

HRC Role and Introduction to FFGS Concept

HYDROLOGIC RESEARCH CENTER

Southeastern Asia – Oceania FFG (SAOFFG) Planning Workshop

2 February 2016





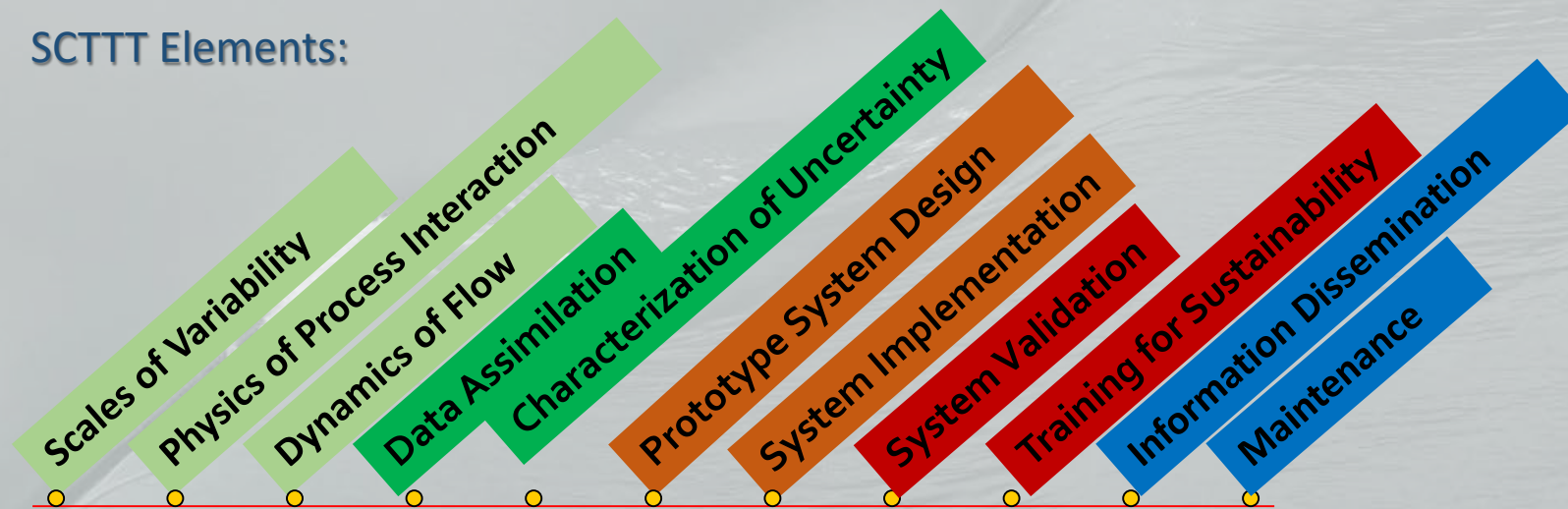
Hydrologic Research Center

Prototype **Nonprofit Public-Benefit** Corporation (Established in **1993**)

Mission: Provide assistance for the solution of water problems worldwide

HRC Project Objective: Science Cooperation - Technology Transfer and Training (SCTTT) activities in the diagnosis, prediction and warning of flash flood occurrence

SCTTT Elements:



DISCIPLINARY

MULTI-DISCIPLINARY

Role of HRC

In collaboration with USAID, WMO, NOAA and Countries

Developed the FFGS concept and system design

Tailors FFGS systems for specific regions (data, geomorphology and hydrometeorology)

Implements system at a regional center in the region

Trains Forecasters in the FFGS component and interface use for warnings

Provides GHE (with agreement with NESDIS) and MWGHE (value added to GHE) to regional systems

Maintains and enhances FFGS system implementations

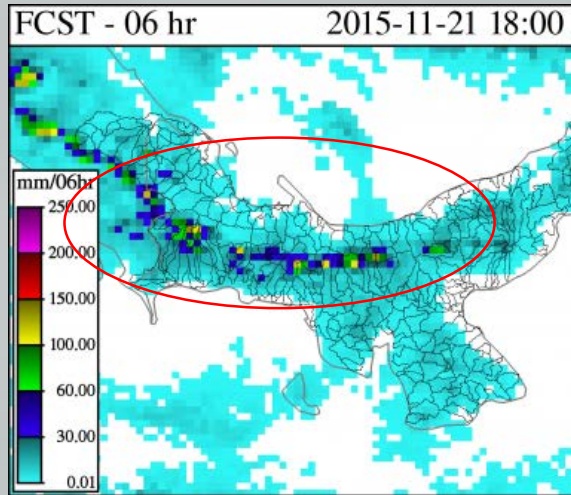


IMAGINE A PANAMA FORECASTER ON 1:00PM LST 21 NOVEMBER 2015 (Saturday)

Panama Time = UTC – 5 hours

It has been raining in Western Panama

What is the rainfall forecast?
FFG System WRF shows:



Home » News » Panama » 12 homes affected in Boquete floods

12 homes affected in Boquete floods

Posted on November 22, 2015 in Panama

HEAVY DOWNPOURS throughout the weekend led to flooding and land slides in Chiriqui and Bocas Del Toro with at least 12 homes affected in the district of Boquete.



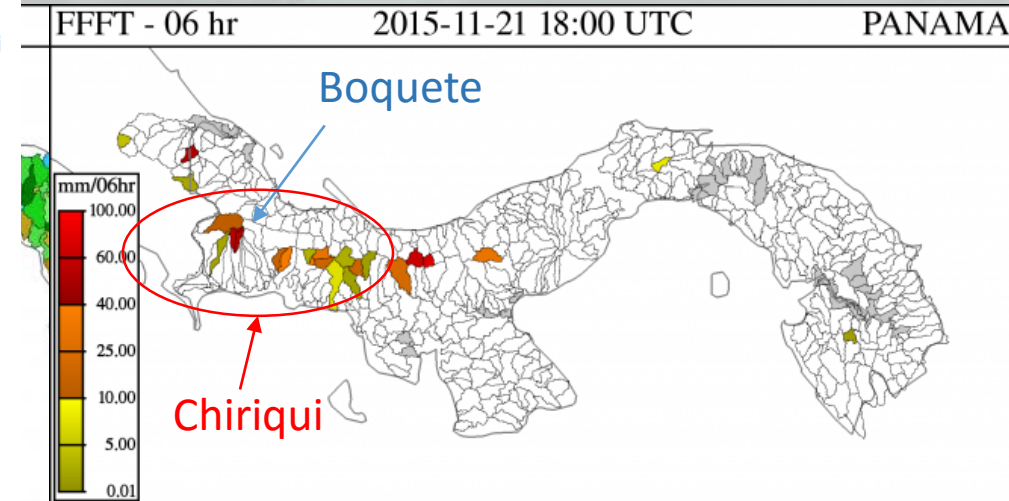
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Post Views: 562

The Joint Task Force (FTC), led by the National Civil Protection System (Sinaproc), said the torrential rain has wreaked havoc in several localities in western Panama, near the border with Costa Rica.

land?
action:

Which small basins are at risk?
FFG System Flash Flood Threat shows:



What do we call Flash Floods?

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:

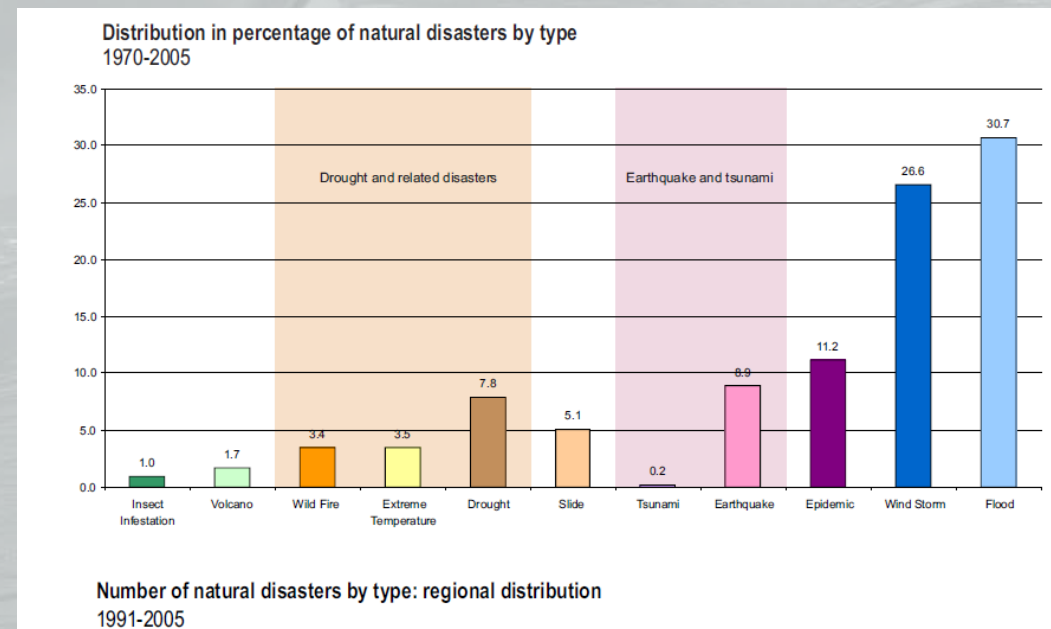
1. BOTH Hydrological and Meteorological expertise for real time forecasting/warning
2. Knowledge of local up to the hour information for effective warning

Usually, flow crest is reached within 6 hours of causative event

Why worry about Flash Flooding?

- “Recent findings of the WMO (2008) country-level survey where of the 139 countries, 105 indicated that *flash floods were among the top two most important hazards around the world and require special attention*”
- On the average, these events kill over 5,000 unsuspecting people and cause millions of dollars of property damage
- Highest mortality rate (people affected / people lost)

U.N. International Strategy for Disaster Reduction



Why Worry About Flash Flooding?

Flash Floods are very significant disasters globally ...

- Highest number of deaths per people affected

... **BUT** there are no discernible trends for loss reduction

- No flash flood warnings for vast populated areas of the world
- Lack of local expertise and of regional cooperation
- Little in situ data in small regions
- Large-river flood-warning strategies ineffective for flash floods
- Climatic changes in several regions increase precipitation intensity

What are natural flash flood causes?

- Intense rainfall from ***slow moving*** thunderstorms or tropical systems
- Orographic rainfall in ***steep*** terrain
- Soil ***saturation or impervious*** land surfaces
- Hydraulic ***channel*** properties
- Sudden release of impounded water (natural dam or human-made dam)

Why is flash flooding different from large river flooding?

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 truly hydro-meteorological forecasting problem*
- *Coordination of forecasting and response is challenging over short times (Careful Planning Needed)*

The Global Initiative for Flash Floods

The **Hydrologic Research Center (HRC)** has signed a joint Memorandum of Understanding to implement regional flash flood guidance systems worldwide with:

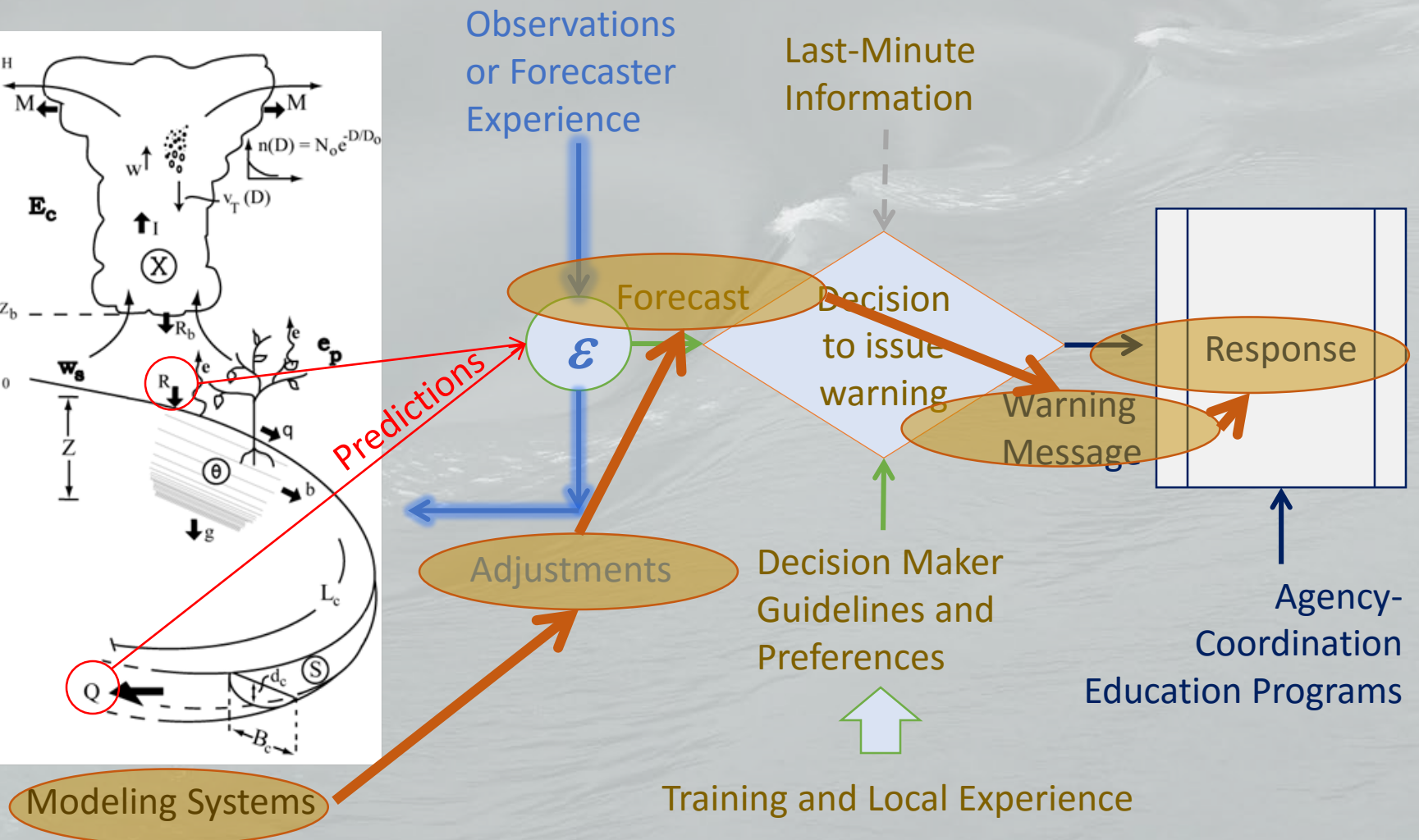
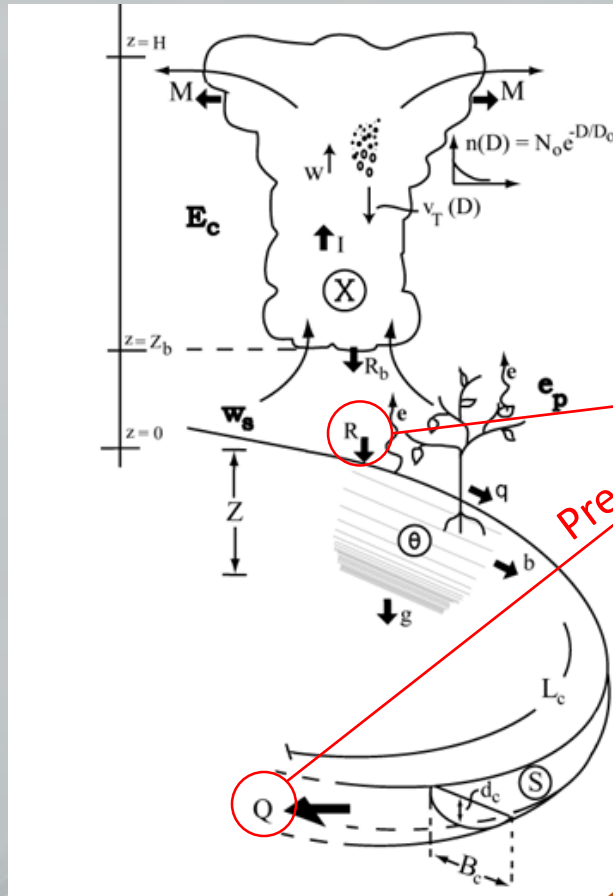
the United Nations – World Meteorological Organization (WMO)

the U.S. Agency for International Development/Office of U.S. Foreign Disaster Assistance (USAID/OFDA)

and the U.S. National Oceanic and Atmospheric Administration (NOAA).

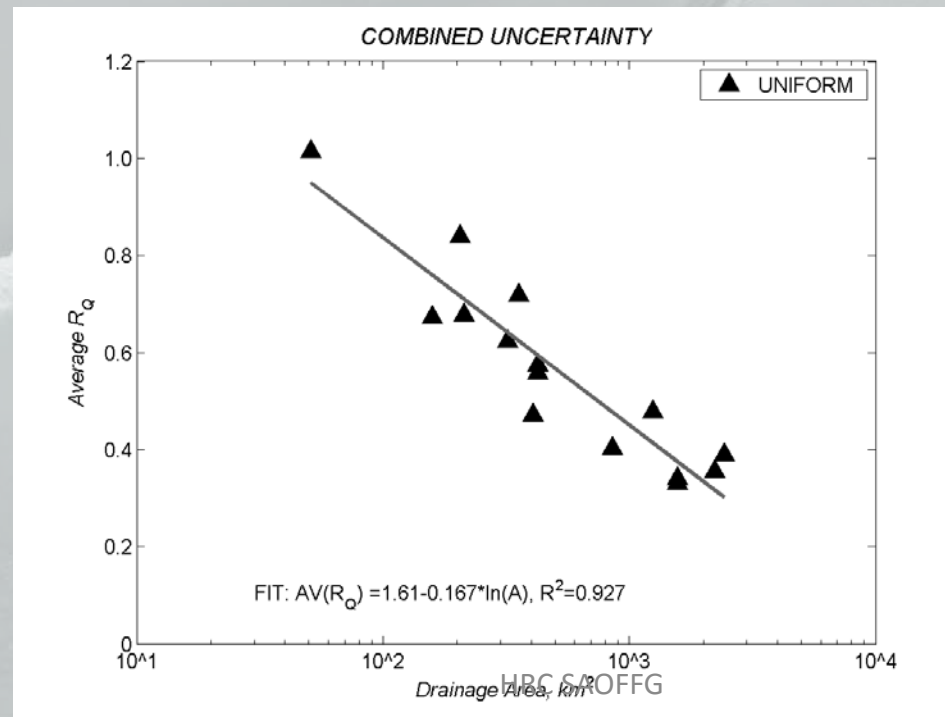


Program Design to Support Integrated Systems Perspective for Real-Time Warning



Operational Approaches for Flash Flood Warning

1. Site Specific (data rich catchments with special forecast interests)
2. Area-wide modeling with remotely sensed data and global datasets
 - 2a. Flash Flood Guidance (data sparse regions for public watches and warnings of flash flood occurrence)
 - 2b. Full Distributed Hydrograph Modeling (in regions with good data when entire hydrographs are needed) (High Uncertainty on smaller scales)



5 BASINS
3 LOCATIONS/BASIN
27 EVENTS/LOCATION

Operational Utility of Systems with Forecaster Adjustments

- Trained forecaster adjustments have a beneficial effect on warning reliability especially for local bias situations
(Use of up to the minute information from the field very useful; Real-time cooperation of meteorologists and hydrologists very useful for effective adjustments)
- In-depth training of forecasters in system model behavior is required for sustainability
(In most cases several-month efforts are required)
- A priori and real-time coordination of forecasters with response agencies necessary for high utility
- Local experience of forecasters invaluable for warnings against short-fuse hydrometeorological phenomena – Validation/Databases
(Mesoscale model biases; hydrologic model biases; local soil behavior and flooding conditions)

What is flash flood guidance?

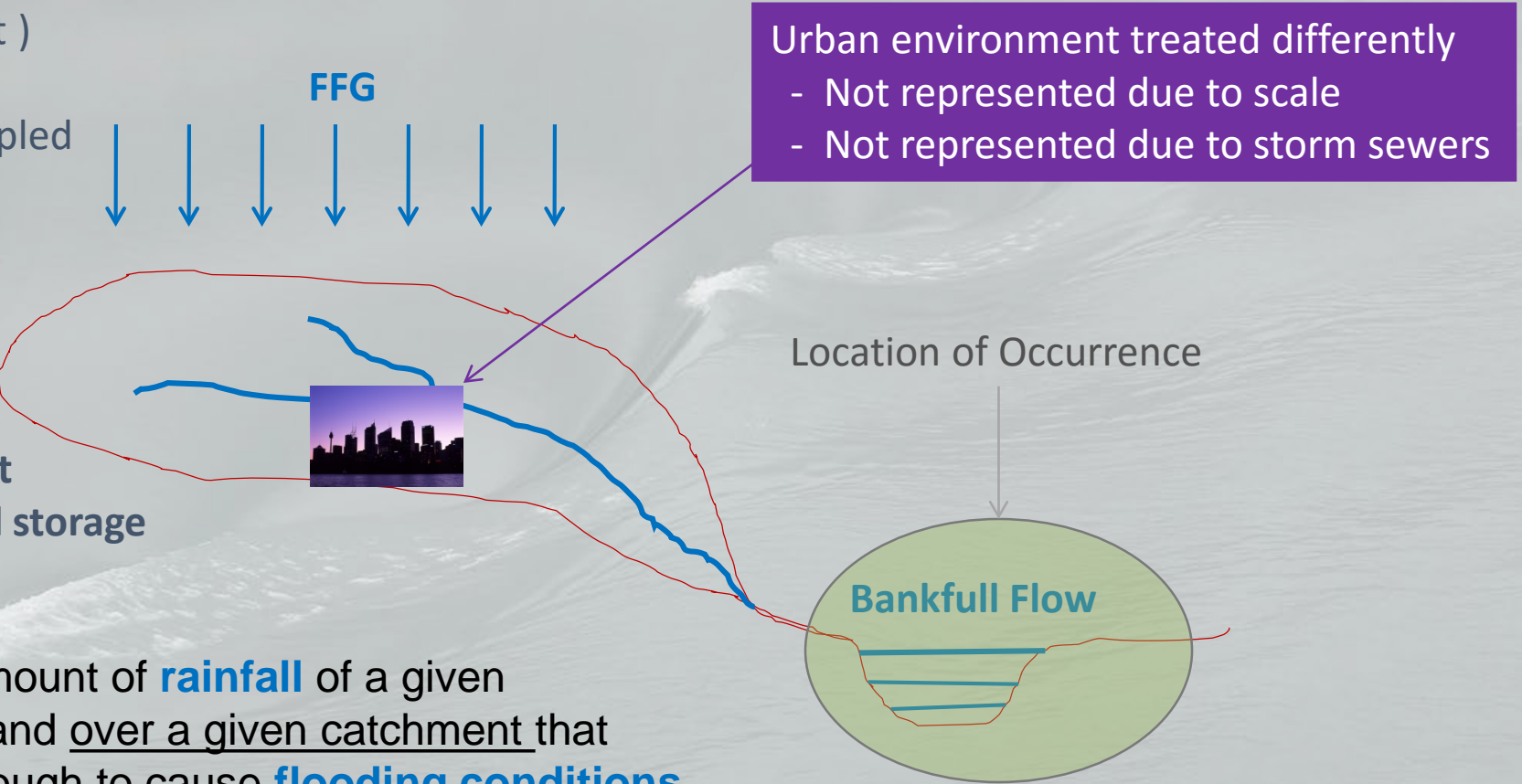
Rainfall threshold (familiar concept)

Meteorology and hydrology decoupled for adjustments

Concerned only with bankfull flow

Soil Water Deficit
Channel bankfull storage

FFG: 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



Threshold exceedance concept to estimate occurrence only!

Why is soil water important for flash flooding in addition to rainfall rate? –Summer Convection

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

658

GEORGAKAKOS ET AL.: HYDROCLIMATOLOGY OF WATERSHEDS, 1

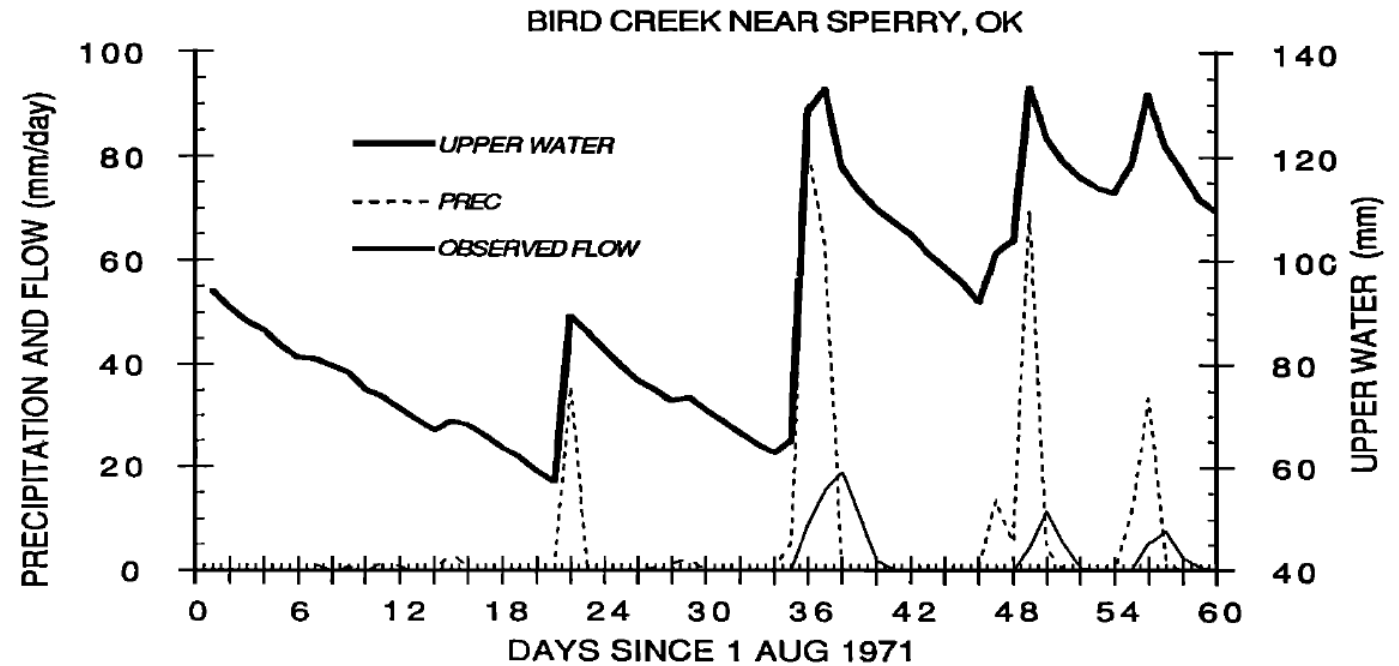
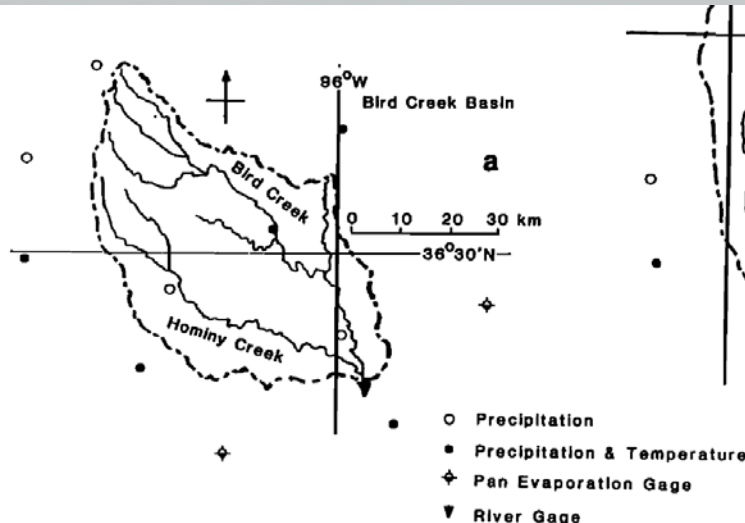


Figure 2. Daily values of rainfall rate (dashed line), flow rate (solid line), and upper soil water (heavy solid line) for Bird Creek near Sperry, Oklahoma, for August and September 1971. Rainfall and flow rates are in millimeters per day and are read on the left ordinate axis. Upper water is in millimeters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

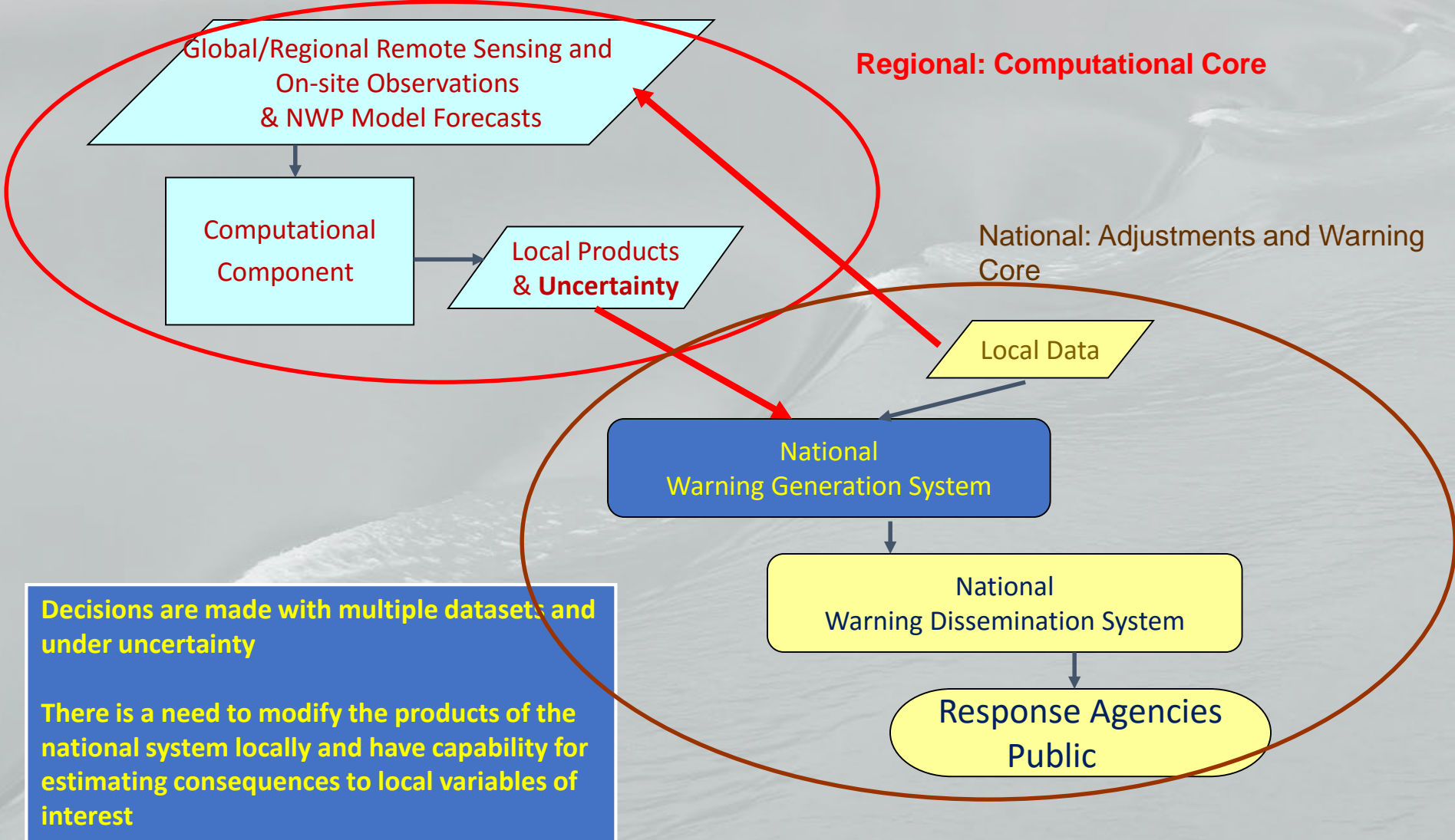


Research and development history

- **1970-1988:** US NWS Produces **FFG statistically** for each River Forecast Center. Also, **research** in adaptive site specific FF prediction systems.
- **1988-1993:** IIHR/HRC develop **physically consistent FFG formulations based on GIS** and create the first operational codes for US NWS
- **1993-2005:** HRC continues **research** in various aspects of the FFG process and system (sparsely gauged basins and uncertainty issues, forcing and models). The development of **prototype regional systems** using FFG is proposed and accepted in work plan of **WMO CHy Working Group on Applications (2002-2003)**
- **2004:** The **Central America Flash Flood Guidance System becomes operational** (serves 7 countries in CA)
- **2008:** **WMO, USAID, NOAA, HRC sign a quad-part Memorandum of Understanding to collaborate in the development of a global flash flood guidance system (currently in second 5-year phase)**

FLASH FLOOD GUIDANCE SYSTEM

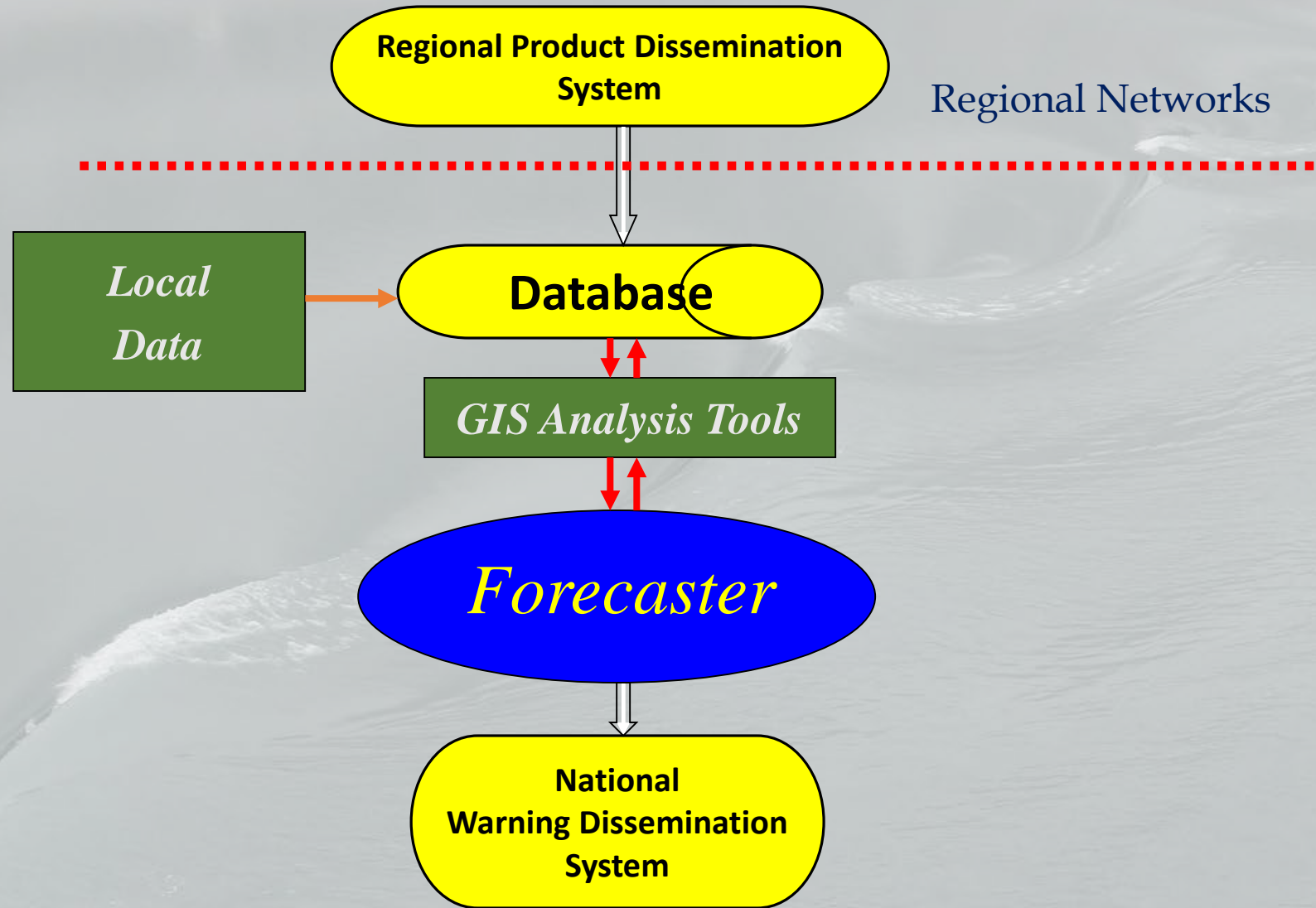
From Global Data and Regional Hydrometeorology to National Data and Warnings



Decisions are made with multiple datasets and under uncertainty

There is a need to modify the products of the national system locally and have capability for estimating consequences to local variables of interest

National System for Warnings



CAFFG - Central America Flash Flood Guidance System

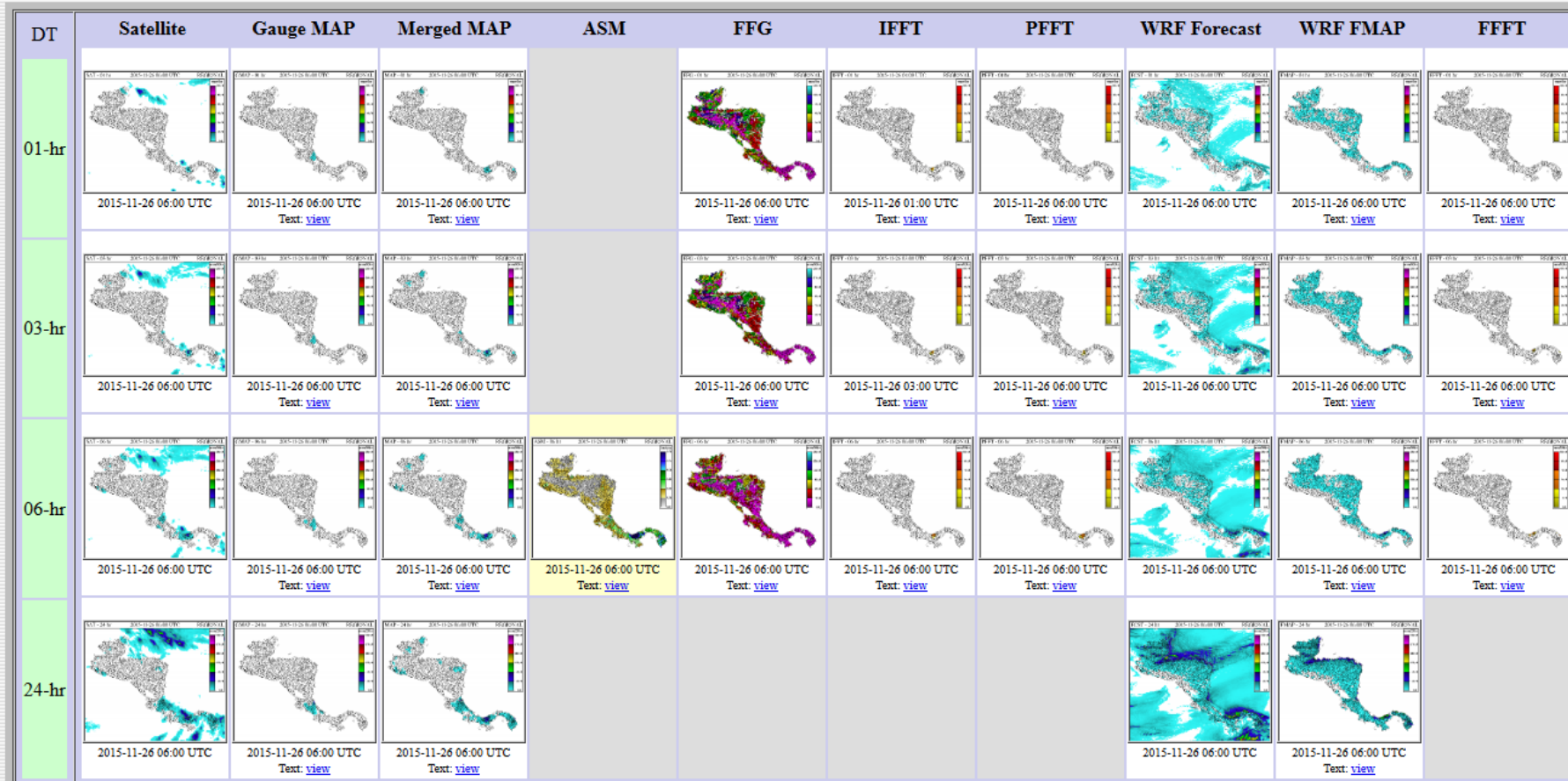
Current Date: 2016-02-01 06:12 UTC

Nav Date: 2015-11-26 06:00 UTC

Year: 2015 Month: 11 Day: 26 Hour: 06 REGION: REGIONAL OPTION: MEDIAN Submit

-1 Month -1 Day -6 Hours -1 Hour +1 Hour +6 Hours +1 Day +1 Month

Prev 6-hr Interval (00 UTC) Reset to Current Next 6-hr Interval (12 UTC)



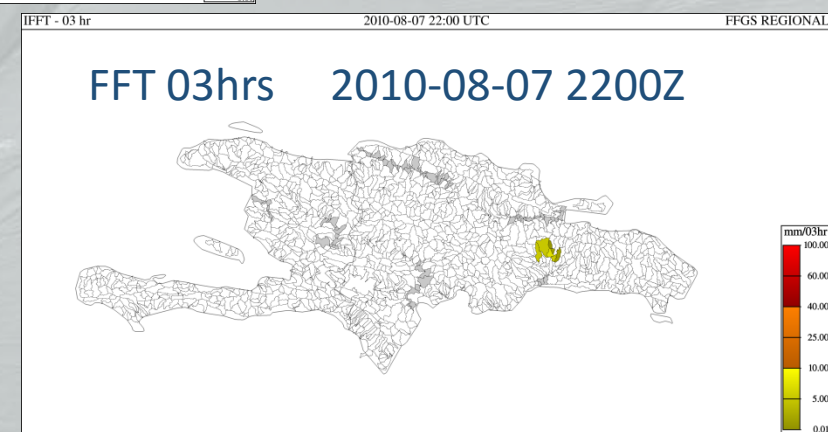
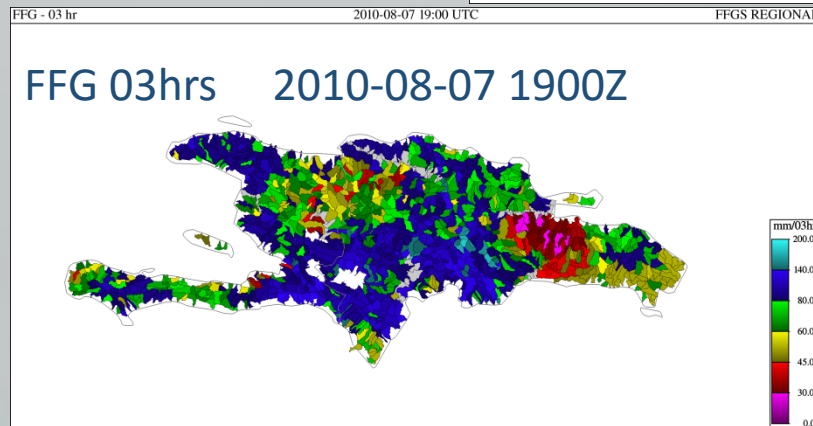
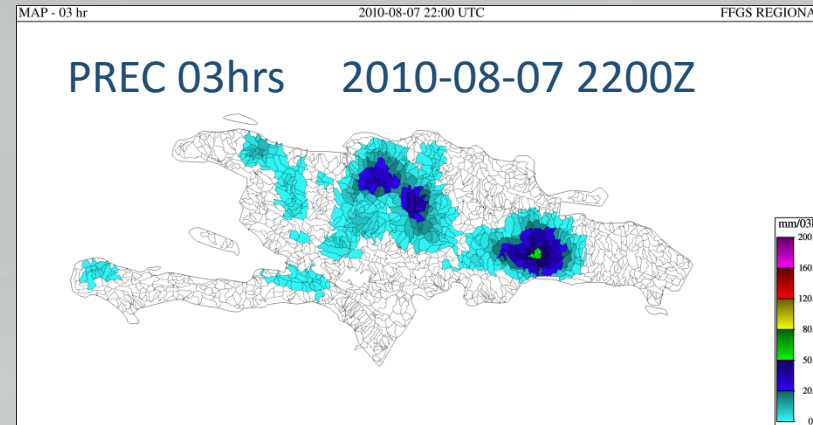
Composite Product... [text](#), [DBF](#)

SFTP data transfer (requires SFTP Client): [EXPORTS/REGIONAL/2015/11/26](#)

Surfmet Gauge Observations at 2015-11-26 06:00 UTC

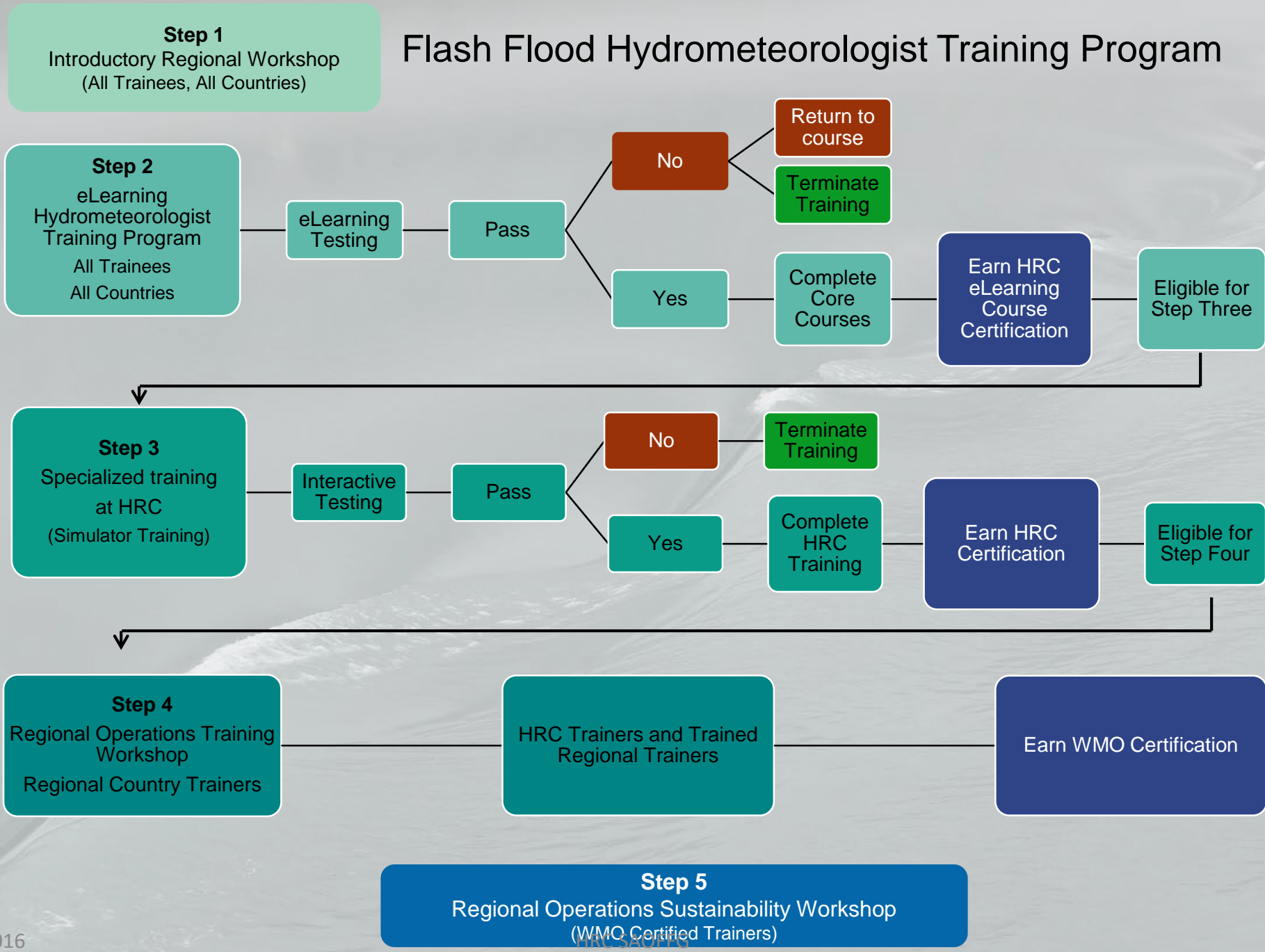
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0500145C	EL ROSARIO	0.00	No Report	NICARAGUA	11.846111111	-86.166666667	Enabled	Disabled
050071BA	ALTAMIRA (ARROCERA)	No Report	No Report	NICARAGUA	12.133055556	-85.713611111	Enabled	Disabled
0500C234	MATAGALPA	No Report	No Report	NICARAGUA	12.947777778	-85.871111111	Disabled	Disabled
0500E4D8	SIUNA	0.00	No Report	NICARAGUA	13.716111111	-84.775	Enabled	Disabled
050146DA	SAN DIONISIO	No Report	No Report	NICARAGUA	12.756388889	-85.845833333	Enabled	Disabled

Example Application of Flash Flood Guidance



Flash Flood Guidance (FFG): The amount of actual rainfall of a given duration over a small basin required to generate flooding flows at the outlet of the basin.

Flash Flood Hydrometeorologist Training Program



Desired Prerequisites

Country data support (e.g., spatial data for soil type and texture, basin delineation verification, historical hydrometeorological data for bias adjustment and snow/soil water model calibration, etc.)

Links of regional center to national real time databases for reduction of uncertainty in precipitation input and increase of reliability

Development of databases of observed flash flood occurrence for validation

Reciprocal training of forecasters and disaster managers and development of well defined a priori plans for response

Enhance public information on flash floods, their perils and the needed response measures

Thank You

