The Flash Flood Guidance System
Design, Functionalities and Products

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What is the rainfall forecast?
FFG System WRF shows:

Panama Time = UTC – 5 hours
It has been raining in Western Panama ...

What is the current saturation of the land?
FFG System Upper Soil Saturation Fraction:

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

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

Panama Time = UTC – 5 hours

It has been raining in Western Panama ....

12 homes affected in Boquete floods

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

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.
Purpose: Support Flash Flood Warning

- WMO (2008) country-level survey of 139 countries around the world, 105 indicated that flash flooding was among top two most important hazards that require attention.
- 5,000 flash flood fatalities per year globally
- 85% of flood-related deaths due to flash flooding and with highest mortality rate (deaths/people affected)

No discernable trend for loss reduction!

U.N. Strategy for Disaster Reduction
The Need

- 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
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).*

**GOAL:**
To support National Meteorological and Hydrological Services worldwide to:
1. provide reliable and effective flash-flood warnings and
2. improve disaster management efficiency
Integration of Data, Models and Human Experience Toward Saving Lives


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Decisions are made with multiple datasets and under uncertainty.

There is need to modify the products of the regional system nationally and have capability for estimating consequences to local variables of interest.

Serve more than 60 countries.
National System for Warnings

Regional or National Dissemination System

Regional and National Networks

Database

GIS Analysis Tools

Forecaster

National or Local Warning Dissemination System

Local Data
Key Technical Components for the FFG System

SOURCES OF INFORMATION FOR THE FFGS
Concept of Flash Flood Guidance

FFG: Amount of rainfall of a given duration and over a given catchment that is just enough to cause bankfull conditions at the outlet of the draining stream.

Of primary concern is the prediction of occurrence of flash flooding, particularly for data-sparse regions.
Westville, OK Site

Reasonably good reproduction of depth integrated soil water deficit
Single Basin Validation: Rio Chagres, Panama

Gauge Interpolated Precipitation – Upper Bound
CAFFG Validation

System operators from Costa Rica and El Salvador were in daily communication with Country Agencies to receive community information regarding local flooding.

Flooding in the Panama Canal verified by local TV news. Flooding time at the airport was reported at approximately 9 p.m. local time.

3-Hourly FF Threat (adjst):
- Hits: 57% (63 – 100%)
- False: 30% (0 - 21%)
- Misses: 13% (0 - 16%)
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)
Implementation Steps

Establishment of National Representatives and their Technical Appointees
Data Collection (Historical and Real Time)
Begin training program (on line courses)
Development of high resolution delineations and review/corrections
Development of input data quality control and tests with historical data
Tailoring the regional (or national) and national (or local) system components to the country of interest (based on established operational protocols)
System operational at HRC with secure net transmission of data and products to the countries involved
Hands-on training at HRC (4 – 6 weeks) (simulator and real-time case studies)
Initial validation and pre-installation adjustments
On site implementation and IT plus operations training (WMO certification)
Annual maintenance support and sustainability training
Flash Flood Hydrometeorologist Training Program

**Step 1**
Introductory Regional Workshop (All Trainees, All Countries)

**Step 2**
eLearning Hydrometeorologist Training Program
All Trainees
All Countries
- eLearning Testing
- Pass
- **Yes**
  - Complete Core Courses
  - Earn HRC eLearning Course Certification
  - Eligible for Step Three
- **No**
  - Return to course
  - Terminate Training

**Step 3**
Specialized training at HRC (Simulator Training)
- Interactive Testing
- Pass
- **Yes**
  - Complete HRC Training
  - Earn HRC Certification
  - Eligible for Step Four
- **No**
  - Terminate Training

**Step 4**
Regional Operations Training Workshop
Regional Country Trainers
- HRC Trainers and Trained Regional Trainers
- Earn WMO Certification

**Step 5**
Regional Operations Sustainability Workshop (WMO Certified Trainers)
Eight courses
Training Simulator
South Africa Case Study
January 2012, Tropical Storm Dando, Kruger National Park

“As an analysis of the storm by the South African Weather Service (SAWS) showed that the Southern Africa FFG system performed very well—indicating the areas of heavy rainfall (left figure) and flash flood threat (right figure) that were in agreement with the observed data.” (From Flash Flood Gazette, May 2012)

“Discussions between the South African Weather Service, the South Africa Department of Water Affairs, and the Kruger National Park officials indicated that the information and data available through the FFG system can be very useful in situations such as this.”
Haiti Case Study 1
Hurricane Thomas Passage

30 October 2010 – 7 November 2010
Haiti Case Study 1
Hurricane Thomas Passage

22 May 2018
HRC FFGS
Haiti Case Study 1
Hurricane Thomas Passage

Pre

Post
Haiti Case Study 2
Flash Flood Risk Assessment
Entire Haiti (Average Basin Area: 72 km$^2$)
Haiti Case Study 2
Flash Flood Risk Assessment
FFGS Development and Implementation
Team at HRC

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Thank you

The strong support of the country National Meteorological, Hydrological and Disaster Management Services has been essential for the useful operational utilization of the regional FFG systems.