Flash Flood Guidance Approach

Hydrologic Research Center, USA
Technical Developer

SAOFFG Steering Committee Meeting 1
10-12 July 2017
Jakarta, INDONESIA

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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):

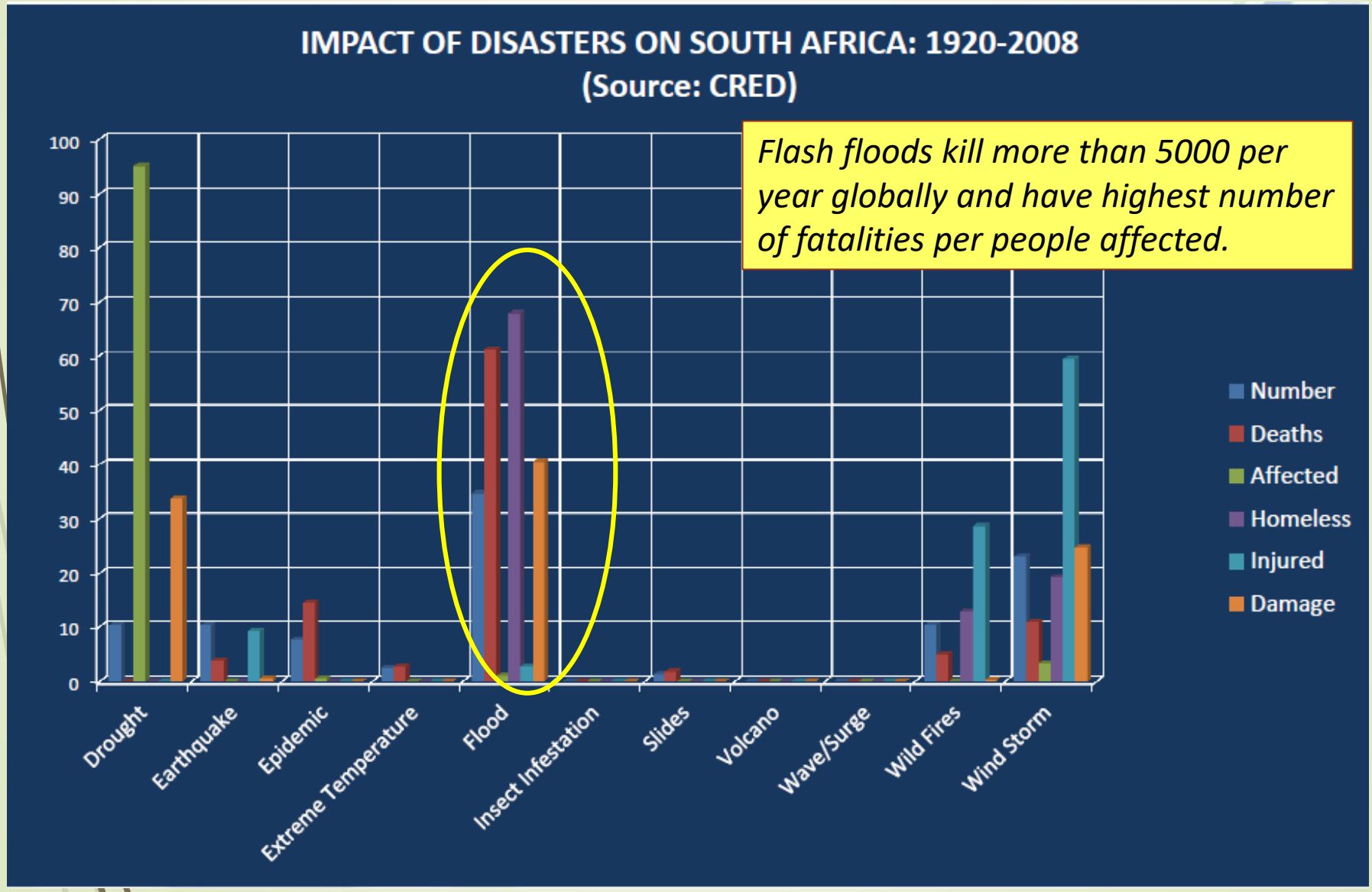
" A flood that rises and falls quite rapidly with little or no advance warning, usually the result of intense rainfall over a relatively small area "

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 **< 2000km^2**).*

What makes FLASH FLOODS unique?



What makes FLASH FLOODS unique?

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

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

LRF	*FF*
❖ *Catchment response affords long lead times*	❖ *Catchment response is very fast and allows very short lead times (< 12hrs)*
❖ *Entire hydrographs can be produced* ❖ *w/ low uncertainty with good quality data*	❖ *Prediction of occurrence is of interest*
❖ *Local information less valuable*	❖ *Local information is very valuable*
❖ *A **hydrologic** forecasting problem primarily*	❖ *A **hydro-meteorological** forecasting problem*
❖ *Affords time for coordination of flood response and damage mitigation*	❖ *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

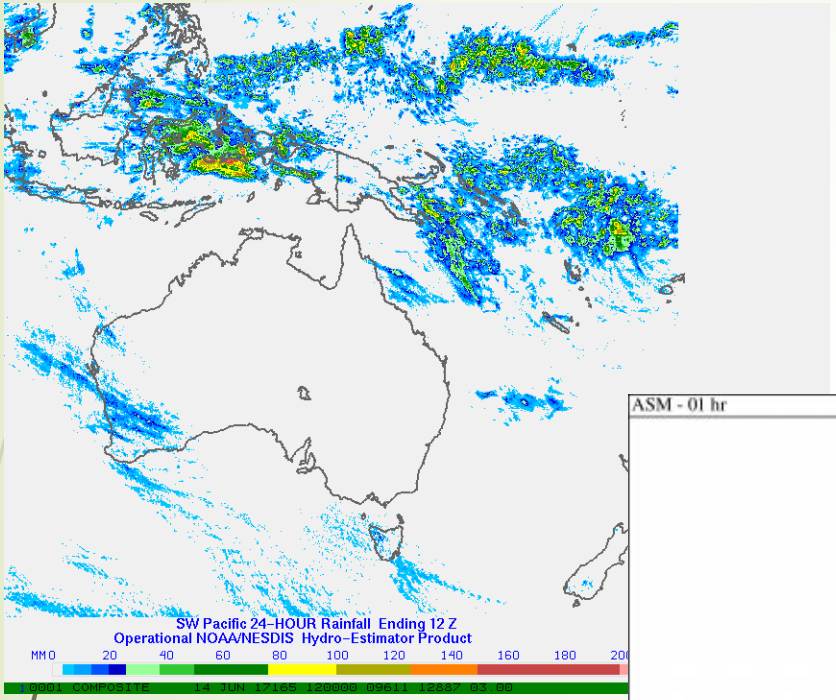
FEW COUNTRIES HAVE EFFECTIVE FLASH FLOOD WARNING SYSTEMS

- 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.

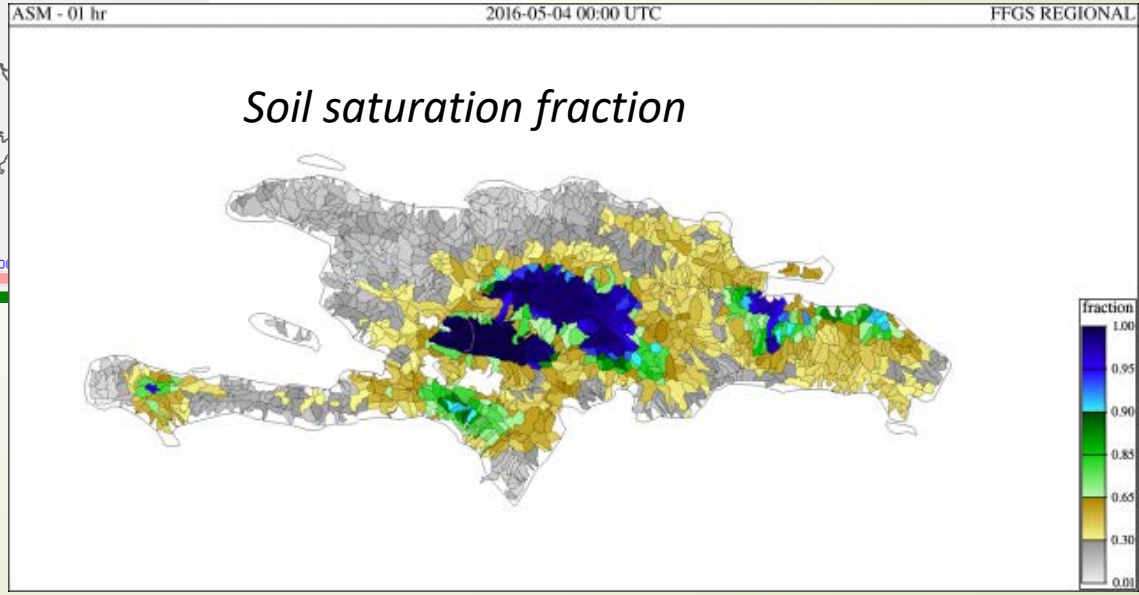
What information is needed to forecast a FLASH FLOOD?

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

1. Precipitation



2. Information on land surface



Why is Soil Moisture Important?

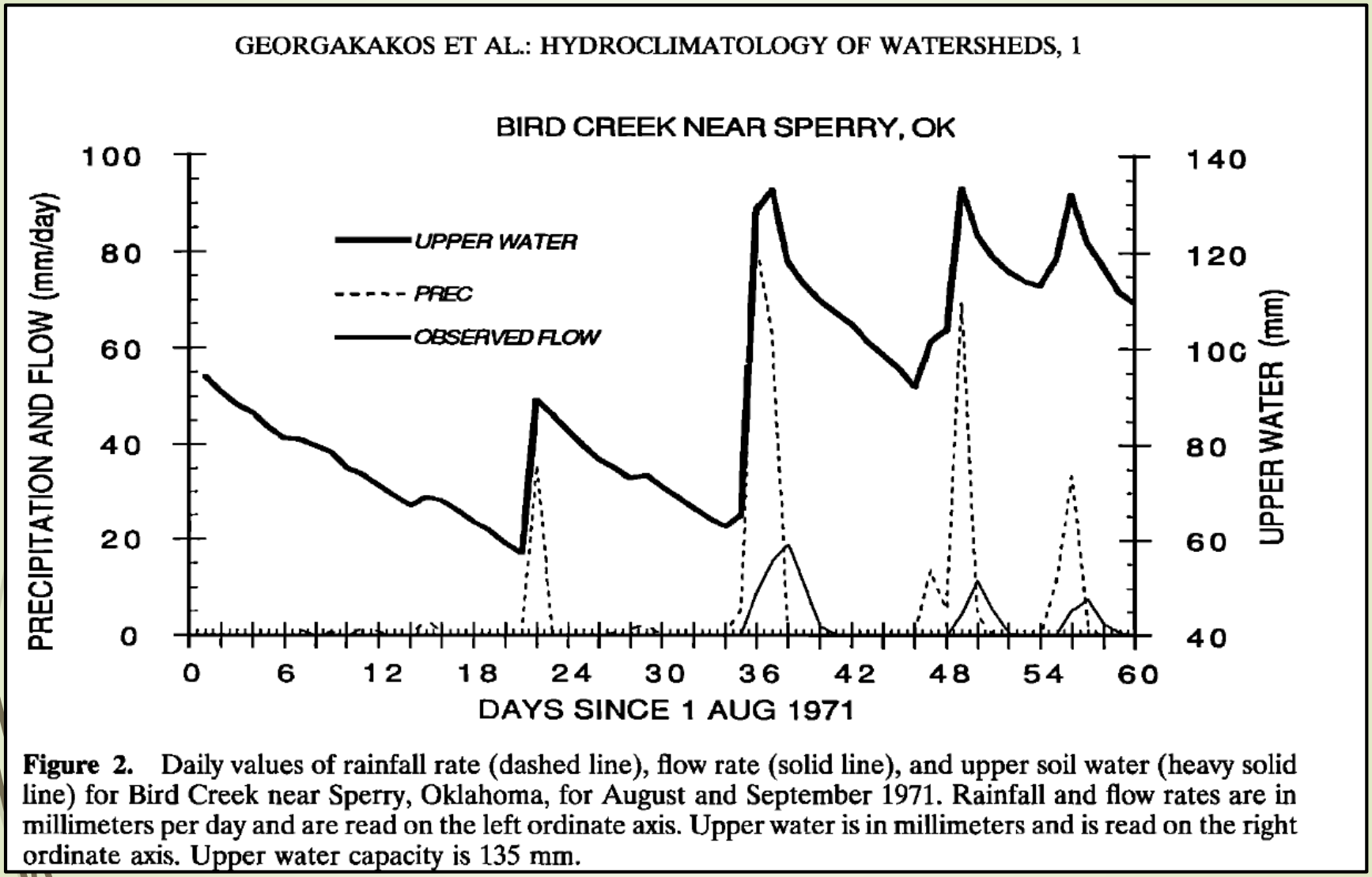
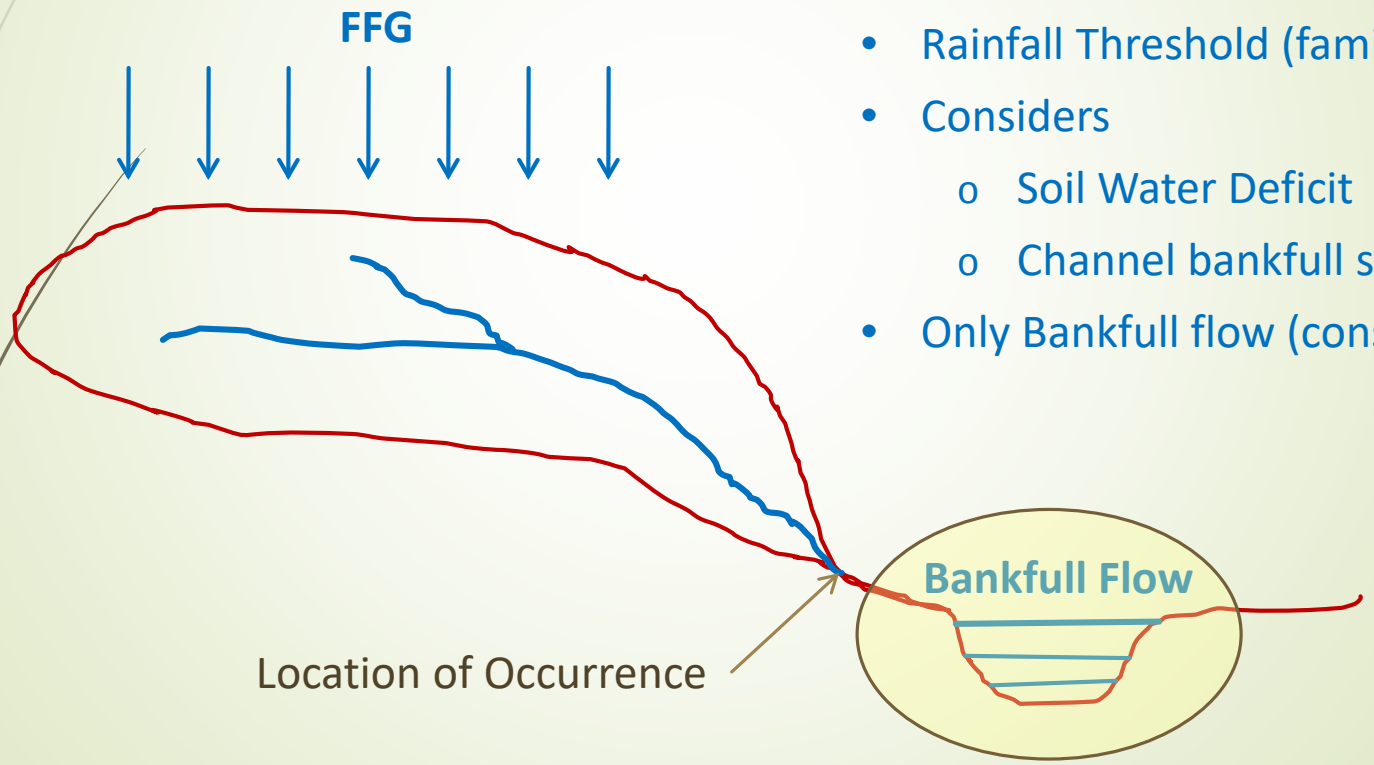


Figure 2. Daily values of rainfall rate (dashed line), flow rate (solid line), and upper soil water (heavy solid line) for Bird Creek near Sperry, Oklahoma, for August and September 1971. Rainfall and flow rates are in millimeters per day and are read on the left ordinate axis. Upper water is in millimeters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

Georgakakos et al., *WRR* **31**(3), 210-220, 1995.

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

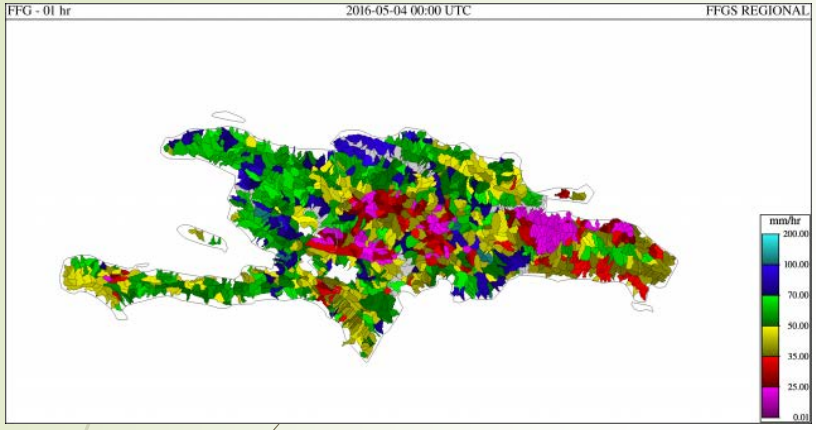


- Rainfall Threshold (familiar concept)
- Considers
  - Soil Water Deficit
  - Channel bankfull storage
- Only Bankfull flow (conservative)

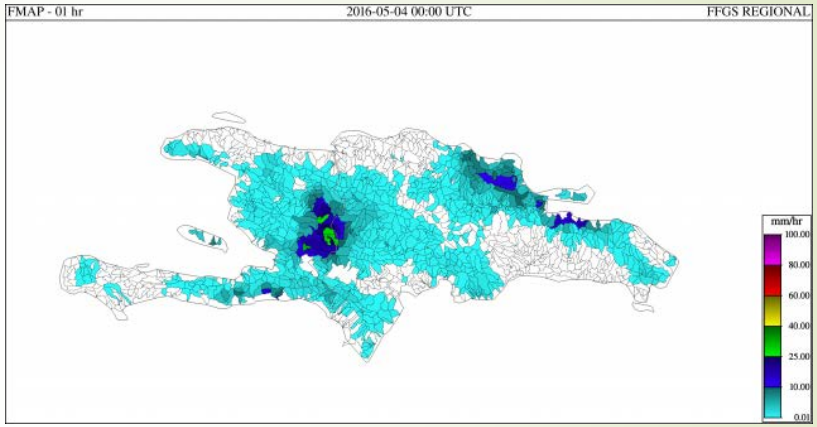
Threshold exceedance concept to estimate occurrence only!

Fundamental Concept of FFG Use

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

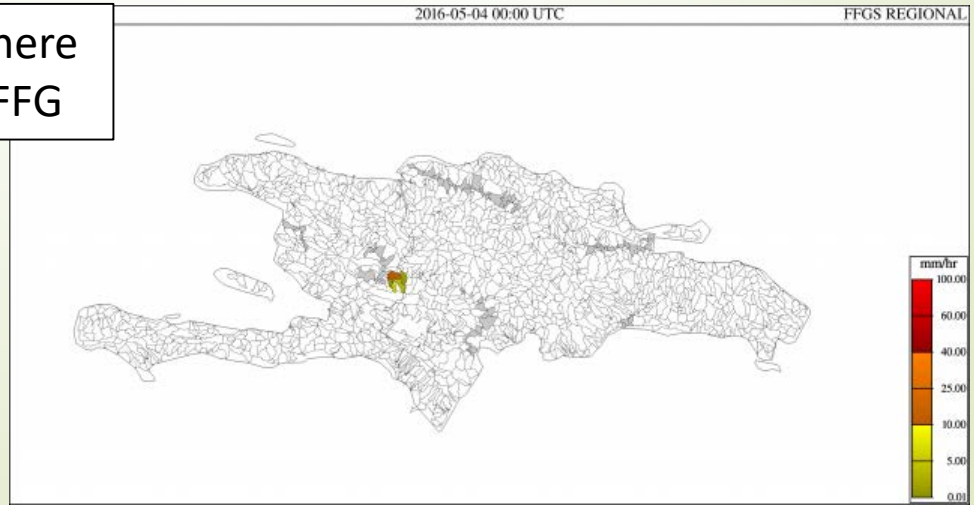


FMAP: How much rain is forecasted?



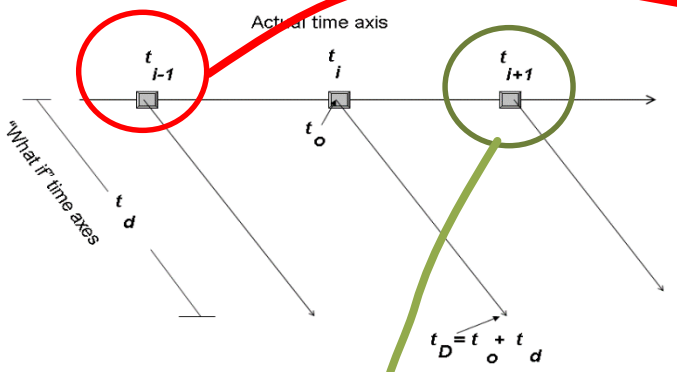
Flash Flood Threat (FFT) Products

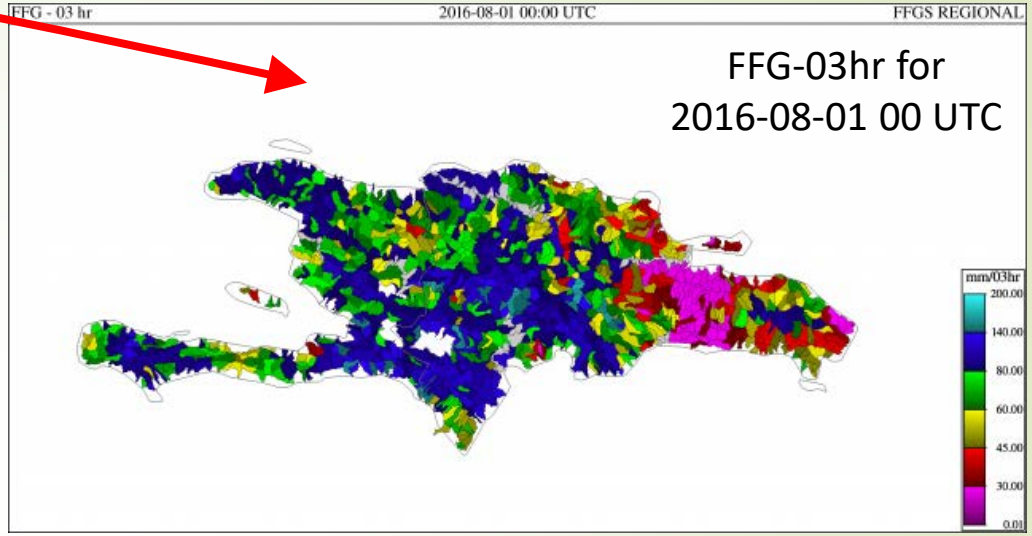
FFTs indicate basins where precipitation exceeds FFG



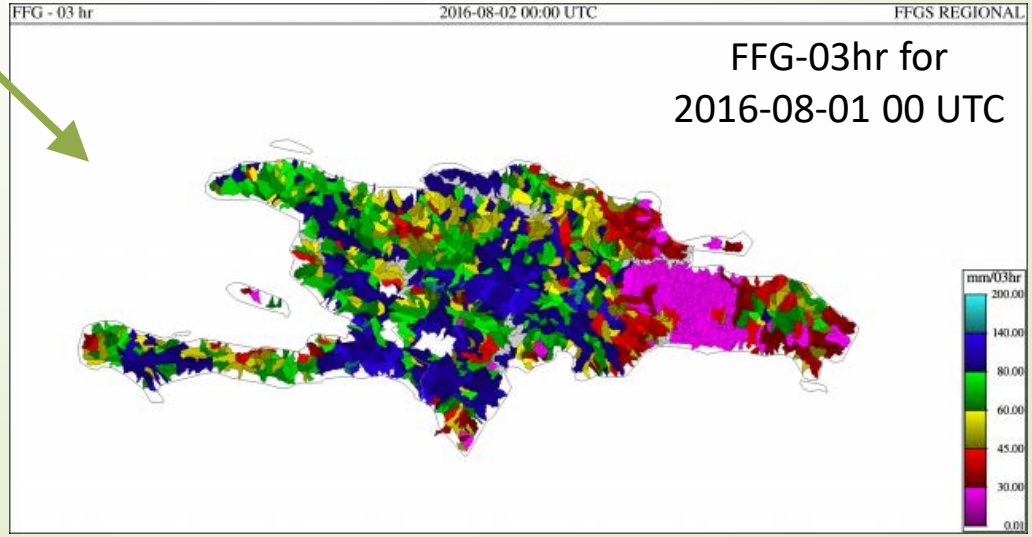
Time-Varying FFG Product

Hydrologic Model Run Time (6-hourly)





FFG-03hr for
2016-08-01 00 UTC



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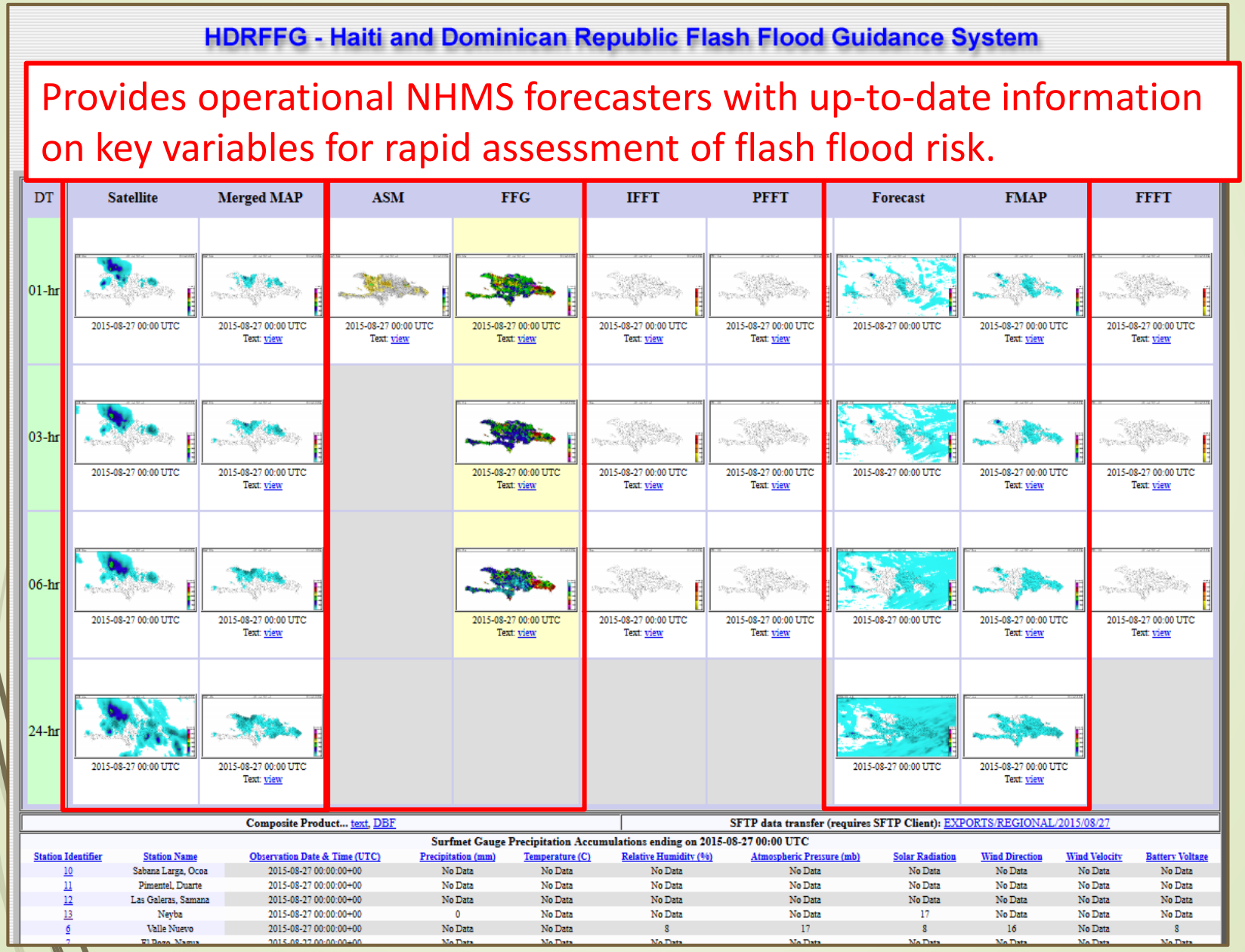
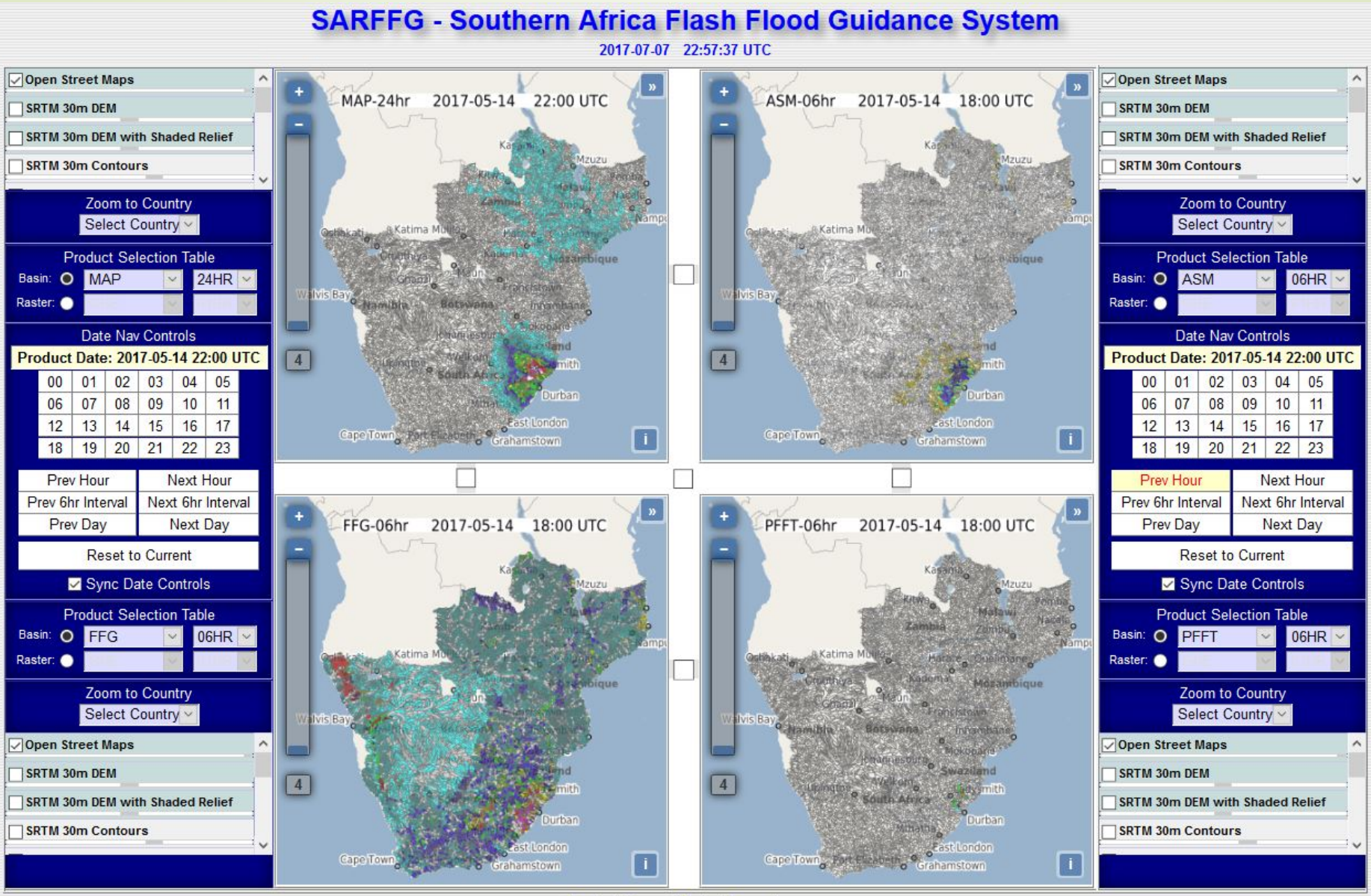
FFG System Forecaster Interface



Recent Advancement: MapServer-Based Forecaster Interface



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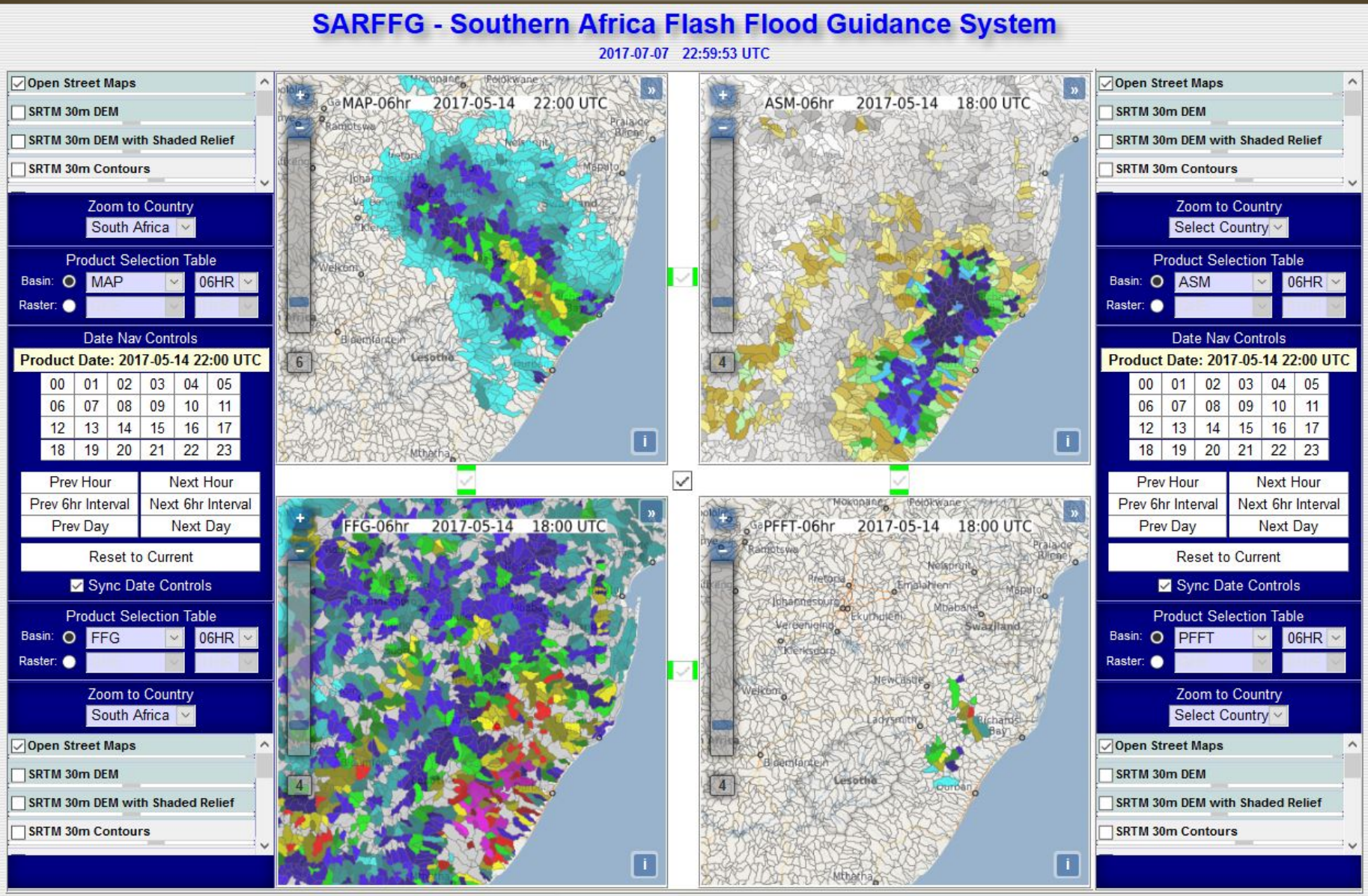

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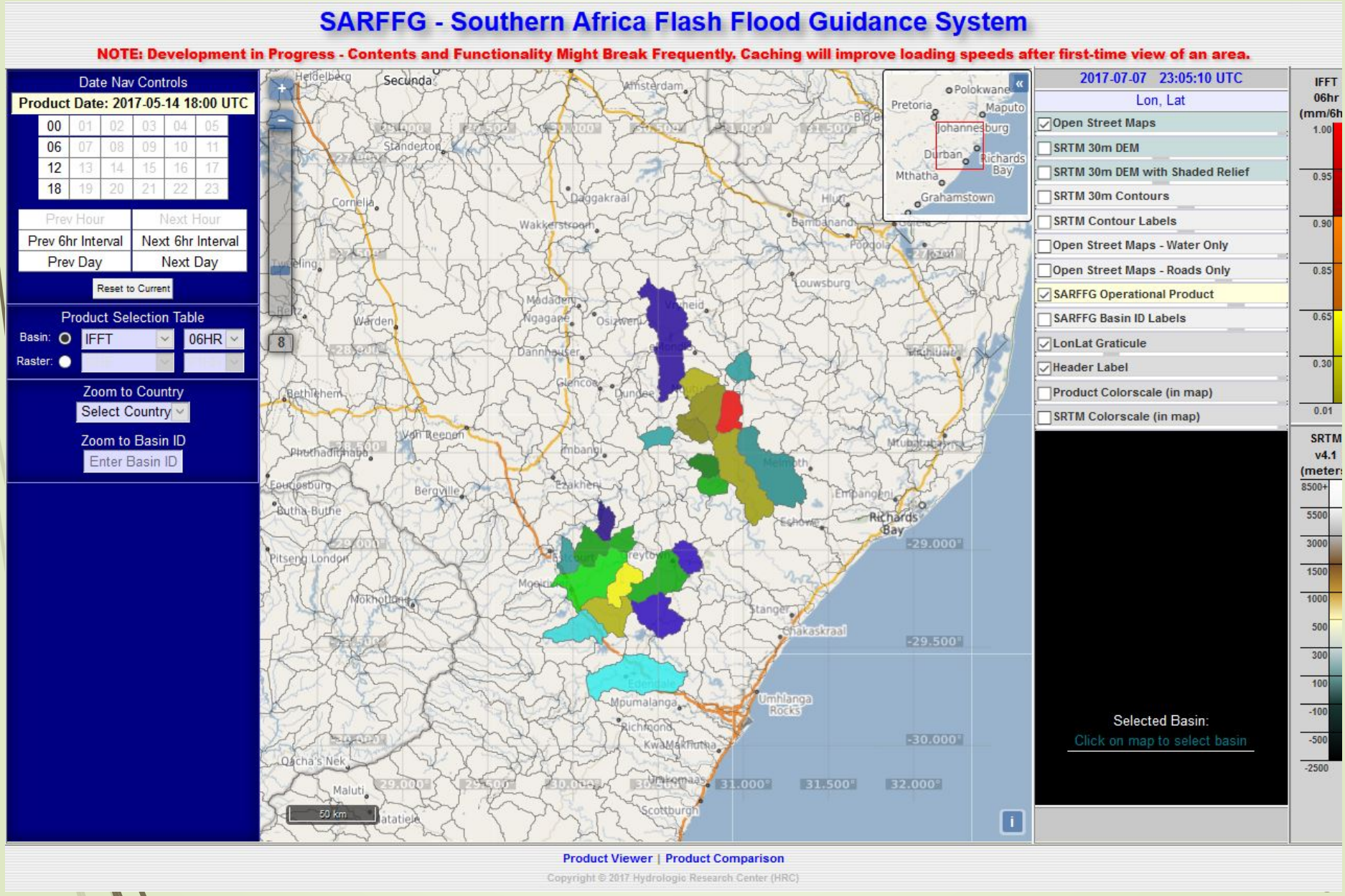
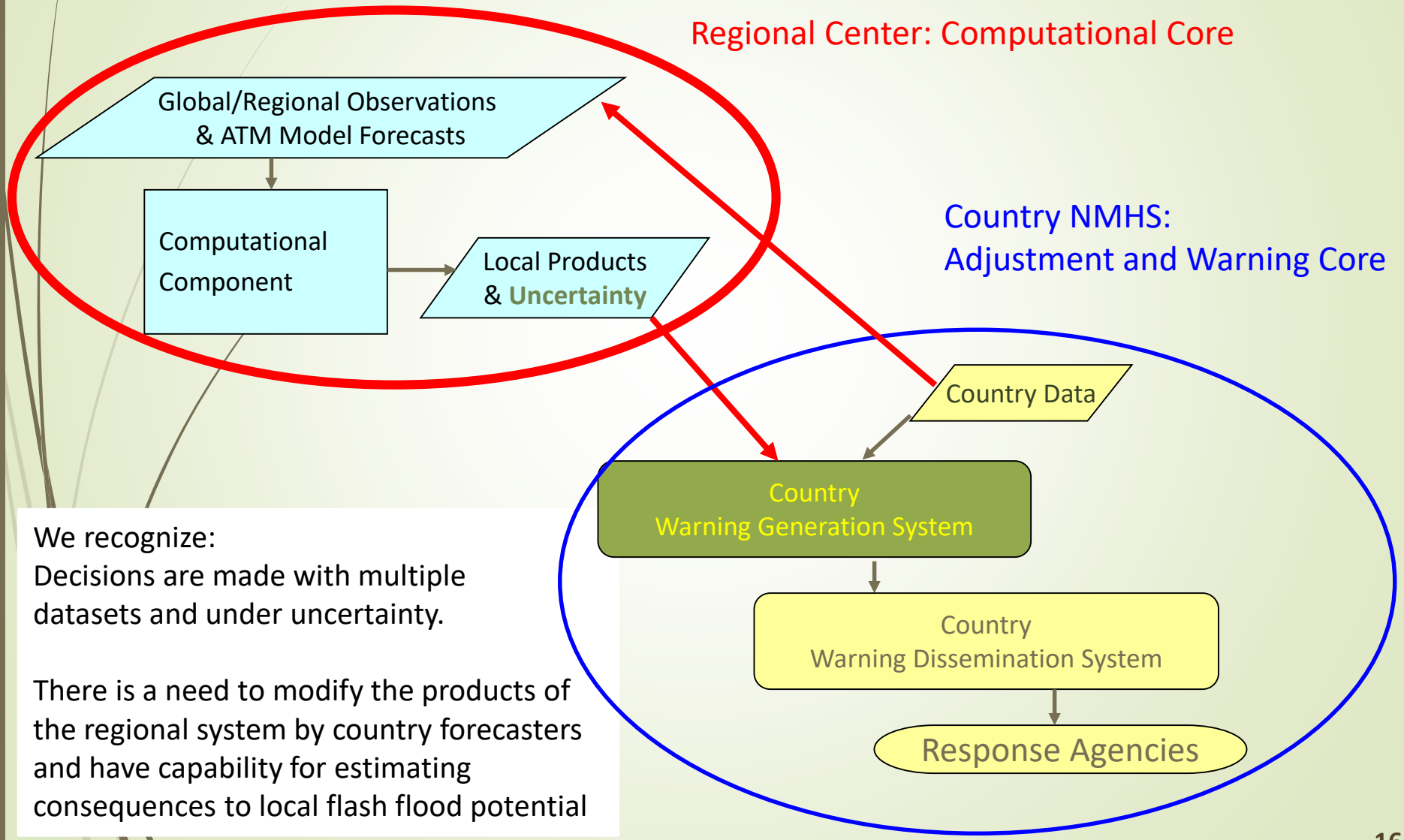


Design of Regional FFG Systems

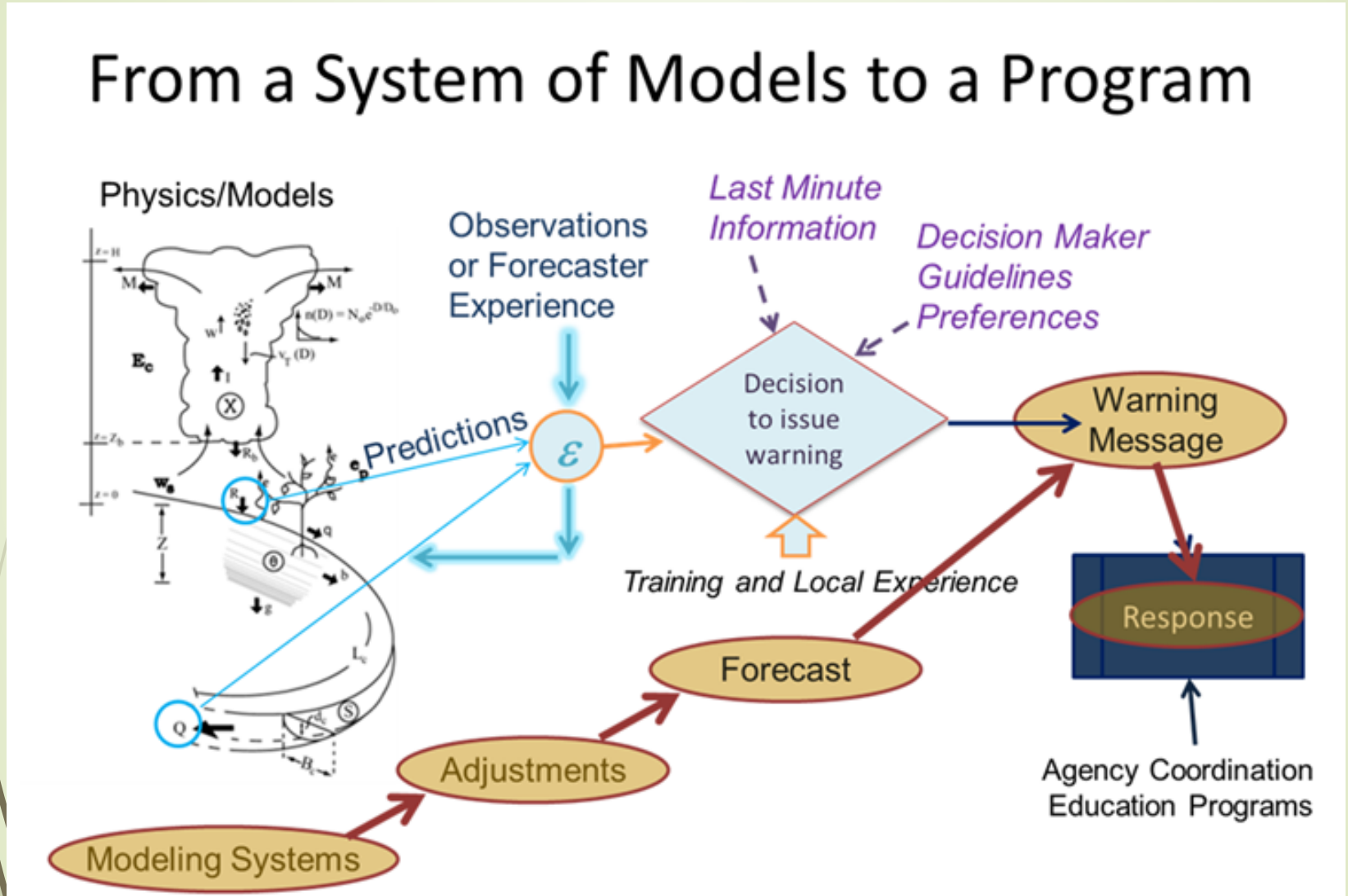
From Global Data and Regional Hydrometeorology to Country Data and Warnings



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



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