# EARLY WARNING SYSTEM FOR FLOOD FORECASTING IN URUGUAY



Expert seminar: "Storm rainfall – Integral aligned risk management in Latin-American" Montevideo, 03 – 07 October 2016



IMFIA and ITU, UNIVERSIDAD DE LA REPÚBLICA (URUGUAY) SINAE, DINAGUA, INUMET, Municipal Authorities



#### **INSTITUCIONAL FRAMEWORK**

- **IMFIA** (Institute of Fluid Mechanics and Environmental Engineering), School of \*\* Engineering), Universidad de la República. Project Leader
- **ITU** (Institute of Theory and Urbanism), School of Architecture, Universidad de \*\* la República)
- SINAE Presidency of the Republic: National coordination unit for the Integrated \*\* **Risk Management** Artigas **Rio Cuareim**
- **INUMET:** Meteorological Service. Oficial \*\* weather forecast meteorological and monitoring.
- **DINAGUA:** Design and implementation of \*\* water resources management national policy. Operation of river level-flow network.

de Aguas













#### **INSTITUCIONAL FRAMEWORK**

#### DEPARTMENTAL GOVERNMENTS

- CECOED: Departmental Emergency Coordination Center.
- UTE & CTM Salto Grande: Electric Co., telemetric hydrometeorologic networks.



salto grande



DINAGUA Dirección Nacional de Aguas SINAE Sistema Nacional de Emergencias Presidencia de la República



) **₩UT**∃.

#### BACKGROUND





- Population: 33,576 inhabitants
- Basin area: 8,750 km<sup>2</sup>
- Tc = 54 hs
- May 2007 and February 2010 floods: 5.500 to 6.000 evacuees (about 20% of the population)

- Population: 40,658 inhabitants
- Basin area: 4,570 km<sup>2</sup>
- Tc = 33 hs
- June 2001 flood: 7600 afected

- Population: 25,477 inhabitants
- Basin area: 4,670 km<sup>2</sup>
- Tc = 30 hs
- May 2007 flood: 2800 afected



#### BACKGROUND





Durazno



February 2014



April 2016



### **Pilot Project PROHIMET (2009-2011): Early** Warning System for flood forecasting applied to Durazno city. Financing: WMO.



### **COMPONENTS of EWS-Durazno**



### **EWS-Durazno: Acquisition of Input Data**

#### • Rainfall:

#### **Numerical Weather Forecast:**

WRF Model from Uruguay's Meteorological Board (INUMET) and IMFIA School of Engineering. COSMO Model INMET, ETA Model CPTEC (Brazil),





#### Real Time measured rainfall:

Telemetric network UTE, Raingauges INUMET



#### • Wind

- Forecast (IMFIA)
- Measurements (INUMET)
- Basin data:
  - Topography, soils, geology, land use.

#### **EWS Durazno:**



### **Coupled Hydrologic-hydrodynamic model**







#### Simulated water surface levels in Durazno city





### EWS Durazno: Hydrologic-hydrodynamic model

The hydrologic-hydrodynamic model based on observed and predicted rainfall provides quantitative information about the future evolution of water surface levels to forecast flooded areas and its permanence in time.



A hydrologic model computes for each sub-basin the input flow hydrograph to Yi River. The input data is observed and forecasted rainfall.



## EWS Durazno: Hydrologic-hydrodynamic model

2 Simulation of the dynamics of water flow in motion to estimate the water level in Durazno city at each time step.

#### **TOPOGRAPHIC SURVEYS**

#### **OAS - CASCOS BLANCOS**

- 75 km close to Durazno city
- 15 cross sections

#### **PROHIMET**

- 80 km upstream Durazno city
- 25 cross sections and 6 bridge sections



## EWS Durazno: Hydrologic-hydrodynamic model

2 Simulation of the dynamics of water flow in motion to estimate the water level in Durazno city at each time step.





#### **EWS-DURAZNO**

#### Web-Output





https://www.fing.edu.uy/imfia/prohimet/Prohimet-Yi/Durazno/Global/data/2014-02-09/WebOutput.htm

### **EWS-D**URAZNO



#### Past extreme events





### **EWS-D**URAZNO

#### Performance assessment in past events



#### **DURAZNO**

- Monday 01/27/2014 Green level
- Tuesday 01/28/2014 Yellow level

Predicted peak (New bridge): 9.24 m. Predicted peak (Old bridge): 8.21 m. Expected dates for the predicted peak: 02/03 to 02/05/2014 Recorded and forecasted rainfall: 127mm





#### DURAZNO

#### • Wednesday 01/29/2014 Red level:

Predicted peak (New bridge): 10.61 m. Predicted peak (Old bridge): 9.48 m. Expected dates for the predicted peak: 02/05 to 02/07/2014 Recorded and forecasted rainfall: 204mm





#### DURAZNO, Sunday 02/02/2014 Red level:

Predicted pek (New bridge): 13.85 m. Predicted peak (Old bridge): 12.51 m. Expected dates for the predicted peak: 02/09 to 02/11/2014 Recorded and forecasted rainfall: 505mm



#### • DURAZNO, Thursday 02/06/2014 Red level

Predicted peak (New bridge): 12.06 m. Predicted peak (Old bridge): 10.83 m. Expected dates for the predicted peak: 02/08 to 02/10/2014 Recorded and forecasted rainfall: 366 mm

#### Recorded maximum water level (New bridge): 11,23 m (-0,83 m) Total recorded rainfall: 362 mm Evacuees: 2290 inhabitants





The EWS allowed to manage the storm that took place between 01/28 to 02/11/2014.

"Before there was chaos. People were evacuated without knowing which was the water level that would reach the river. People were evacuated 24 hours a day. Now we can manage the actions, using less trucks, with more time before the flood, more safely, "said Jesus Mario Rodríguez, director of the Durazno Emergency Coordinatation Center, The Observer 02/08/2014.



### **EXTENDING THE PILOT PROJECT**



Due to the successful performance of the Durazno pilot proyect, the national autorities promoted and supported the **formulation of two complementary projects**:

- SATI-UY: EWS for flood forecasting and managment (2014-2017).
  Financing: National Agency for Research and Innovation (ANII) & Partners counterpart.
  - Improvement of Durazno's EWS and development of Artigas's EWS.
  - Stablish the Follow-up Coordination Unit (technical support to local actors), USPI.
- <u>"Steps to extend the EWS to the cities of Artigas and Treinta y Tres"</u> (2014-2016). Financing: WMO.
  - Pre hydrologic-hydrodynamic model of the Cuareim & Olimar rivers, based on daily accumulated rainfall.

### **EWS DURAZNO - IMPROVEMENTS**



New telemetric stations to better represent rainfall's spatial distribution





### **EWS OF ARTIGAS AND TREINTA Y TRES**

#### Rainfall and water level stations



### **CONCLUSIONS**

- EWS-Durazno provides sufficient information on maximum water level and permanence, with sufficient lead time for the local authorities and civil forces to plan and manage the emergency (tents, food, clothing, medical attention).
- After its successful operation in Durazno the EWS earned the trust of local authorities first and national authorities after, who adopted the EWS nationwide (Artigas, Treinta y Tres, Rio Branco?)
- Strengthened institutional collaboration: SINAE-INUMET-DINAGUA-UDELAR in order to create the Follow-up Coordination Unit (technical support to local actors), USPI ("Unidad de Seguimiento Permanente de Inundaciones").
- Institutional involvement will also ensure the continuous improvement of the EWS.



