

Flash Flood Guidance Approach

Hydrologic Research Center, USA
Technical Developer

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What makes FLASH FLOODS unique?

WORLD METEOROLOGICAL ORGANIZATION (WMO):

“ A flood of short duration with a relatively high peak discharge ”

AMERICAN METEOROLOGICAL SOCIETY (AMS):

“ A flood that rises and falls quite rapidly with little or no advance warning, usually the result of intense rainfall over a relatively small area ”

A local hydrometeorological phenomenon that requires:

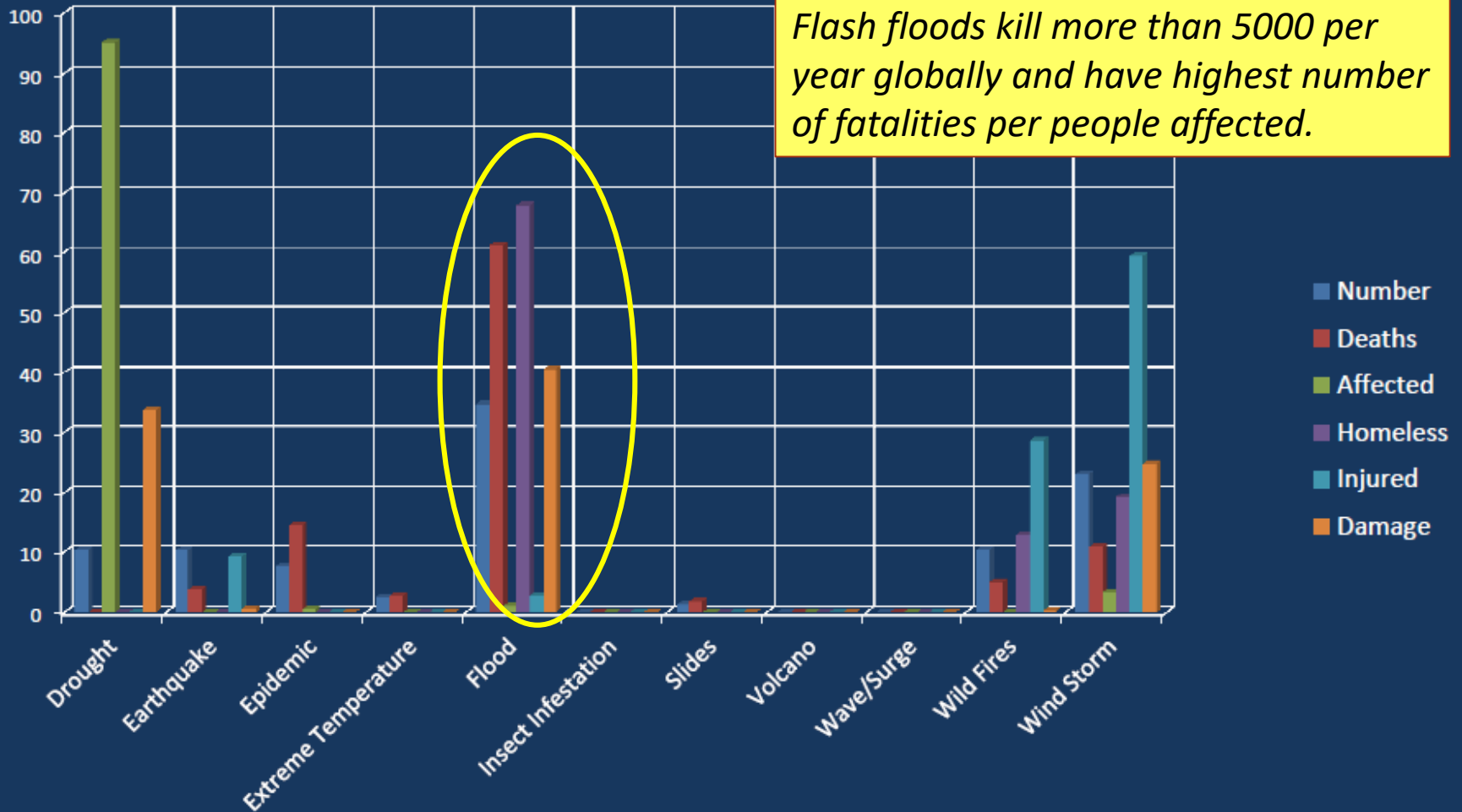
1. BOTH Hydrological and Meteorological expertise for real time forecasting/warning
2. Knowledge of local up to the hour information for effective warning

*Usually, flow crest is reached within **6 hours** of causative event
(Only consider < **2000km²**).*

What makes FLASH FLOODS unique?

IMPACT OF DISASTERS ON SOUTH AFRICA: 1920-2008
(Source: CRED)

Flash floods kill more than 5000 per year globally and have highest number of fatalities per people affected.



What makes FLASH FLOODS unique?

Flash floods (FF) are different than Large River Floods (LRF)



Flash Floods (FF) versus Large River Floods (LRF)

LRF

- ❖ *Catchment response affords long lead times*
- ❖ *Entire hydrographs can be produced*
- ❖ *w/ low uncertainty with good quality data*
- ❖ *Local information less valuable*
- ❖ *A **hydrologic** forecasting problem primarily*
- ❖ *Affords time for coordination of flood response and damage mitigation*

FF

- ❖ *Catchment response is very fast and allows very short lead times (< 12hrs)*
- ❖ *Prediction of occurrence is of interest*
- ❖ *Local information is very valuable*
- ❖ *A **hydro-meteorological** forecasting problem*
- ❖ *Coordination of forecasting and response is challenging over short times (Careful Planning Needed)*

Flash Flood Forecasting Systems

FLASH FLOODS ARE DIFFICULT TO FORECAST:

- Combination of rainfall rate and hydrologic forcing/situation
- Rapid and efficient production of runoff
- Short time scales

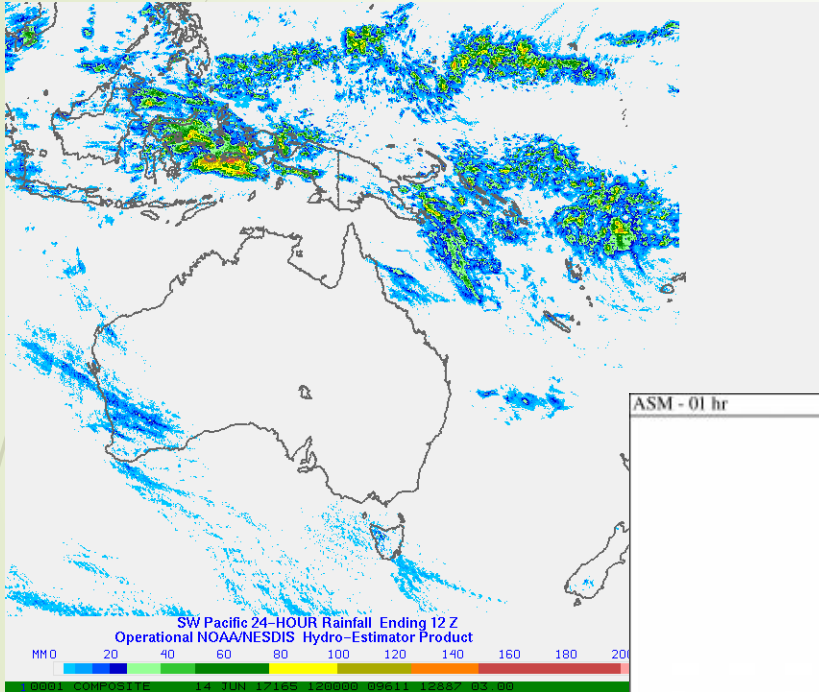
FEW COUNTRIES HAVE EFFECTIVE FLASH FLOOD WARNING SYSTEMS

- In UK and France, flash flood specific warnings only in the last decade.
- Effective warning message and understanding of risk by general population.
- In USA, flash flood guidance approach has been active for many years, with significant public education programs.
- Very few developing countries have any means of warning for flash floods.

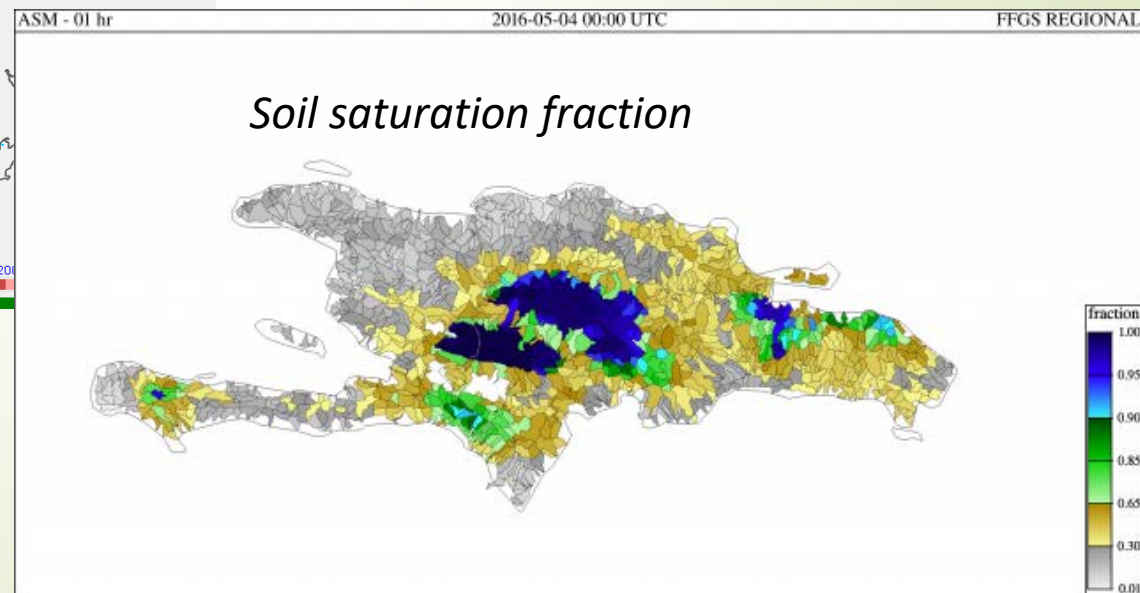
What information is needed to forecast a FLASH FLOOD?

Historical warnings: “heavy rain with potential for flash floods”

1. Precipitation



2. Information on land surface



Why is Soil Moisture Important?

GEORGAKAKOS ET AL.: HYDROCLIMATOLOGY OF WATERSHEDS, 1

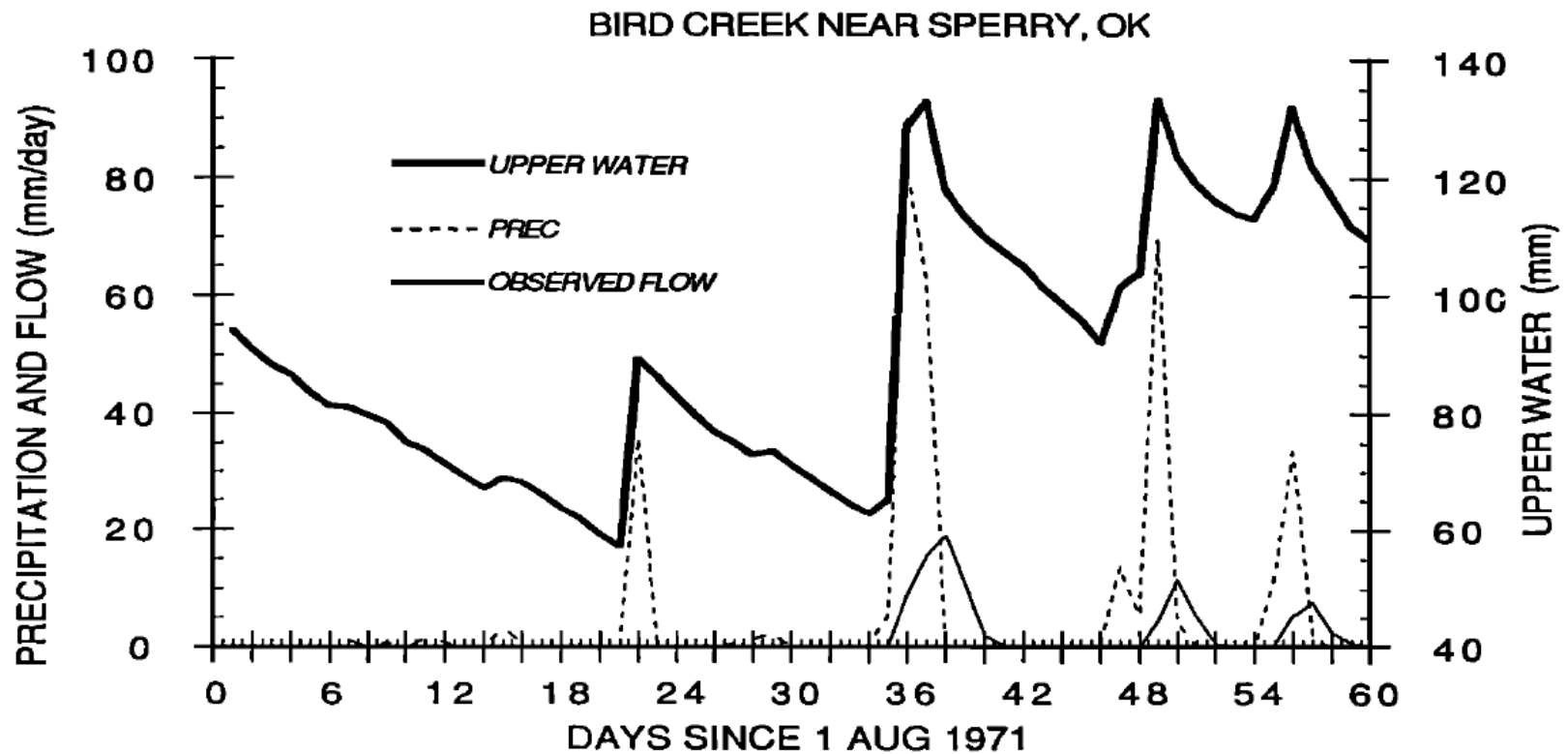
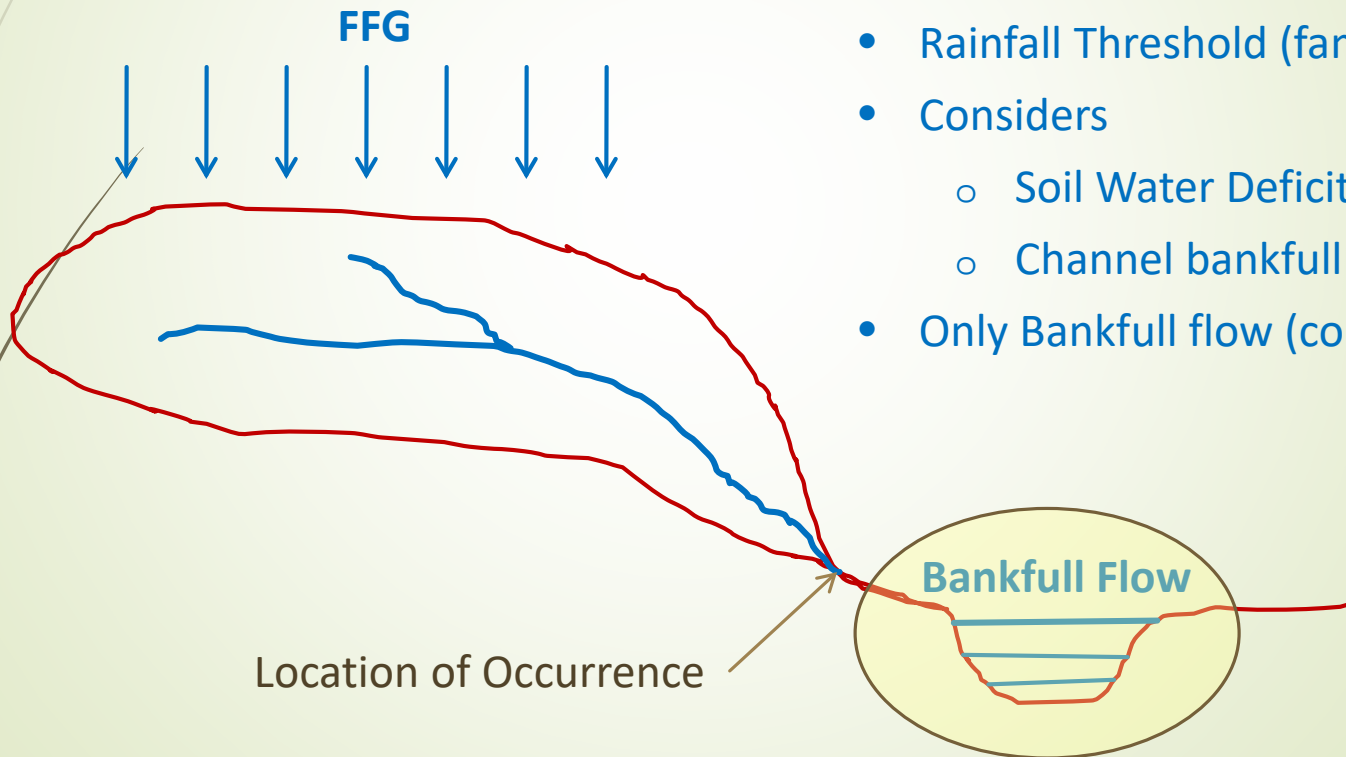


Figure 2. Daily values of rainfall rate (dashed line), flow rate (solid line), and upper soil water (heavy solid line) for Bird Creek near Sperry, Oklahoma, for August and September 1971. Rainfall and flow rates are in millimeters per day and are read on the left ordinate axis. Upper water is in millimeters and is read on the right ordinate axis. Upper water capacity is 135 mm.

FFG Fundamental Concepts

Flash Flood Guidance (FFG): defines the amount of **rainfall** of a given duration and over a given catchment that is just enough to cause **flooding conditions** at the outlet of the draining stream

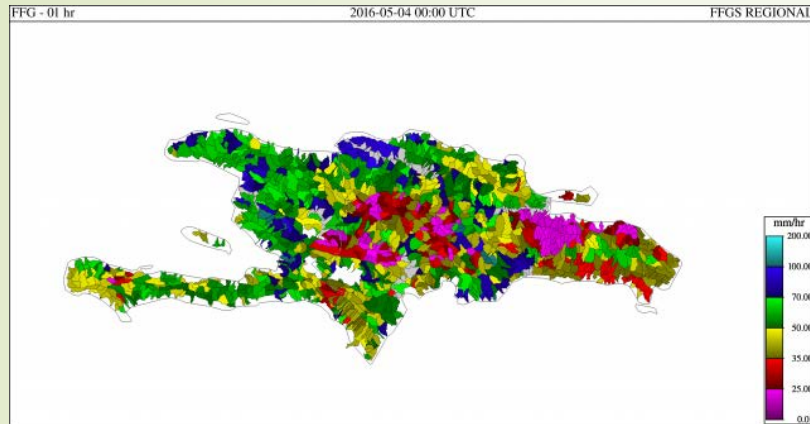


- Rainfall Threshold (familiar concept)
- Considers
 - Soil Water Deficit
 - Channel bankfull storage
- Only Bankfull flow (conservative)

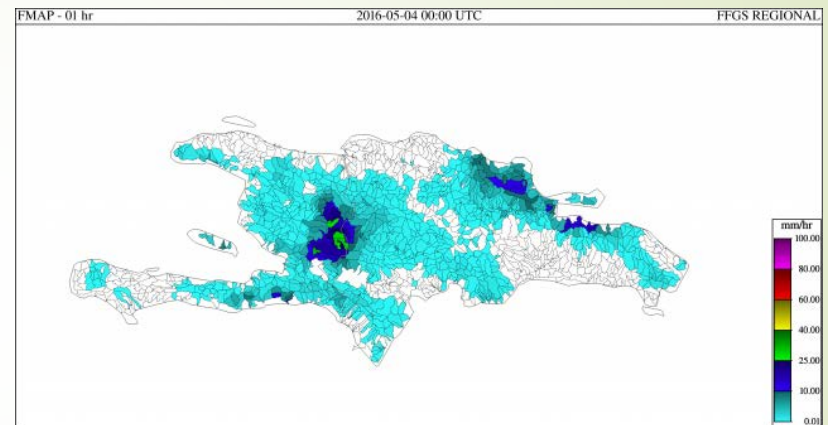
Threshold exceedance concept to estimate occurrence only!

Fundamental Concept of FFG Use

FFG: How much rain is *needed* to reach flooding conditions?

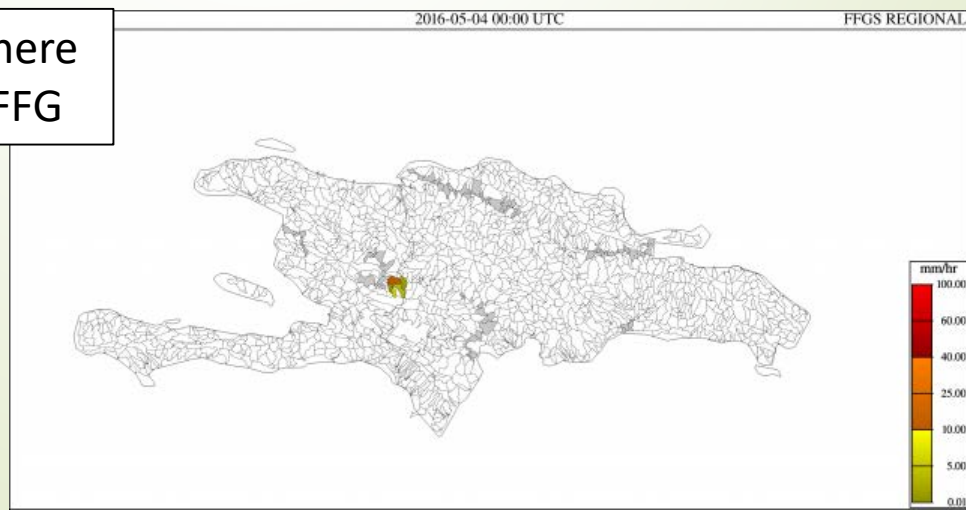


FMAP: How much rain is forecasted?



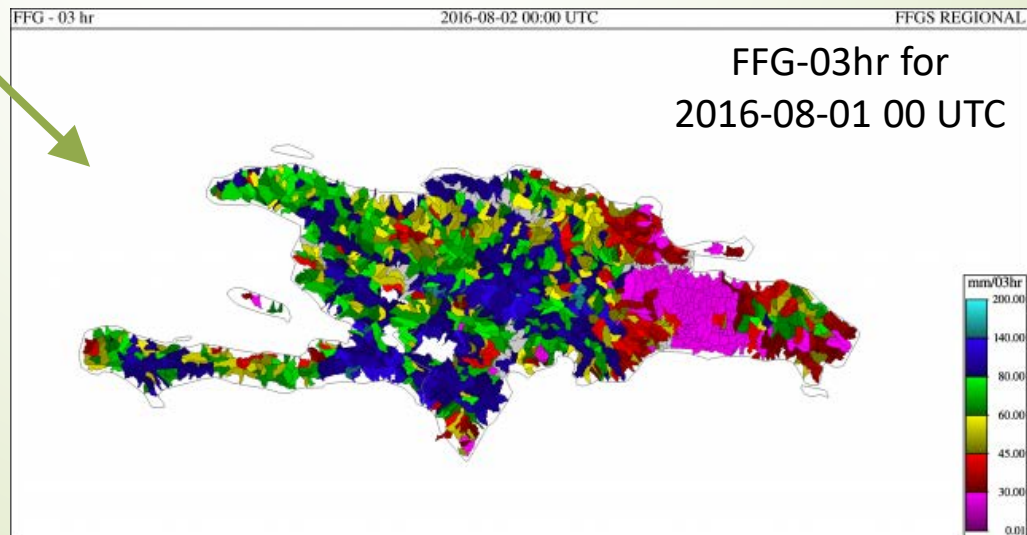
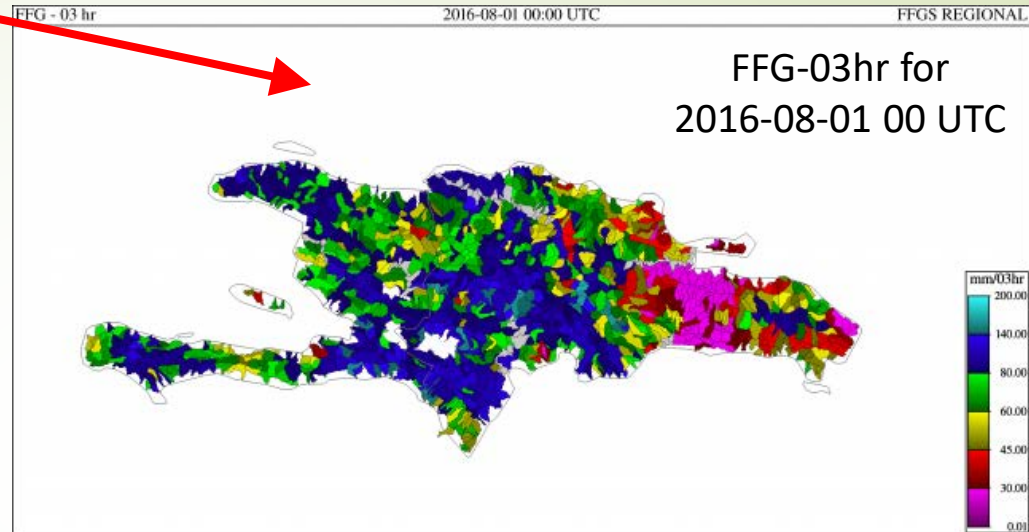
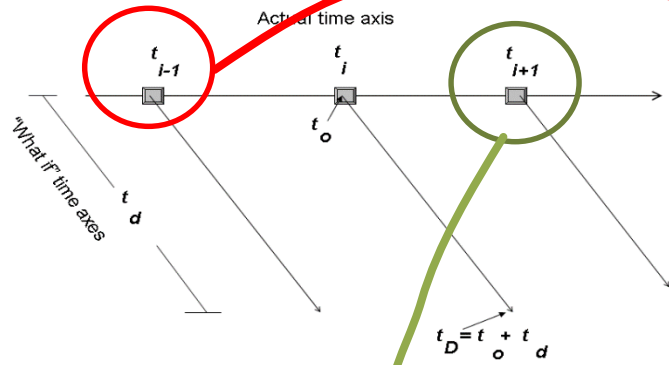
Flash Flood Threat (FFT) Products

FFTs indicate basins where precipitation exceeds FFG



Time-Varying FFG Product

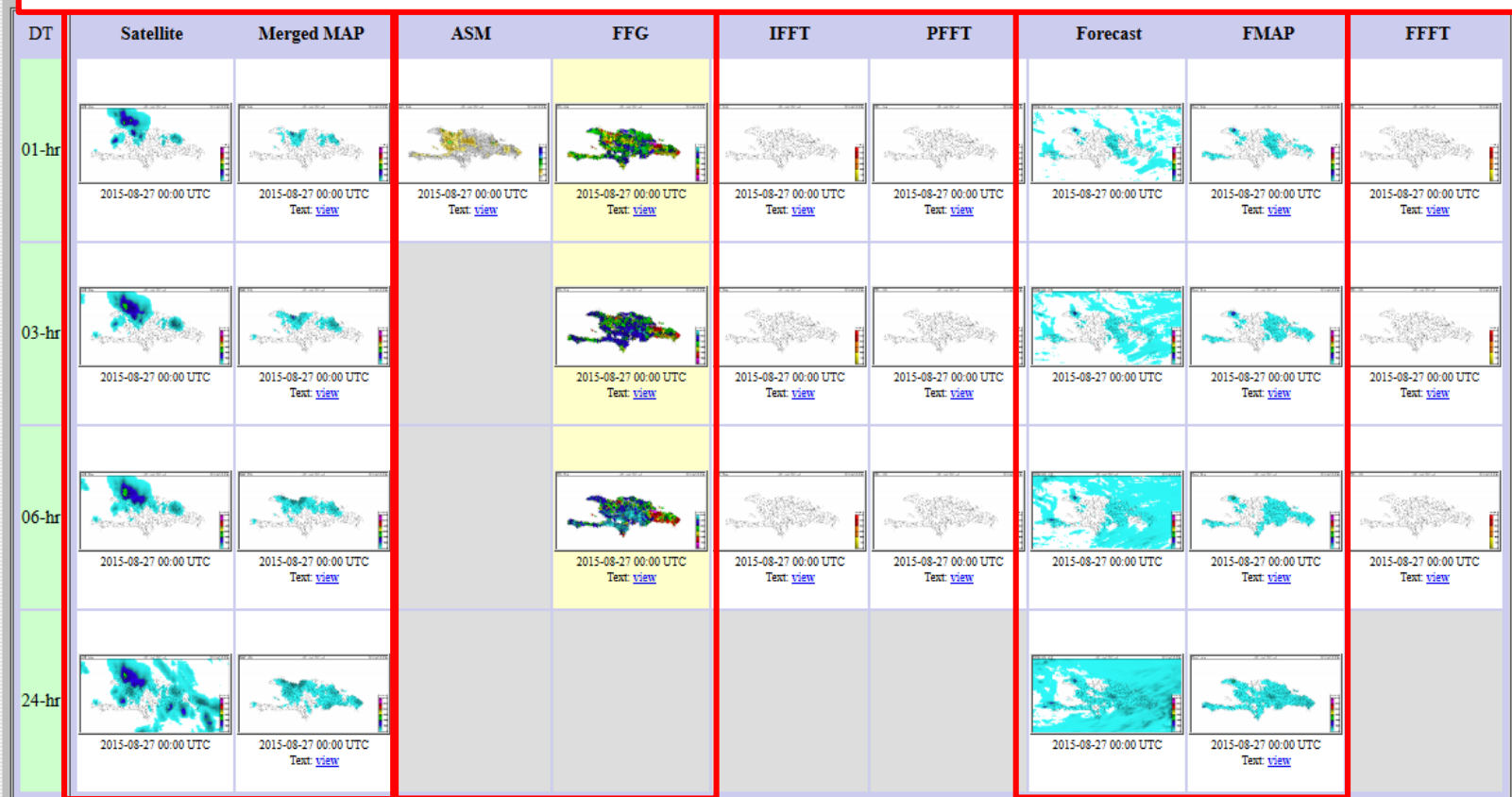
Hydrologic Model Run Time (6-hourly)



FFG System Forecaster Interface

HDRFFG - Haiti and Dominican Republic Flash Flood Guidance System

Provides operational NHMS forecasters with up-to-date information on key variables for rapid assessment of flash flood risk.



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

SFTP data transfer (requires SFTP Client): [EXPORTS/REGIONAL/2015/08/27](#)

Surfmet Gauge Precipitation Accumulations ending on 2015-08-27 00:00 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
10	Sabana Larga, Ocoa	2015-08-27 00:00:00+00	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
11	Pimentel, Duarte	2015-08-27 00:00:00+00	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
12	Las Galeras, Samana	2015-08-27 00:00:00+00	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
13	Neyba	2015-08-27 00:00:00+00	0	No Data	No Data	No Data	17	No Data	No Data	No Data
6	Valle Nuevo	2015-08-27 00:00:00+00	No Data	No Data	8	17	8	16	No Data	8
7	El Paso, Namu	2015-08-27 00:00:00+00	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data

Recent Advancement: MapServer-Based Forecaster Interface

SARFFG - Southern Africa Flash Flood Guidance System

2017-07-07 22:57:37 UTC

Open Street Maps

SRTM 30m DEM

SRTM 30m DEM with Shaded Relief

SRTM 30m Contours

Zoom to Country
Select Country ▾

Product Selection Table
Basin: MAP ▾ 24HR ▾
Raster: ▾ ▾

Date Nav Controls
Product Date: 2017-05-14 22:00 UTC

00	01	02	03	04	05
06	07	08	09	10	11
12	13	14	15	16	17
18	19	20	21	22	23

Prev Hour Next Hour
Prev 6hr Interval Next 6hr Interval
Prev Day Next Day

Reset to Current

Sync Date Controls

Product Selection Table
Basin: FFG ▾ 06HR ▾
Raster: ▾ ▾

Zoom to Country
Select Country ▾

Open Street Maps

SRTM 30m DEM

SRTM 30m DEM with Shaded Relief

SRTM 30m Contours

MAP-24hr 2017-05-14 22:00 UTC

ASM-06hr 2017-05-14 18:00 UTC

FFG-06hr 2017-05-14 18:00 UTC

PFFT-06hr 2017-05-14 18:00 UTC

Open Street Maps

SRTM 30m DEM

SRTM 30m DEM with Shaded Relief

SRTM 30m Contours

Zoom to Country
Select Country ▾

Product Selection Table
Basin: ASM ▾ 06HR ▾
Raster: ▾ ▾

Date Nav Controls
Product Date: 2017-05-14 22:00 UTC

00	01	02	03	04	05
06	07	08	09	10	11
12	13	14	15	16	17
18	19	20	21	22	23

Prev Hour Next Hour
Prev 6hr Interval Next 6hr Interval
Prev Day Next Day

Reset to Current

Sync Date Controls

Product Selection Table
Basin: PFFT ▾ 06HR ▾
Raster: ▾ ▾

Zoom to Country
Select Country ▾

Open Street Maps

SRTM 30m DEM

SRTM 30m DEM with Shaded Relief

SRTM 30m Contours

[Product Viewer](#) | [Product Comparison](#)

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Latest Advance: MapServer-Based Forecaster Interface

SARFFG - Southern Africa Flash Flood Guidance System

2017-07-07 22:59:53 UTC

Open Street Maps

SRTM 30m DEM

SRTM 30m DEM with Shaded Relief

SRTM 30m Contours

Zoom to Country
South Africa

Product Selection Table
Basin: MAP ASM FFG PFFT
06HR

Date Nav Controls
Product Date: 2017-05-14 22:00 UTC

00	01	02	03	04	05
06	07	08	09	10	11
12	13	14	15	16	17
18	19	20	21	22	23

Prev Hour | Next Hour
Prev 6hr Interval | Next 6hr Interval
Prev Day | Next Day

Reset to Current

Sync Date Controls

Product Selection Table
Basin: FFG PFFT
06HR

Zoom to Country
South Africa

Open Street Maps

SRTM 30m DEM

SRTM 30m DEM with Shaded Relief

SRTM 30m Contours

MAP-06hr 2017-05-14 22:00 UTC

ASM-06hr 2017-05-14 18:00 UTC

FFG-06hr 2017-05-14 18:00 UTC

PFFT-06hr 2017-05-14 18:00 UTC

Open Street Maps

SRTM 30m DEM

SRTM 30m DEM with Shaded Relief

SRTM 30m Contours

Zoom to Country
Select Country

Product Selection Table
Basin: ASM PFFT
06HR

Date Nav Controls
Product Date: 2017-05-14 22:00 UTC

00	01	02	03	04	05
06	07	08	09	10	11
12	13	14	15	16	17
18	19	20	21	22	23

Prev Hour | Next Hour
Prev 6hr Interval | Next 6hr Interval
Prev Day | Next Day

Reset to Current

Sync Date Controls

Product Selection Table
Basin: PFFT FFG
06HR

Zoom to Country
Select Country

Open Street Maps

SRTM 30m DEM

SRTM 30m DEM with Shaded Relief

SRTM 30m Contours

Product Viewer | Product Comparison

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Latest Advance: MapServer-Based Forecaster Interface

SARFFG - Southern Africa Flash Flood Guidance System

NOTE: Development in Progress - Contents and Functionality Might Break Frequently. Caching will improve loading speeds after first-time view of an area.

Date Nav Controls

Product Date: 2017-05-14 18:00 UTC

00	01	02	03	04	05
06	07	08	09	10	11
12	13	14	15	16	17
18	19	20	21	22	23

Prev Hour Next Hour

Prev 6hr Interval Next 6hr Interval

Prev Day Next Day

Reset to Current

Product Selection Table

Basin: IFFT 06HR

Raster:

Zoom to Country
Select Country

Zoom to Basin ID
Enter Basin ID

2017-07-07 23:05:10 UTC

Lon, Lat

- Open Street Maps
- SRTM 30m DEM
- SRTM 30m DEM with Shaded Relief
- SRTM 30m Contours
- SRTM Contour Labels
- Open Street Maps - Water Only
- Open Street Maps - Roads Only
- SARFFG Operational Product
- SARFFG Basin ID Labels
- Lon/Lat Graticule
- Header Label
- Product Colorscale (in map)
- SRTM Colorscale (in map)

IFFT 06hr (mm/6hr) 1.00

SRTM v4.1 (meter) 8500+ 5500 3000 1500 1000 500 300 100 -100 -500 -2500

Selected Basin:
[Click on map to select basin](#)

Design of Regional FFG Systems

From Global Data and Regional Hydrometeorology to Country Data and Warnings

Regional Center: Computational Core

Country NMHS:
Adjustment and Warning Core

Global/Regional Observations
& ATM Model Forecasts

Computational
Component

Local Products
& **Uncertainty**

Country Data

Country
Warning Generation System

Country
Warning Dissemination System

Response Agencies

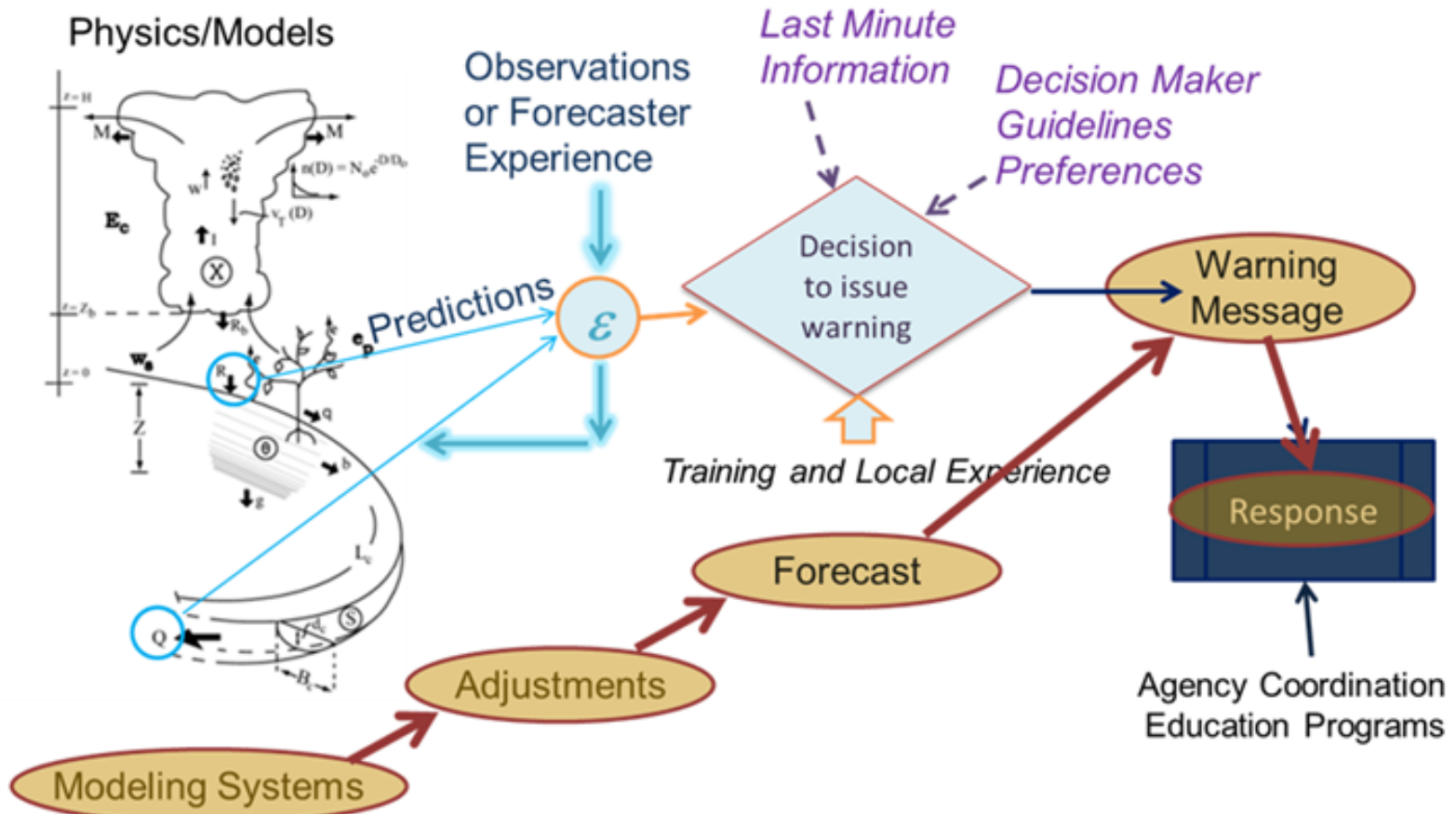
We recognize:

Decisions are made with multiple datasets and under uncertainty.

There is a need to modify the products of the regional system by country forecasters and have capability for estimating consequences to local flash flood potential

FFG System Products in Context of End-to-End Chain

From a System of Models to a Program



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

Flash Flood Guidance Approach

