Flash Flood Guidance Approach

Hydrologic Research Center, USA
Technical Developer

SAOFFG Steering Committee Meeting 1
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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?

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)
<table>
<thead>
<tr>
<th>LRF</th>
<th>FF</th>
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<tbody>
<tr>
<td><strong>Catchment response affords long lead times</strong></td>
<td><strong>Catchment response is very fast and allows very short lead times (&lt; 12hrs)</strong></td>
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<td><strong>Entire hydrographs can be produced</strong></td>
<td><strong>Prediction of occurrence is of interest</strong></td>
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<td><strong>w/ low uncertainty with good quality data</strong></td>
<td><strong>Local information is very valuable</strong></td>
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<tr>
<td><strong>Local information less valuable</strong></td>
<td><strong>A hydro-meteorological forecasting problem</strong></td>
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<tr>
<td><strong>A hydrologic forecasting problem primarily</strong></td>
<td><strong>Coordination of forecasting and response is challenging over short times (Careful Planning Needed)</strong></td>
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<td><strong>Affords time for coordination of flood response and damage mitigation</strong></td>
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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

Soil saturation fraction
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.

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.

**Location of Occurrence**
- 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)

\[ t_D = t + t_d \]

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

FFG-03hr for 2016-08-02 00:00 UTC
Provides operational NHMS forecasters with up-to-date information on key variables for rapid assessment of flash flood risk.
Recent Advancement: MapServer-Based Forecaster Interface

SARFFG - Southern Africa Flash Flood Guidance System

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

<table>
<thead>
<tr>
<th>Basin</th>
<th>FFG</th>
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<td>MAP</td>
<td>06</td>
<td>07</td>
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<tr>
<td>ASM</td>
<td>06</td>
<td>07</td>
</tr>
</tbody>
</table>

Reset to Current

Sync Date Controls

Product Selection Table

Zoom to Country

Select Country

Open Street Maps

SRTM 30m DEM

SRTM 30m DEM with Shaded Relief

SRTM 30m Contours
**Latest Advance: MapServer-Based Forecaster Interface**

**SARFFG - Southern Africa Flash Flood Guidance System**

**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.
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

Physics/Models

Observations or Forecaster Experience

Last Minute Information

Decision Maker Guidelines
Preferences

Decision to issue warning

Warning Message

Training and Local Experience

Forecast

Response

Agency Coordination Education Programs

Modeling Systems

Predictions

Adjustments

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

THANK YOU