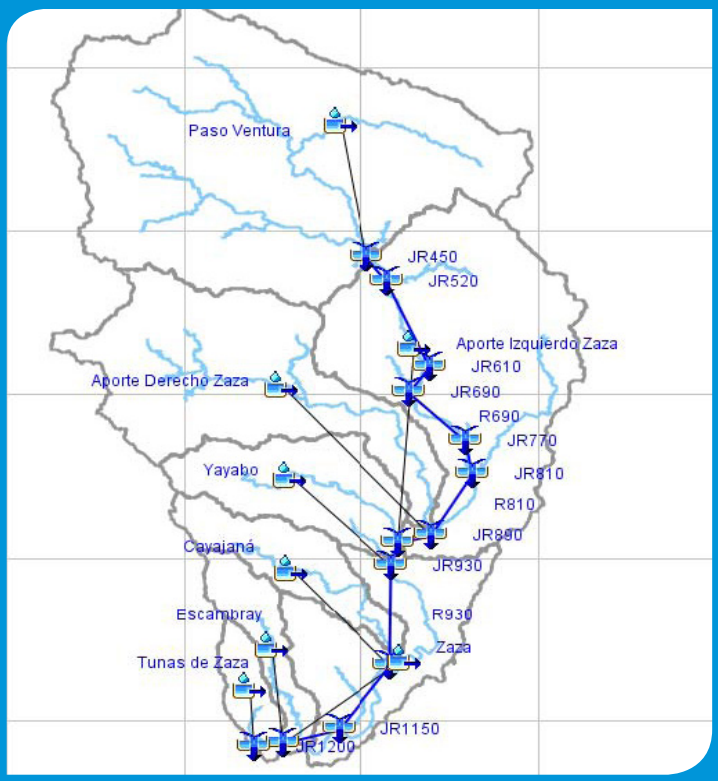
FLOOD FORECASTING IN REAL TIME THROUGH THE USE OF AUTOMATED HYDROLOGICAL AND HYDRAULIC MODELING

A qualitative upgrade is proposed in the capacity of provincial and national hydrological services in the timely estimation of flood peak flows, based on the great progress at both national and international levels in the development and use of the computer systems, measurement technologies, simulation of meteorological, hydrological and hydraulic processes and information delivery systems on the Internet. The system will adopt the distributed modeling of runoff to assimilate the details of rainfall, soil characteristics and land use with proper temporal and spatial resolution, while generating a detailed time and space runoff behavior description.

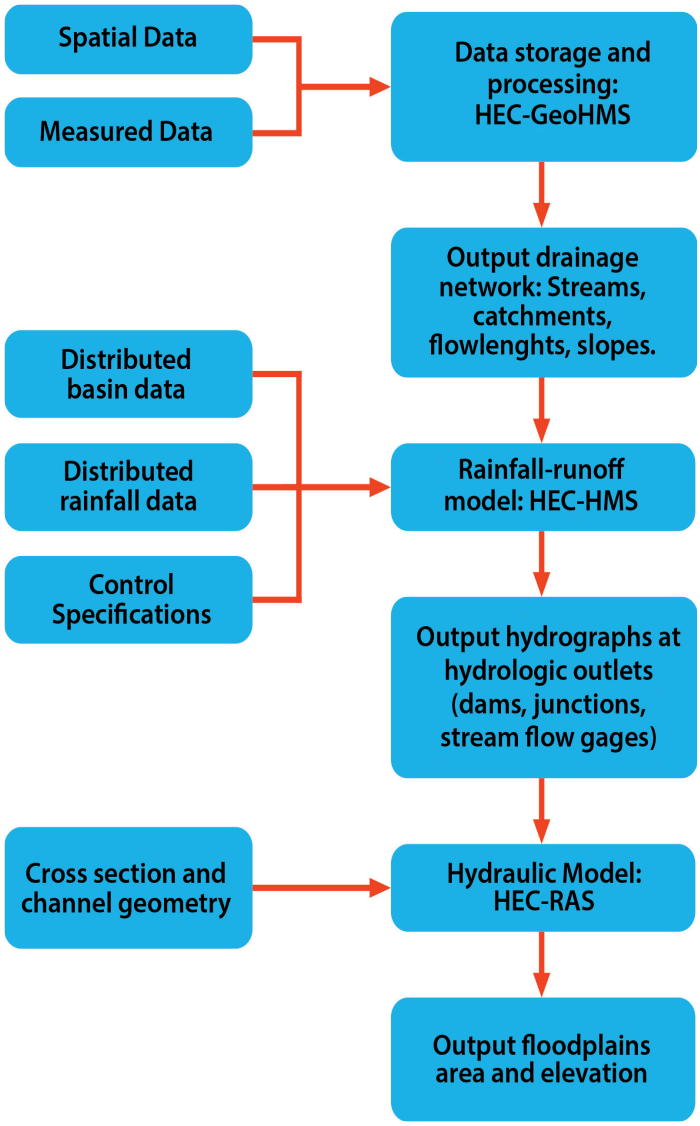
Computer Software

- Hydrologic Modeling System "HEC-HMS": physically based, distributed and deterministic multi-purpose model, designed to simulate the rainfall-runoff transformation process of dendritic watershed systems. It can be used for both event and long term continuous simulations applications.
- Hydraulic Modeling System "HEC-RAS": performs one-dimensional steady and unsteady flow river hydraulics calculations for entire networks of both natural and artificial channels, taking as input the output hydrographs from the HEC-HMS hydrologic model.
- Geospatial extensions Hec-GeoHMS and Hec-GeoRAS: visualization, processing and analysis of spatial information. Delineation of watersheds, stream networks and floodplains. Creating hydrological inputs for direct use with HEC-HMS and HEC-RAS.



Hydrological Prediction. Conceptual Model

System Design



Spatial data (elevation, soil type and land use, etc) are collected along with observed discharge time series. Through HEC-GeoHMS extension the processing of spatial data is performed whose result is exported to the HEC-HMS hydrologic modeling system. Rainfall data from ground rain gage stations and meteorological radar-based rainfal estimations are processed while watershed parameters for the study area are obtained.

The hydrological model is run using these inputs and the calculation methods defined by the user. The channel geometry (obtained using elevation data) and the hydrographs derived from hydrological modeling are used as input for running the hydraulic model HEC-RAS. Time series of river cross sections water heights are processed in HEC-GeoRAS for obtaining the floodplains.

This material has been made in the framework of the project: **"Improvement of the hydro-meteorological Early Warning Systems to increase disaster preparedness and to reduce vulnerability of the population living in the affected provinces by Hurricane Sandy (Cuba)"**; implemented by the United Nations Development Programme (UNDP); under the Action Plan for the Caribbean from the European Commission's Disaster-Preparedness Programme (DIPECHO).

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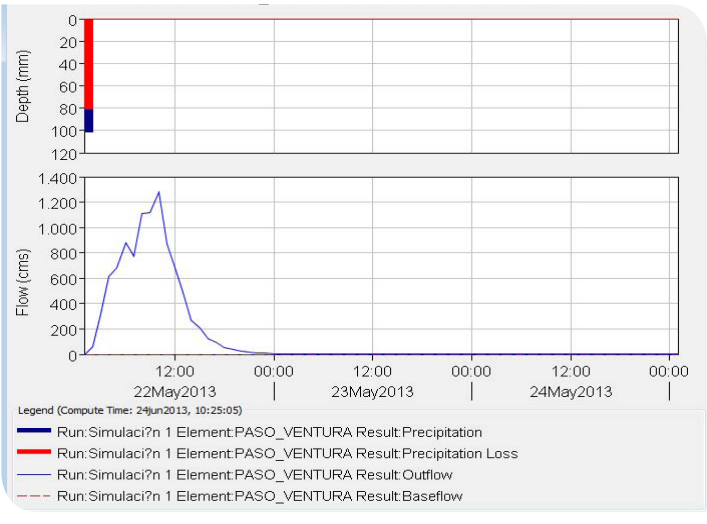
System operation: input data and results

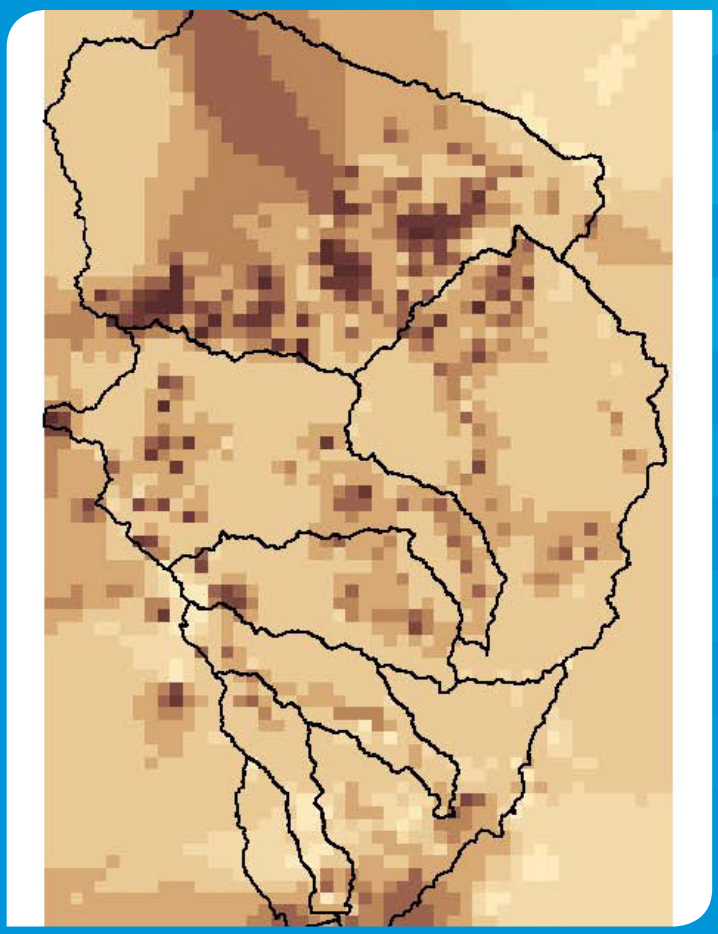
Depending on the stage of concern facing a hurricane or heavy rainfall event: the oncoming stage (before), impact stage (through) or remoteness stage (after), the system will use the following entries:

- Very short term quantitative precipitation forecast generated by meteorological numerical forecast models.
- Coastal flooding forecast.
- Hydrological baseline (levels, volumes, discharges and antecedent soil moisture).
- Digital maps of elevation, soil type, land cover and use, etc.
- Radar-based rainfall estimations.
- Conventional measurements of rainfall, stream level/discharge and reservoir storage.
- Measurements in telemetric hydro-meteorological stations.

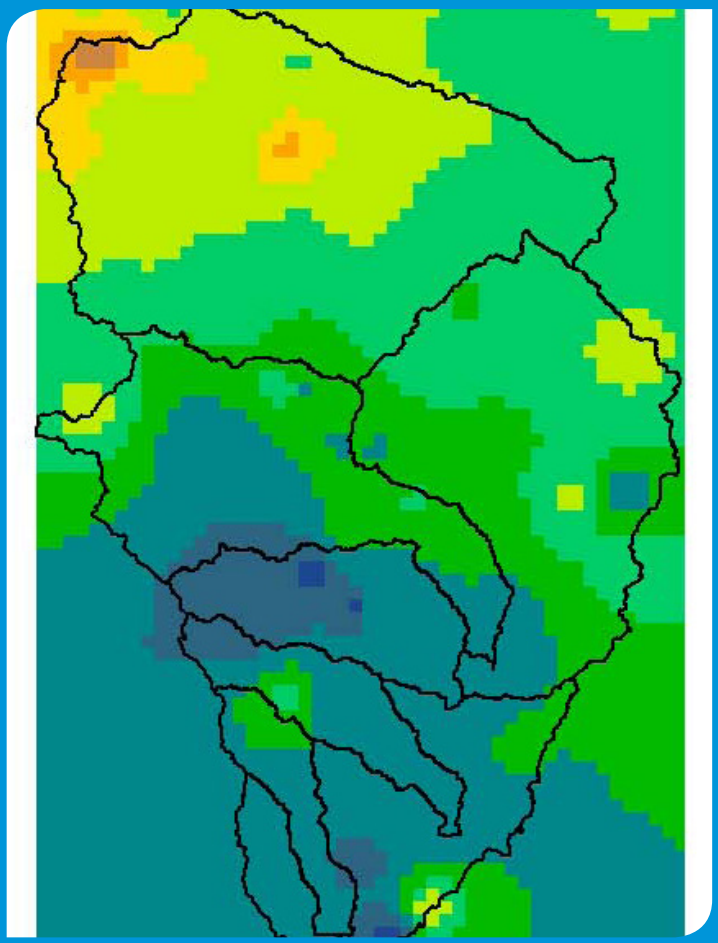
The processing and analysis of the input data and information, conveniently combined depending on their availability at any time, will generate:

- Forecast of peak flows and time-delay for different hydrological outlets based on quantitative precipitation forecasts by numerical models.
- Flood hydrographs outputs from hydrological modeling based on real-time ground rain gage measurements and radar-based precipitation estimates.
- Water heights and floodplains in river and channel reaches.





Hydrological Prediction. Number of curve



Hydrological Prediction. Rain