees, traffic problems, damage in roads, total or partial collapse of property, blackout, risk of falling of trees), two in high-income areas (delay in works and damage to property). A single one, collapse of a television tower, was unrelated to any social class.

Therefore, extreme phenomena have increased in number and types along the last five decades in Campinas and have more routinely and more dramatically affected the less-favored social groups. However, regardless of class, all neighborhoods were affected, showing that practically the whole population is exposed to risk, no matter of which magnitude.

The situation in Campinas is similar to that of other Brazilian cities, evidencing the increase of risk to hazardous episodes triggered by extreme atmospheric events. However, the consequences vary according to social condition and are more negative to low-income groups.

IV. ACKNOWLEDGMENTS

We wish to thank FAPESP – *Fundação de Amparo à Pesquisa do Estado de São Paulo* (Proc. 08/57002-7) and CAPES for the financial support, and the Campinas Civil Defense for making important data available for this research. The results of this research are fundamental for Project FAPESP 2008/58161-1.

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