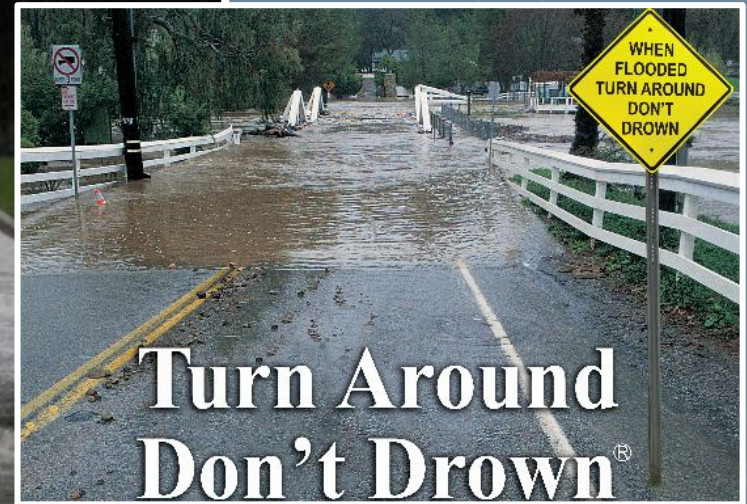


# Introduction of the Flash Flood Guidance Concept



**Dr. Rochelle Graham – Climate Scientist**

**Haiti-Dominican Republic Flash  
Flood Guidance Workshop**

Hydrologic Research Center  
<http://www.hrcwater.org>



# Haitian and Dominican Republic Flash Flood Guidance System

## Program Partners



**USAID/Office of U.S. Foreign  
Disaster Assistance**



**World Meteorological  
Organization**



**National Oceanic and  
Atmospheric  
Administration/National Weather  
Service**



**Hydrologic Research Center**

Program is part of global initiative that addresses the need to provide **early warnings for flash floods**



**The overarching purpose of the program is to limit societal vulnerability and preserve resiliency in basic human needs: livelihoods, agriculture, water resources, healthy ecosystems, and natural resources.**

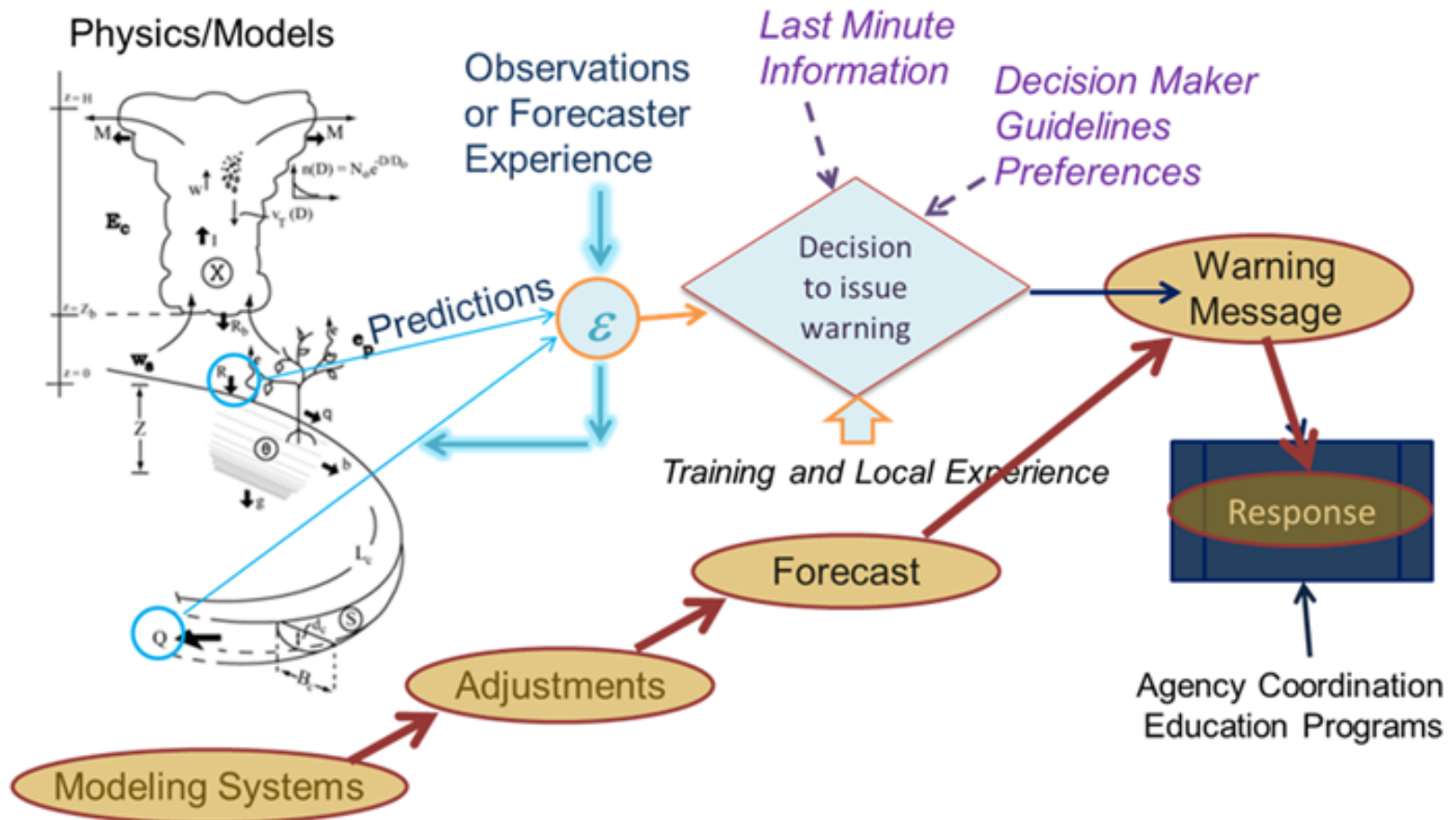
The ***flash flood guidance*** approach for flash flood warnings rests on the comparison in real time of observed or forecast rainfall volume of a given duration and over a catchment to a characteristic volume of rainfall for that duration and catchment that generates bank full flow at the outlet.

If the observed or forecast rainfall volume is greater than the characteristic rainfall volume then flooding in the catchment is likely. The characteristic rainfall volume for a catchment and duration is ***flash flood guidance*** .

***Flash flood guidance*** depends on factors such as the catchment and drainage network characteristics and soil water deficit determined by antecedent rainfall, evapotranspiration and groundwater loss.

# The Flash Flood Guidance System is an Integrated System for Real-Time Warning

## From a System of Models to a Program



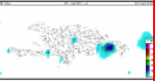
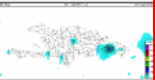

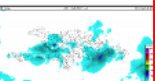
GFFG Integrated Approach for Real-Time Warnings:  
End-to-End Chain - Modeling-Adjustments-Forecasts-Warning-Response

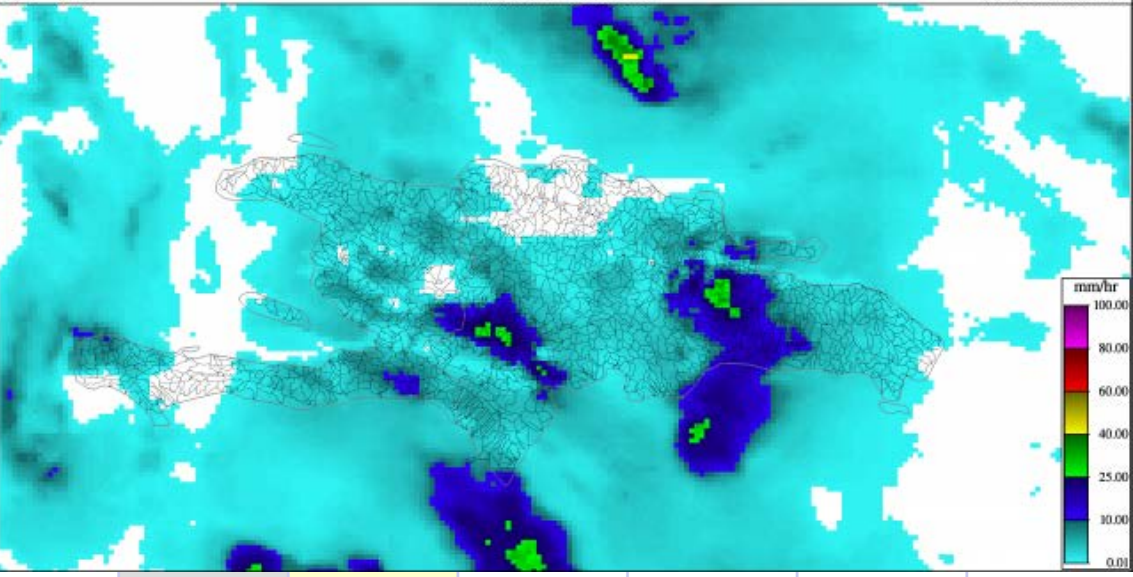





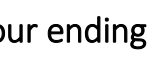
# HDRFFG System Interface

## Products: Satellite

HDGHE - 01 hr
2013-07-11 00:00 UTC
FFGS REGIONAL

DT	Satellite	Me
01-hr	 2013-08-23 20:00 UTC	2013
03-hr	 2013-08-23 20:00 UTC	2013
06-hr	 2013-08-23 20:00 UTC	2013-08-23 20:00 UTC <a href="#">Text: view</a>
24-hr	 2013-08-23 20:00 UTC	2013-08-23 20:00 UTC <a href="#">Text: view</a>



FFFT
 2013-08-23 20:00 UTC <a href="#">Text: view</a>
 2013-08-23 20:00 UTC <a href="#">Text: view</a>
 2013-08-23 20:00 UTC <a href="#">Text: view</a>
 2013-08-23 20:00 UTC <a href="#">Text: view</a>

SAT: Total of precipitation as estimated by the **HydroEstimator** over the last hour ending on the current navigation hour. (mm/1hr).

Composite Product... [text](#), [DBF](#)
SFTP data transfer (requires SFTP Client): [EXPORTS/REGIONAL/2013/08/23](#)

Station Identifier	Station Name	Observation Date & Time (UTC)	Surfmet Gauge Precipitation Accumulations ending on 2013-08-23 20:00 UTC	Precipitation (mm)	Temperature (C)	Relative Humidity (%)	Atmospheric Pressure (mb)	Solar Radiation	Wind Direction	Wind Velocity	Battery Voltage
Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing

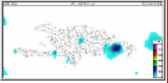
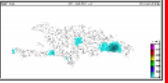


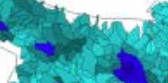

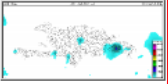
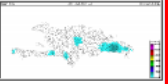

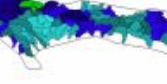
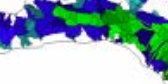


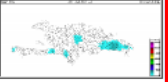

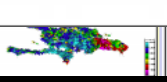


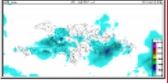
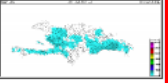
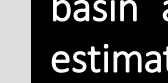
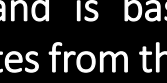
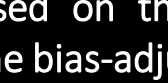
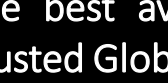
# HDRFFG System Interface

## Products: Merged MAP

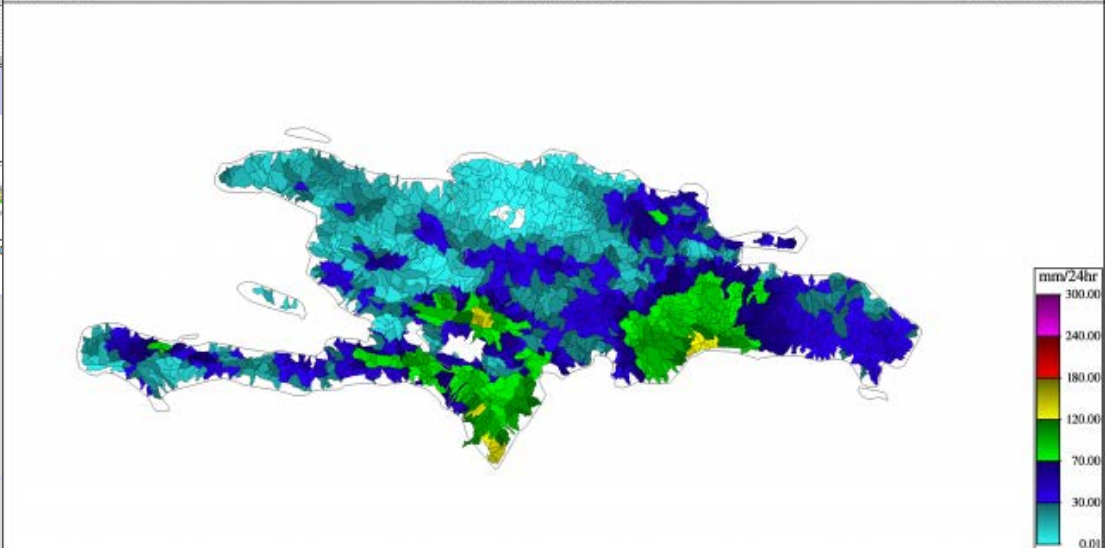
**HDRFFG - Haiti and Dominican Republic Flash Flood Guidance System**

Current Date: **2013-08-23 21:27 UTC**      Nav Date: **2013-08-23 20:00 UTC**  
 Year: 2013    Month: 08    Day: 23    Hour: 20    REGION: REGIONAL   

MAP - 24 hr      2013-07-11 13:00 UTC      FFGS REGIONAL

DT	Satellite	Merged MAP	Satellite	Merged MAP	Satellite	Merged MAP
01-hr	 2013-08-23 20:00 UTC	 2013-08-23 20:00 UTC Text: <a href="#">view</a>				
03-hr	 2013-08-23 20:00 UTC	 2013-08-23 20:00 UTC Text: <a href="#">view</a>				
06-hr	 2013-08-23 20:00 UTC	 2013-08-23 20:00 UTC Text: <a href="#">view</a>				
24-hr	 2013-08-23 20:00 UTC	 2013-08-23 20:00 UTC Text: <a href="#">view</a>				

Composite Product...



The Merged Mean Areal Precipitation (MAP) product is derived for each basin and is based on the best available mean areal precipitation estimates from the bias-adjusted Global HydroEstimator and/or available gauges.

Surfmet Gauge Precipitation Accumulations ending on 2013-08-23 20:00 UTC										
Station Identifier	Station Name	Observation Date & Time (UTC)	Precipitation (mm)	Temperature (C)	Relative Humidity (%)	Atmospheric Pressure (mb)	Solar Radiation	Wind Direction	Wind Velocity	Battery Voltage
Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing



# HDRFFG System Interface

## Products: ASM

**HDRFFG - Haiti and Domin**

Current Date: 2013-08-23  
 Year: 2013 Month: 08  
 -1 Month -1 Day -6 h  
 Prev 6-h

DT	Satellite	Merged MAP	ASM	FFGS REGIONAL		
01-hr						
03-hr						
06-hr						
24-hr						

Composite Product... [text](#), [DBF](#)      SFTP data transfer (requires SFTP Client): [EXPORTS REGIONAL/2013/08/23](#)

Surfmet Gauge Precipitation Accumulations ending on 2013-08-23 20:00 UTC

Station Identifier	Station Name	Observation Date & Time (UTC)	Precipitation (mm)	Temperature (C)	Relative Humidity (%)	Atmospheric Pressure (mb)	Solar Radiation	Wind Direction	Wind Velocity	Battery Voltage
Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing

Average Soil Moisture (ASM) product provides soil water saturation fraction for the upper zone (about 20-30 cm depth) for each of the sub-basins.

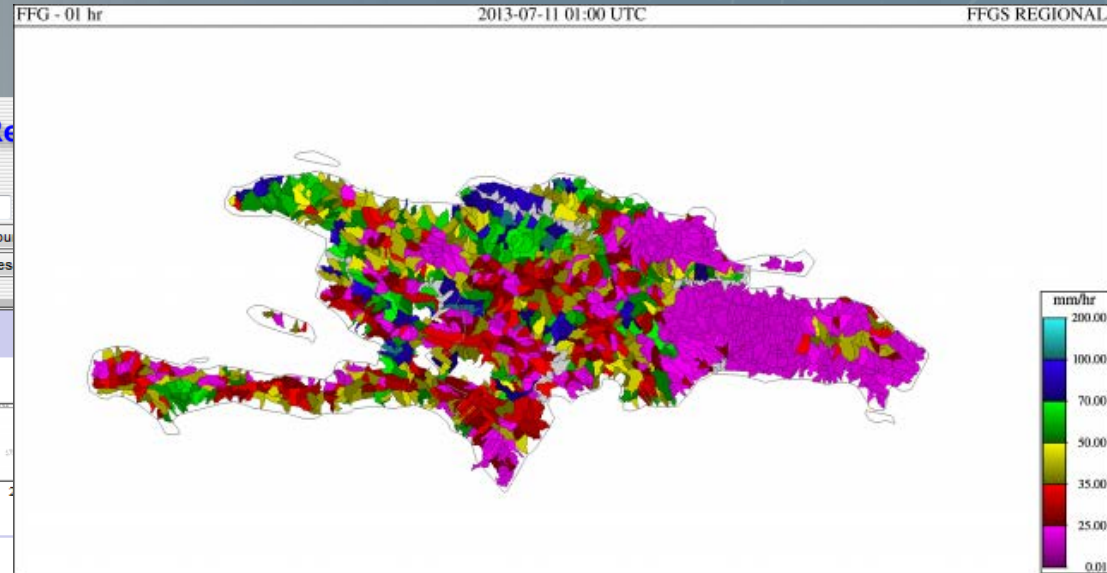
# HDRFFG System Interface

## Products: FFG

### HDRFFG - Haiti and Dominican Republic

Current Date: 2013-08-23 21:27 UTC  
 Year: 2013 Month: 08 Day: 23  
 -1 Month -1 Day -6 Hours -1 Hour  
 Prev 6-hr Interval Res

DT	Satellite	Merged MAP	ASM	FFG
01-hr				
03-hr				
06-hr				
24-hr				



The Flash Flood Guidance (FFG) product is an index that indicates:

- the total volume of rainfall
- over the given duration and
- over a given small catchment

which is just enough to cause bankfull flow at the outlet of the draining stream.

Composite Product... [text](#), [DBF](#)

SFTP data trans

Surfmet Gauge Precipitation Accumulations ending on 2013-08-23 20:

Station Identifier	Station Name	Observation Date & Time (UTC)	Precipitation (mm)	Temperature (C)	Relative Humidity (%)	Atmospheric P
Missing	Missing	Missing	Missing	Missing	Missing	Miss

# HDRFFG System Interface

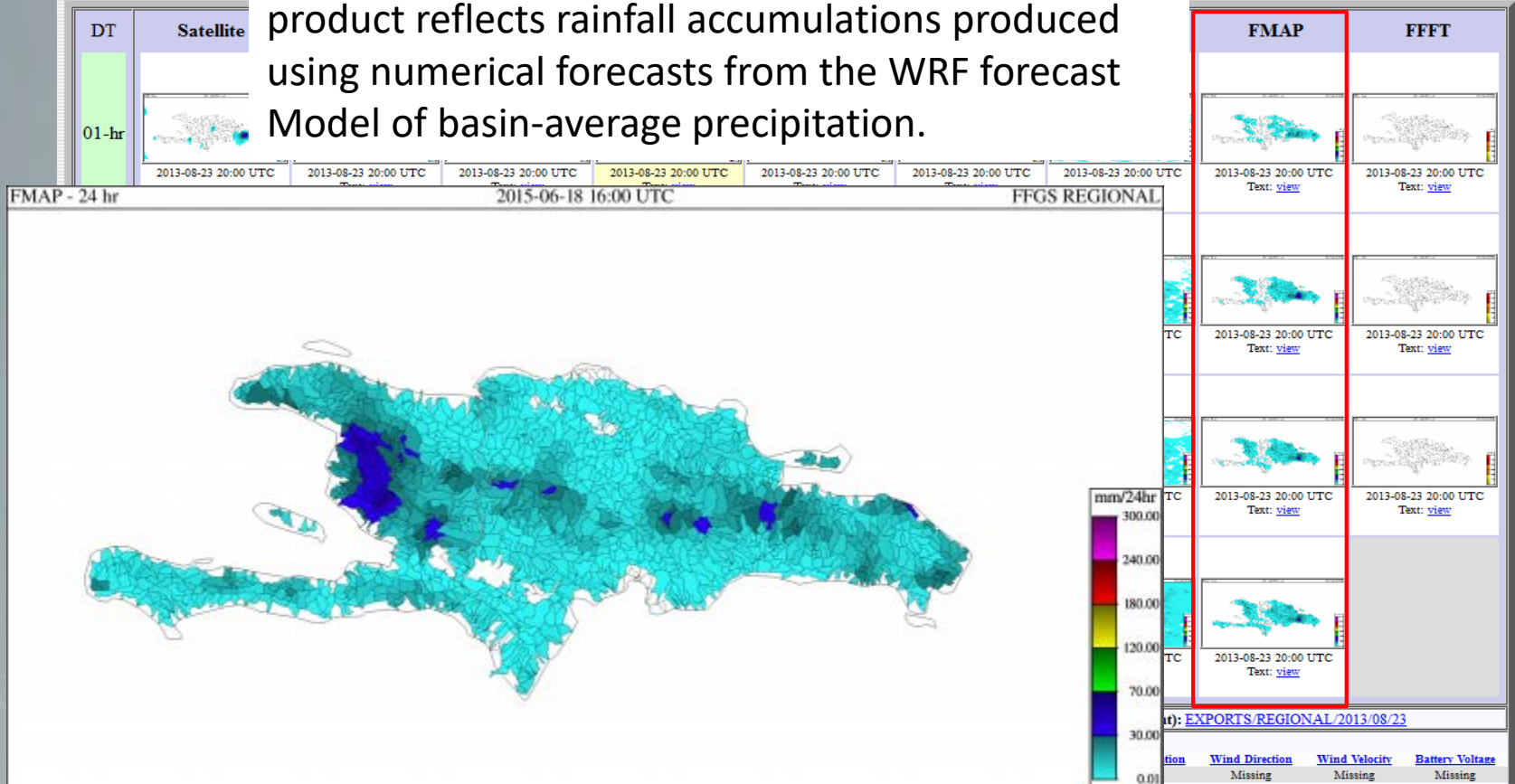
## Products: Forecast MAP

### HDRFFG - Haiti and Dominican Republic Flash Flood Guidance System

Current Date: 2013-08-23 21:27 UTC Nav Date: 2013-08-23 20:00 UTC

Year: 2013 Month: 08 Day: 23 Hour: 20 REGION: REGIONAL Submit

The Forecast Mean Areal Precipitation (FMAP) product reflects rainfall accumulations produced using numerical forecasts from the WRF forecast Model of basin-average precipitation.



# HDRFFG System Interface

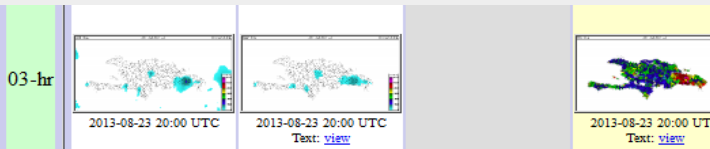
## Informational Products: FFTs

Forecast Flash Flood Threat (FFFT) Product provides the forecaster with an idea of regions forecasted to be of concern for flash flooding.

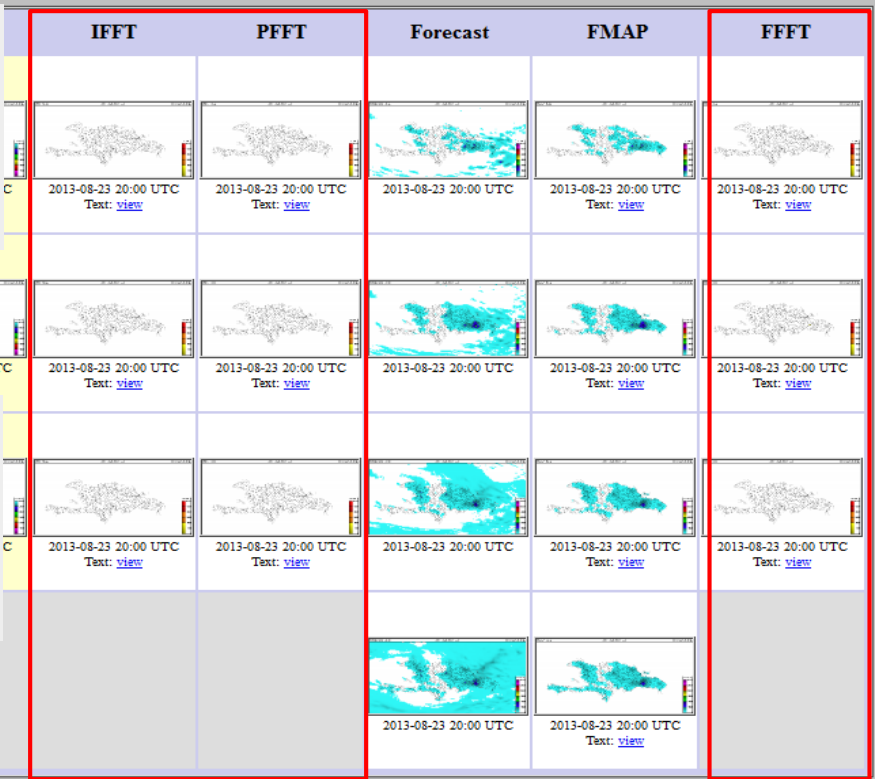
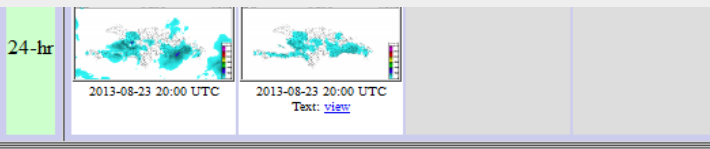
### HDRFFG - Haiti and Dominican Republic Flash Flood

Current Date: 2013-08-23 21:27 UTC      Nav Date: 2013  
 Year: 2013    Month: 08    Day: 23    Hour: 20    REGION: REG  
 [-1 Month] [-1 Day] [-6 Hours] [-1 Hour] [+1 Hour] [+6 Hours] [-]  
 [Prev 6-hr Interval] [Reset to Current] [Next 6-hr Interval]

The Imminent Flash Flood Threat (IFFT) product provides the forecaster with an idea of likely regions of imminent flash flood threats.



The Persistence Flash Flood Threat (PFFT) product is a forecast of flash flood threat with persistence used as the rainfall forecast for each basin.



Composite Product... [text](#) [DBF](#)

SFTP data transfer (requires SFTP Client): [EXPORTS REGIONAL/2013/08/23](#)

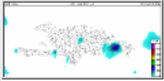
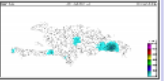
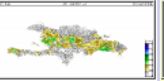
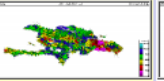


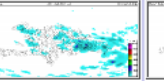
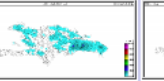

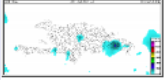
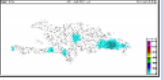
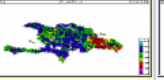


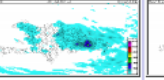
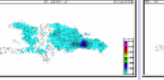



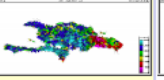


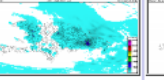
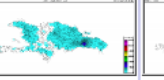

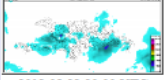
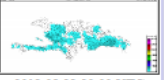
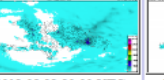
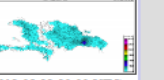
#### Surfnet Gauge Precipitation Accumulations ending on 2013-08-23 20:00 UTC

Station Identifier	Station Name	Observation Date & Time (UTC)	Precipitation (mm)	Temperature (C)	Relative Humidity (%)	Atmospheric Pressure (mb)	Solar Radiation	Wind Direction	Wind Velocity	Battery Voltage
Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing	Missing

# Operational Approaches for Flash Flood Guidance

## HDRFFG - Haiti and Dominican Republic Flash Flood Guidance System

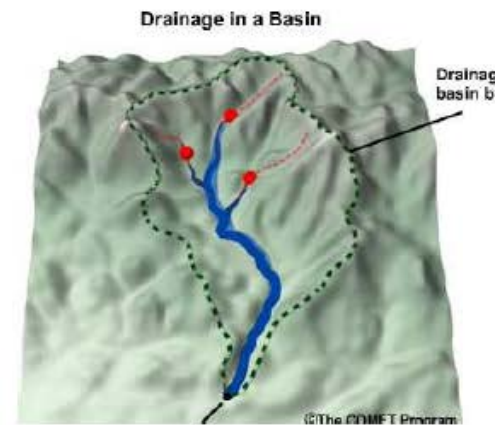
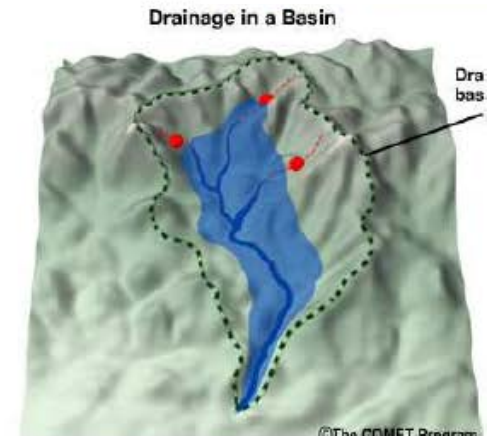
Current Date: 2013-08-23 21:27 UTC      Nav Date: 2013-08-23 20:00 UTC  
Year: 2013    Month: 08    Day: 23    Hour: 20    REGION: REGIONAL    Submit  
-1 Month    -1 Day    -6 Hours    -1 Hour    +1 Hour    +6 Hours    +1 Day    +1 Month  
Prev 6-hr Interval    Reset to Current    Next 6-hr Interval

DT	Satellite	Merged MAP	ASM	FFG	IFFT	PFFT	Forecast	FMAP	FFFT
01-hr	 2013-08-23 20:00 UTC	 2013-08-23 20:00 UTC Text: <a href="#">view</a>	 2013-08-23 20:00 UTC Text: <a href="#">view</a>	 2013-08-23 20:00 UTC Text: <a href="#">view</a>	 2013-08-23 20:00 UTC Text: <a href="#">view</a>	 2013-08-23 20:00 UTC Text: <a href="#">view</a>	 2013-08-23 20:00 UTC	 2013-08-23 20:00 UTC Text: <a href="#">view</a>	 2013-08-23 20:00 UTC Text: <a href="#">view</a>
03-hr	 2013-08-23 20:00 UTC	 2013-08-23 20:00 UTC Text: <a href="#">view</a>		 2013-08-23 20:00 UTC Text: <a href="#">view</a>	 2013-08-23 20:00 UTC Text: <a href="#">view</a>	 2013-08-23 20:00 UTC Text: <a href="#">view</a>	 2013-08-23 20:00 UTC	 2013-08-23 20:00 UTC Text: <a href="#">view</a>	 2013-08-23 20:00 UTC Text: <a href="#">view</a>
06-hr	 2013-08-23 20:00 UTC	 2013-08-23 20:00 UTC Text: <a href="#">view</a>		 2013-08-23 20:00 UTC Text: <a href="#">view</a>	 2013-08-23 20:00 UTC Text: <a href="#">view</a>	 2013-08-23 20:00 UTC Text: <a href="#">view</a>	 2013-08-23 20:00 UTC	 2013-08-23 20:00 UTC Text: <a href="#">view</a>	 2013-08-23 20:00 UTC Text: <a href="#">view</a>
24-hr	 2013-08-23 20:00 UTC	 2013-08-23 20:00 UTC Text: <a href="#">view</a>					 2013-08-23 20:00 UTC	 2013-08-23 20:00 UTC Text: <a href="#">view</a>	

System can provide forecasters with information on the likelihood of flooding of small streams by using bias-corrected satellite precipitation estimates and soil moisture estimates to produce flash flood guidance and flash flood threat

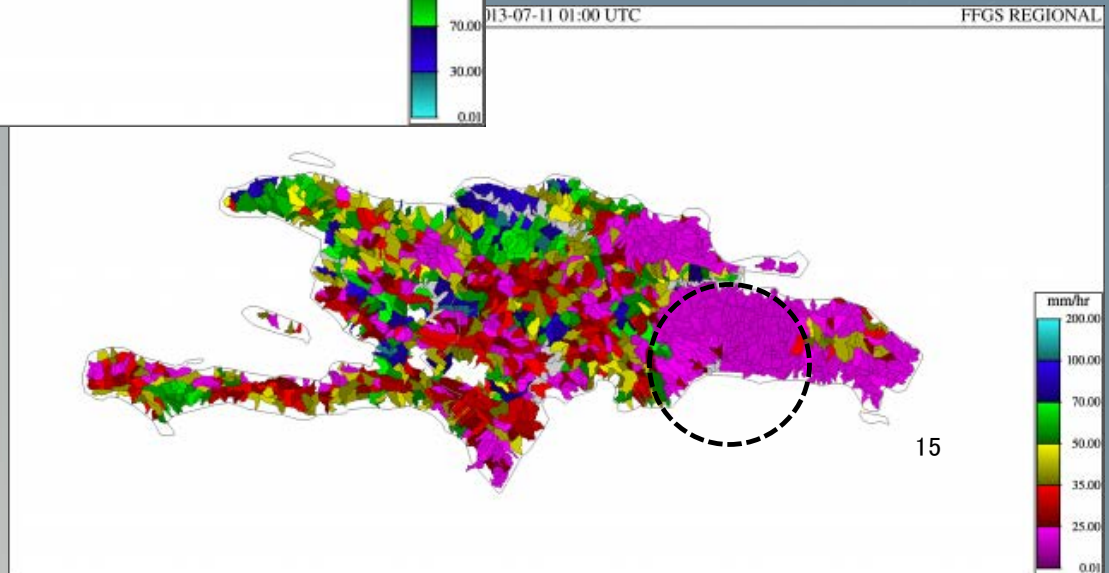
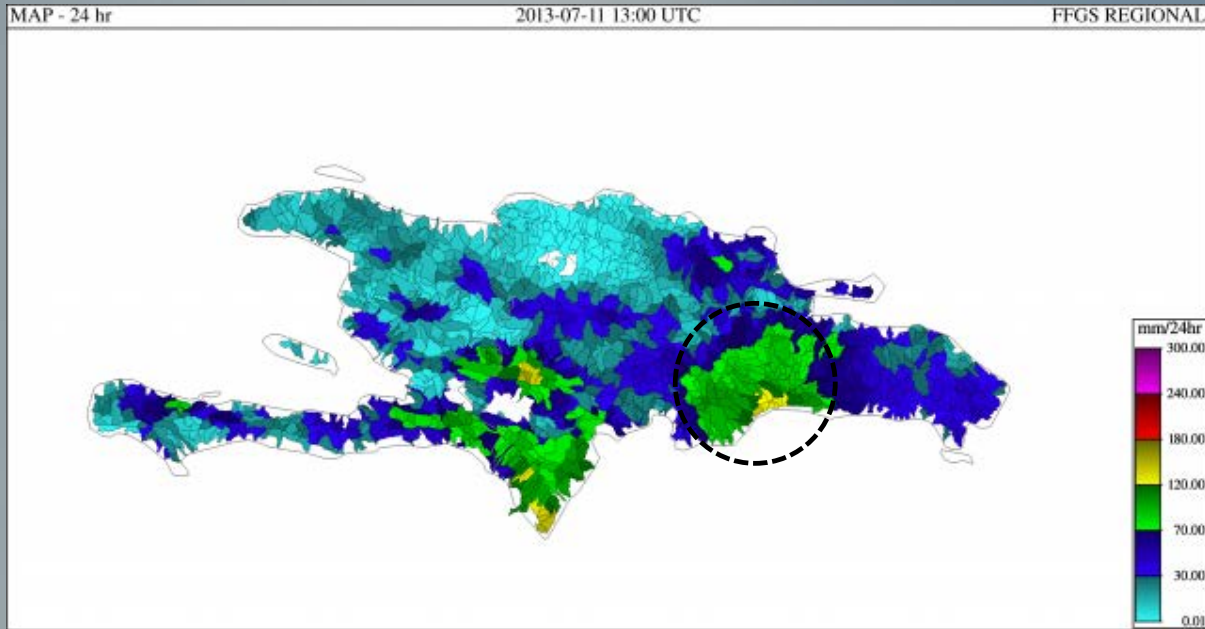
# How do you predict a flash flood?

- Forecaster's question:
    - How much rain will cause a flood in this particular area?
  - What do you need to know to answer this question?
    - How much water will run off?
    - How full is the stream?
    - What about recent rain?
    - How river basin responds - Hydrology
  - How much rain am I expecting over this area?
    - Weather forecasting – Meteorology
- = Hydro-meteorological problem



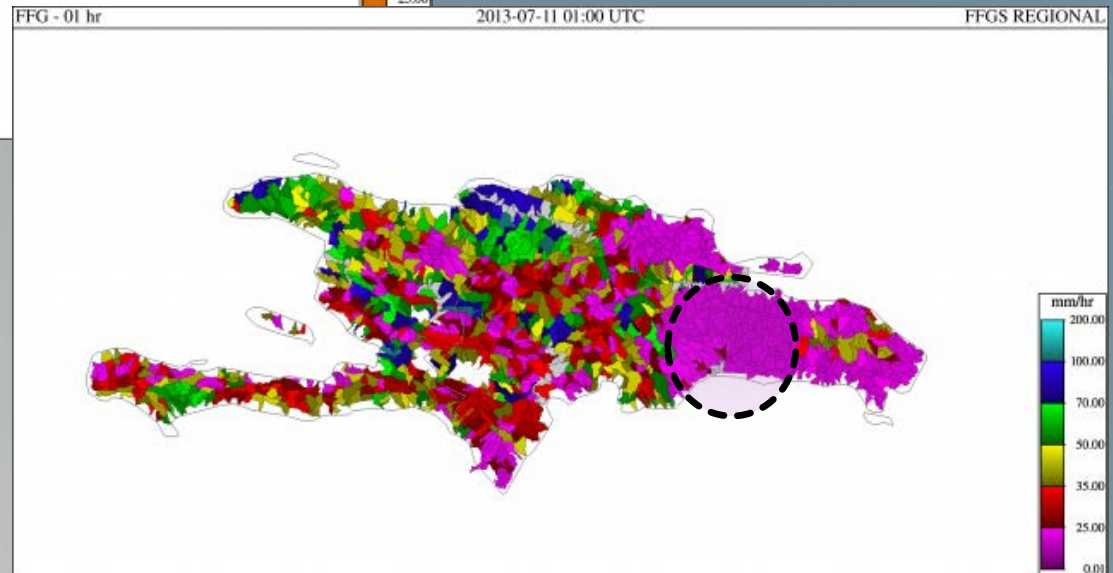
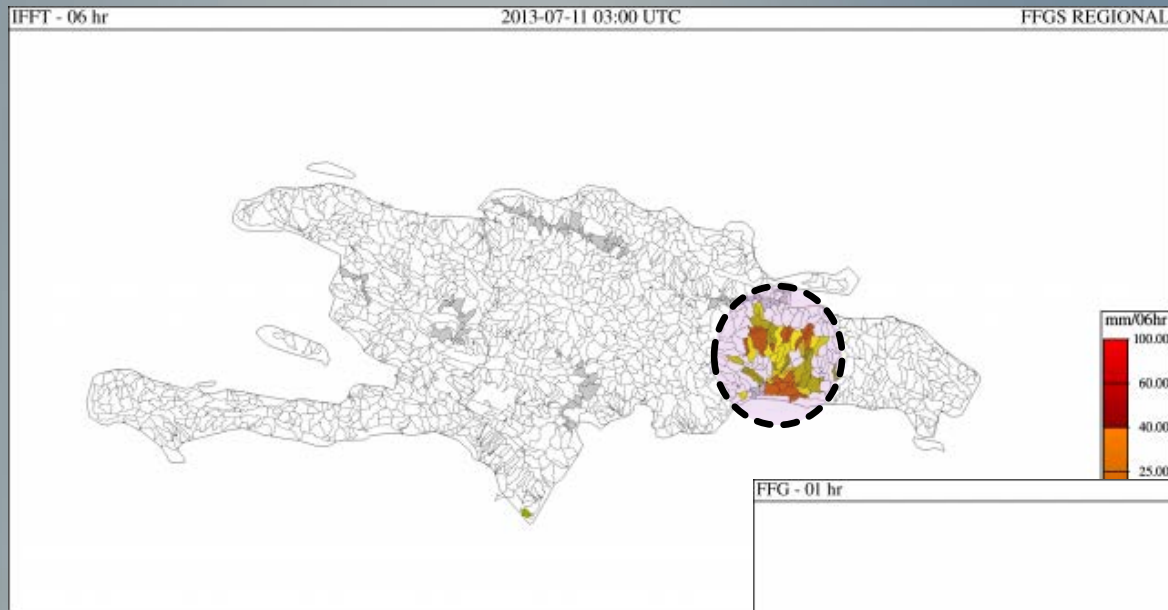
# Operational Approaches for Flash Flood Guidance

Application of remotely sensed data and hydrologic modeling products to develop a high spatial resolution, rapid-response system that can be used as a tool for flash flood warnings (guidance)



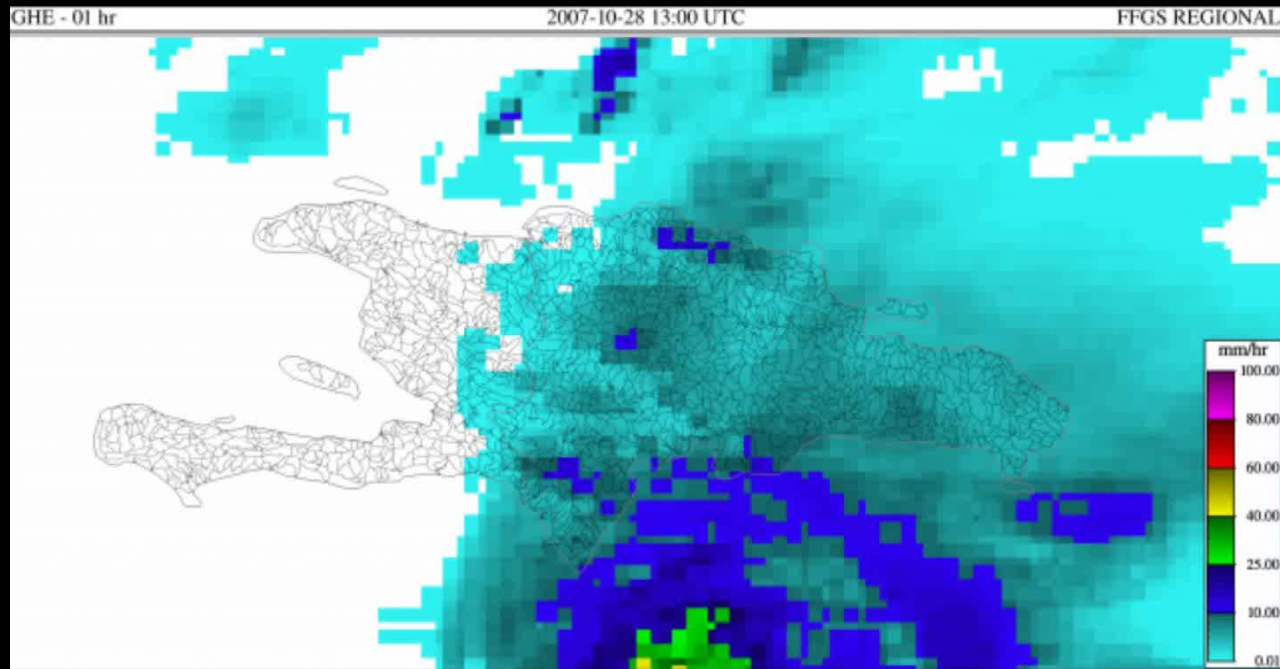
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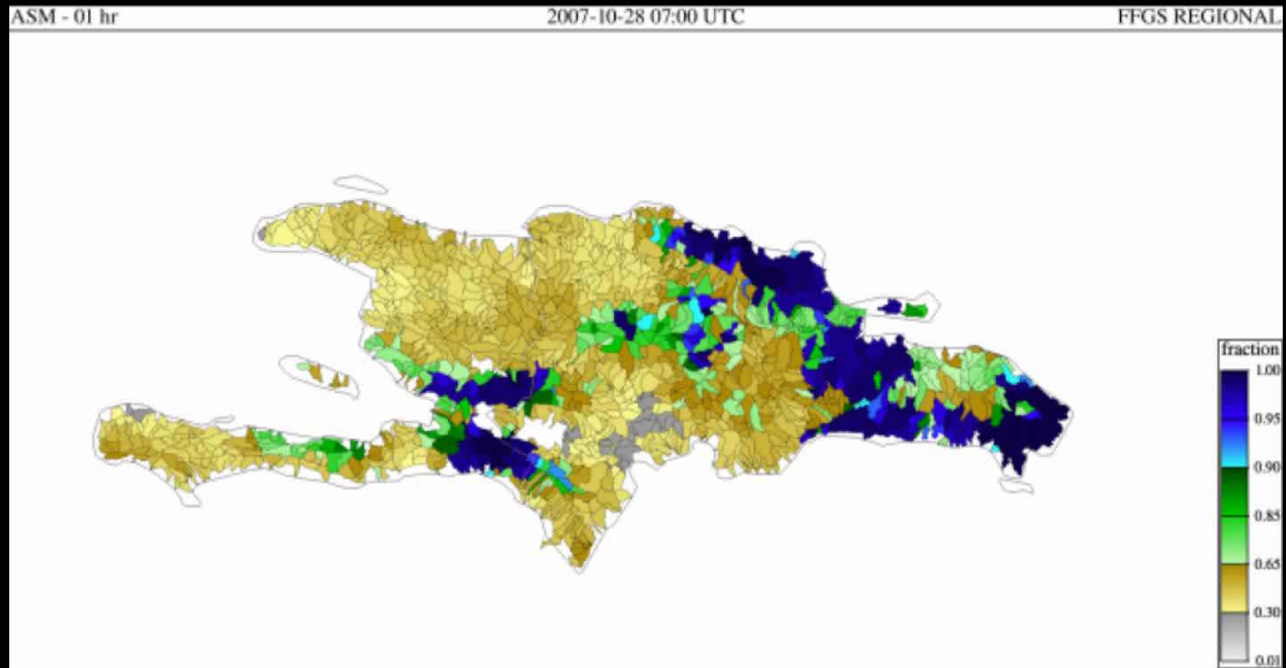




# Global Hydro-Estimator Product



# Average Soil Moisture Product







# ATTRIBUTES OF THE FFG SYSTEM

System already implemented under a variety of conditions throughout the world

System is proven easily implementable and sustainable worldwide because it supports existing locally-operating government agencies



The system is economical and sustainable as it uses existing infrastructure and covers large areas (we have an integrated training program to enhance sustainability)

In Haiti and Dominican Republic, extreme weather and climatic events including droughts, flash floods and floods have and will continue to have significant impacts on economic sectors, natural resources, ecosystems, livelihoods, and human health (IPCC 2014).



Thank You