Technical Cooperation Workshop for Development of the Caribbean Regional Cooperation Programme in Multi-Hazard Early Warning System

Hydro-meteorological Forecasting and Opportunities for Climate Analysis
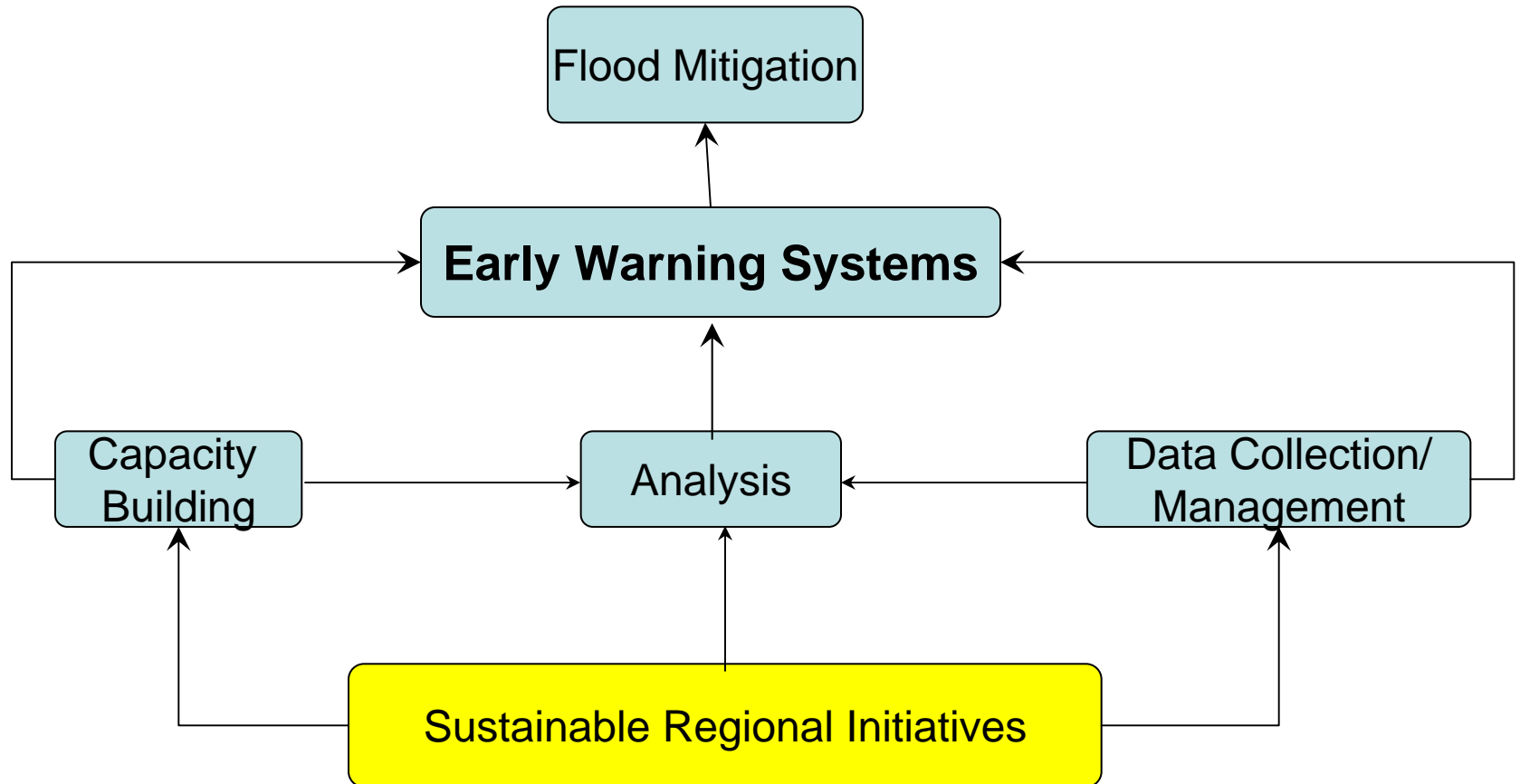
November 2-5, 2010

Presenter: Shawn Boyce

Caribbean Institute for Meteorology and Hydrology

Husbands, St. James

Barbados

Building Resilience to Flooding Through Early Warning Systems

Flood Mitigation

Early Warning Systems

Capacity Building

Analysis

Data Collection/ Management

Sustainable Regional Initiatives

# Regional Initatives

- Comprehensive Flood Forecasting for the Caribbean
  - Data Rescue (Data Collection)
  - **Carib-HYCOS Project (Data Collection/Management)**
  - **CADM II (Data Collection, Analysis)**
  - **Caribbean Regional Weather Radar Project (Real-time data collection)**
  - **Real-time Flood Forecasting Project (Analysis)**
  - Italian Civil Defence Project (Analysis, Information System)
  - Caribbean Satellite Pilot

Carib-HYCOS

- Assist the NHSs and NMSs of the participating countries to modernize and strengthen their activities in the field of water resources
  - Contribute to a world wide network of hydrological reference stations that allows the evaluation of fresh water resources and their evolution
    - Facilitate the exchange of dependable, standardised data concerning water resources
    - Develop technical capacity through training and transfer of technologies
    - Development of regional co-operation
    - **Real-time data acquisition and management**
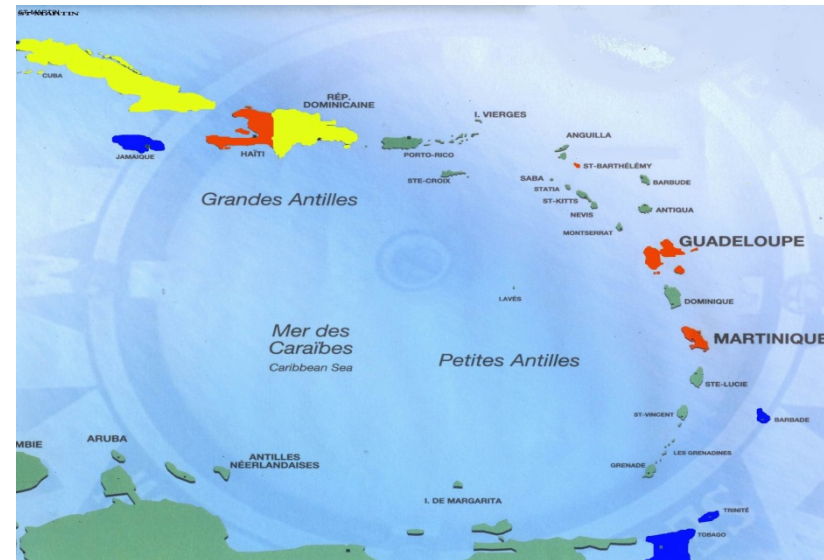
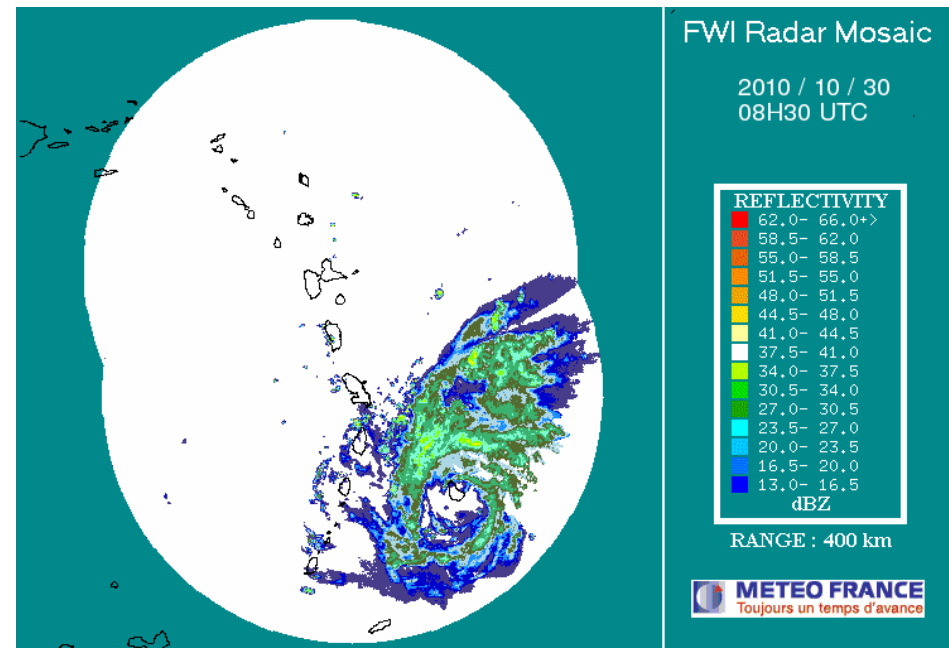# Caribbean Disaster Management Project (Phase II)

- Mitigate flood hazard in CDEMA participating states
  - Flood hazard maps at each pilot site
  - *Early* flood warning system for community
    - Alarms triggered by recorded rainfall and/or water levels
    - Warnings triggered as event is taking place
    - Delineation of at risk areas for flood forecasting focus
    - Real-time data acquisition

Typical remote transmission setup

Caribbean Regional Weather Radar Project

- Four new Doppler digital radars installed in Barbados, Belize, Guyana and Trinidad & Tobago
  - Provision of continuous real-time radar coverage out to 400 kilometres from each site
- The Project will link the new radars with others already in place to form a modern network of nine radars as part of the Caribbean Early Warning System for severe weather conditions.
  - Short range forecast tool
  - Alarms can be triggered based on radar reflectivity values
  - Outputs can be linked to numerical models
  - Lead time < 10 hrs

FWI Radar Mosaic
2010 / 10 / 30
08H30 UTC

REFLECTIVITY

dBZ
62.0 – 66.0+>
58.5 – 62.0
55.0 – 58.5
51.5 – 55.0
48.0 – 51.5
44.5 – 48.0
41.0 – 44.5
37.5 – 41.0
34.0 – 37.5
30.5 – 34.0
27.0 – 30.5
23.5 – 27.0
20.0 – 23.5
16.5 – 20.0
13.0 – 16.5

RANGE : 400 km

METEO FRANCE
Toujours un temps d'avance

Martinique/Guadeloupe composite

Source: CCRIF Event Briefing

Real-time Flood Forecasting Project

- RFFP
  - Floods are a concern in the Caribbean region.
  - Inadequate and untimely flood forecasts often lead to significant economic losses, and in extreme cases, the loss of life
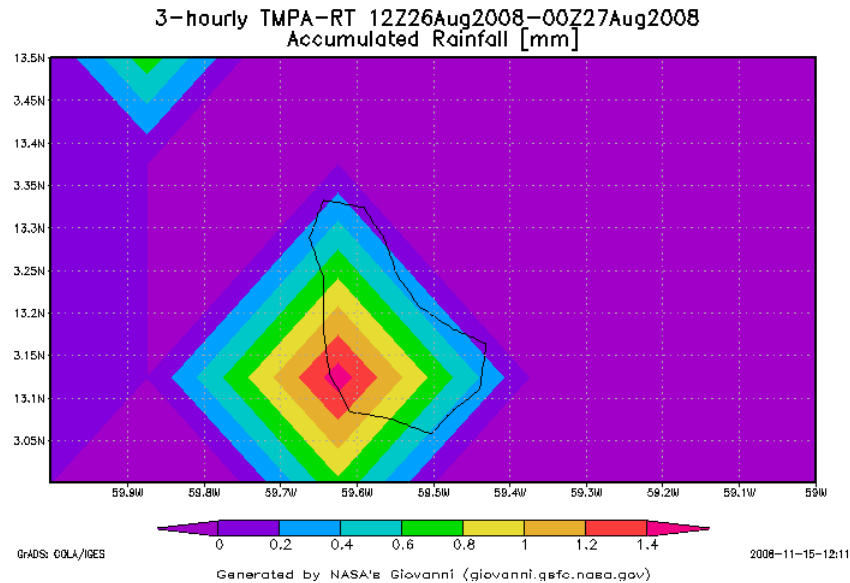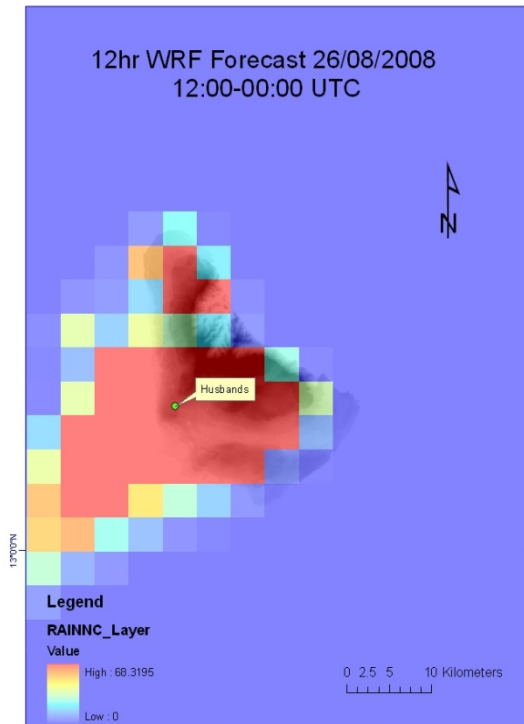

Jamaica

Barbados

RFFP cont'd…

- Mitigate flood hazard in participating countries
- Integrate precipitation forecasts into a hydrological model
  - *Early* flood warning system
    - Warnings triggered based on outputs from numerical models
    - Warnings triggered before the event
    - Leads times of at least two days
    - Forecast updates
    - Water depths simulated throughout catchment
    - Flood extent delineation available

RFFP cont'd…

Typical precipitation output: *Localized convective event in Barbados 26/08/2008, 12:00-00:00 UTC*


12hr WRF Forecast 26/08/2008 12:00-00:00 UTC

3-hourly TMPA-RT 12Z26Aug2008-00Z27Aug2008
Accumulated Rainfall [mm]

Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

Instrument	Resolution	Rainfall (mm)
Rain gauge	Point estimate	29
TRMM 3B42	0.25° x 0.25°	1.4
WRF V3.0	4km x 4km	60.9

*TMPA-RT

Application

- **Level 1**
- System > 400km from land *(Outside radar coverage)*
  - 48hr precipitation forecasts extracted from WRF
  - Hourly accumulations extracted
  - Data from hydrometric network used to establish initial hydrologic condition (Carib-HYCOS??)
  - Input to continuous distributed hydrological model
    - Advanced numerical model
    - 2D hydrodynamic model
  - Output from hydrologic model
    - Probable inundation zones
   - Water depth GIS layer

Application cont'd...

Radar coverage with 400 km range
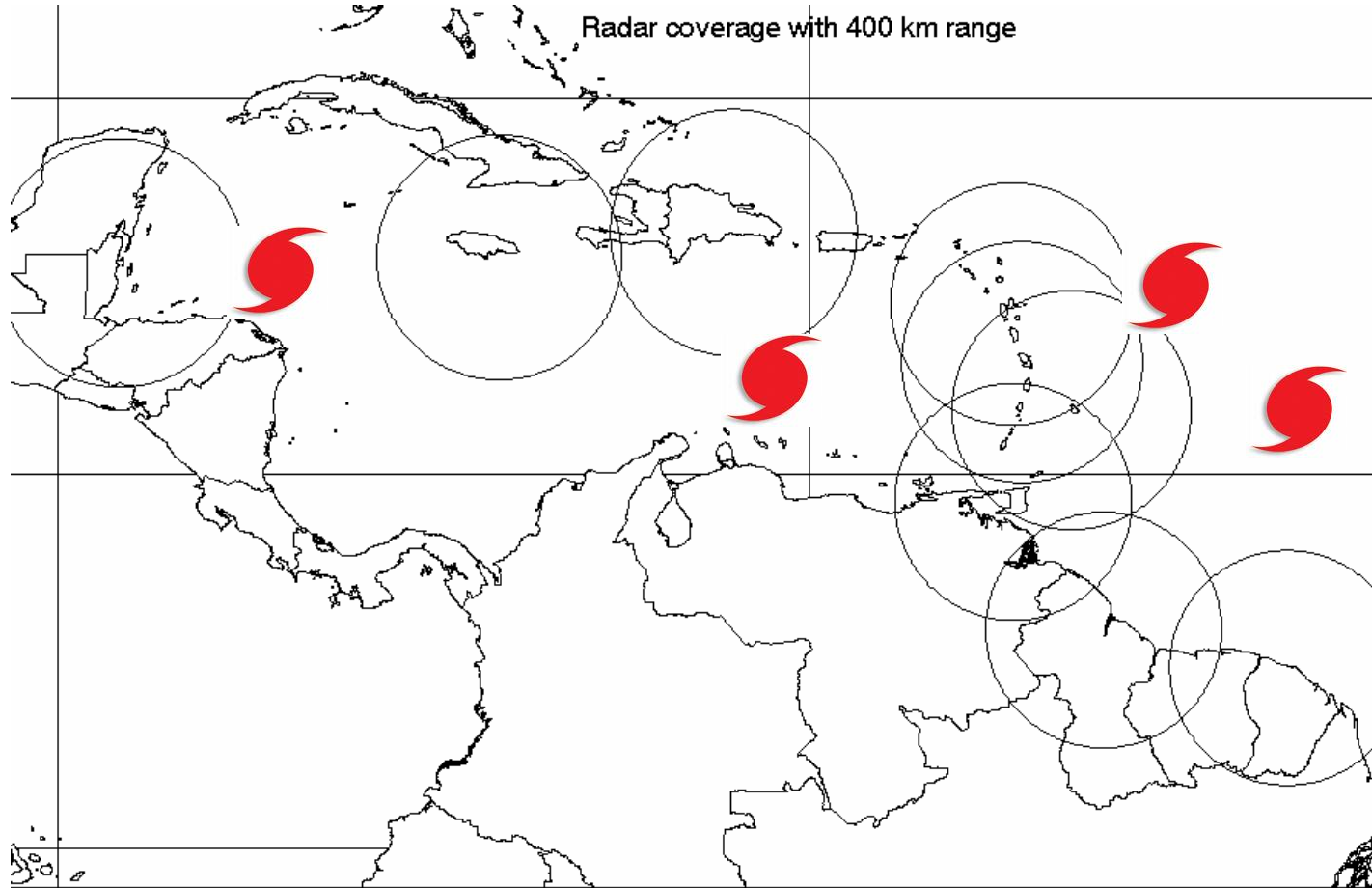
Application cont'd...

- **Level 2**
- System < 400km from land
  - Radar outputs from calibrated weather radar extracted
  - Radar outputs used to improve WRF forecasts
  - Precipitation forecasts extracted from WRF
  - Hourly accumulations extracted
  - Radar/WRF input to continuous hydrological model
  - Output from hydrologic model for decision makers
    - Probable inundation zones
    - GIS layers
  - Data from hydrometric network used to validate performance of integrated model
  - Satellite imagery to validate inundation extents and to assist disaster managers

Application cont'd...

Radar coverage with 400 km range
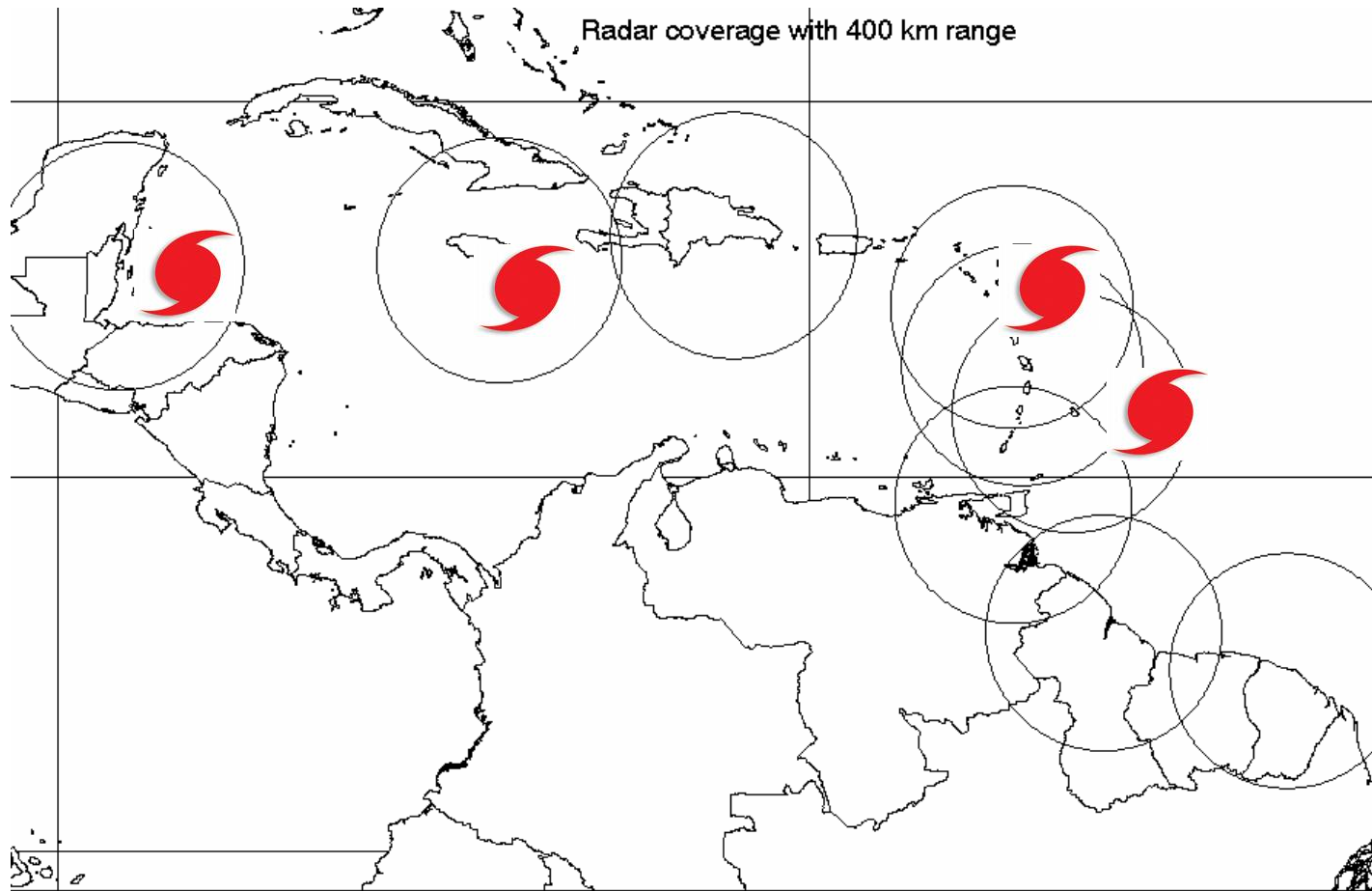
Application cont'd...

- **Level 3**
- System affecting country
  - Radar outputs from calibrated weather radar extracted
  - Outputs from hydrological models for decision makers
  - Ground based hydrometric data recorded/disseminated
  - Warnings issued to disaster officials via telemetry (CADM II??)
- Post Event
  - Post event hydrometric data collection
  - Review of system performance
    - Data from hydrometric network used to validate performance of integrated model
   - Satellite imagery to validate inundation extents

Application - Haiti Support

- Less than 24hrs after the January 12 earthquake CIMH began producing high resolution (4km) predicted rainfall over Haiti daily

- Support for search and rescue personnel in Haiti

- Very often during the rescue and recovery stages of the disaster cycle the influence of weather is overlooked

- Unexpected rainfall can increase losses on the ground and restrict rescue efforts

- To date four fully automated products are provided to the user community by CIMH

Haiti Support cont'd…

Caribbean Institute for Meteorology and Hydrology
Disaggregated precipitation (mm) Valid 23Z 19/08 2010
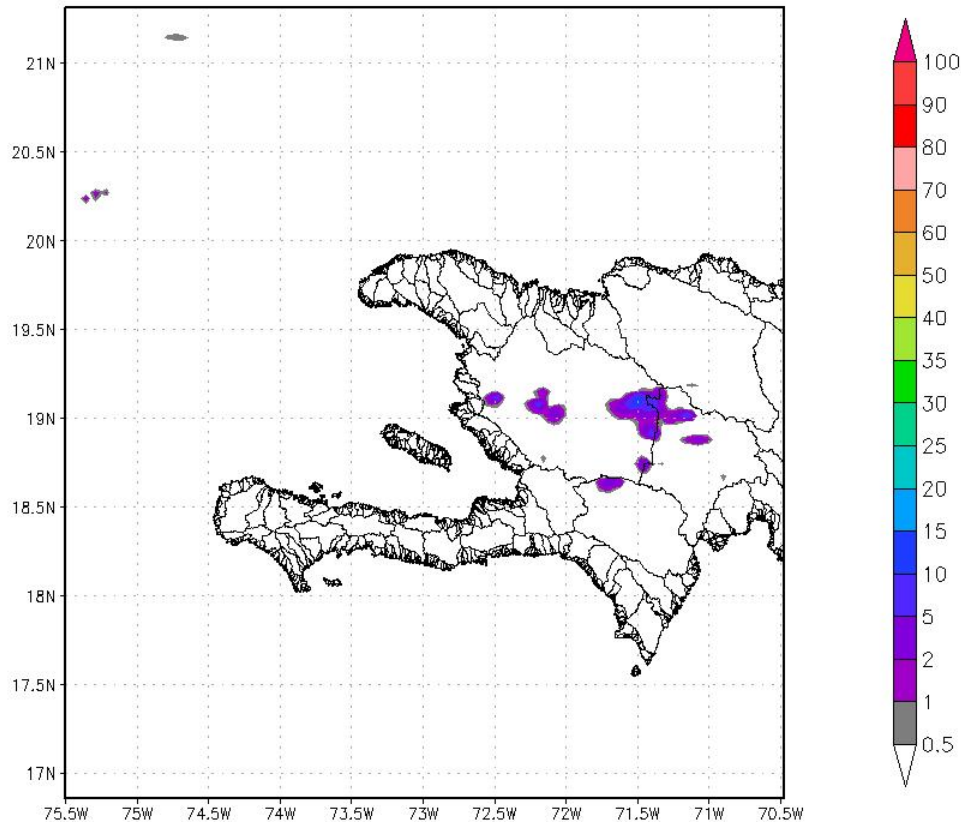
- Hourly precipitation output from 48-hour high resolution (4 km) numerical weather prediction model run over Haiti watersheds. Ideal for forecasting the potential for flash flooding.
- Output available as kmz file format (Google Earth)

http://63.175.159.26/~haiti/late/disag/latest.html
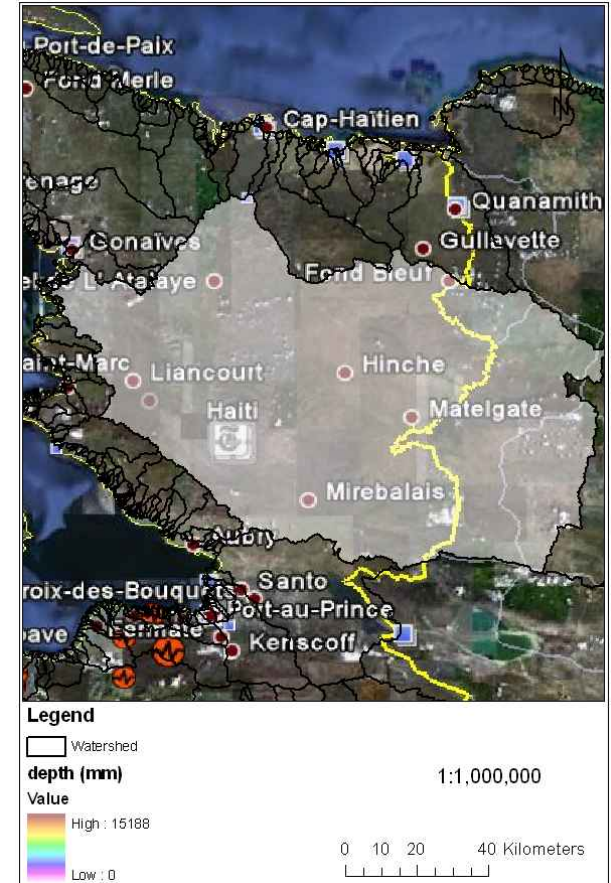
Haiti Support cont'd…

Caribbean Institute for Meteorology and Hydrology
Accumulated precipitation (mm) Valid 12Z 21/08 2010
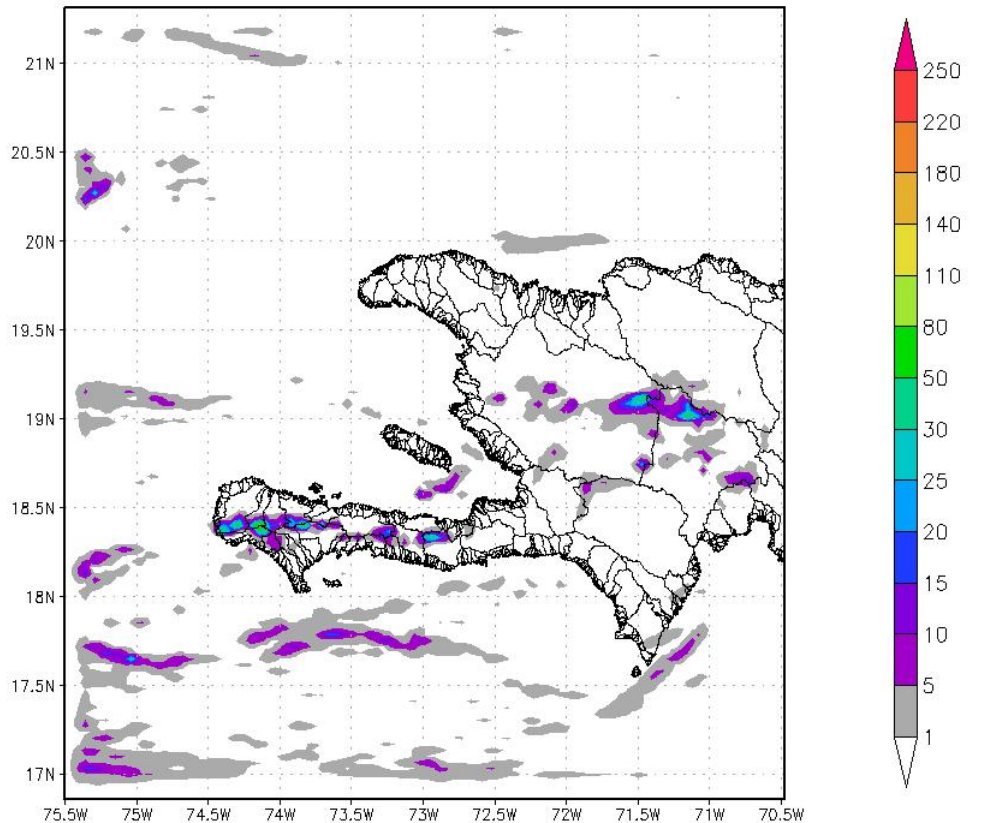
- Running cumulative 48-hour precipitation output from 48-hour high resolution (4 km) numerical weather prediction model run over Haiti watersheds. Ideal for assessing the potential for flooding and landslides due to multiple precipitation evens over 48 hours.

http://63.175.159.26/~haiti/late/latest.html

Haiti Support cont'd…

- Effort started January 13, 2010 with production of high resolution rainfall estimates after the earthquake;

- Development work subsequently financed by the CCRIF with the product being used by the international community;

- Flood forecasting based on explicit hydrologic model that uses rainfall predictions over watersheds;

- System to be implemented in watersheds in the Caribbean under a Japan-CARICOM funded RFFP project.

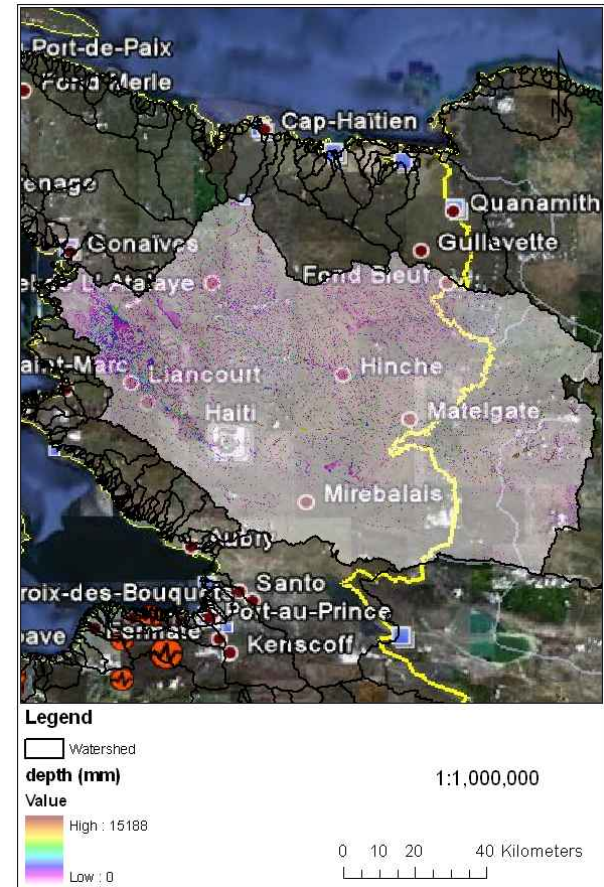- Hydrometric data needed for robust model calibration.

Initial water depth in the watershed prior to the start of the rainfall event.
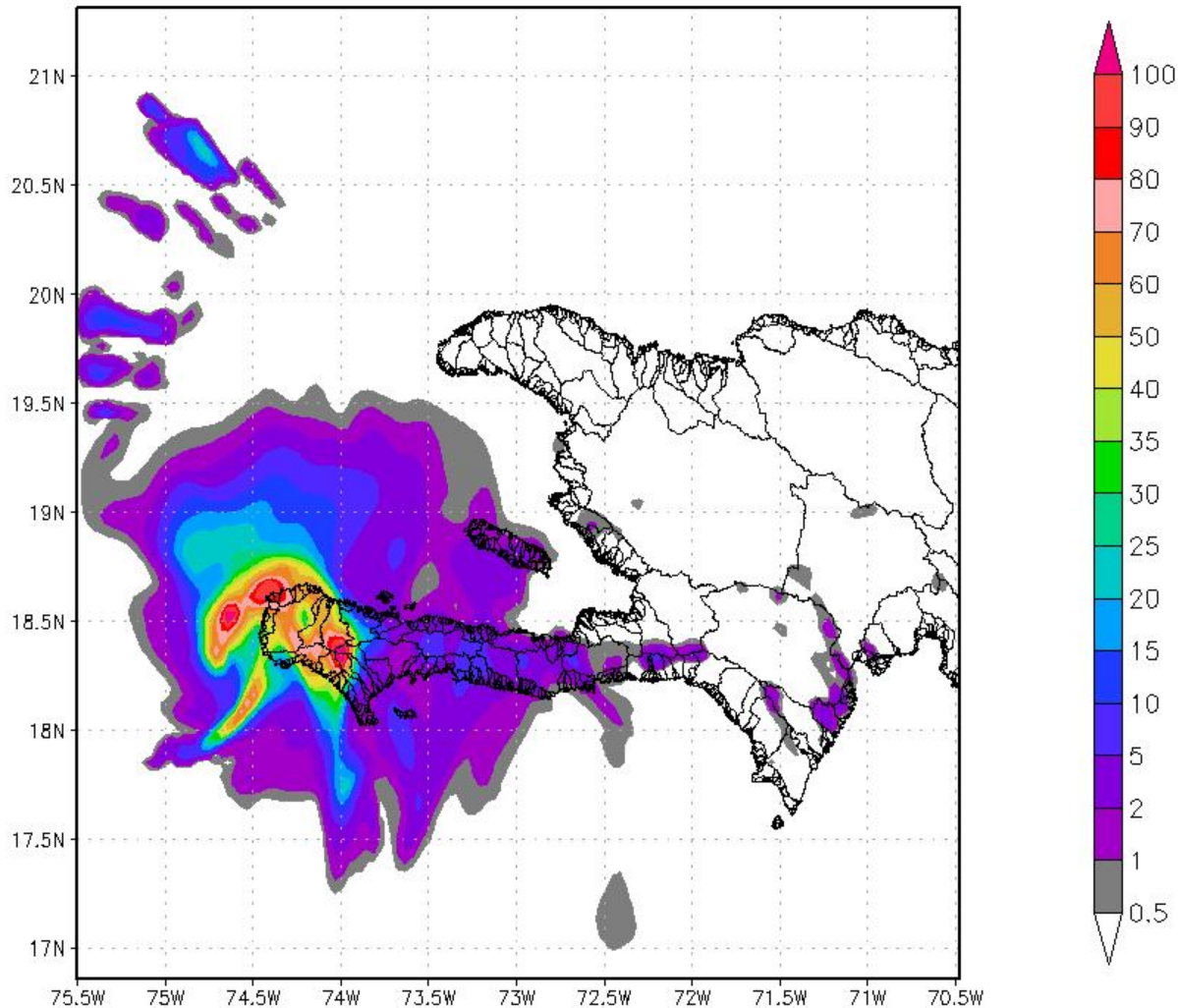
Haiti Support cont'd...
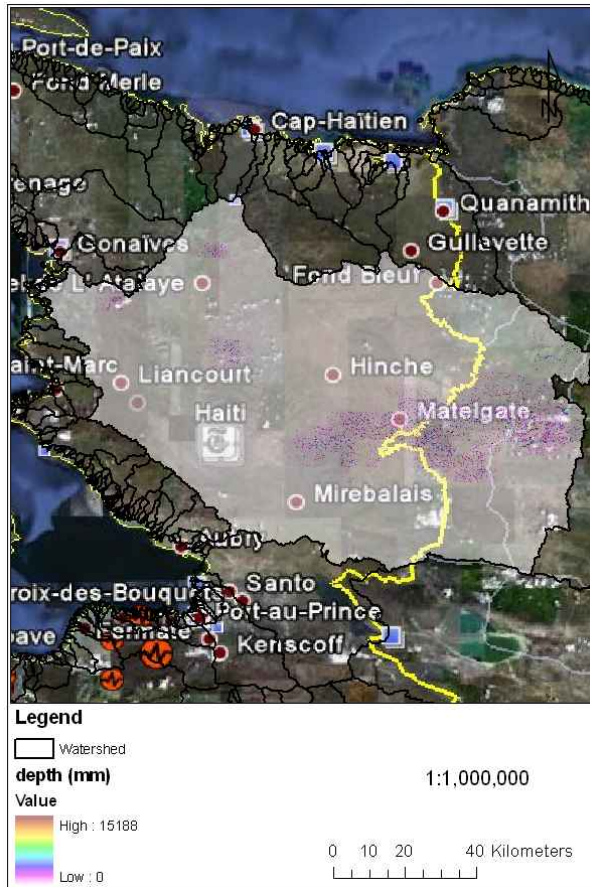
Modeled water depths across the watershed approximately 5 hours after the start of the event.

Modeled water depths across the watershed approximately 12 hours after the start of the event.

CIMH Haiti Prediction

Caribbean Institute for Meteorology and Hydrology
Disaggregated precipitation (mm) Valid 06Z 05/11 2010

Thank You!