The Global Flood Monitoring System (GFMS) on the recent flood events in southern United States

— Comparison with various flood information

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Global Flood Monitoring System (GFMS) http://flood.umd.edu

Global Flood Detection (12 km res.)

TMPA/GPM

DRIVE Model

Indus River basin Aug. 20 2013

Flood Detection/Intensity (Depth above Threshold [mm])

Experimental Inundation Mapping at 1 km resolution

Time Histories at a Point

12km Streamflow (m³/s)

Satellite Forecast NWP

Wu, Adler et al., WRR 2014
GFMS visits of last week

Snapshot taken on 09/19/2016
Satellite precipitation estimates merged via the GPM product are utilized as a key input into the Global Flood Monitoring System (GFMS) utilizing land surface and routing models at 12 and 1 km resolution to estimate the occurrence and intensity of floods. The hydrological calculations are extended into the future (out to five days) using GEOS-5 rainfall predictions.

During the Louisiana floods in August GFMS images and data were provided showing large-scale current conditions and forecasts as in upper left image (3-hr resolution). The forecasts were used by FEMA to help plan their response. The 1-km resolution inundation estimates from GFMS (example in lower left) were downloaded by FEMA and used to estimate number of structures and homes impacted. The GFMS inundation estimates were also used to compare with those from optical and SAR data, when
FEMA: How many houses, people flooded in Louisiana?

158,629 occupied houses and 507,495 people -- 10 percent of the state's population -- were "affected" by the flood.
Global evaluation TMPA real-time (DRIVE-RT) and research (rain gauge adjusted, DRIVE-V7) [15yrs (1998~), 3-hrly, 1/8° res.]

(1) **Flood event** based evaluation using 2,086 archived flood events by Dartmouth Flood Observatory [Wu, et al., JHM, 2012]

(2) **Streamflow** based evaluation at 1,121 river gauges by GRDC, across the globe.

*Wu, et al., WRR, 2014*
Data collection

Hazards Data Distribution System (HDDS)
http://hddsexplorer.usgs.gov/
Overview and Forecast for Southern Floods

Streamflow above Flood Threshold [m^3/s]

GFMS/UMD
Estimated Inundation Evolution

9 March 2016

11 March 2016

13 March 2016

Today
15 March 2016

Inundation map 1km res. [mm]
Yellow: modified flooding area
Radarsat Acquisition: 16 March 2016; (12:12:03 UTC).

- Radarsat vs. MODIS
- Radarsat vs. DRIVE model
- Drive model vs. Modified MODIS
Modified MODIS flood mapping on Mar 16 (14-day combined)
Inundation Fraction at 1/8th degree (%)
Integration of MODIS and DRIVE model based flood mapping

POD=0.89  FAR=0.85  CSI=0.14

POD=0.82  FAR=0.23  CSI=0.66

POD=0.84  FAR=0.85  CSI=0.15

POD=0.82  FAR=0.38  CSI=0.56
Integration of MODIS and DRIVE model based flood mapping @ 1km res.

POD=0.52 FAR=0.58 CSI=0.30
Sensitivity at $16^{\text{th}}$ degree
Sensitivity at 1km res.

+5mm

+0mm

-8mm

-20mm
Main areas of flooding along Brazos show up in both optical-based inundation estimate and GFMS calculations.
Some interesting similarities and differences between MODIS-based inundation estimate and GFMS calculation for 2 June. Main areas of flooding along Brazos show up in both, with some less flooded areas also agreeing—but still lots of differences, especially at fine scales.
Summary

(1) GFMS well detected the recent flood events over southern states of USA.

(2) DEM based hydraulic modification of MODIS flood mapping seems positive in recovering the missing flooding areas while it assumes the validity of the identified inundation area by MODIS.

(3) This kind of comparison can be the first step and very useful for integration of various satellite and hydrological model derived flood information.

(4) The consistency in the satellite and modeled inundation extent is a function of spatial resolution, which indicates the values of the integrated flood mapping at various spatial resolutions.
Thank You!
1 km Inundation Estimates

Inundation map 1km res. [mm]
09Z02Jun2016

X Hempstead

Brazos River

X Richmond
GFMS calculated streamflow at Hempstead, TX streamgauge along Brazos River (31.10N, 96.08W) matches well in magnitude and timing, but shows larger dip over last day (different units, linear plot vs. log, and GMT vs. Local time). Forecast indicates another peak (not as big) in next couple of days.