Flash Flood Guidance: SARFFG modeling system

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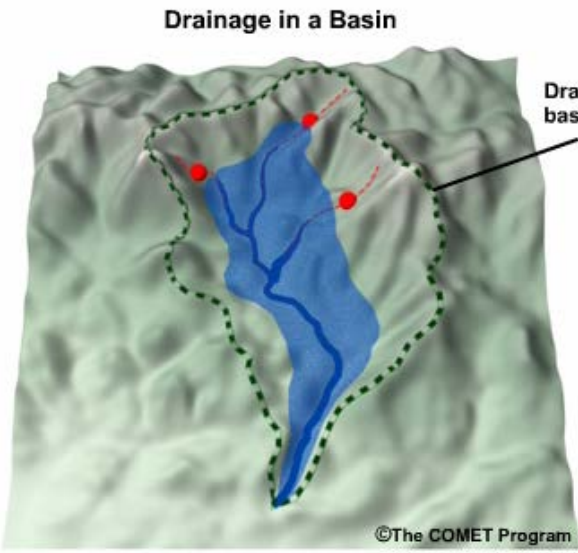
Flash Floods vs. River Floods

- *River floods* are caused by heavy rain over long periods (days) in the upper catchment leading to rising water levels and flooding as the flood wave move down river. It can take the flood wave a number of days to move down river.

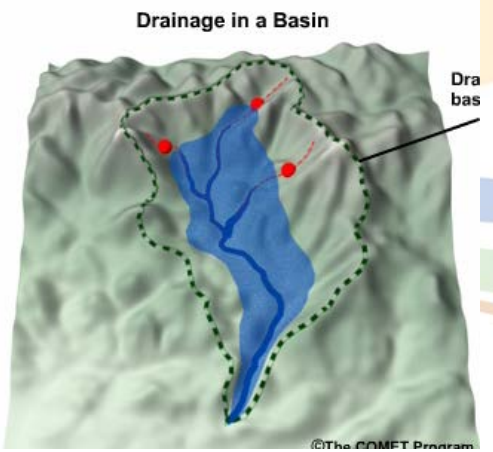
- *Flash floods* are quick response flood events causing sudden flooding in small river basins.
  - Flooding follows within 6 hours or less after the heavy rain event.
  - Flash floods can happen anywhere,
  - even where there is no clear river

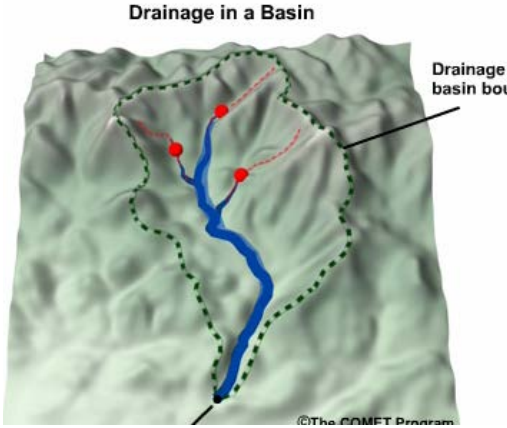


How do you predict a flash flood?

- Forecaster's question:
  - How much rain will cause a flood in this particular area?
- What do you need to know to answer this question?
  - How much water will run off?
  - How full is the stream?
  - What about recent rain?
  - ➢ How river basin responds - Hydrology
- How much rain am I expecting over this area?
  - ➢ Weather forecasting – Meteorology

= Hydro-meteorological problem





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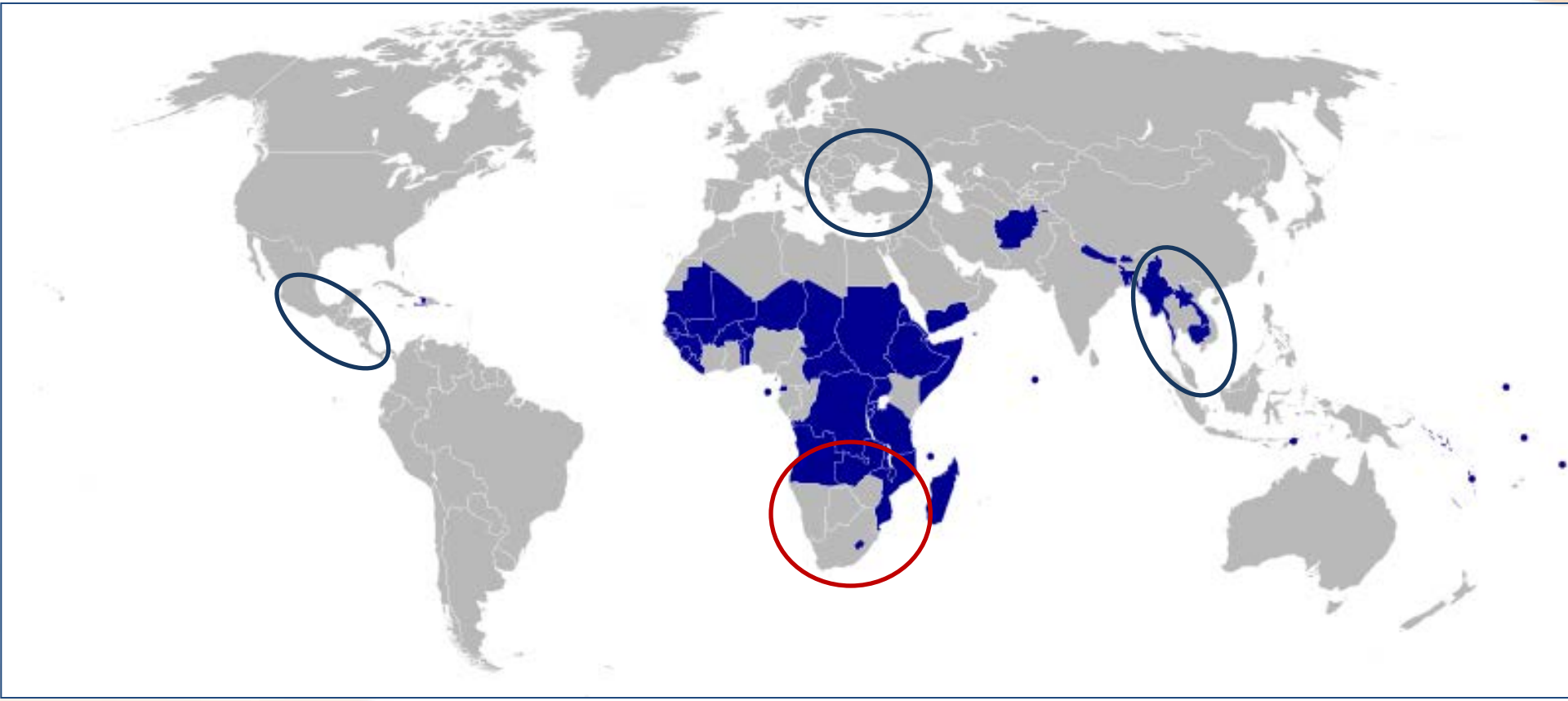
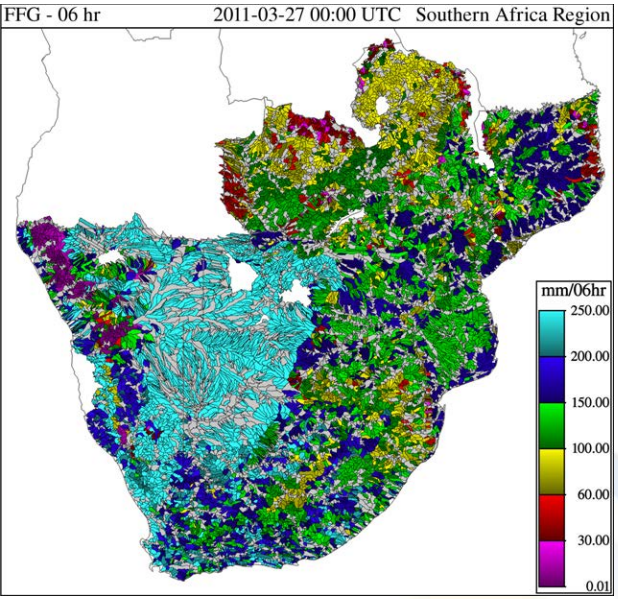
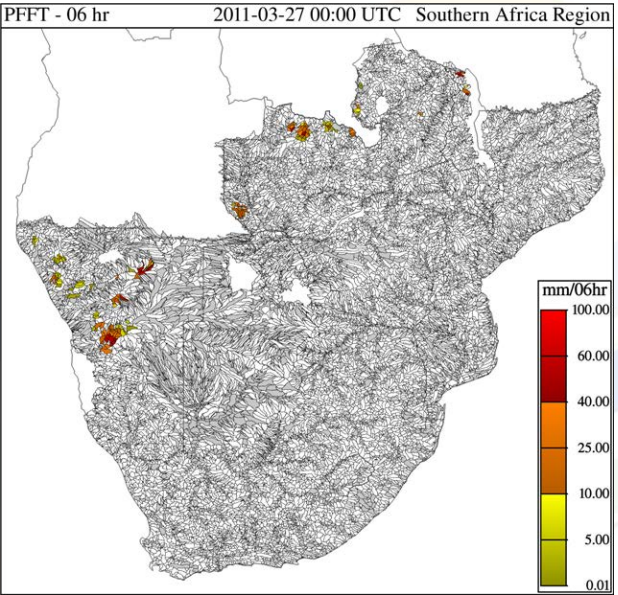
Background of FFGS in Southern Africa

- 2008: WMO initiated a global project to implement flash flood guidance systems (FFGS) in various regions of the world
  - Based on the system implemented in Central America (Costa Rica)
- Southern Africa (9 countries) identified as such a region



SARFFG: Southern African Regional Flash Flood Guidance system





- SARFFG implemented operationally in Feb 2014 with NMSs
- 2 Training workshops to forecasters (Feb and Oct 2014)
- Country training in San Diego during September 2015 – 1 forecaster per country
- Aim is to improve flash flood warnings to disaster management and the public
- Provide guidance to forecaster to aid to issue flash flood warnings
- Nowcasting application based on satellite information

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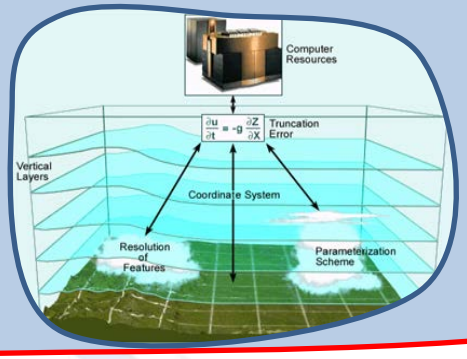
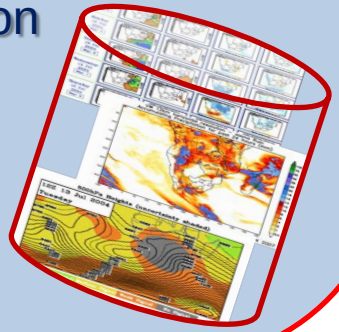
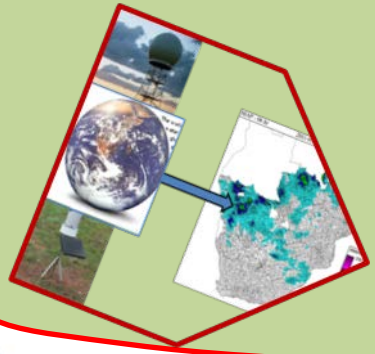
Modelling Hazard Forecasting: Weather vs Flash Flooding

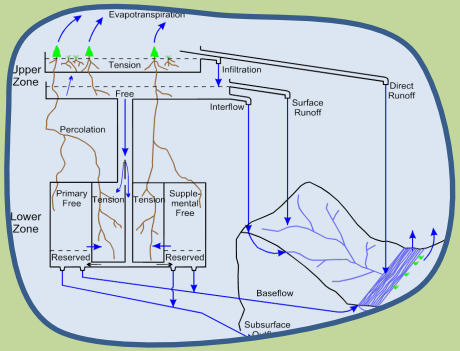
UM - Numerical Weather Prediction

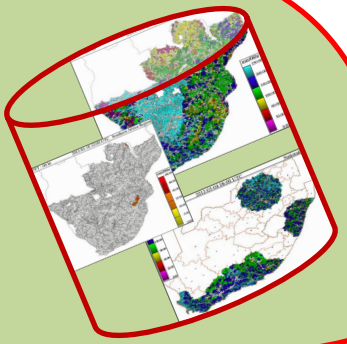




FFGS – Numerical Flash Flood Guidance







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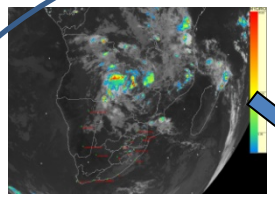
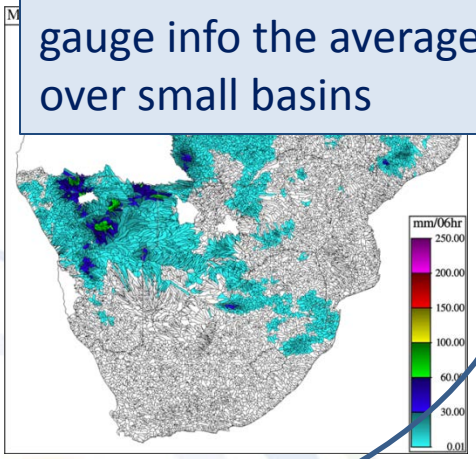
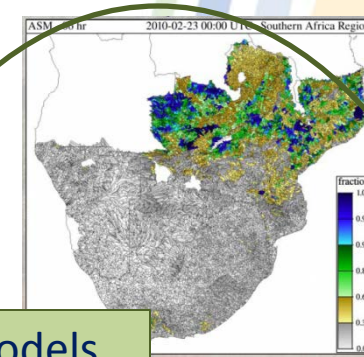
Flash Flood Guidance Process:

How much rain in a basin can cause a flash flood?

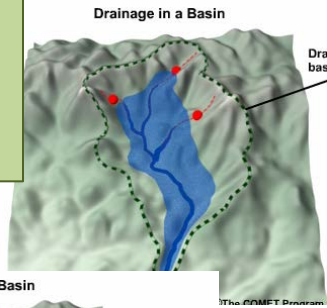


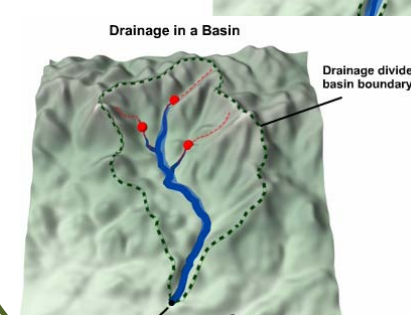
Calculate from satellite & rain gauge info the averaged rainfall over small basins



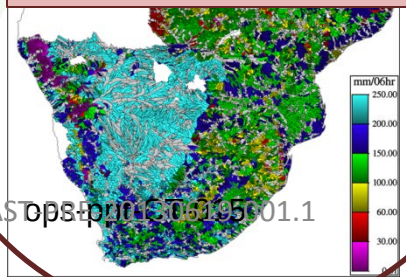


Hydrologic models determine likely soil moisture and rainfall runoff for small basins





Determines amount of rain for flash floods



Forecasters issue Warnings to Disaster Management and Public

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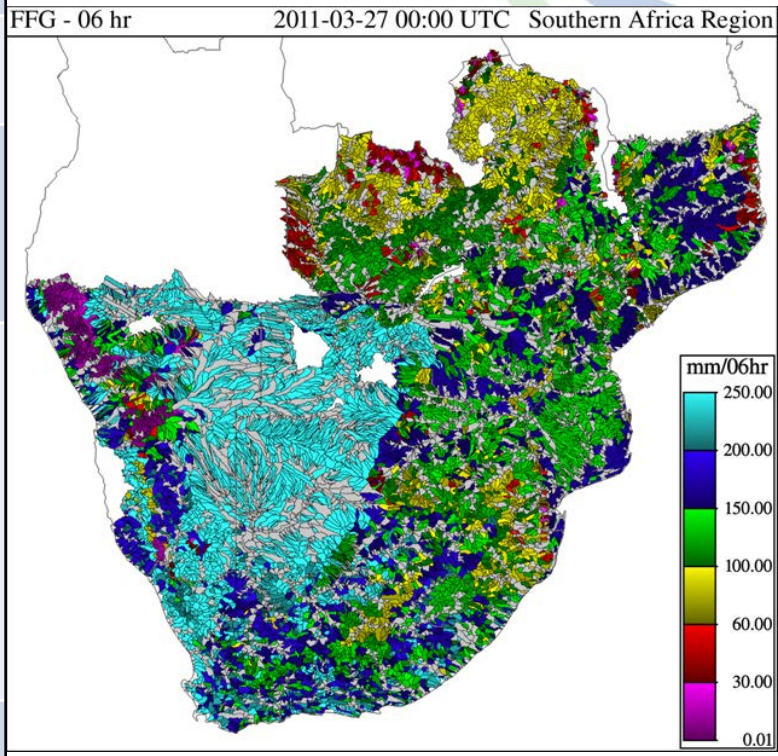
Main features of the SARFFG system

SARFFG (SADC Regional version)
Domain: 9 SADC countries
Basin size 150 km^2 average
Rainfall input from satellite and gauges
Updates soil moisture and FFG values every 6 hours providing a *6-hour* nowcast of potential flash floods
Main system runs at RSMC Pretoria, with internet links from NMHSs in SADC



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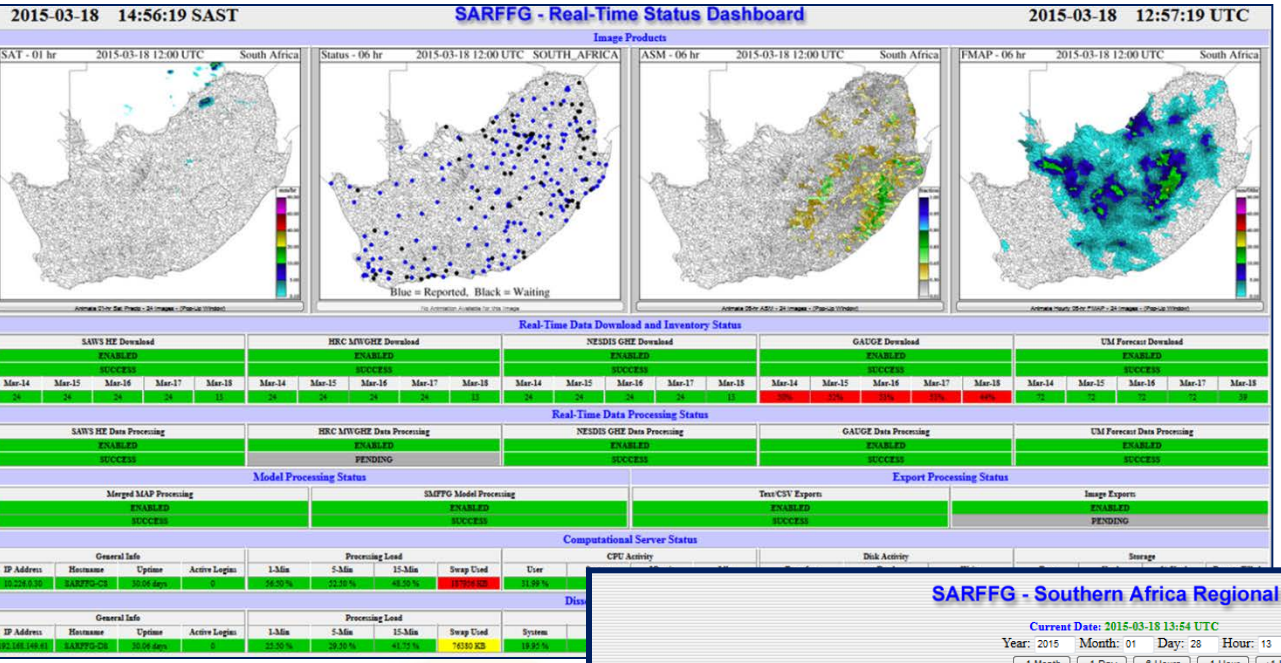
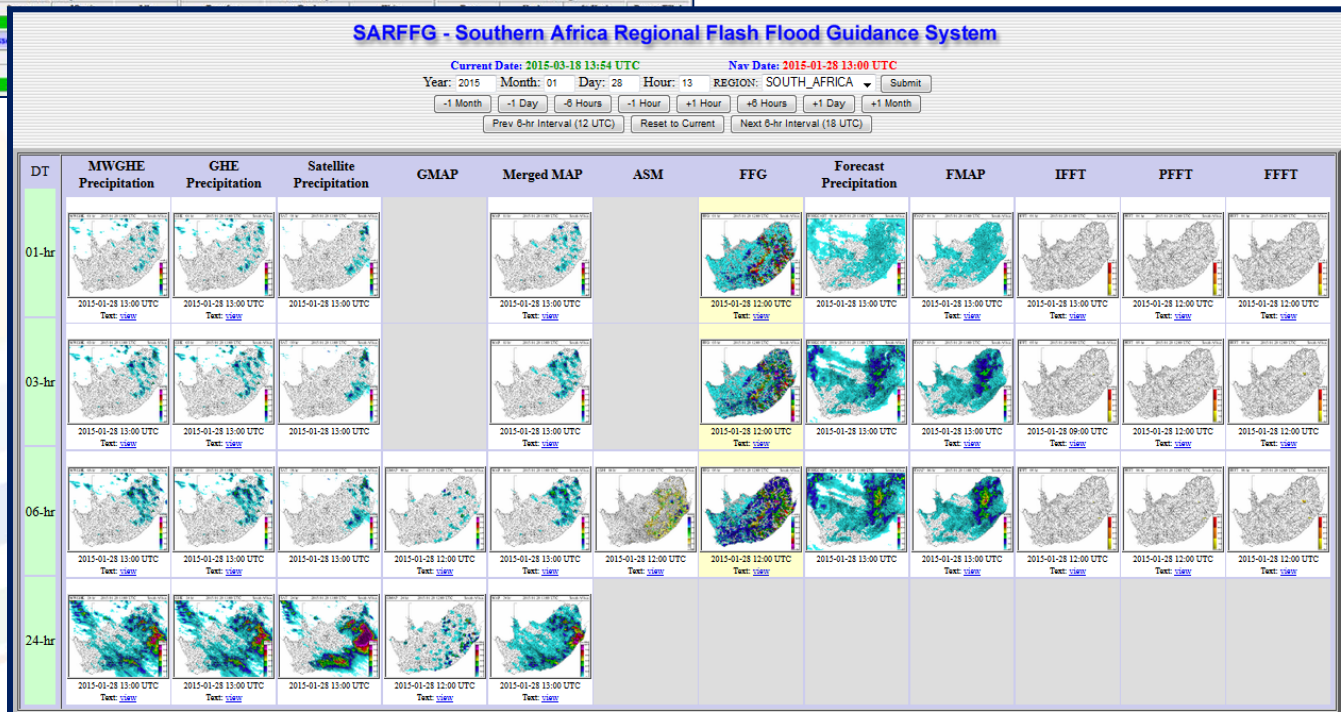
FFGS Forecaster Interfaces



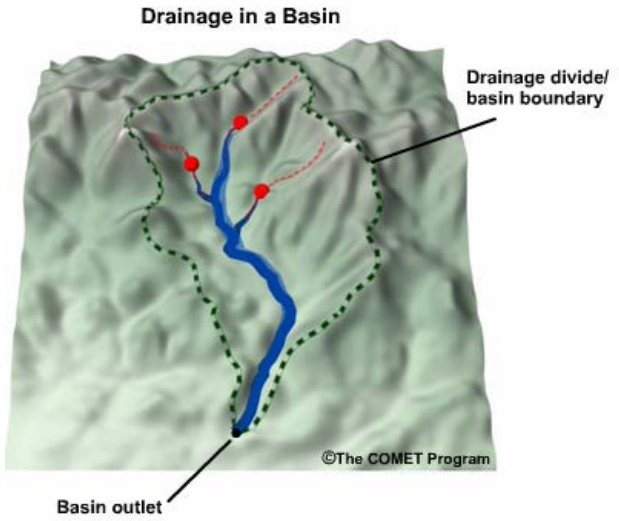
SARFFG

- SARFFG opens at the "Dashboard"
  - Move the forecaster interface by clicking on button at the bottom of page
  - Toggle between these two pages also for SAFFG



Main Parameters

- Mean Areal Precipitation (MAP)
  - Average amount of rain falling of the entire basin (mm)
- Average Soil Moisture (ASM)
  - Soil water fraction of the Upper Zone (20-30 cm) as modeled by the Sacramento model from antecedent rain
- Flash Flood Guidance (FFG)
  - Amount (mm) of rain needed over the entire basin in a specified time to cause bankfull at the outlet of the basin
- Flash Flood Threat (FFT)
  - Excess amount of rainfall in a specified time over what is needed to cause bankfull flows (i.e. minor flooding) in small streams
  - Indication of likelihood of flash flooding in basin
  - Directly linked to FFG and MAP (FFT = MAP – FFG)



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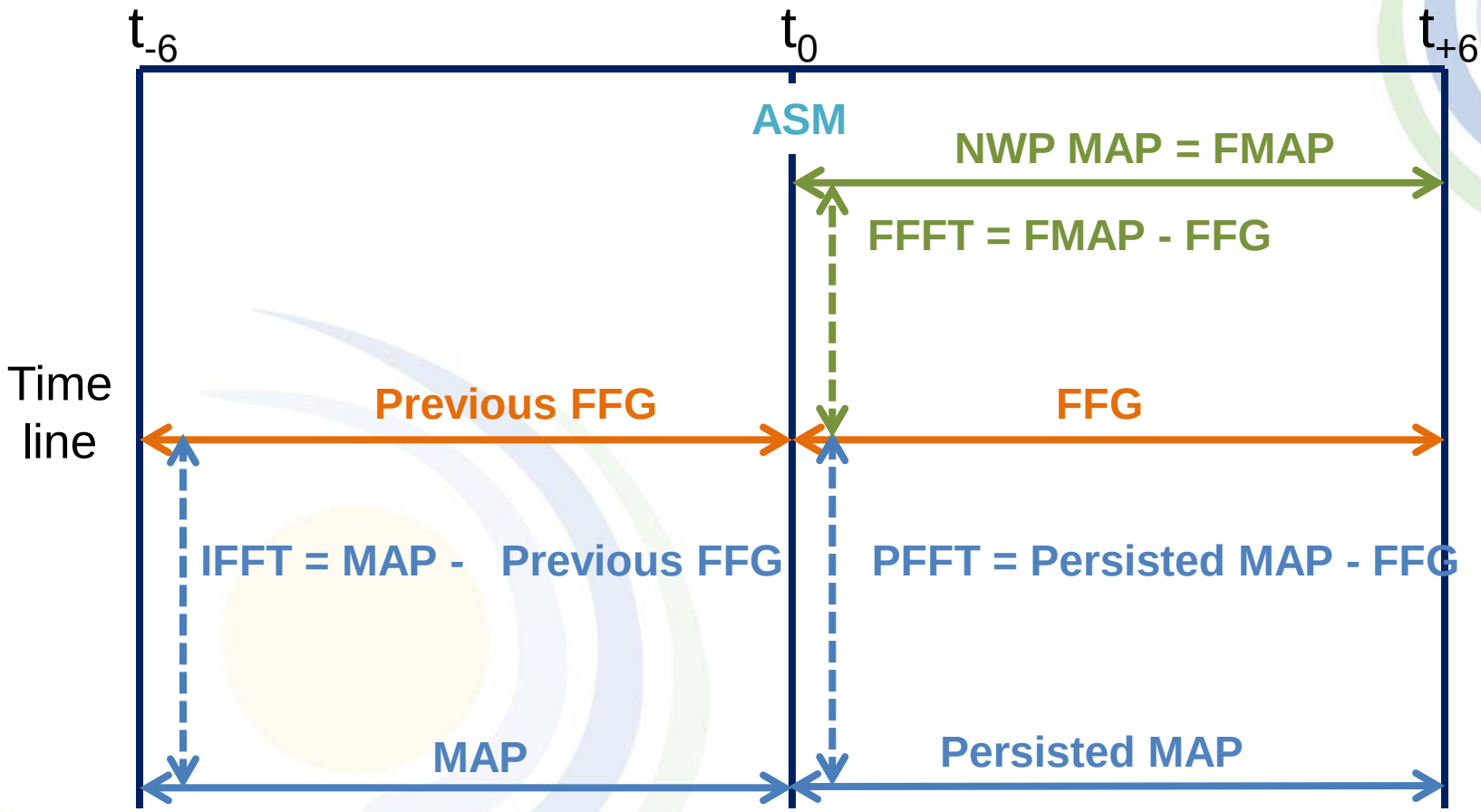
Link between Main Parameters



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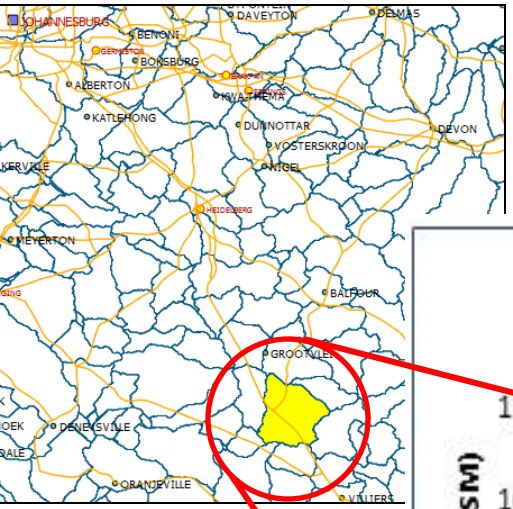
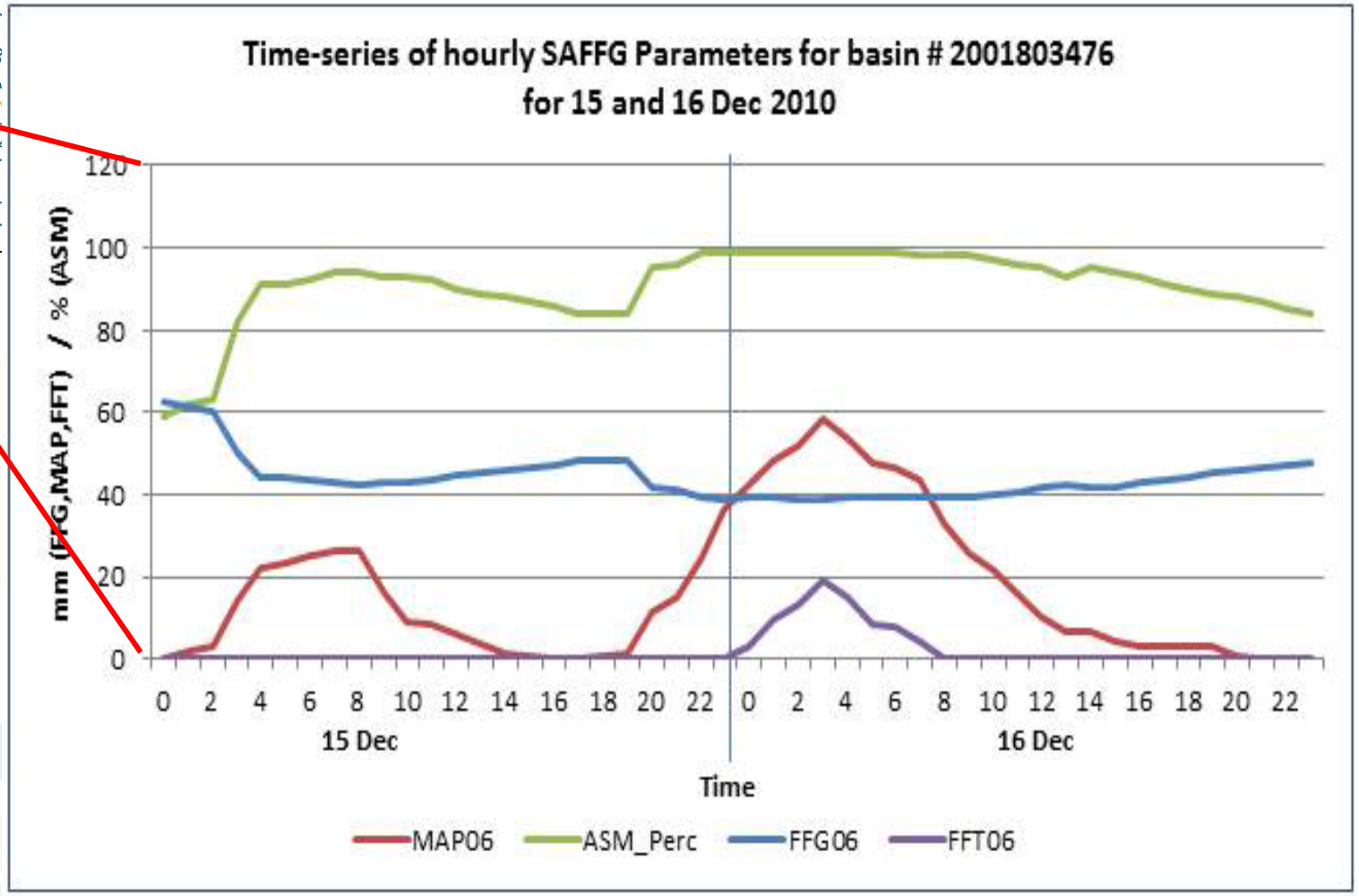
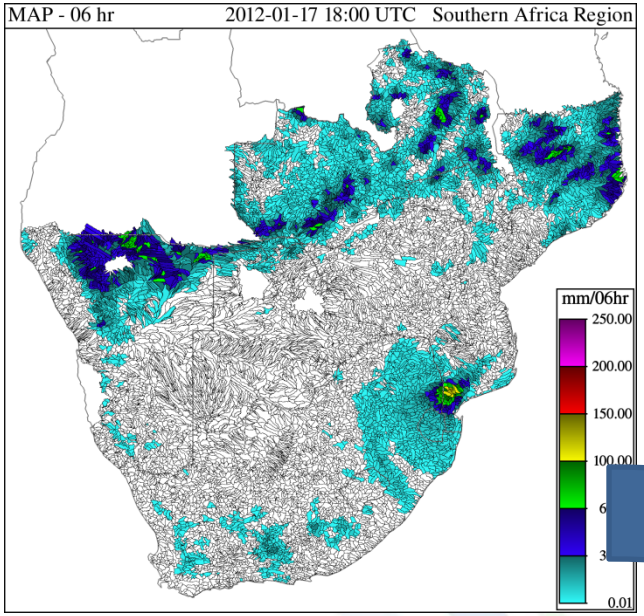
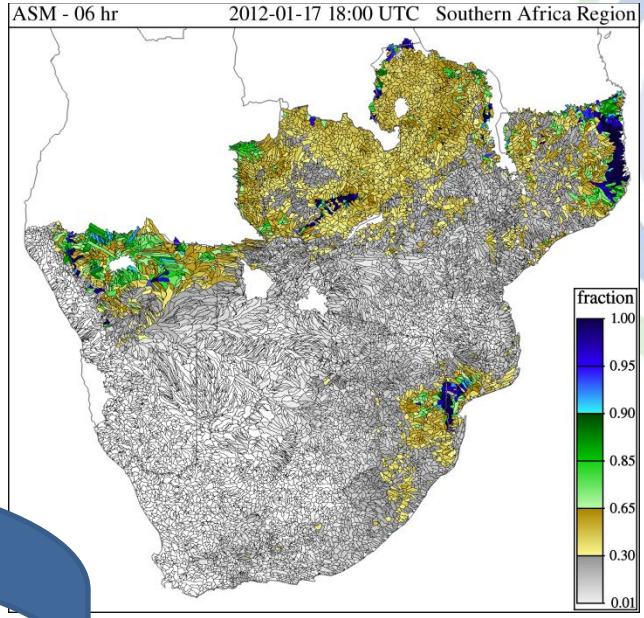
Example of interaction of parameters in a single basin

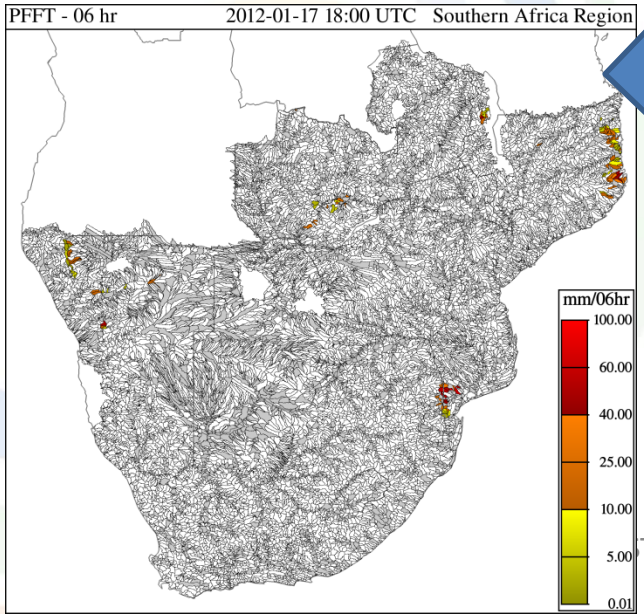


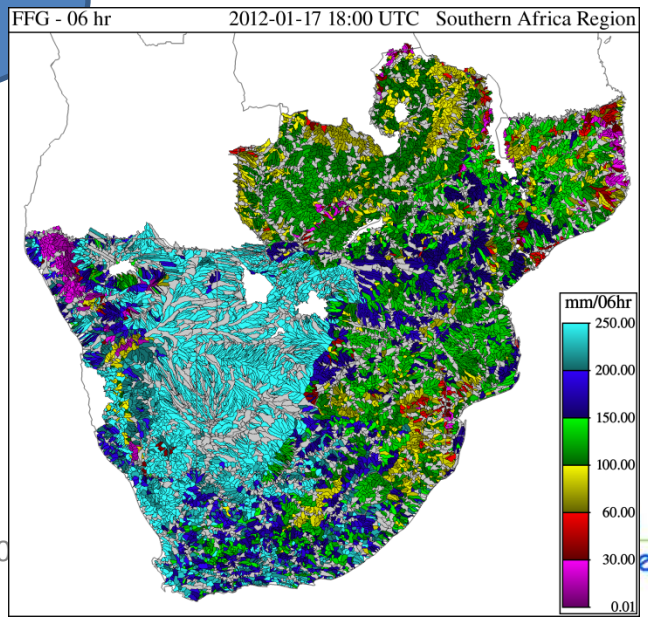


Tropical Cyclone Dando: 17-18 Jan 2012









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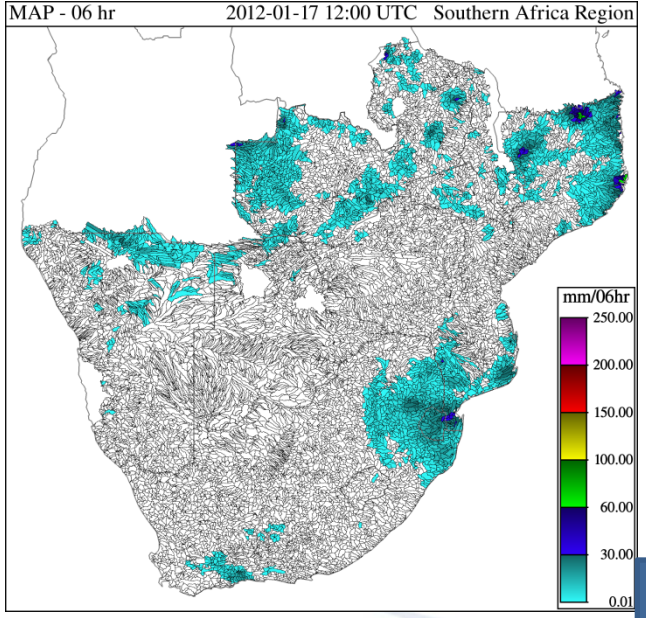

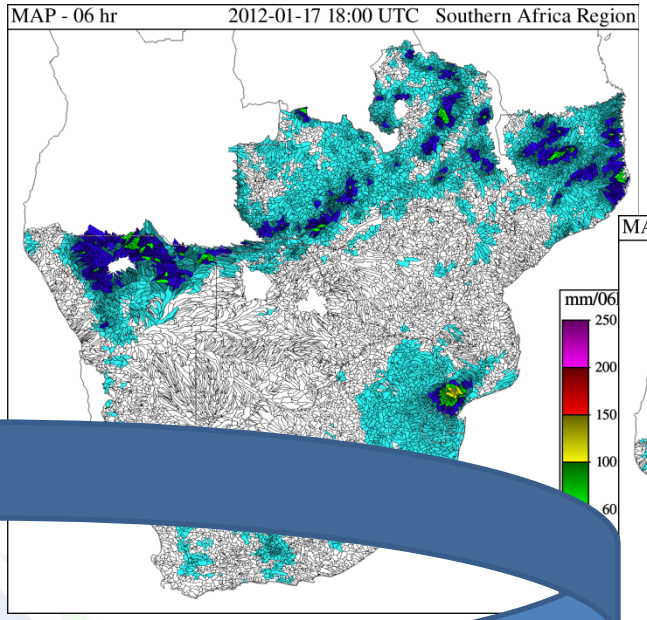

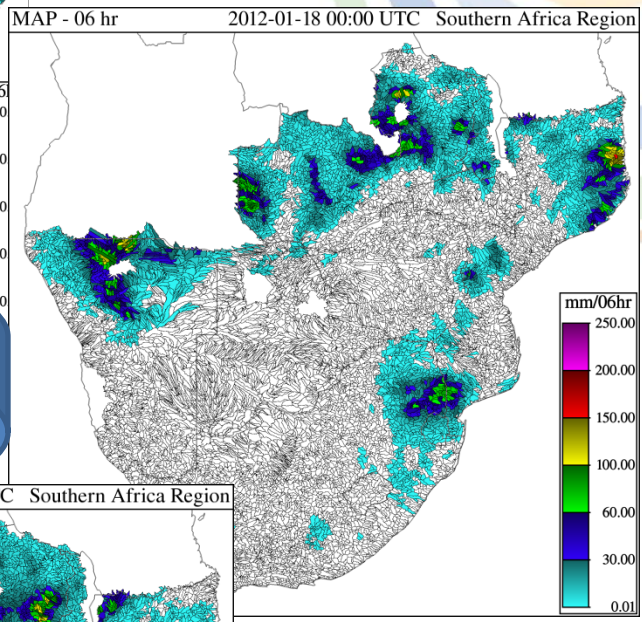

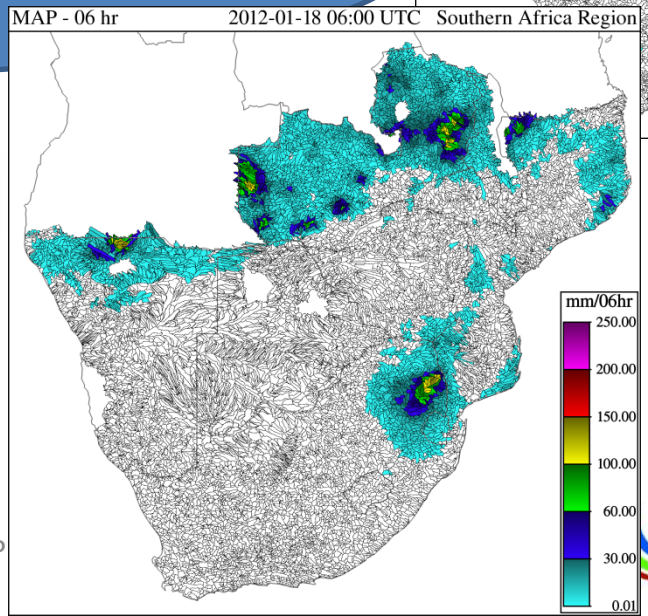

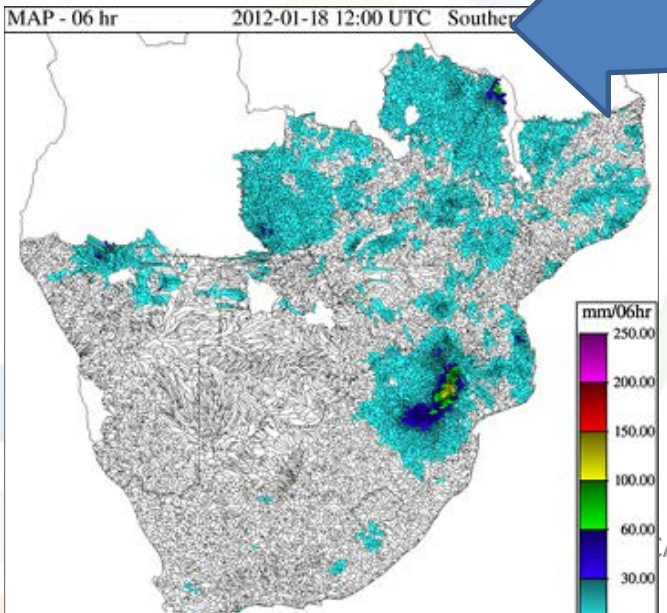

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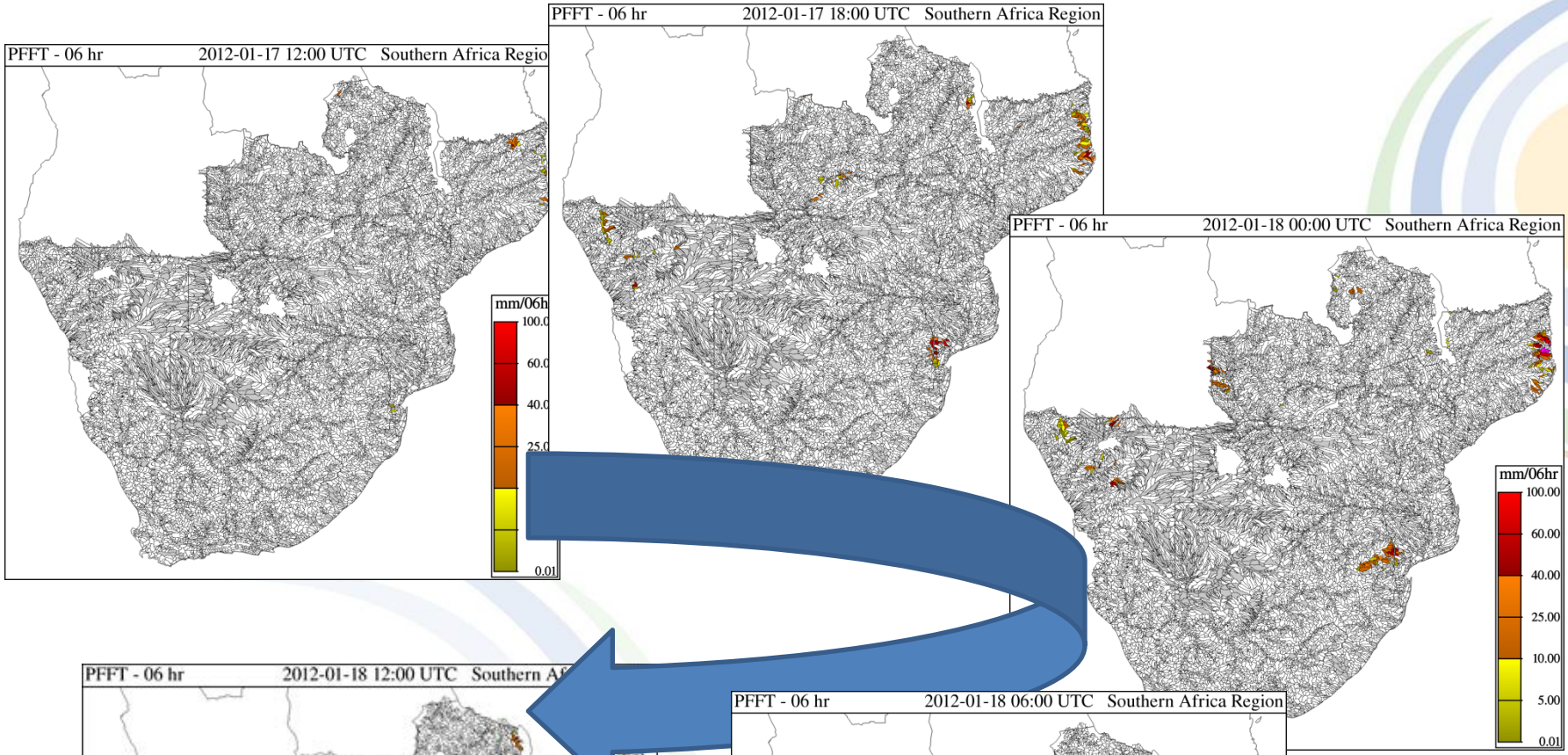

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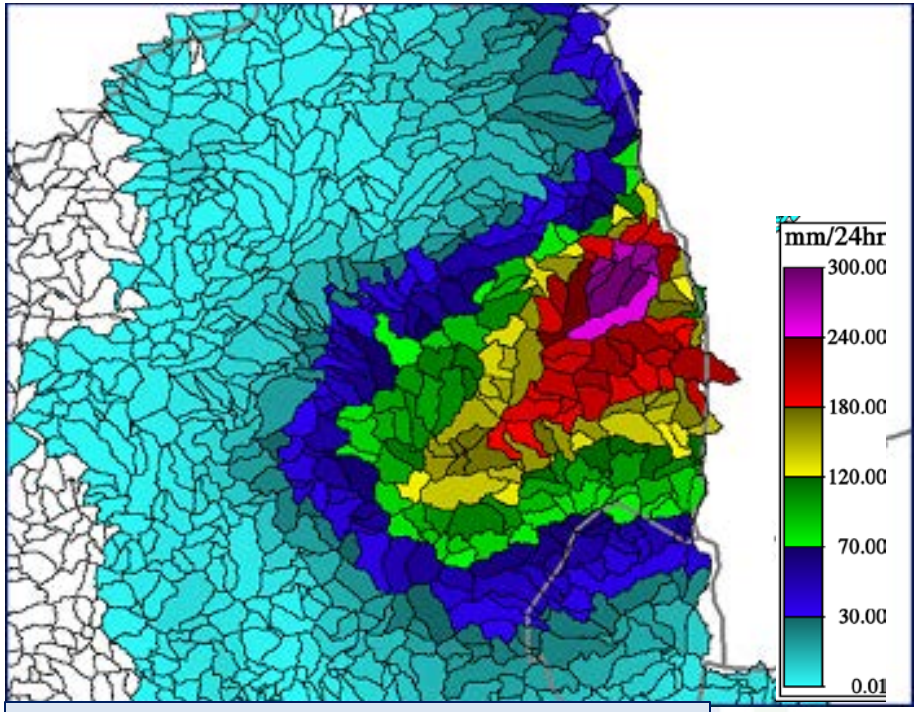
Tropical Cyclone Dando - 18 Jan 2012



Basin average rainfall for the past 24 hours on 18th 12:00 UTC as measured by satellite

STATION NAME	TOTAL RAINFALL
Kruger Airport	215 mm
Nelspruit	142 mm
Skukuza	278 mm
Phalaborwa	141 mm

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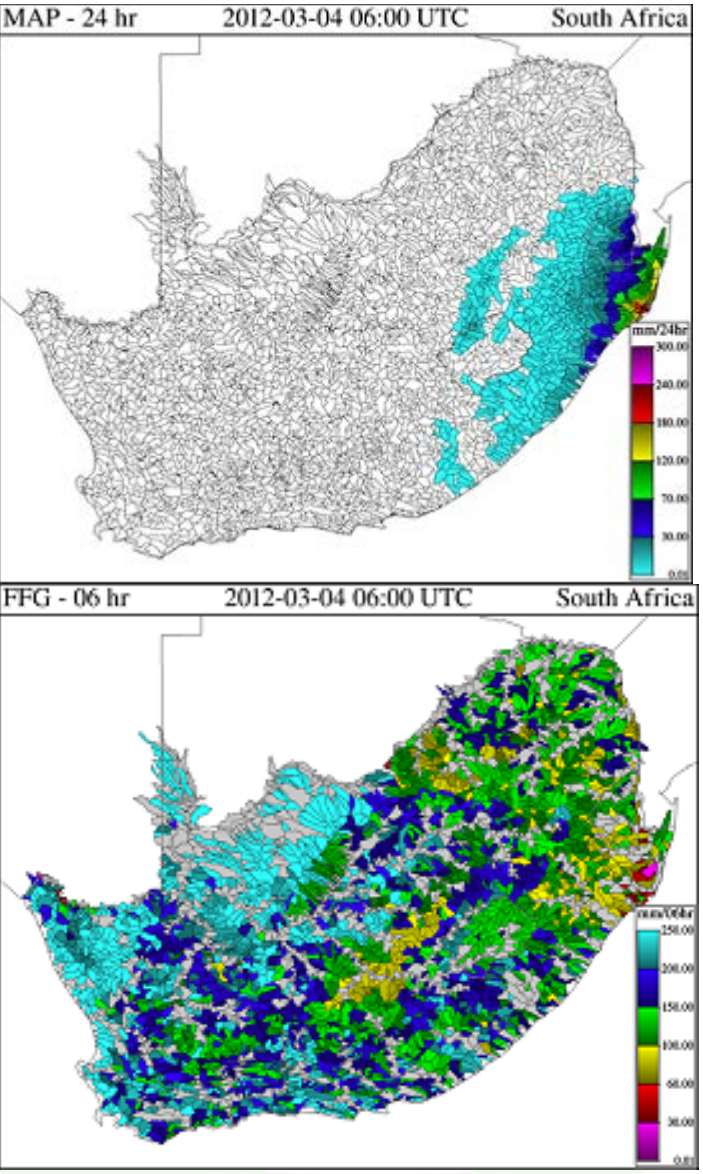
Performance of FFGS so far



- SARFFG gave useful guidance particularly for larger scale systems on potential flooding over southern Africa
- The FFGS systems in the region using satellite rainfall estimation
  - Deal well with larger scale events (TCs, MCSs)
  - Struggle with small scale high intensity events (individual T/S)
- FFGS generally struggle with heavy rain from stratiform clouds (this is only a problem for south-western coastal regions of SA
- SARFFG provides valuable guidance to forecasters in the SADC region of a hazard that we had no information on in the past

Summary

- SARFFG provides hydrological information on the response of small basins to heavy rain
- Unique in that it requires only satellite rainfall estimation as input
- Aimed at supporting forecasters and hydrologists to decide on issuing flash flood warnings

Thank you

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