"Anticipando la Crecida"

Tools for the contribution in risk and disaster management due o southeasterly winds and precipitation floods in "La Ribera" district, Buenos Aires province, Argentina

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RÉSUMÉ.

Le projet argentin interdisciplinaire "Anticipando la crecida" cible les inondations récurrentes dans le bassin de la Plata. L´objectif principal est l'amélioration de la gestion des risques amenant à des catastrophes, associés à des événements de pluie intense et de vents de sud-est « sudestadas », et conduisant aux inondations. La zone d'étude est connue comme " La Ribera ", située à Quilmes, ville de la province de Buenos Aires en Argentine. Le projet repose sur une recherche interdisciplinaire et sur des activités participatives impliquant les acteurs locaux Cette approche va permettre d'intégrer la connaissance environnementale et sociale des chercheurs et des populations locales de ce phénomène. Le but est de créer une méthodologie adaptée aux échelles spatiales et temporelles de ce risque côtier. Les enquêtes de terrain seront complétées par l'analyse territoriale géographique ainsi que par le diagnostic météorologique et océanographique afin d'optimiser les cartes des zones inondables et de risques ainsi que les outils de prévisions

ABSTRACT.

The interdisciplinary Argentinean project “Anticipando la Crecida” deals with recurrent floods in the La Plata Basin. The main focus is the improvement of disaster risk management associated with intense rain events and southeasterly wind « sudestadas » driven floods. The study area is known as “La Ribera”, located at Quilmes City of the Buenos Aires province in Argentina. The project is based on interdisciplinary research and participative activities also involving local stakeholders. The approach is expected to integrate environmental and social knowledge of scientists and local community. The aim is to create an adapted methodology to spatial and temporal scales of this coastal risk. Participative observations and open interviews will be complemented with geographic territorial analysis and meteorological and oceanographically diagnosis in order to optimize risk and flood maps as well as prediction tools.

MOTS-CLÉS : bassin du Río de la Plata, inondation, gestion des risques

KEYWORDS: Río de la Plata basin, flooding, risk management

1. Introduction

Extreme weather events, exposure and vulnerability are influenced by a range of factors, including anthropogenic climate change, natural climate variability and economic development. Extreme natural phenomena can contribute to the occurrence of disasters, but the risks and potential disasters not only obey physical phenomena. Risks and/or disasters arise from the interaction between weather and climate extremes, and social vulnerability and its distribution in the territory. Therefore, the severity of the impacts related to extreme weather events have a multi-causal, resulting in hazardous situations or disasters when there is population affected, and severe alterations in the organization of the communities involved (IPCC, 2012). Between these extremes, there are the "sudestada", which is characterized by the occurrence of persistent winds, moderate to strong intensity, from the south-southeast direction, usually accompanied with persistent rain. Characteristically this phenomenon affects the estuary of the "Río de la Plata" (RdP) growing and causing major flooding in the Buenos Aires Metropolitan Area (AMBA) where more than 12 million inhabitants. It lasts for 1-3 days, but there have been cases of longer duration. The "sudestada" phenomenon affects margins and the alluvial valley of the RdP and the" Riachuelo" with a backwater effect, up above the bridge of "La Noria", and margins and the bottom of the basins. The rising river and streams due to "sudestadas" in metropolitan Buenos Aires affect much of the population living on the margin of the Rio de la Plata and its tributaries (streams). When the "sudestada" is combined with rainfall, the flooded area is usually higher. The vulnerable populations are most affected by the flooding of the RdP, causing property damage and health problems for children and old people.

In March 2013, the Research Center of the Sea and Atmosphere (CIMA) - the UMI FAECI 3351 (CNRS) and Department of Atmospheric and the Oceans Sciences (DCAO), Faculty of Natural Sciences (UBA) began the project "Anticipando la crecida" whose overall objective is to contribute to before-disaster risk management associated with flooding by heavy rains and "sudestadas" event in the Metropolitan Area of Buenos Aires through dialogue with the different stakeholders. With the project “Anticipando la crecida”, partnerships are made with the National Weather Service of Argentina, the National Water Institute, the Naval Hydrographic Service, the National Geographic Institute, the Faculty of Philosophy and Literature and the

Faculty of Engineering of the University of Buenos Aires. In a first phase of the study, the area corresponds to the "La Ribera" district of Quilmes (Buenos Aires, Argentina). According to Social census conducted by the Municipality of Quilmes, about 15,000 people live in the study area. In 791 households, being registered in condition of high social vulnerability 3247 inhabitants, including 860 children under 9 years old and 142 people over 65 years.

To achieve the "Anticipando la crecida" project objective, which is to explore the social, physical and natural causes, in coordination with the adaptation to these events, highlighting the knowledge and technologies for predicting, it is necessary to enhance work fields in the study area. The challenge is the improvement of development of products derived from numerical modeling of the atmosphere and the validation of these poses.

2. Study area and interdisciplinary group, methodology

2.1. Study area: from the estuary to the floodplain

The "Ribera" (Figure 1A) area extends from the coast of the RdP to the break line called "barranca", where the maximum flood elevation produced by "sudestadas" event (Vera Gaspar *et al*, 2006) is found. The region were delimited made by the Executive Unit of the “Ribera de Quilmes”, The west limit is the "Buenos Aires - La Plata" highway, The north limit is the Alsina street up to the intersection with Italy Avenue that spans a narrow strip comprising the Yacht Club of Quilmes. The Cervantes Avenue who runs parallel to the RdP coast, delimit the boundary at the east, and extends up to Echeverría Street, which is the south limit of the Ribera to the intersection with the highway. Since its origin, the waterfront acted like a marsh adjacent to the Costa of the RdP, appearing as a low elevation floodplain, subject to recurrent flooding as a result of the rains and winds from the southeast. The homogeneity conferred by its natural functioning as retention area and regulation of surplus flood water was lost during the years as a result of human intervention and occupation of coastal space. Currently, this area is considered as with a high complexity and heterogeneity, given that the processes of appropriation and occupation of the lands have negative impacts not only on the ecological functions of the original but also bathed in modifying the drainage and natural course of streams that flow into the Costa del Río de la Plata.

The RdP (Figure 1B) has a northwest to southeast oriented funnel shape approximately 300 km long that narrows from 220 km at its mouth to 40 km at its upper end (Balay, 1961). The estuarine area is 35,000 km^2 and the fluvial drainage area is 3.1×106 km^2 (Depetris and Griffin, 1968). This estuary has a complex geometry and bathymetry. It is divided into two regions by the “Barra del Indio” shoal, a shallow area (7-10 m) that crosses the estuary following a line between “Punta Piedras” and Montevideo. The upper region is mainly occupied by fresh water; except for a few coastal channels, depths in this area are less than 7 m. Seawards the shoal is the Maritime Channel, a wide depression with depth between 12 and 20 m.” Samborombón” Bay is a very shallow and extensive area with depths ranging from 2 to 10 m extending south of “Punta Piedras”. The estuary is a micro-tidal system. Tidal waves associated with the South Atlantic amphidromes reach the Continental Shelf while propagating northward (Simionato *et al.,* 2004). The tidal regime in the estuary is mixed, dominantly semidiurnal, with M_2 being the most

significant constituent (M_2 has an amplitude of 0.27 m at Buenos Aires); however, there are significant diurnal inequalities, mostly caused by O_1, with an amplitude of 0.15 m at Buenos Aires (D'Onofrio *et al.,* 1999). The liquid discharge to the RDP is determined by the Paraná and Uruguay rivers in more than 97% (Bombardelli *et al.,* 1995; Framiñan *et al.*, 1999) and displays a weak seasonal cycle with a maximum in winter of around 30.000 m^3s^{-1} and a minimum in summer of approximately 20,000 m^3s^{-1} (Nagy *et al.*, 1997; Simionato *et al.*, 2001). The atmospheric general circulation in the RDP region is controlled by the influence of the quasi-permanent South Atlantic high-pressure system. Southwestward circulation, associated with this high, advects warm and moist air from subtropical regions over the estuary (Minetti and Vargas, 1990). On the other hand, cold systems coming from the south drive cold and dry air masses over the area with a dominant periodicity of around 4 days (Vera *et al.*, 2002). As a result, an alternation of winds from the northeast to the southwest in a scale of a few days is the dominant feature of wind variability in the area. Due to the highest frequency of storms in the cold season, northeasterlies are dominant in spring-summer, whereas south westerlies are more frequent in fall-winter (Simionato *et al.*, 2005).

Balay (1961) defined risk water levels average for the RdP in 2.50 m for alert, 2.80 m for emergency and 3.20 m for evacuation (Escobar et *al.*, 2004) for all AMBA (Metropolitan Buenos Aires Area) coast. In 2013, the National Hydrographic Service adopted two type of levels one for warning and one for alert in the RdP -south and north of AMBA-. La Ribera neighborhood is situated in the south of AMBA where the warning level is 2.10 m and the alert level is 2.70 m. Strong southeast wind conditions can increase the risk of high level water in the coast of La Ribera.

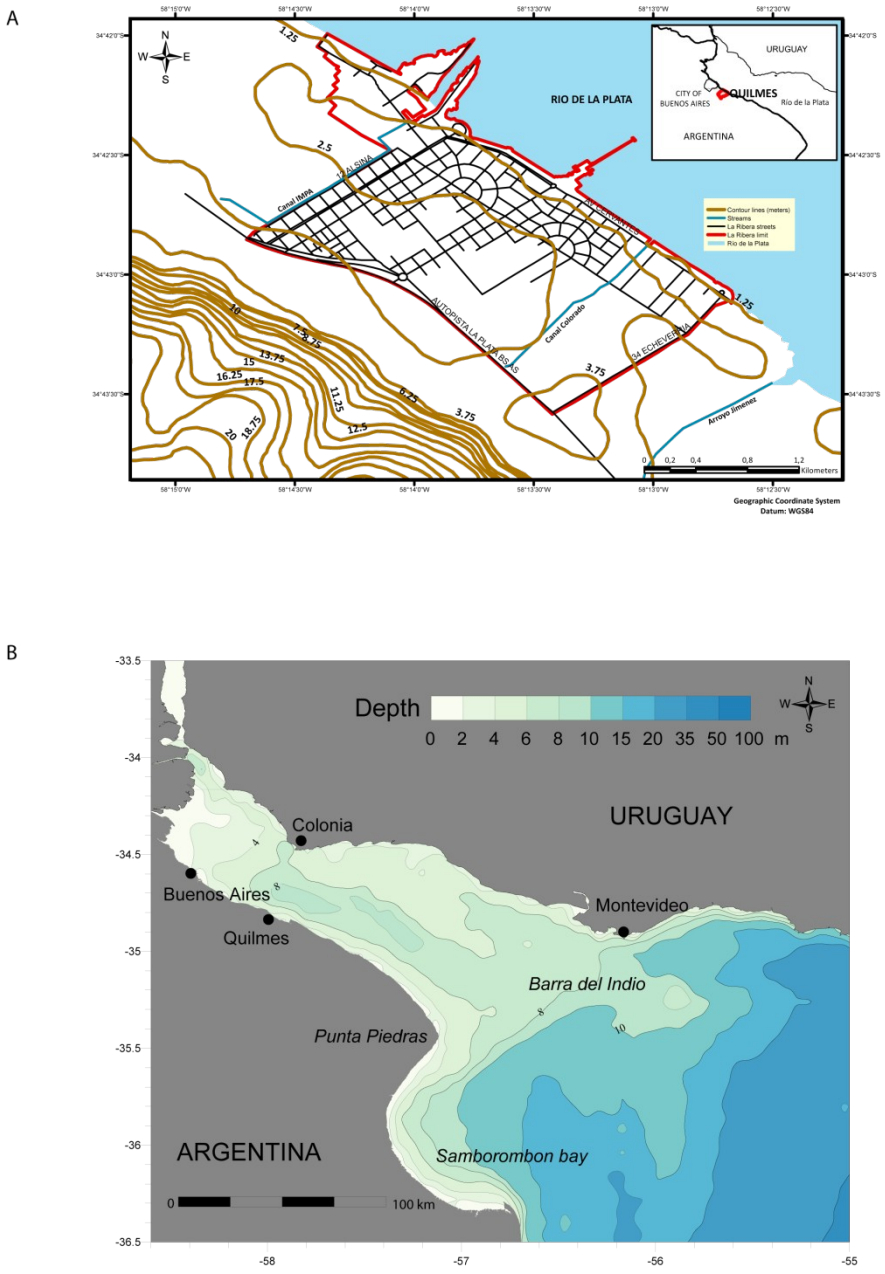

Figure 1: Study area: "La Ribera" of Quilmes, Buenos Aires Province (A) and bathymetry of Río de la Plata (B), Argentina.

2.2. The interdisciplinary group

The "Anticipando la Crecida" group was growing in participants and institutions, for this reason the ideas and tasks were performing as the group grew (Figure 2). We can differentiate two groups: one dedicated to meteorology and oceanography and the other related to geography and others human sciences. The group

dedicated to the forecast improvement, the characterization of the “sudestada” event, the flood process, and the persistent rain is composed to the Department of Atmospheric and the Oceans Sciences, Research Center of the Sea and Atmosphere, National Weather Service and Naval Hydrographic Service. The group dedicated to the Social fields surveys, map design, regional characterization, determination of flood levels, and water runoff is integrated by the "Programa de Investigación en Recursos Naturales" (PIRNA), National Geographic Institute, National Water Institute and Faculty of Engineering.

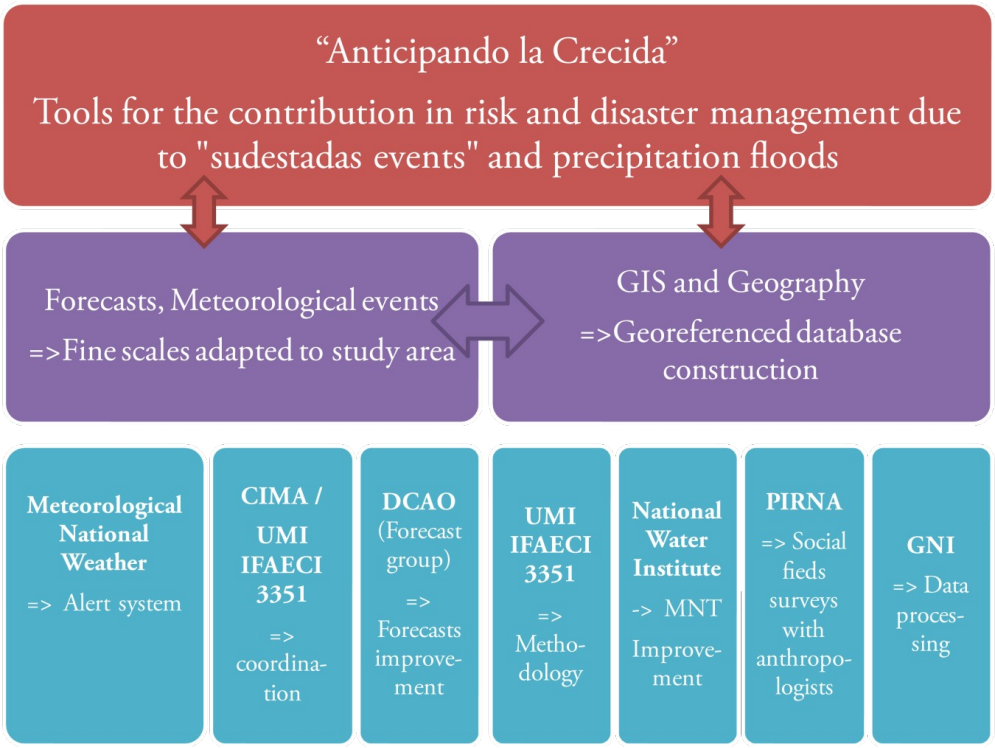

Figure 2: An interdisciplinary group between human sciences and climate sciences.

2.3 Methodology

Each group has different objectives and methodologies with a common objective that was described above. The first activity by the group dedicated to the forecast and atmospheric and oceanographic data, was to collect all the data available and to investigate past events, also the way to improve the analysis made with these information. Then they contacted the authorities and institutions involved in the alert system to know about the work they made and the alert system itself, and to think the way to provide better information, improving the alert system. Also the group is working in the improvement of the forecast and regional model (atmospheric and coastal). In the other hand, the group involved with the geographical and social activities, made different meetings with the institutions stakeholders with the aim to know and study the alert system. The interviews were different according to the institution and the interviewed person, and they were recorded for later use. The interdisciplinary equip organized workshops with the people and local stakeholders, professors, researchers and students of meteorology,

oceanography, social sciences, and engineers as well as professionals of different national institution, with the aim of improve the communication among scientists and local authorities, and helped to identify vulnerable regions where contingency plans have to be improving. Flooding level and watercourses maps were performed with the available data. All the information collected by both groups will integrate in a set of geo-referenced information and available on a website for public use.

3. A complex alert system with deficiencies

3.1. Preliminary view of this system

The National Weather Service and National Hydrographic Service dispatch the alerts or warnings (Figure 3), which are received by the National Civil Defense and they re-transmit the alert to the local Civil Defense (Figure 3). Since mid-2013 communication of warnings to local Civil Defense is through text messages on cell phones. This has allowed better communication. Currently the communication of alerts to society is through a siren mounted on a car, and mechanisms of communication between neighbors. The local Civil Defense notifies the local Firefighters and Secretary of Social Development, which is responsible for enabling the evacuation centers. Secretary of Social Development of local government carried out a survey of affected households and structured assistance for the victims. In post "sudestada" La Ribera neighborhood is still flooded in many cases, there’s a local organization guided by Municipal Emergency Committee in which Quilmes Civil Defense, the Secretary of Social Development of Quilmes and Climate Emergencies and Contingencies Direction are the main institutions who organize the help to the population who has suffer the flood. In addition Voluntary Firefighters of Quilmes, CREM (Radio-Link Center for Medical Emergencies), Quilmes Red Cross, Boyscouts associations and others institutions or groups take actions to assistance local population. Moreover, there’s a strong solidarity of neighborhoods offering a place to stay, donations of food, building material, etc.

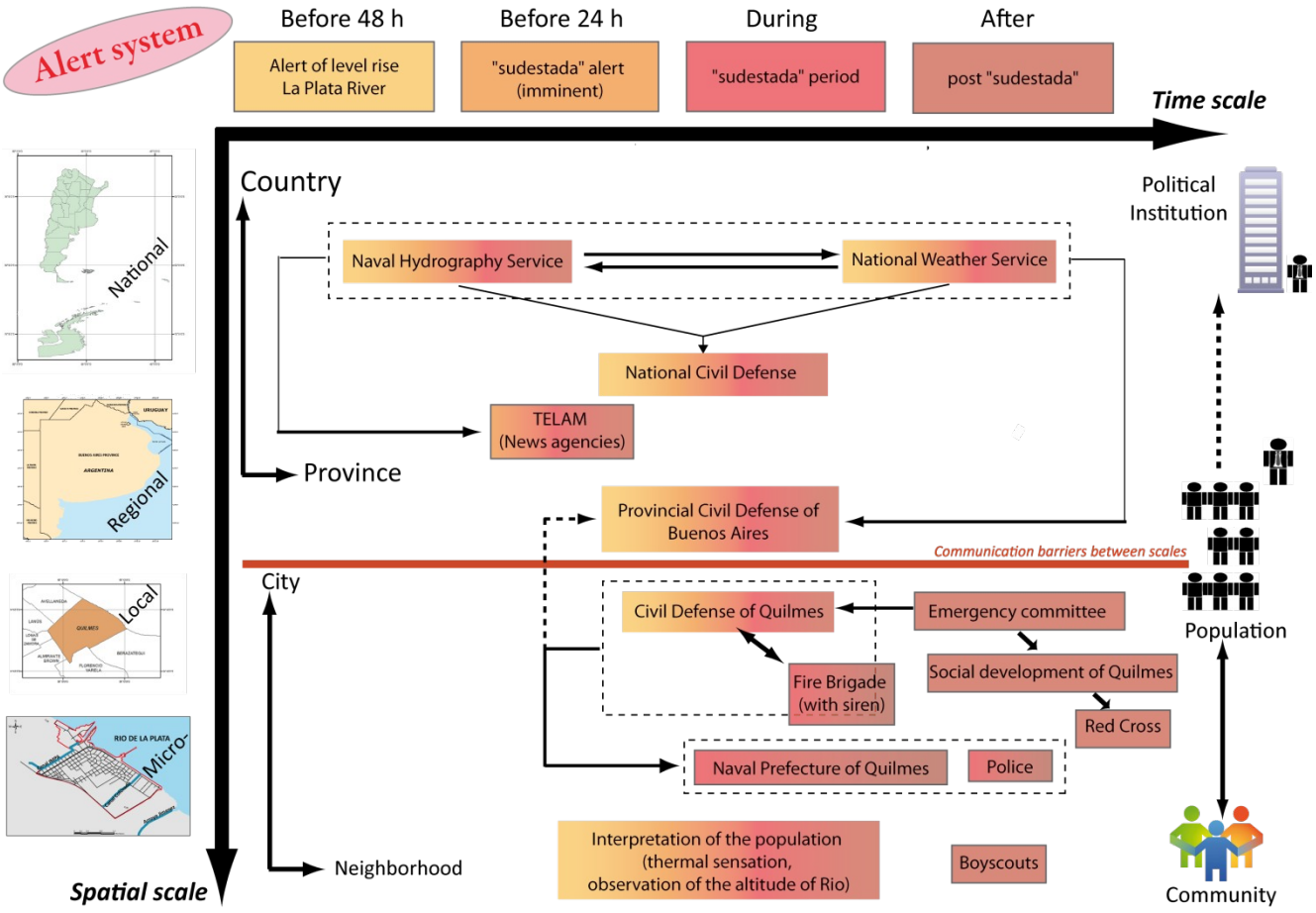

Figure 3: The actual alert system and its spatial and temporal scales.

3.2. How to improve the alert system?

The main problem registered in the alert system is related with the communications between the different institutions involved. In some cases, the information or the message doesn't arrive with the necessary time to take the appropriated actions. Also the local Civil Defense stays in alert and watches the synoptic situation and the RdP water level in other measure station at the south of La Ribera. An improved communication via text message was implemented in 2013 even if some delay was observed in communication since the issued alert until the local population registers the alert. The "Anticipando la crecida" project identified the need for social validation for alerts, ie, a systematic data collection mechanism to quantify affected households. The social validation will enable, not only to contribute to the improvement of flood forecasting models, but also the socialization of oceanographic and meteorological information between neighbors.

4. Conclusions and perspectives

"Anticipando la crecida" is an interdisciplinary and inter-sectorial project. It proposed co-produced knowledge through the interaction between the academic community, and the citizens and decision makers in La Ribera Quilmes. The co-

production of knowledge can guide lines of research to contribute to the resolution of specific problems. Through joint activities, participants of the project have identified different research to deepen : the understanding of floods and thus contribute to the improvement of tools to anticipate flooding in the study area (validation of wave models of the National Weather Service in Buenos Aires, improvement of information display system for monitoring, etc.)

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