

Initial Results in Global Flood Monitoring Using GPM Data

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George J. Huffman²**

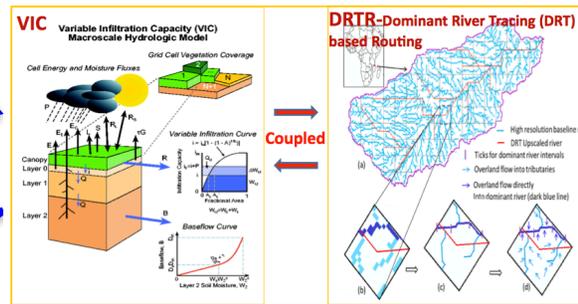
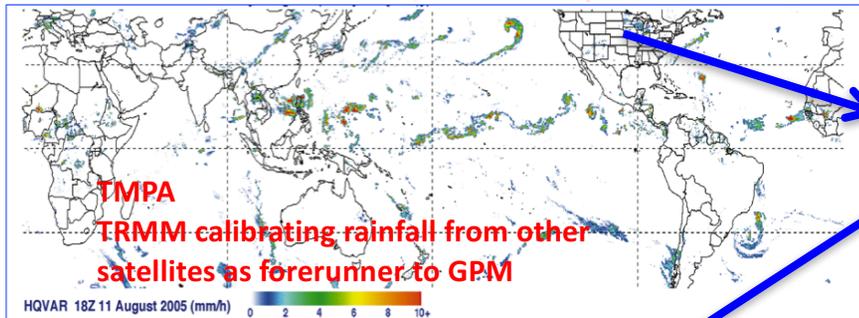
**¹Earth System Science Interdisciplinary Center, University of
Maryland, College Park, MD 20740**

²NASA Goddard Space Flight Center, Greenbelt, MD 20771

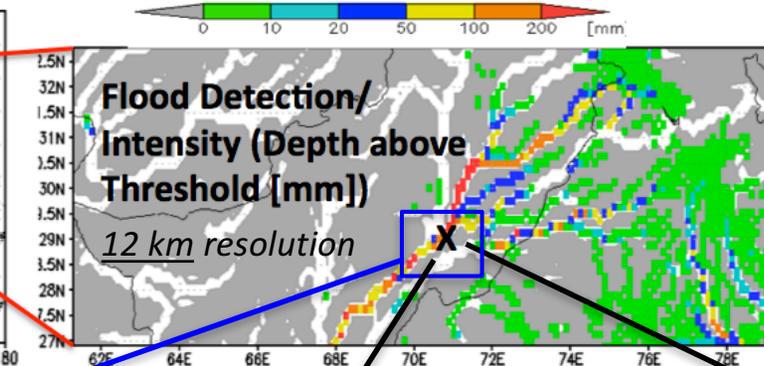
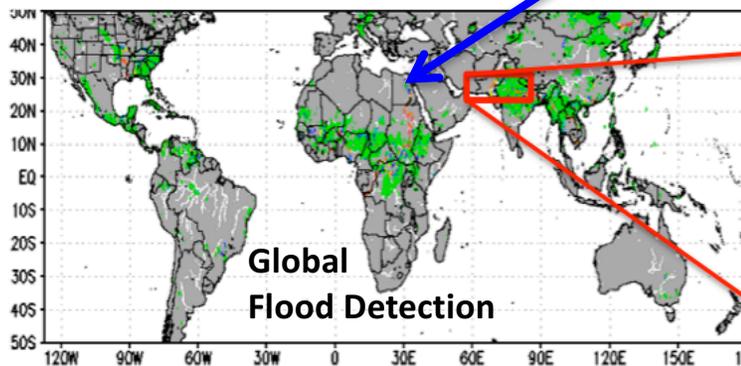
Global Flood Monitoring System (GFMS)

<http://flood.umd.edu>

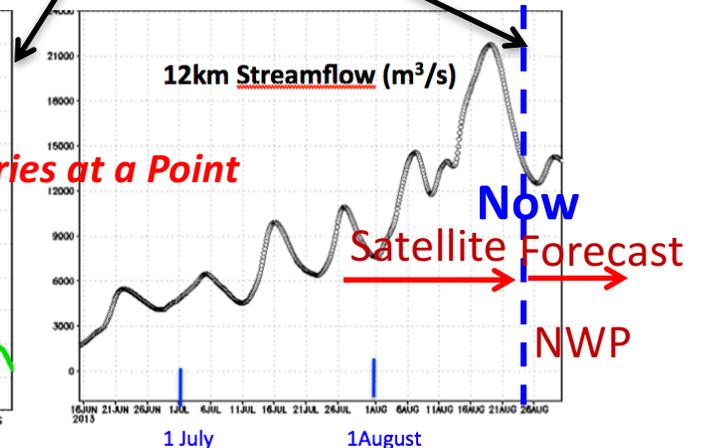
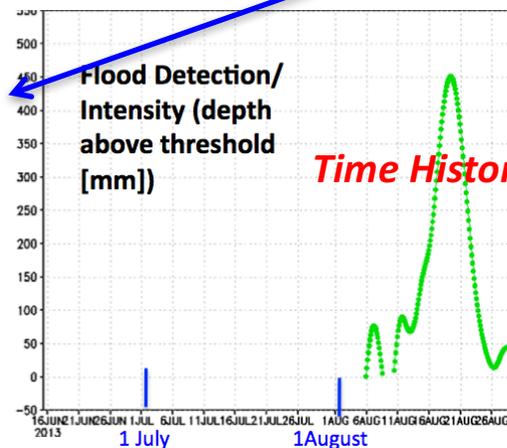
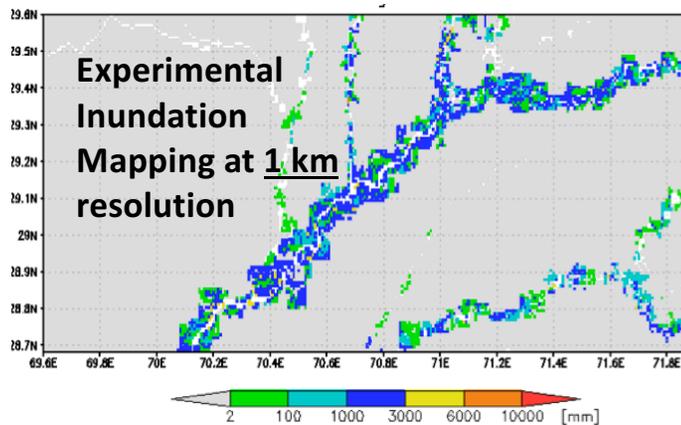
Global Real-time Flood Calculations Using Satellite Rainfall and Hydrological Models

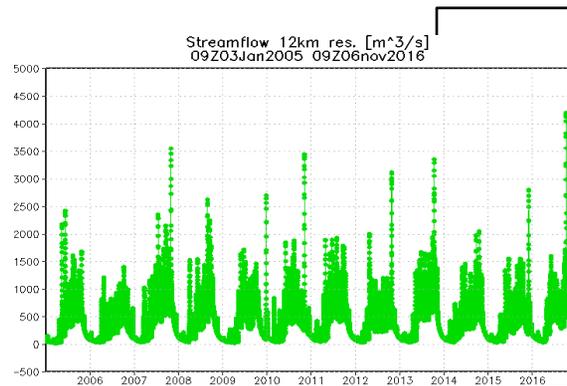
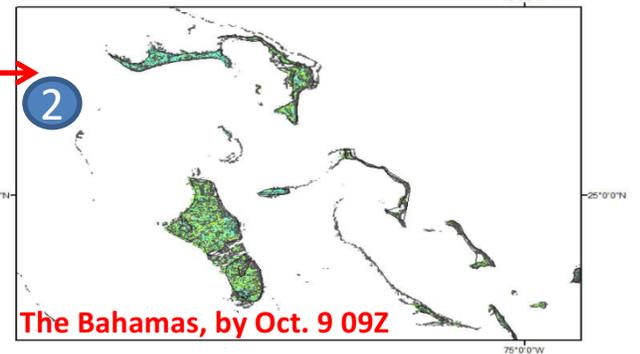
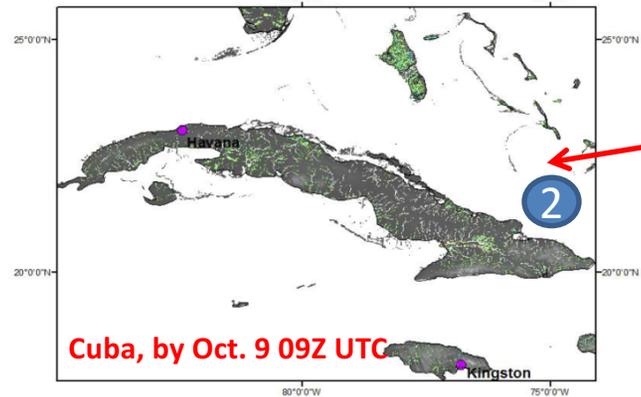
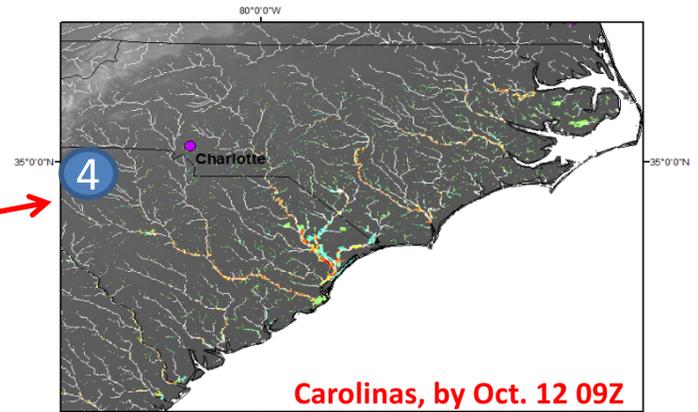
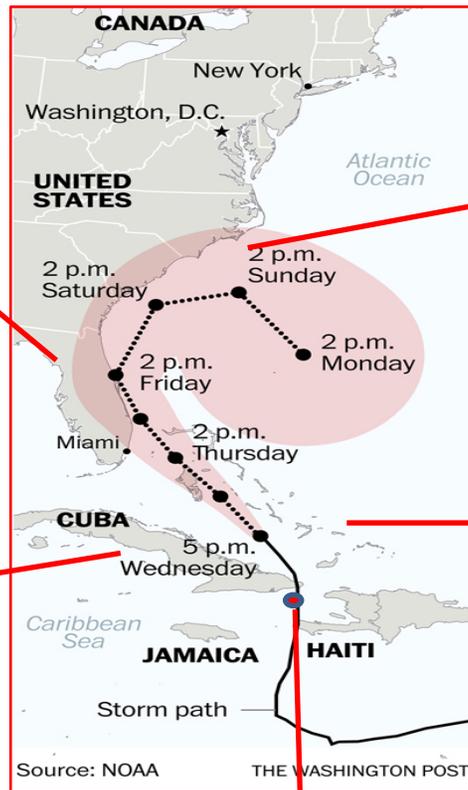
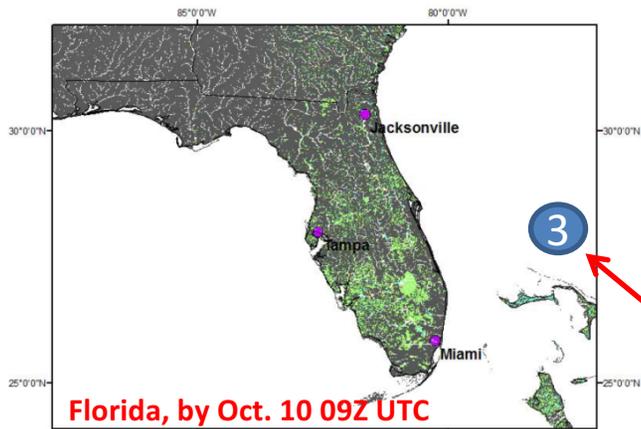


TRMM/GPM rainfall into land surface and routing models for water depth and stream flow calculations compared to flood thresholds--every three hours

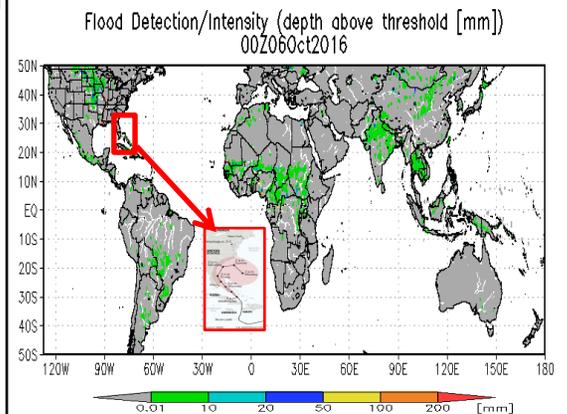
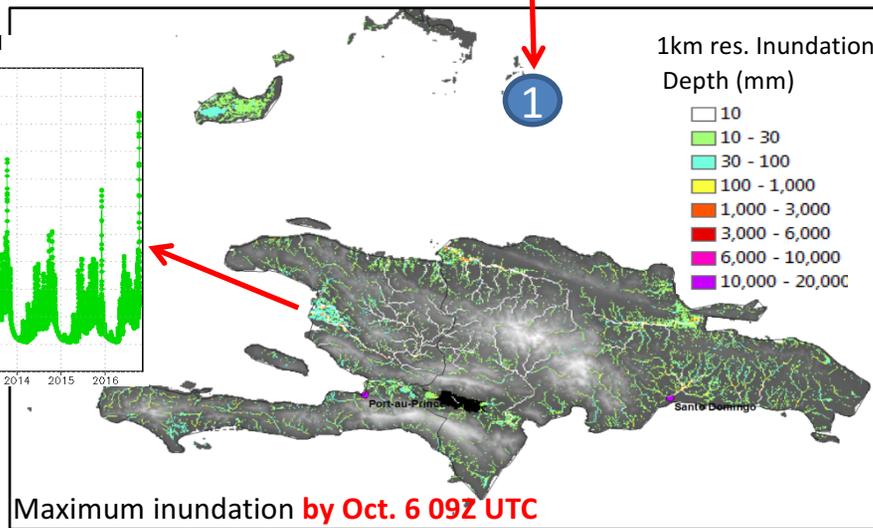


Indus River basin Aug. 20, 2013



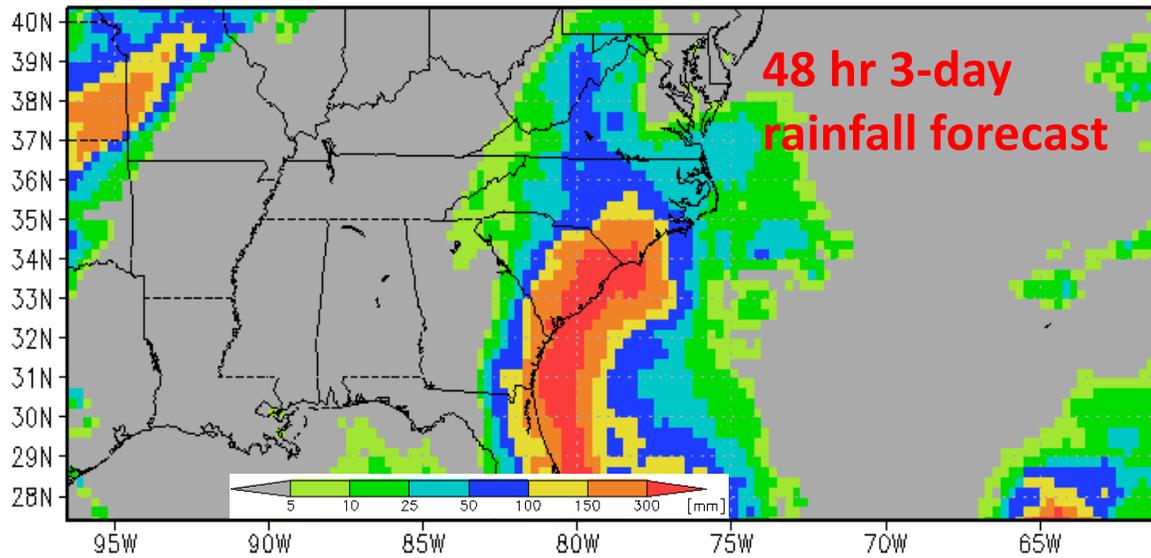


**Largest peak since 2005
@ La Artibonite River mouth**

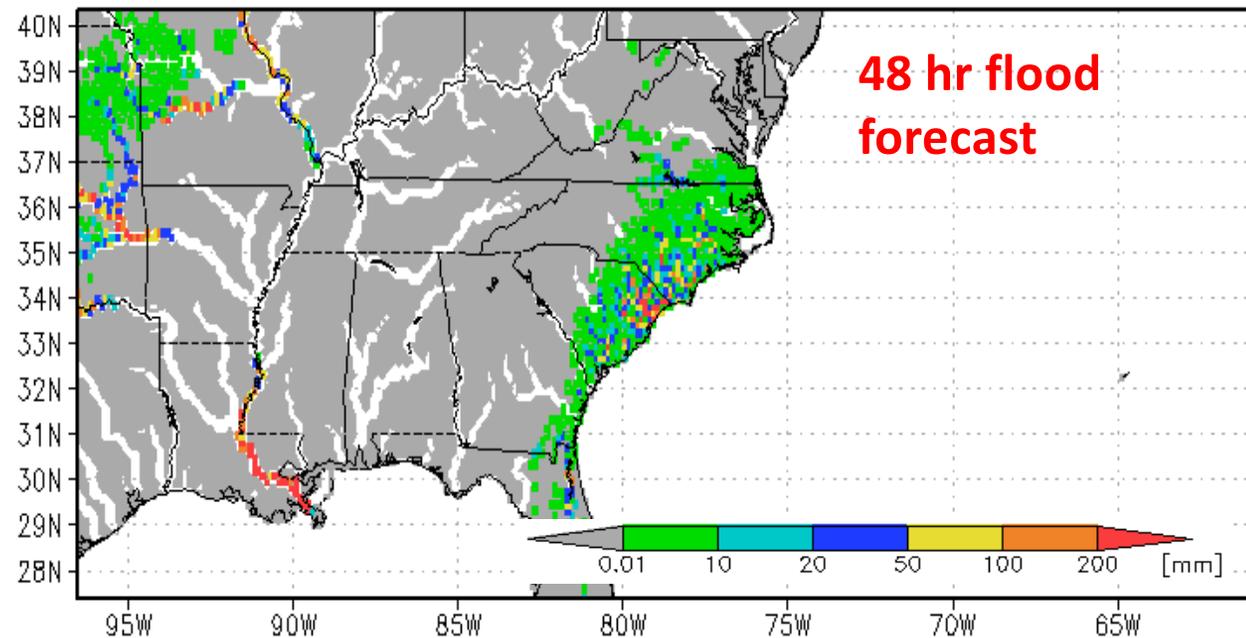


**8th degree global flood detection and intensity
For Hurricane Matthew**

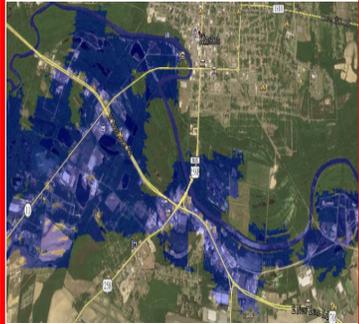
Rainfall (3-day accum.) [mm] 09Z09Oct2016



Flood Detection/Intensity (depth above threshold [mm])
12Z09Oct2016

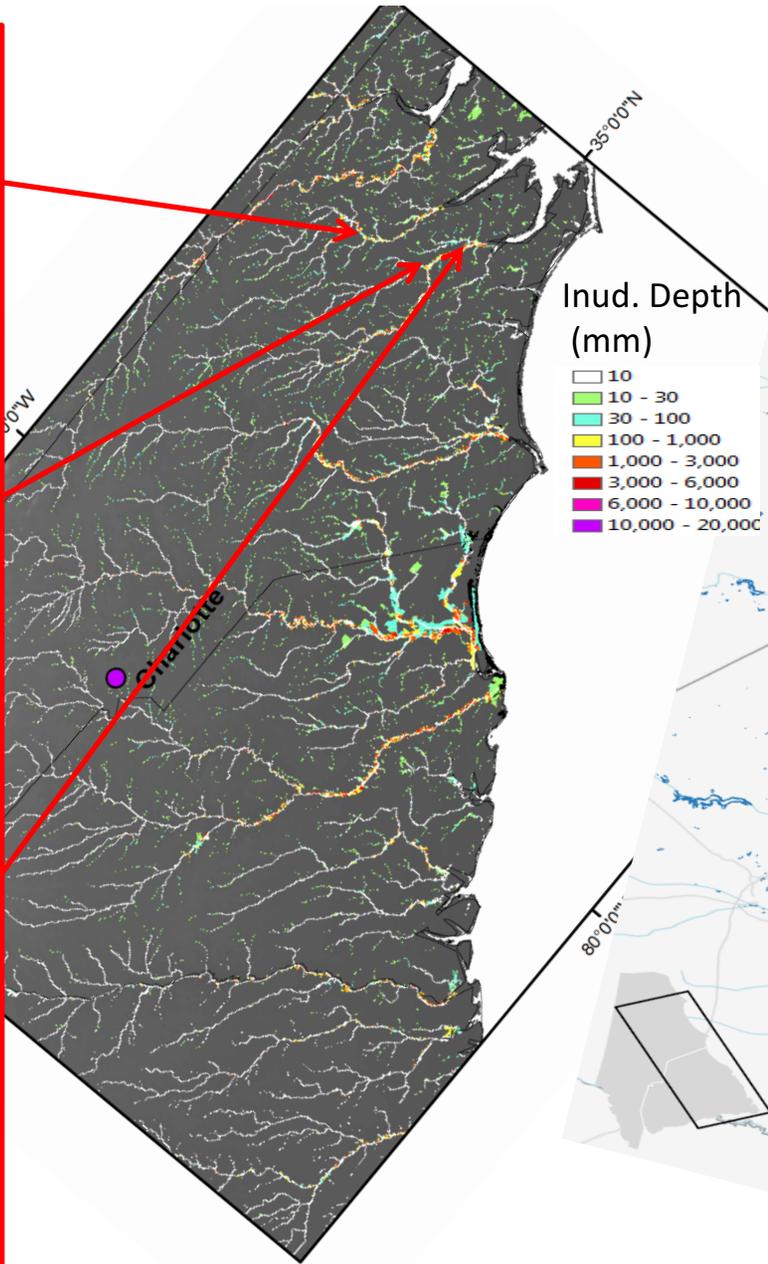


Hurricane Matthew (Oct. 13, 2016)

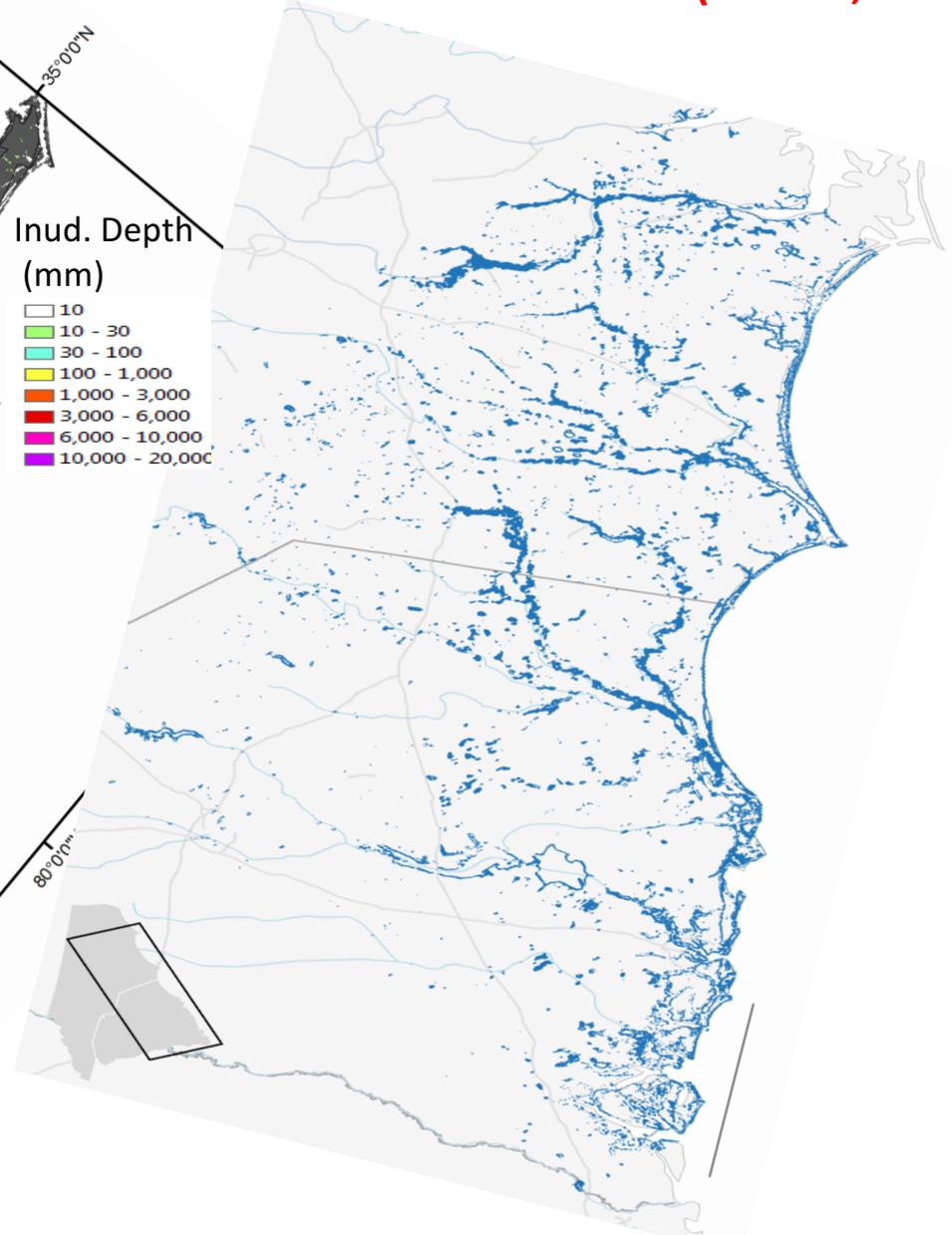


Goldsboro, NC

VIIRS downscaled
9-m flood map on
Oct. 13
(Sun/GMU)



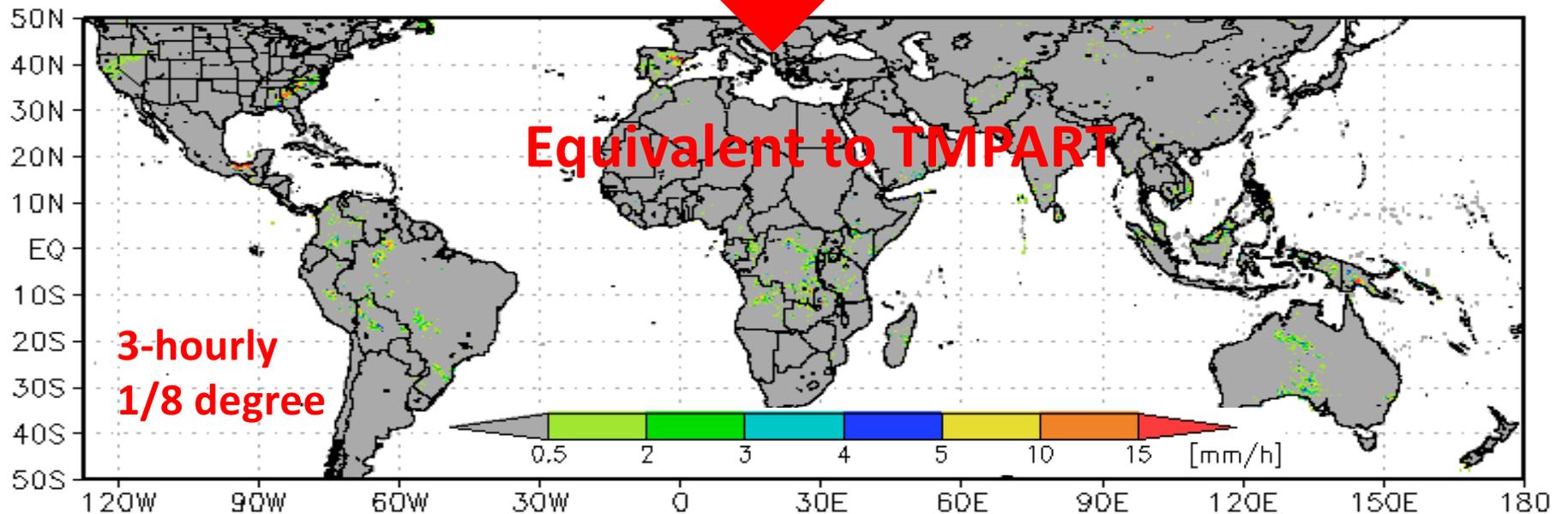
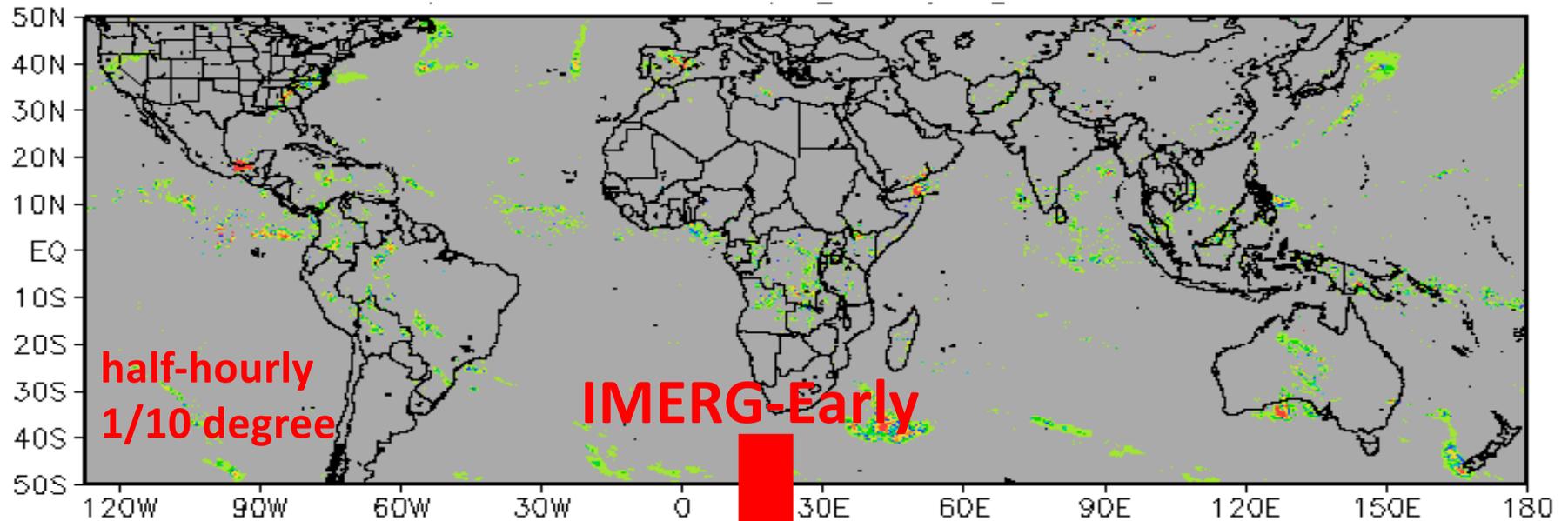
GFMS maximum flood depth during period of Oct 11-13.



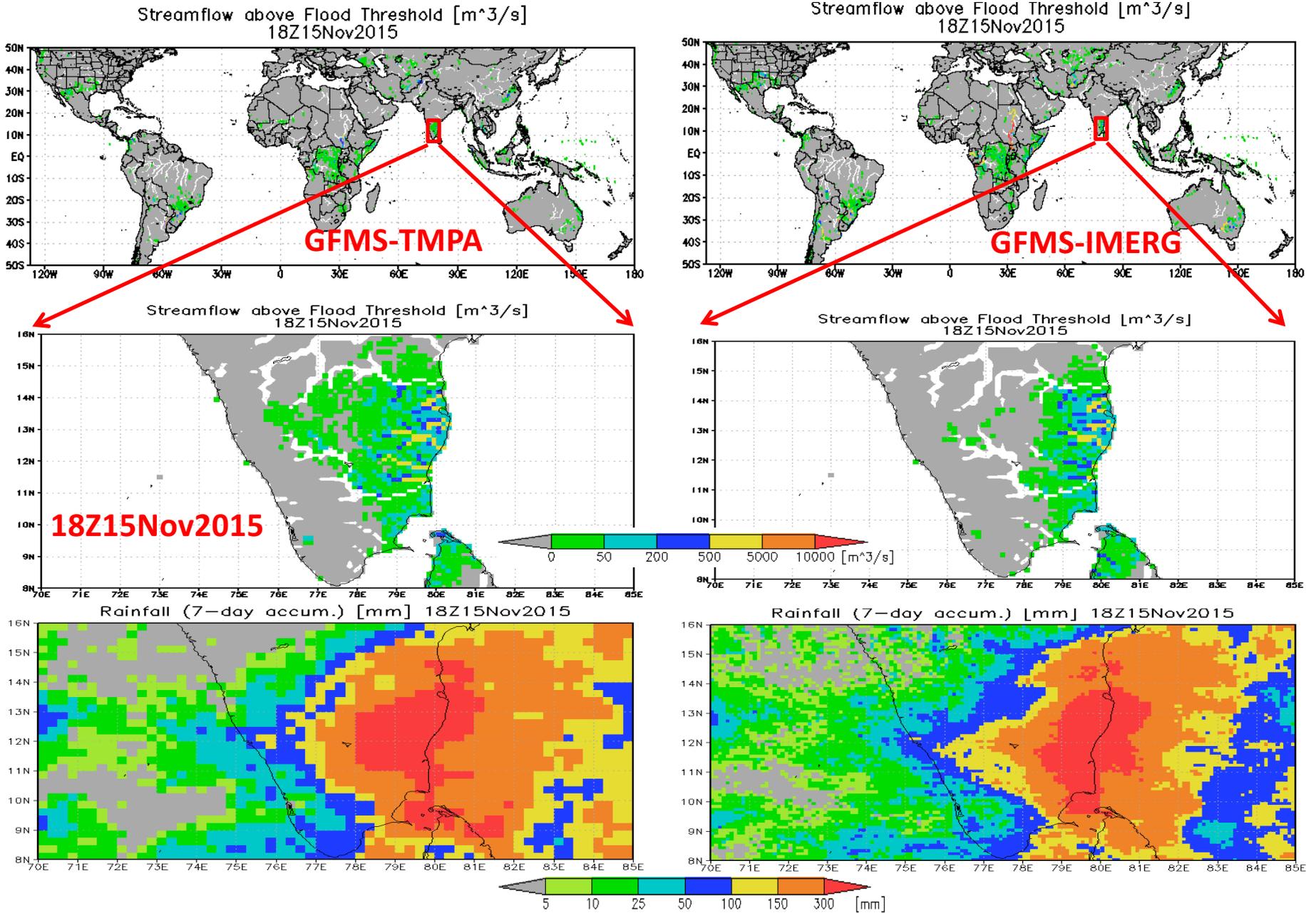
Flood Observatory U. Of Colorado
From MODIS, In NYTimes

GFMS from TRMM to GPM era

IMERG (early and late) added up into 3-hr periods to be equivalent to TMPA

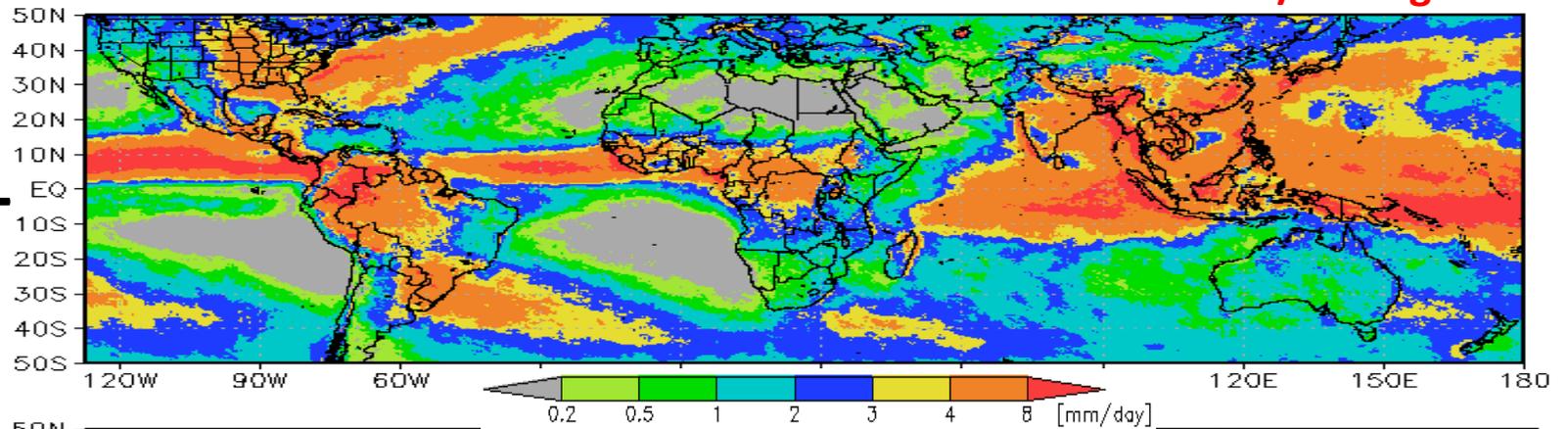


Global to regional flood monitoring

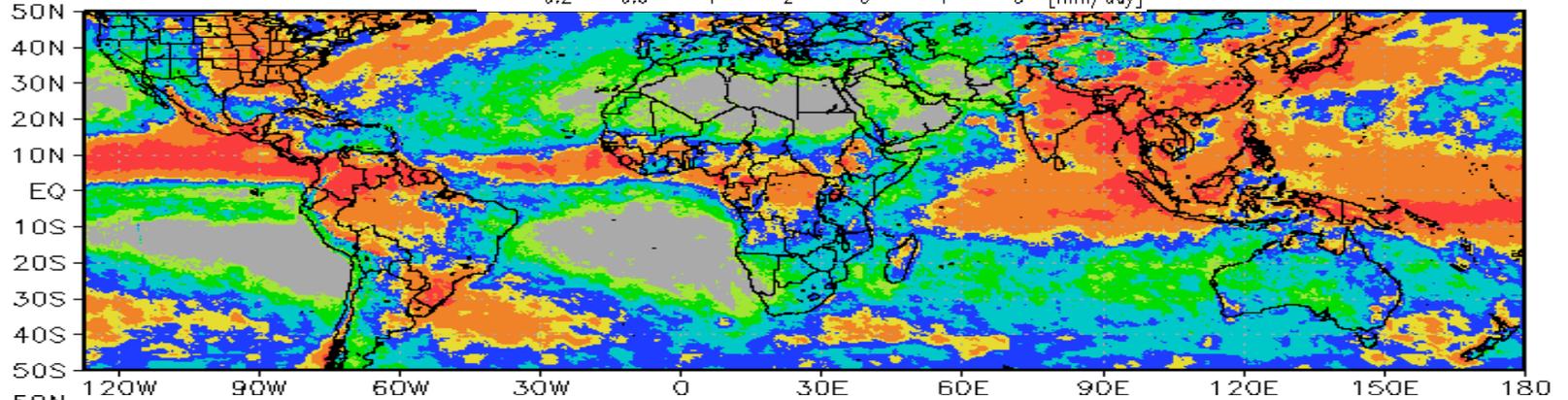


Difference between IMERG & TMPART over May 1, 2015 to Oct. 15, 2016
1/8th degree

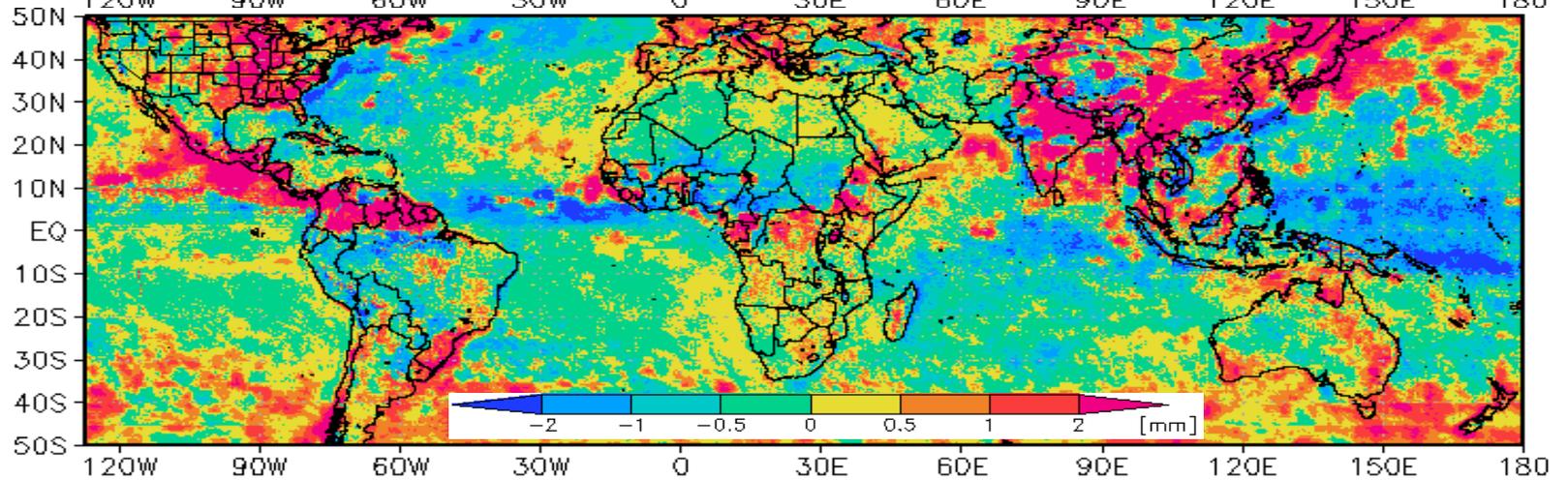
TMPART



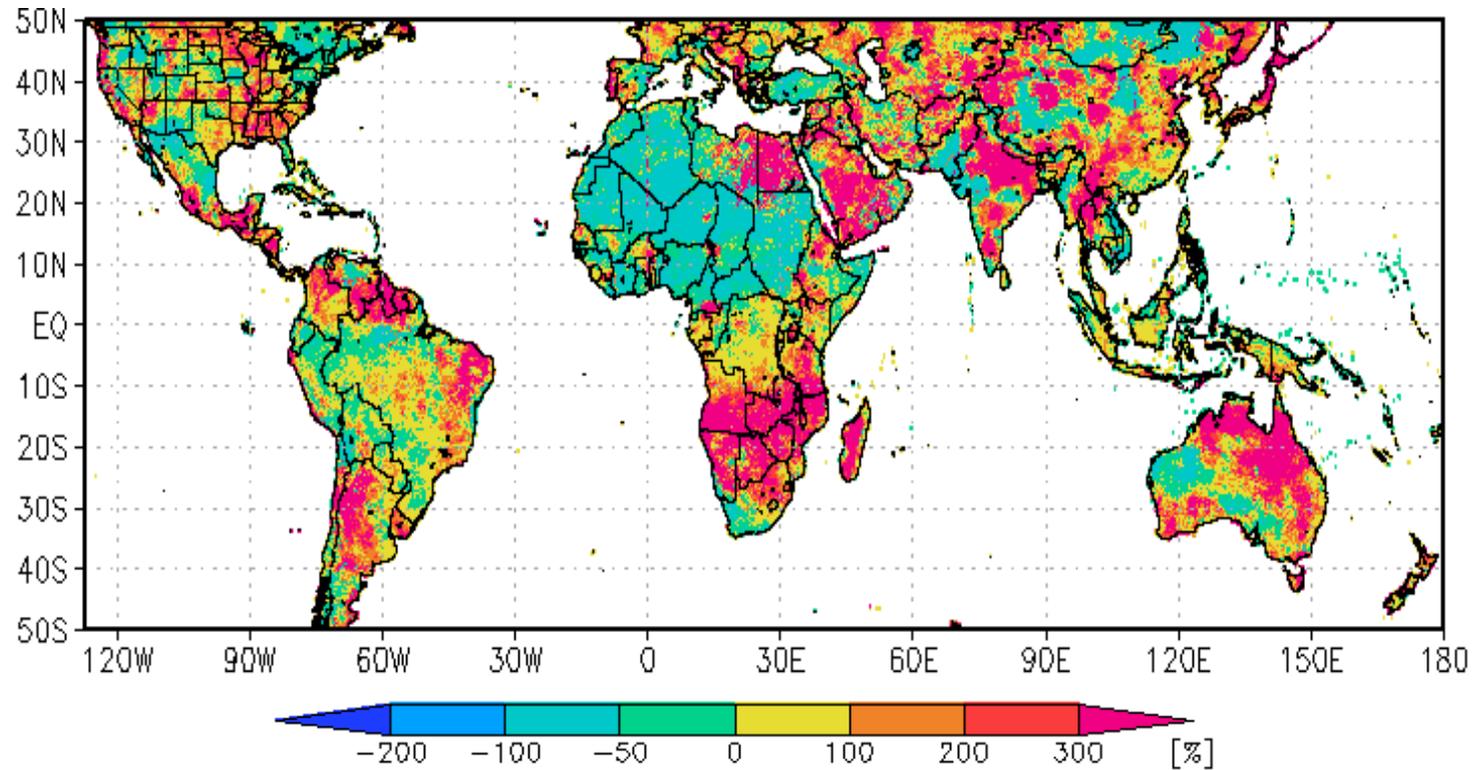
IMERG



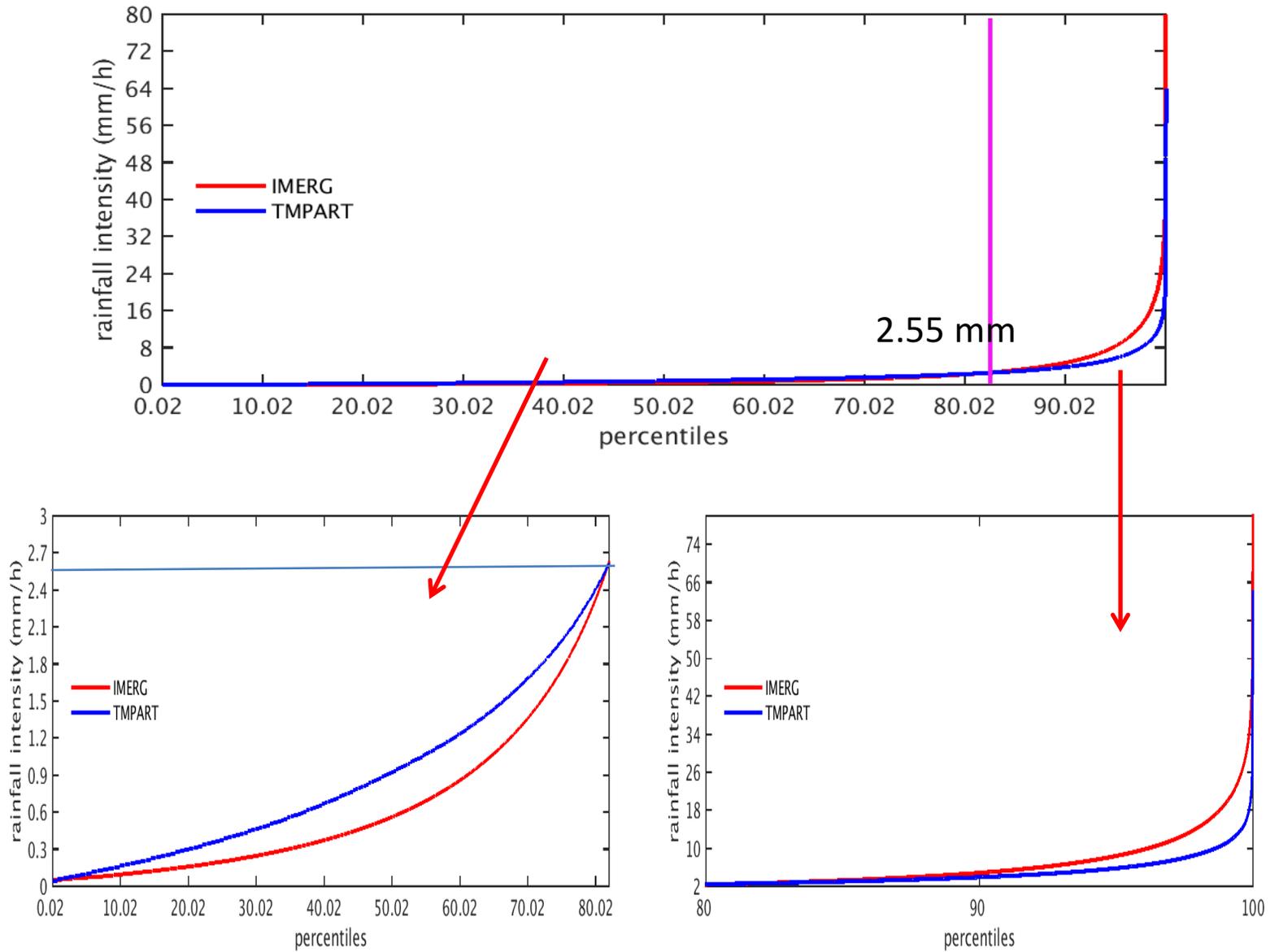
**IMERG -
TMPART
(mm)**



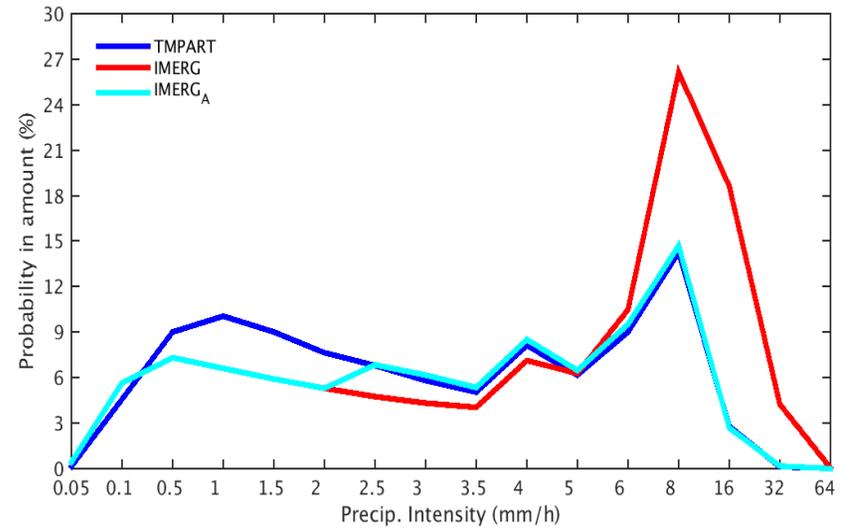
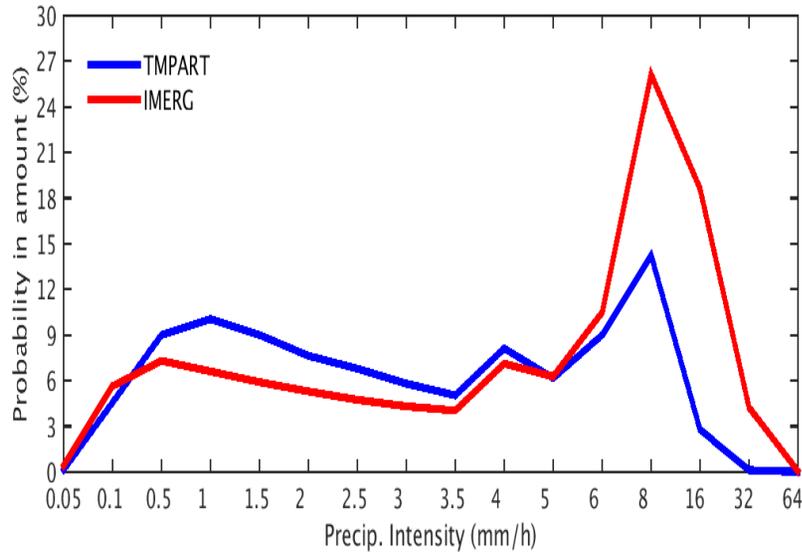
Difference (%) in 95th-percentile streamflow (m³/s) (IMERG-TMPART)/TMPART



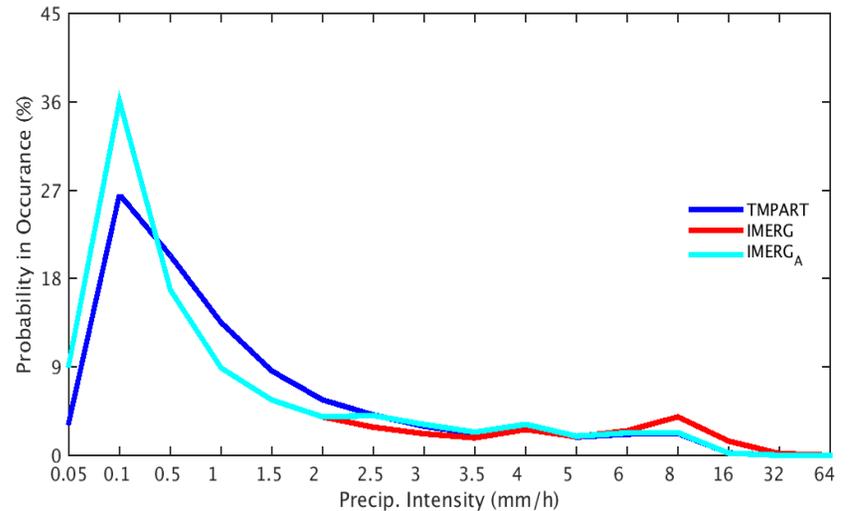
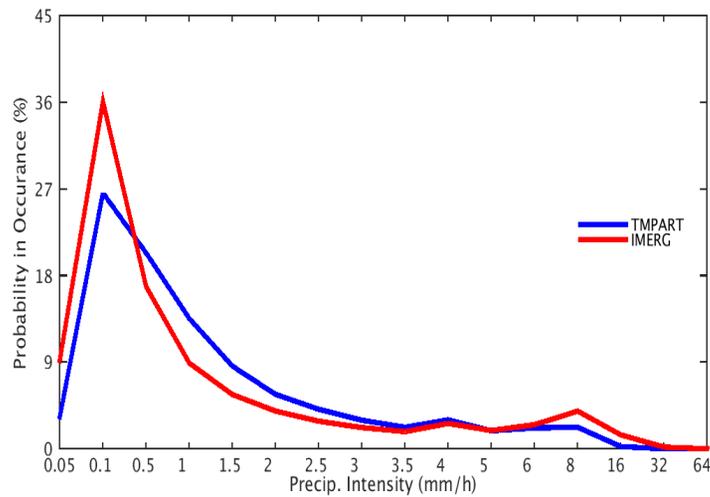
IMERG-Early: converted to be equivalent to TMPART, 1/8degree and 3-hourly Global domain: 50°S-50°N; Aug.1 – Sep. 30, 2016



Probability distribution of Precipitation amount and occurrence Normalized with TMPART

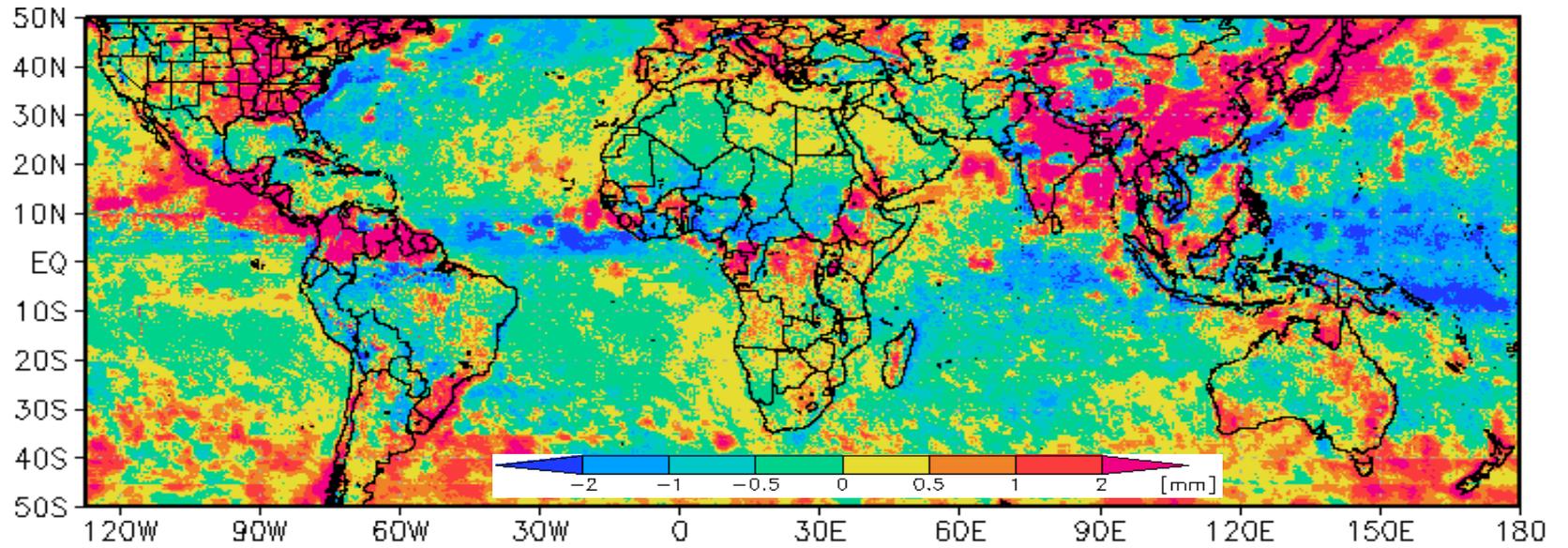


Probability in amount

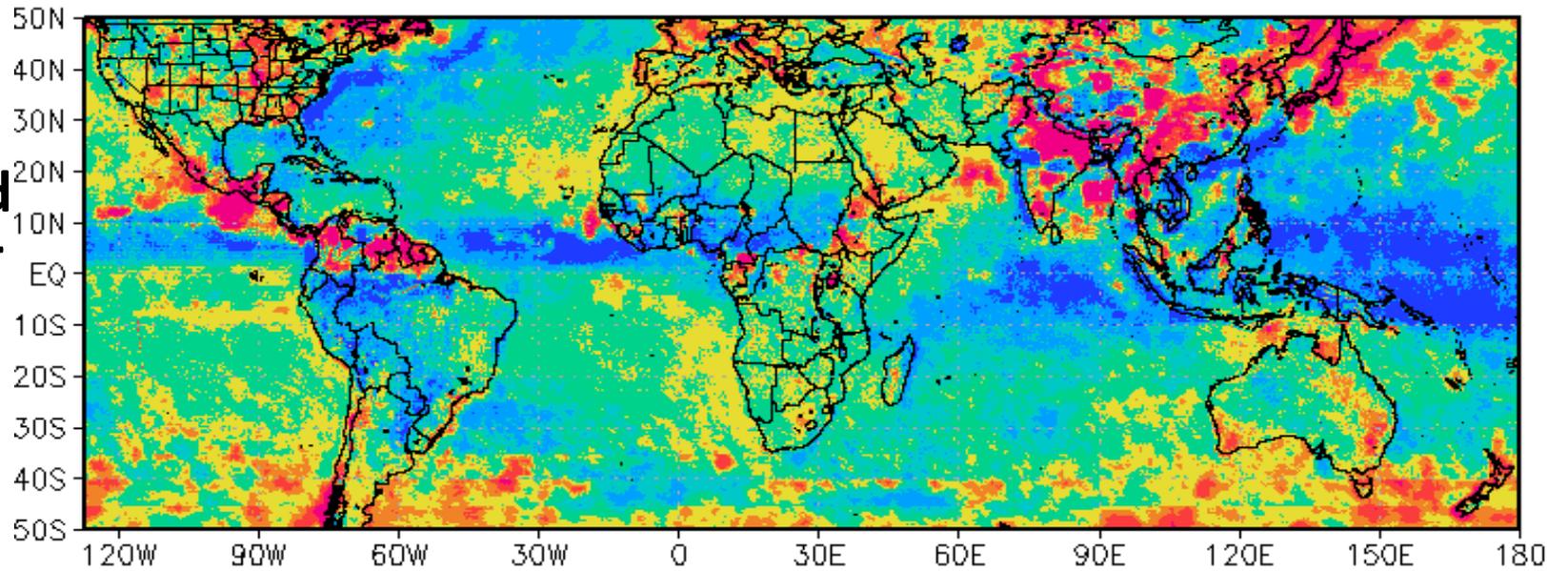


Probability in occurrence

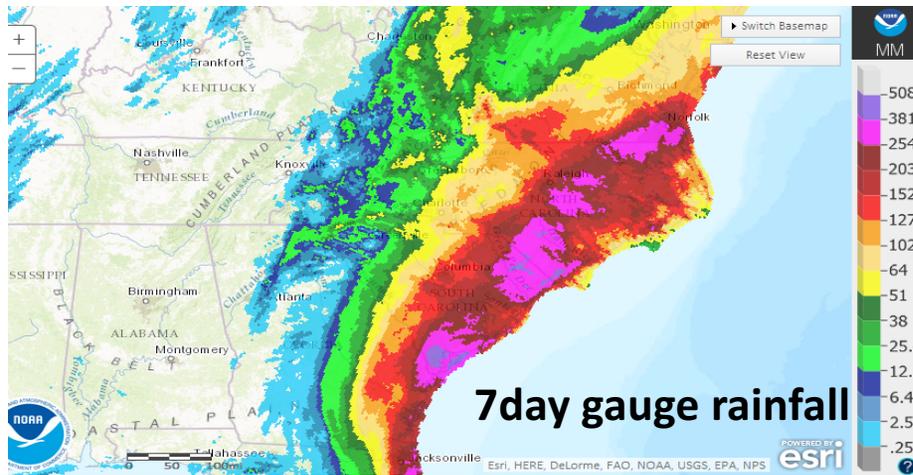
**IMERG –
TMPART
(mm)**



**IMERG_{ad}
– TMPART
(mm)**



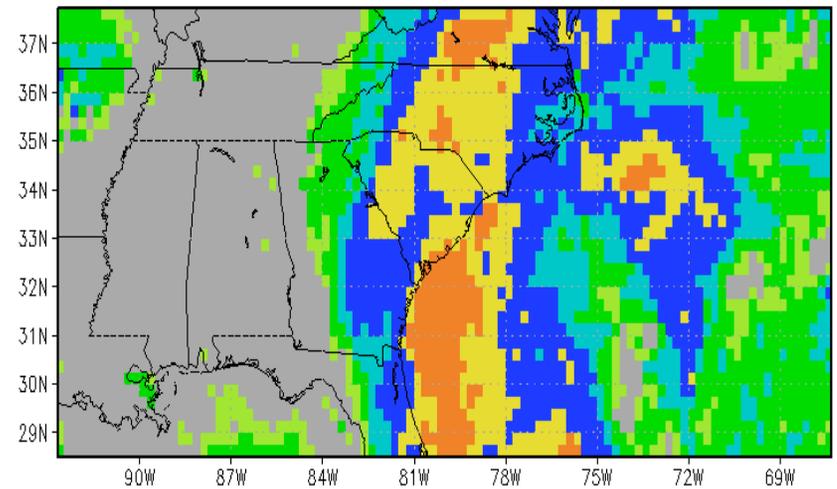
GFMS flood update @09Z UTC, Oct 12



Gauge

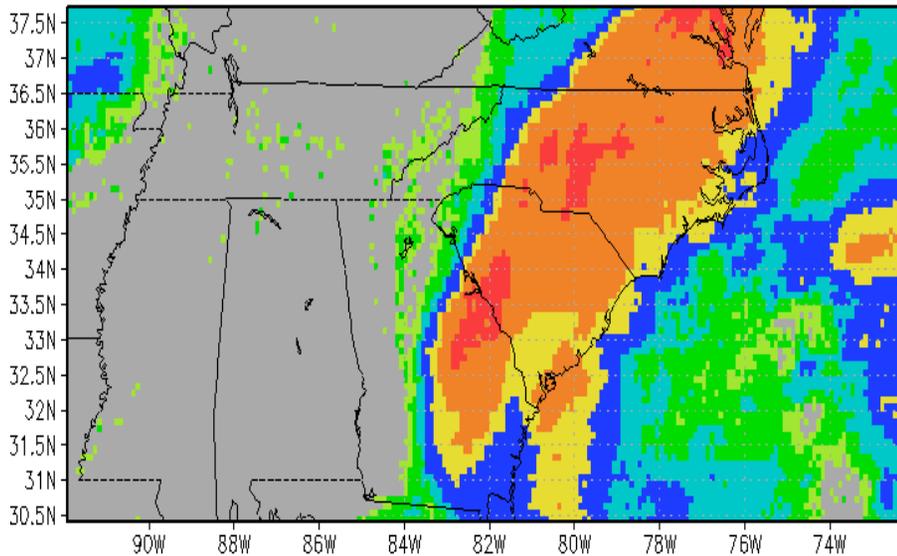
Hurricane Matthew (Oct. 12, 2016)

Rainfall (7-day accum.) [mm] 00Z12Oct2016

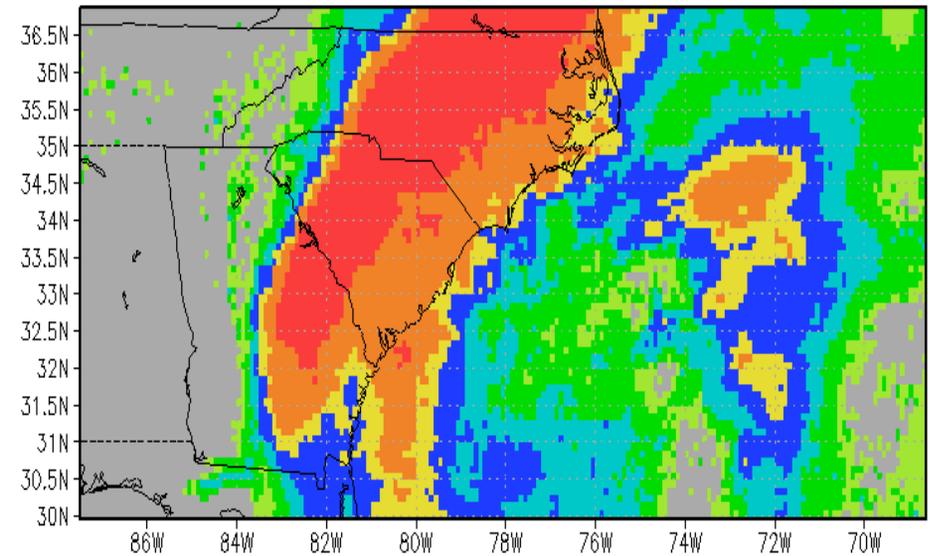


TMPART

Rainfall (7-day accum.) [mm] 00Z12Oct2016

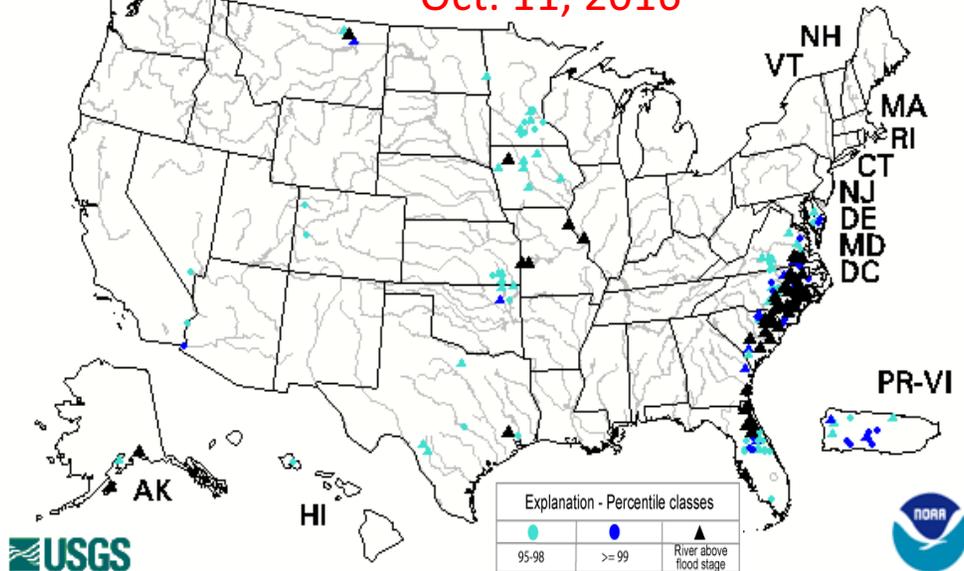


Rainfall (7-day accum.) [mm] 00Z12Oct2016



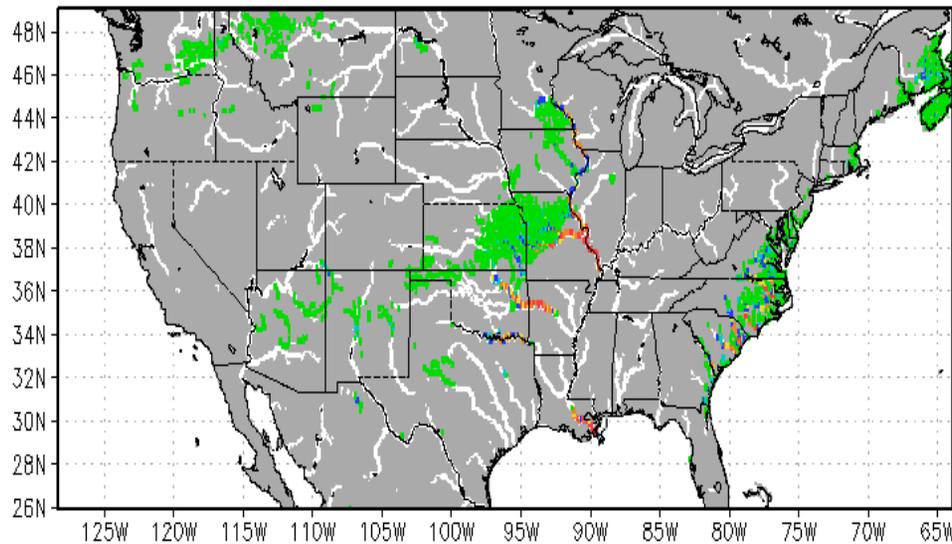
Hurricane Matthew (Oct. 11, 2016)

Archive of streamflow maps (United States)
Oct. 11, 2016



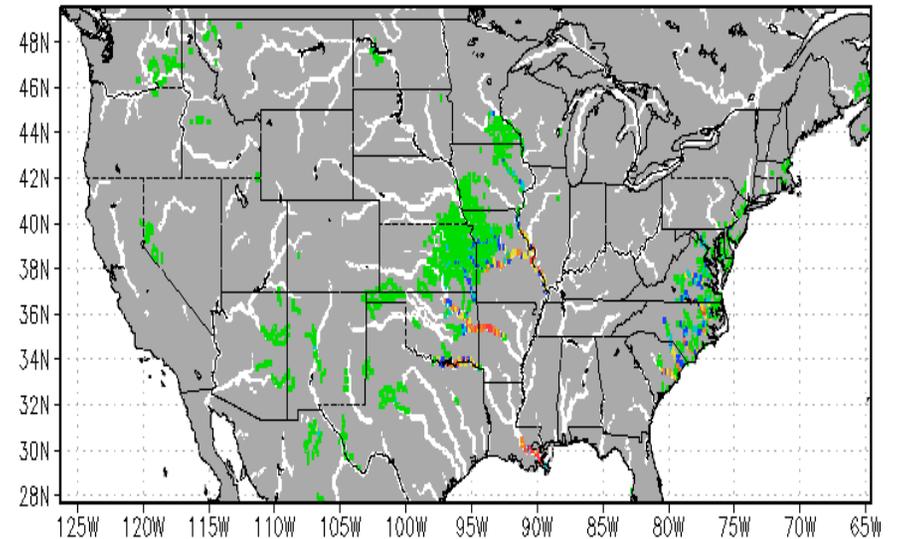
Gauged Flood

Flood Detection/Intensity (depth above threshold [mm])
00Z11Oct2016



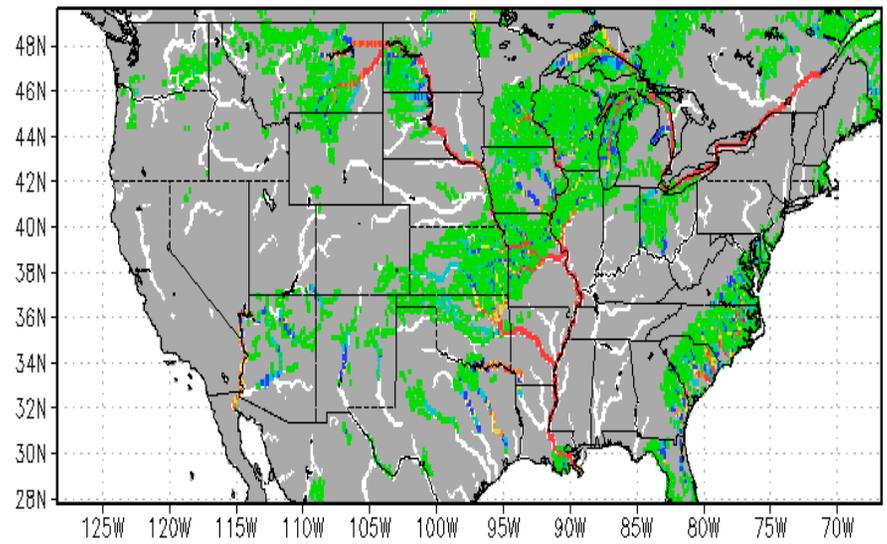
GFMS/IMERG (PDF adjusted)

Flood Detection/Intensity (depth above threshold [mm])
00Z11Oct2016



GFMS/TMPA

Flood Detection/Intensity (depth above threshold [mm])
00Z11Oct2016

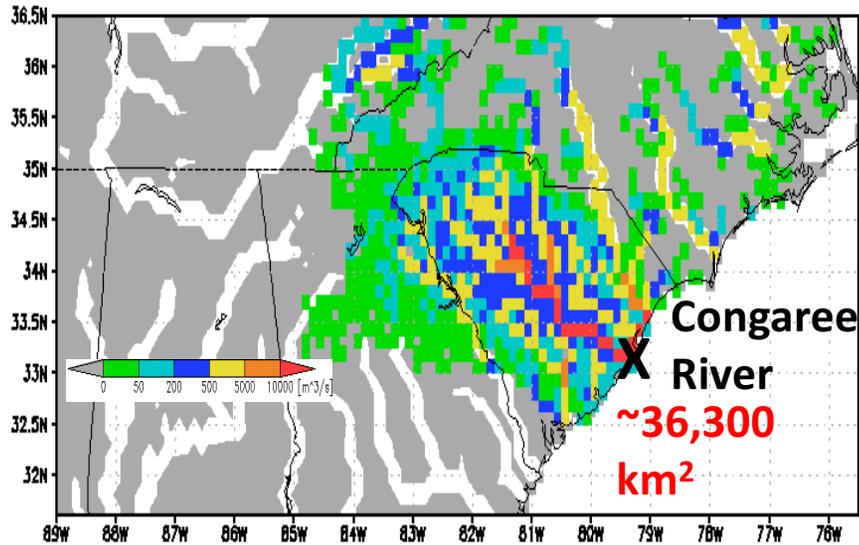


GFMS/IMERG (Original)

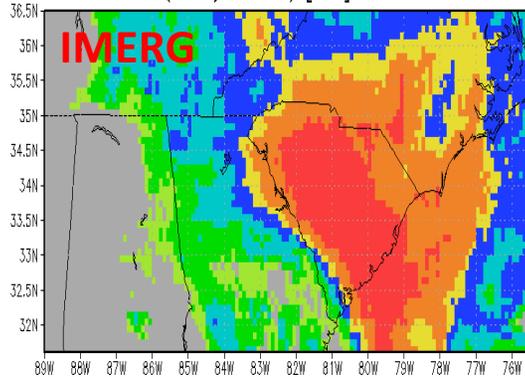


Basin averaged daily rainfall vs. runoff (May 1, 2015- Nov 15, 2015)

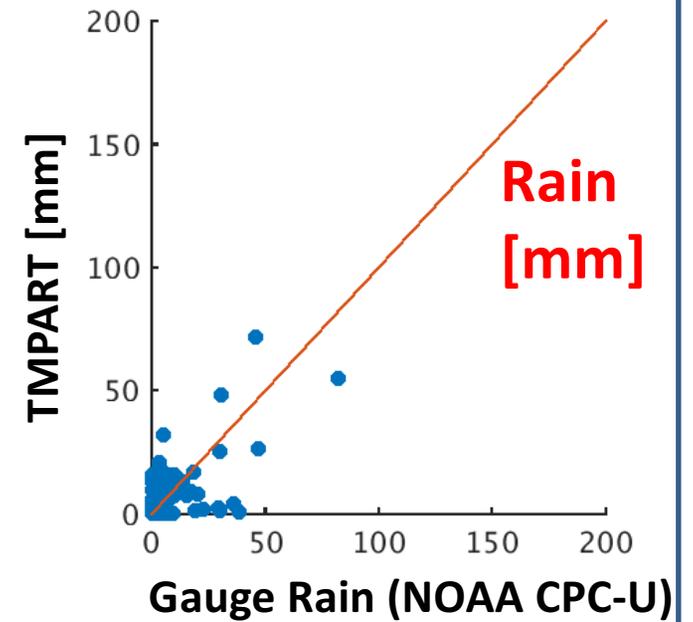
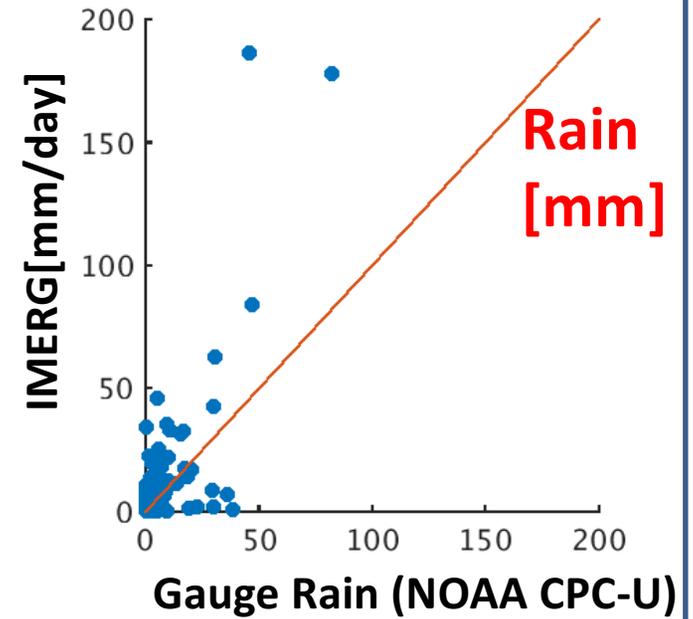
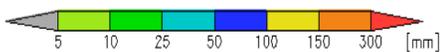
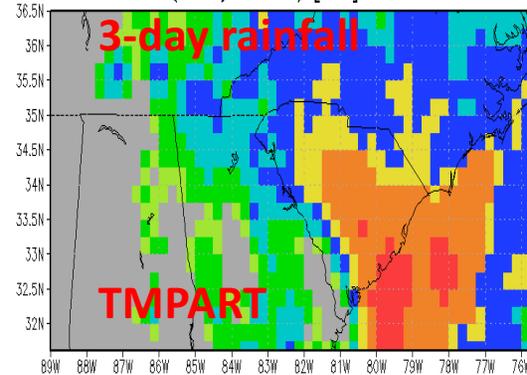
Streamflow above Flood Threshold [m^3/s]
15Z04Oct2015



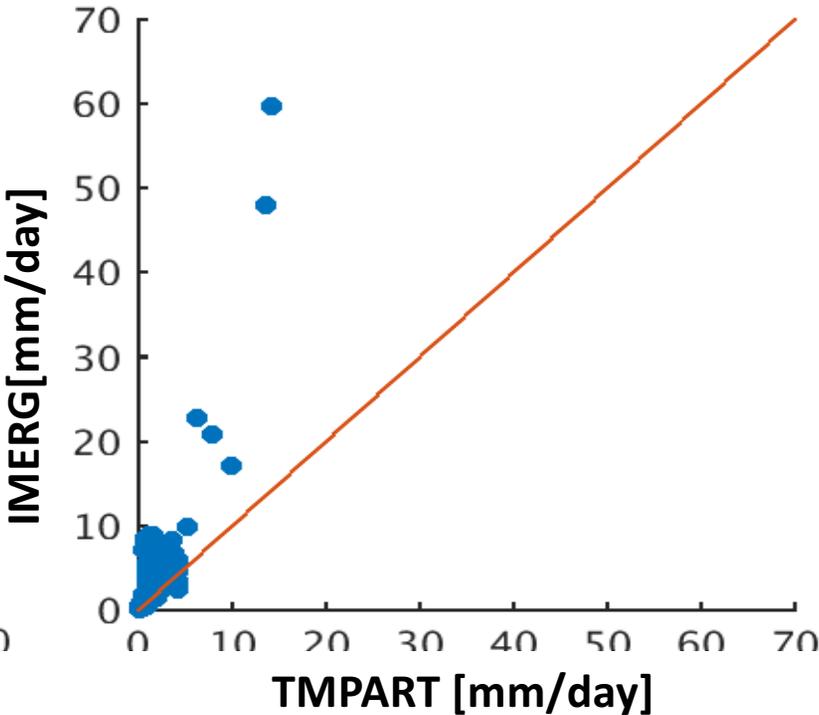
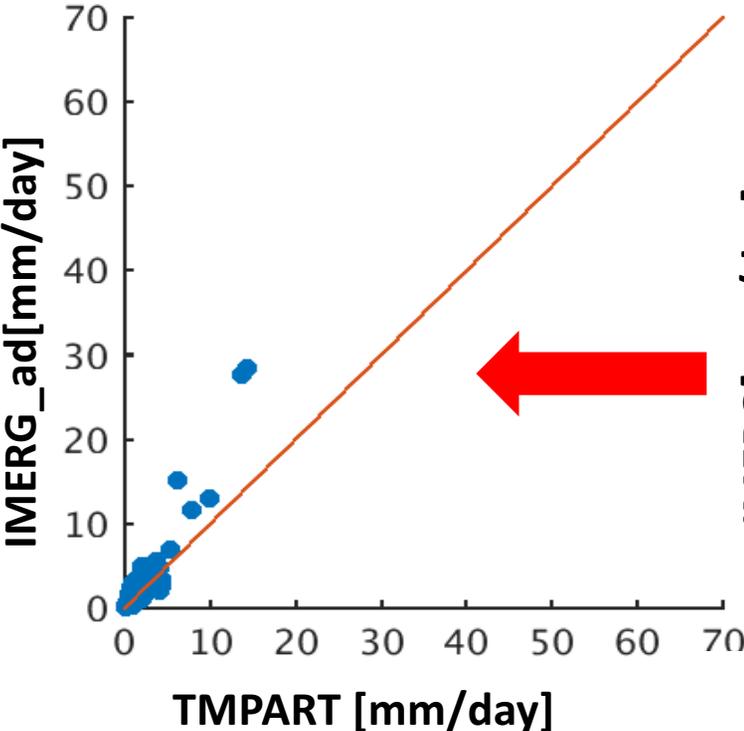
Rainfall (3-day accum.) [mm] 15Z04Oct2015



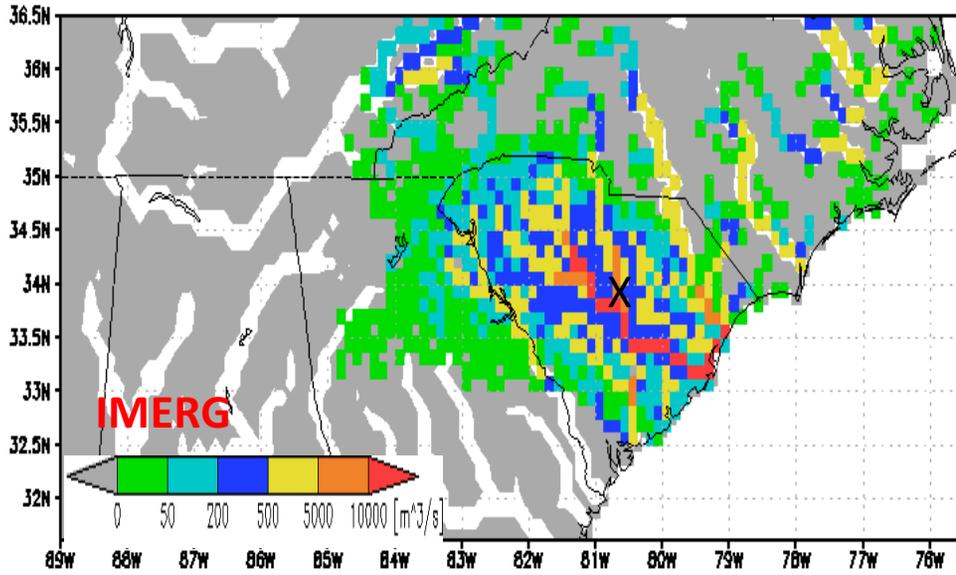
Rainfall (3-day accum.) [mm] 15Z04Oct2015



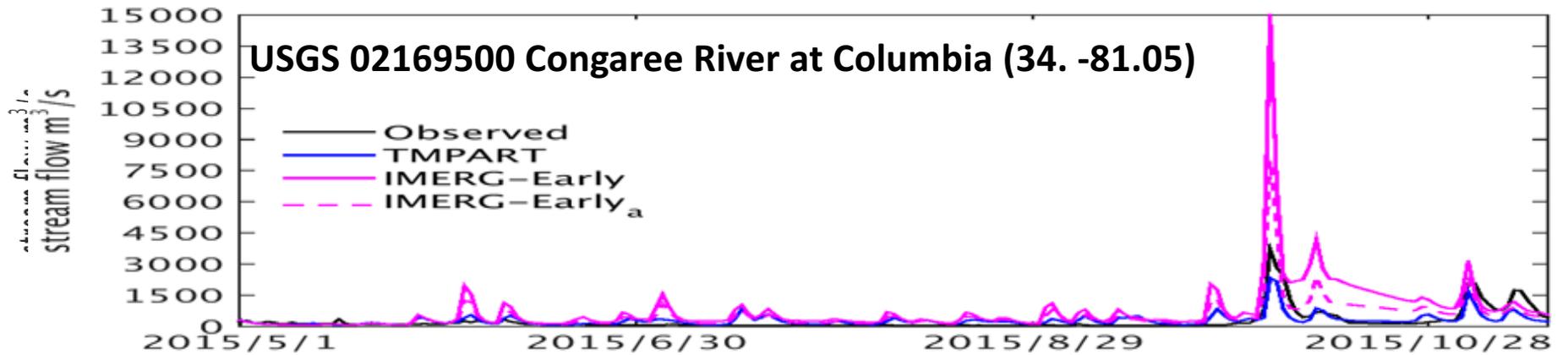
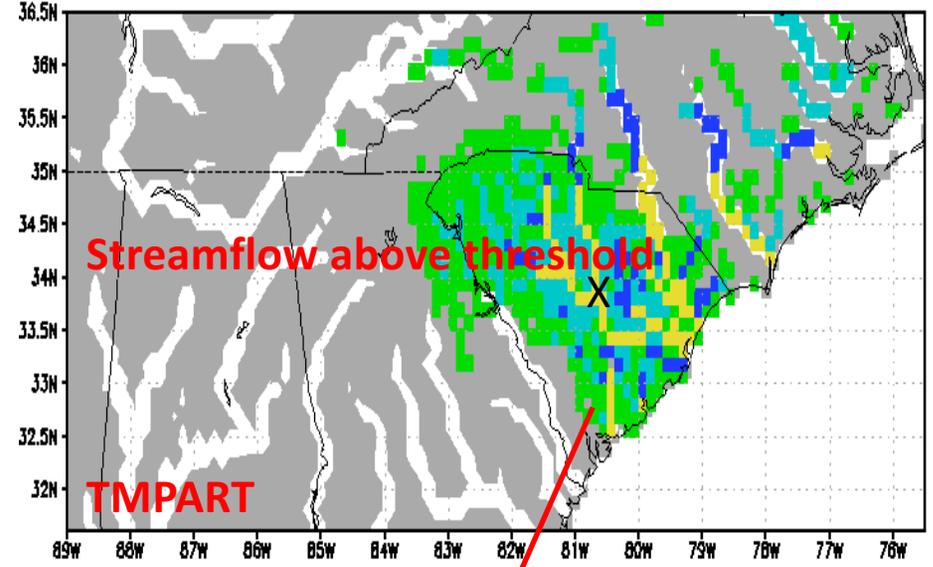
River basin area averaged Runoff [mm] using IMERG



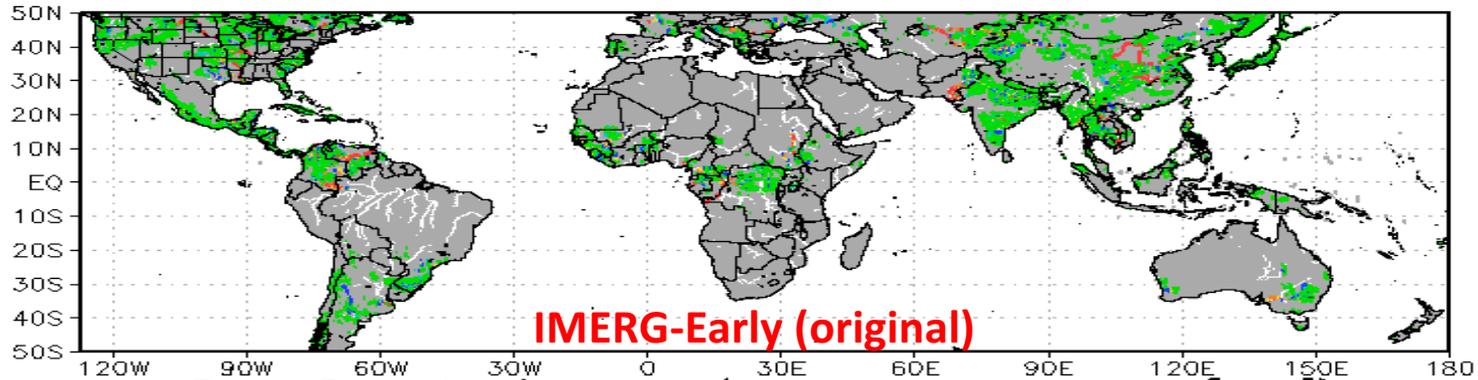
Streamflow above Flood Threshold [m^3/s]
15Z04Oct2015



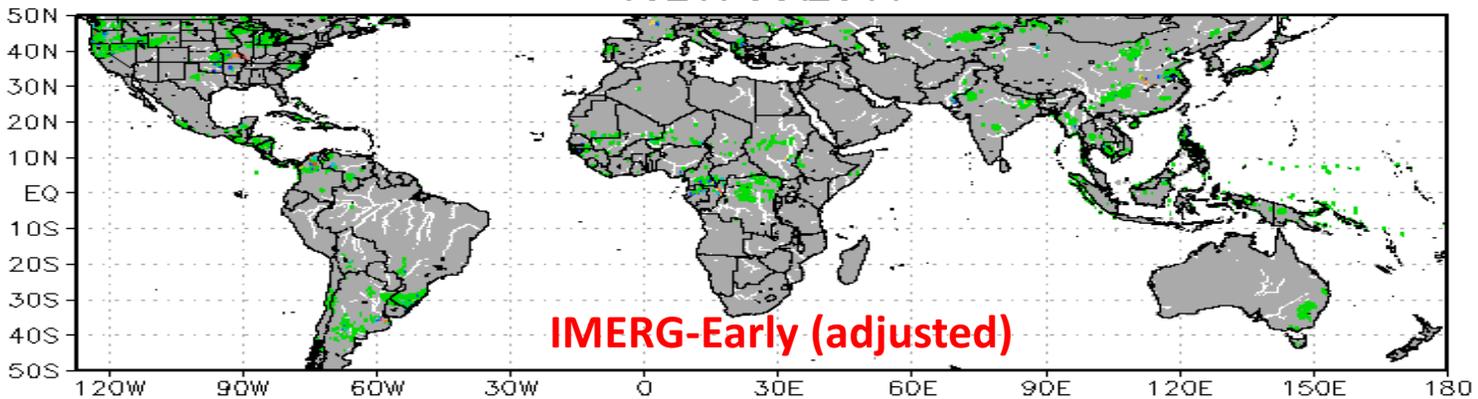
Streamflow above Flood Threshold [m^3/s]
15Z04Oct2015



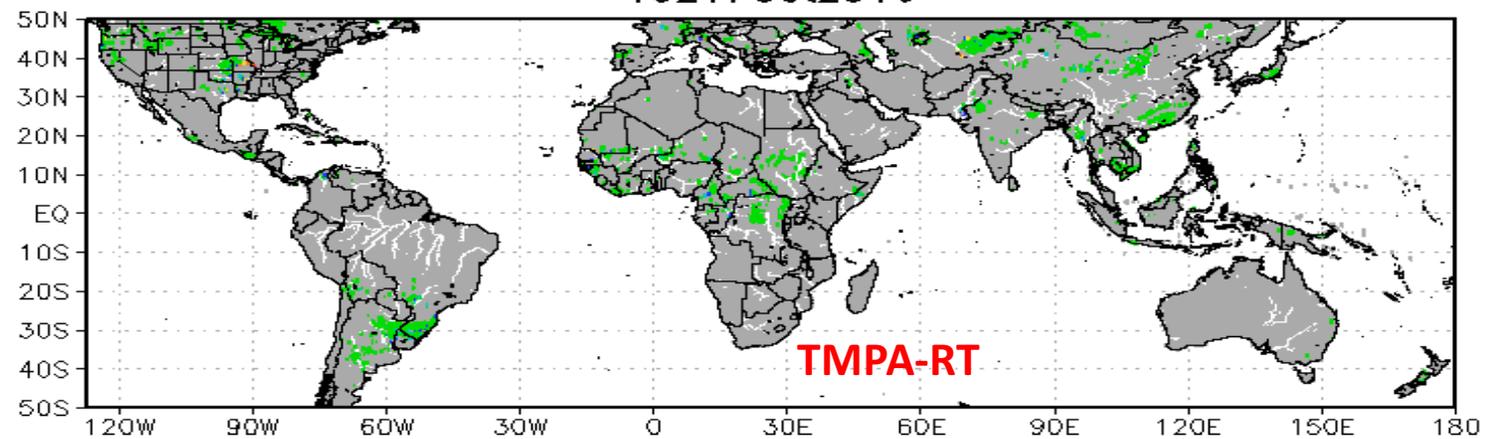
Flood Detection/Intensity (depth above threshold [mm])
15Z17Oct2016



Flood Detection/Intensity (depth above threshold [mm])
15Z17Oct2016



Flood Detection/Intensity (depth above threshold [mm])
15Z17Oct2016



Summary

- (1) GFMS routinely functions well in monitoring on-going flood events, such as Hurricane Matthew caused inland flooding recently.
- (2) New GPM IMERG products have been initially driving the Global Flood Monitoring System (GFMS), paralleled with TMPART based current system, for first-cut evaluation.
- (3) IMERG showed higher estimation than TMPART in most of land areas, while with lower estimation in some other areas , e.g., some deep tropical areas, which indicated different flood threshold map is needed for GFMS-IMERG.
- (4) In order to use the existing global flood threshold map derived using TRMM era data, a simple PDF matching of IMERG to TMPART showed significantly improved flood detection and intensity mapping, and flood peak estimation.

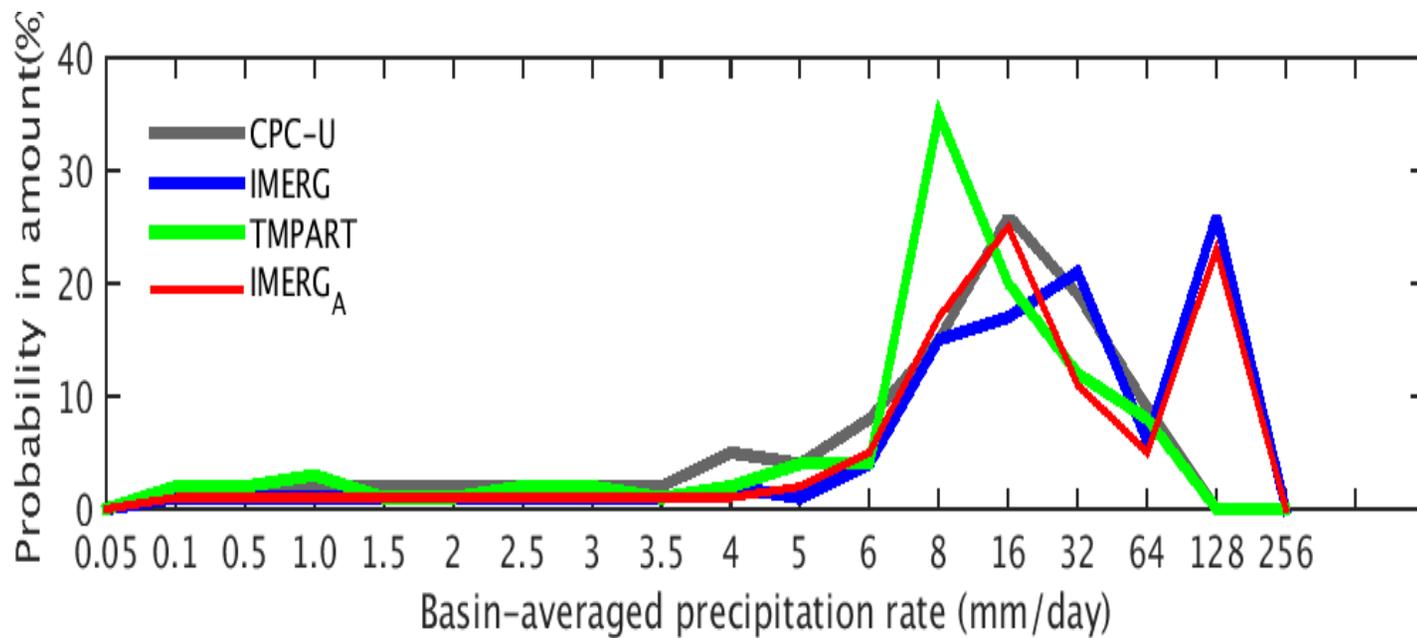
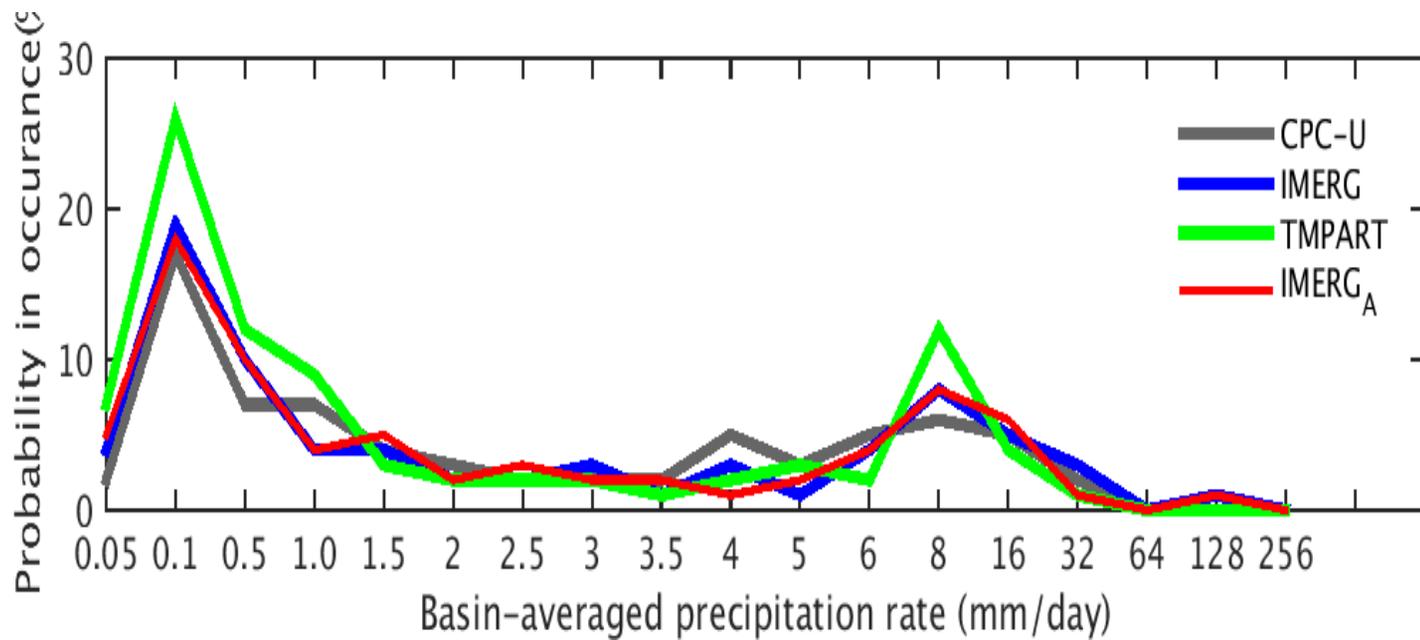
Next work

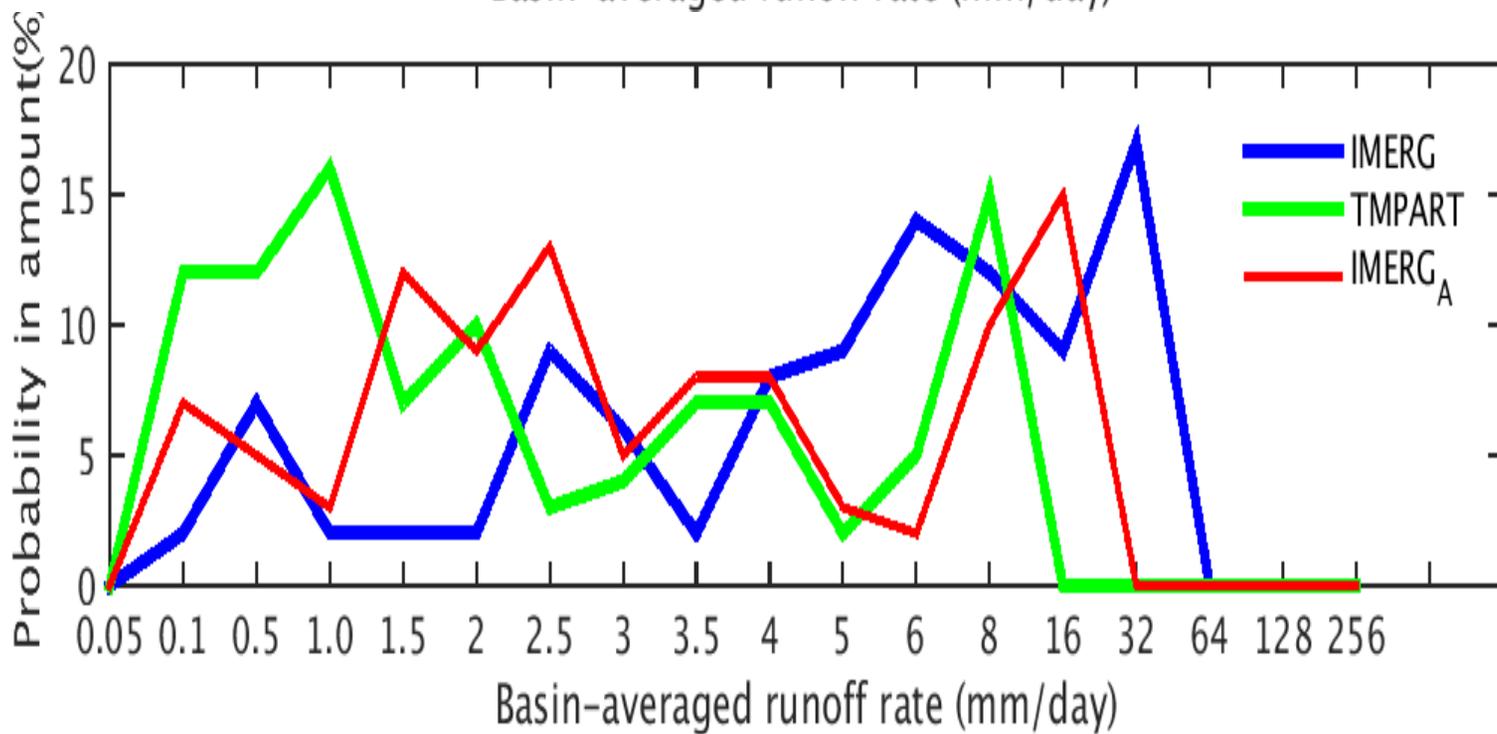
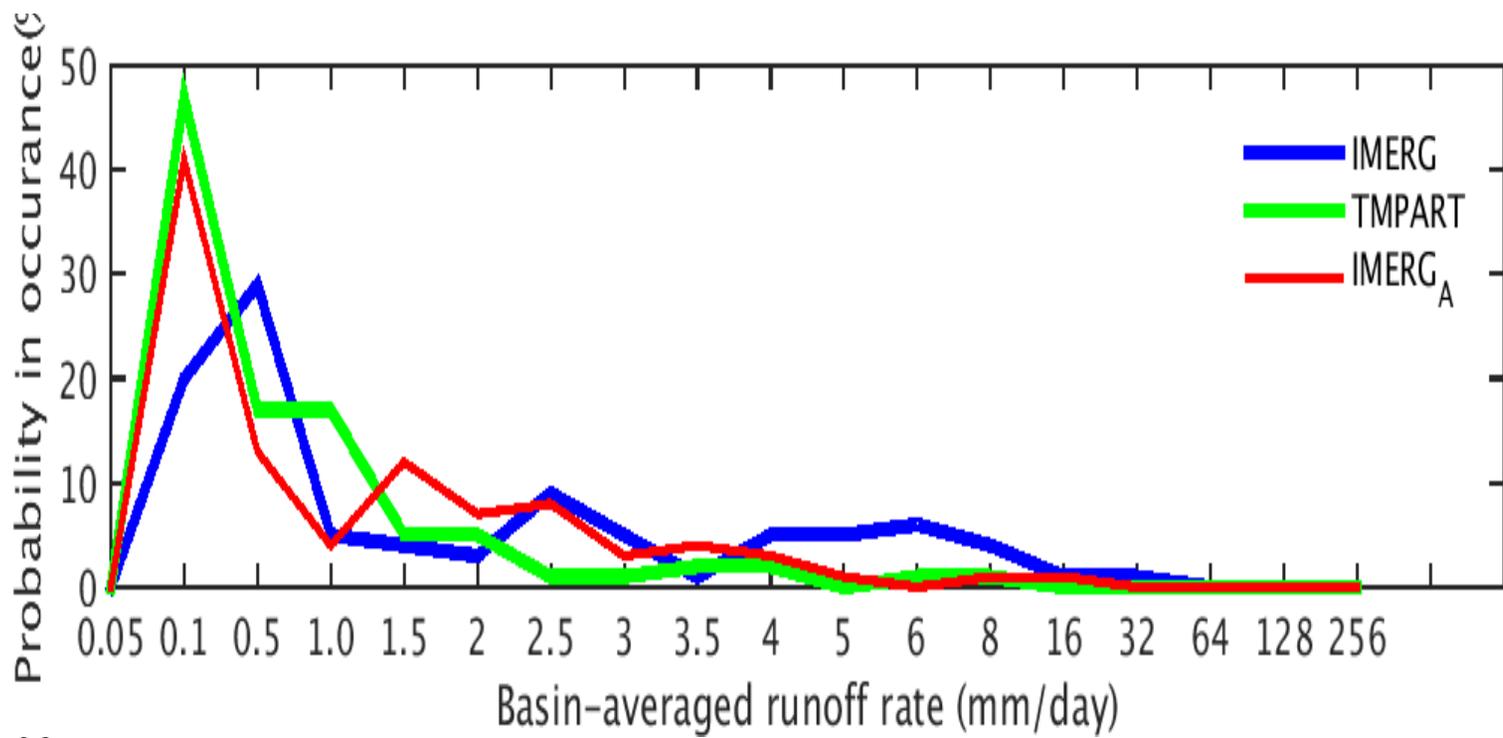
- (1) A study on improved PDF matching of IMERG and TMPA will be performed to further improve the usage of IMERG before it accumulates up a long record.
- (2) Further improve GFMS/DRIVE system by taking full advantage of GMP IMERG in higher time and space resolution, precipitation phase, high latitude coverage etc.
- (3) Global to local scale evaluation and comparison between GFMS-IMERG and GFMS-TMPA

Thanks

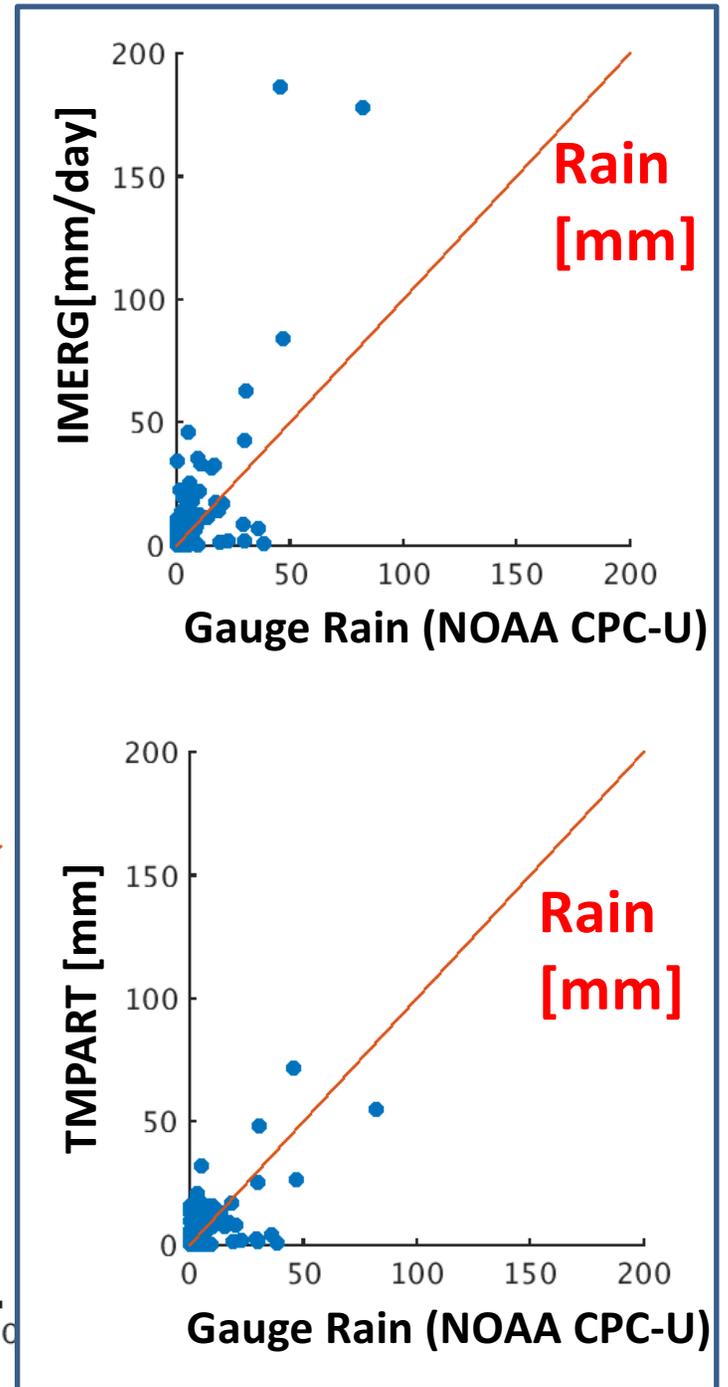
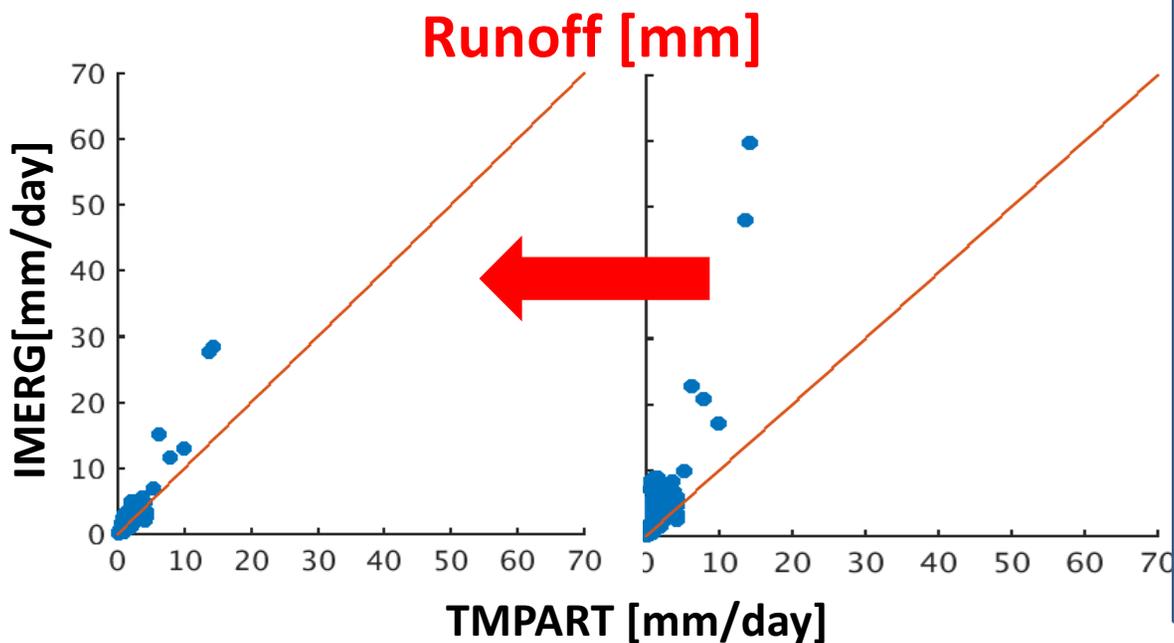
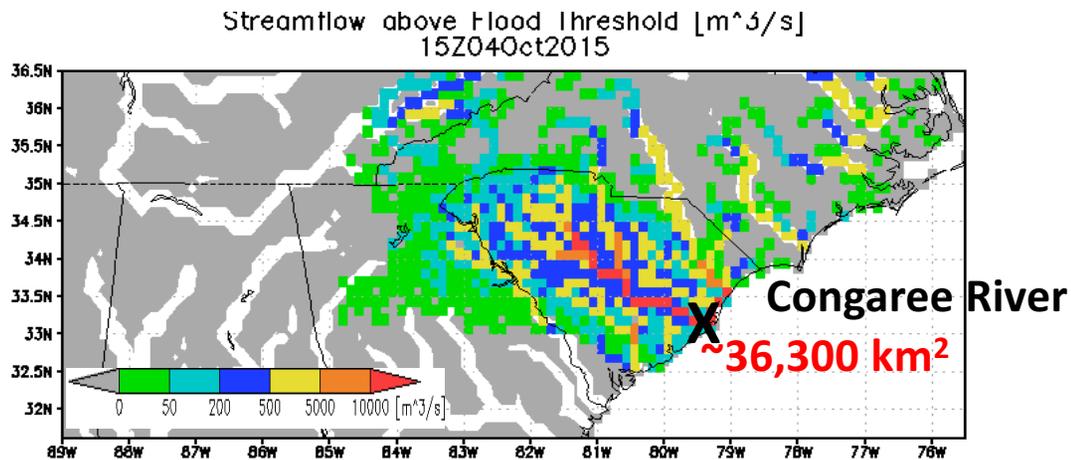
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Questions!



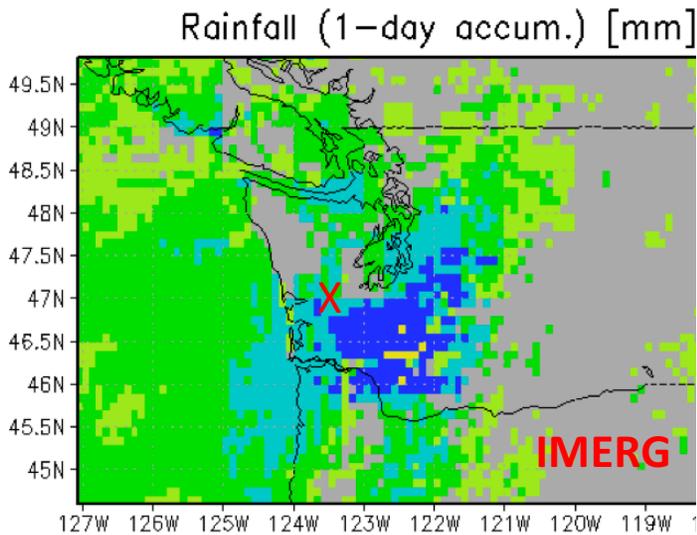
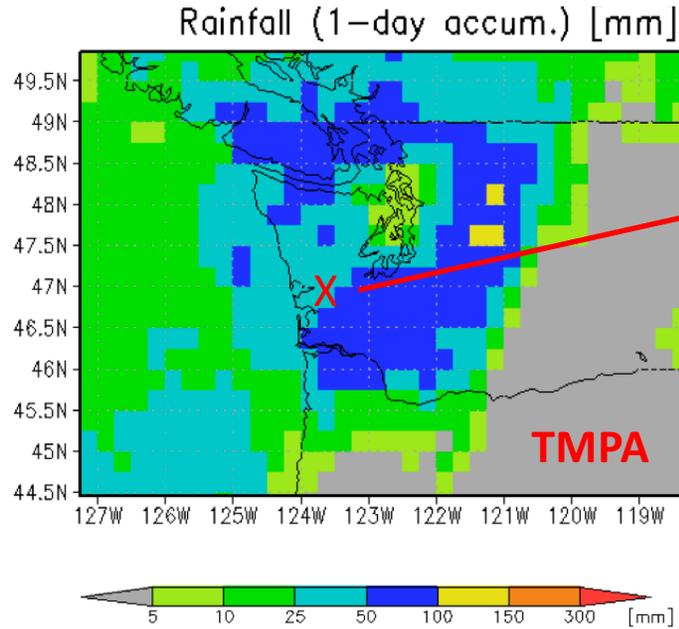


Basin averaged daily rainfall vs. runoff (May 1, 2015- Nov 15, 2015)

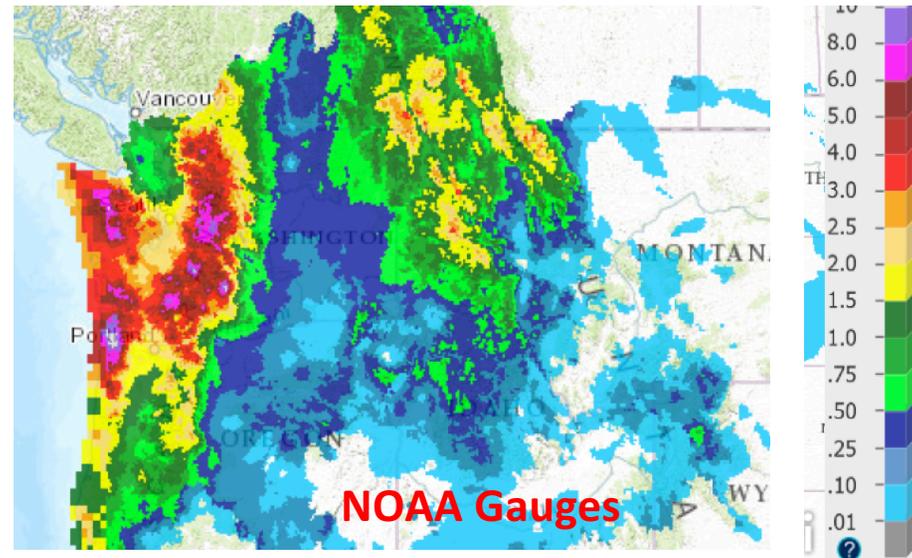
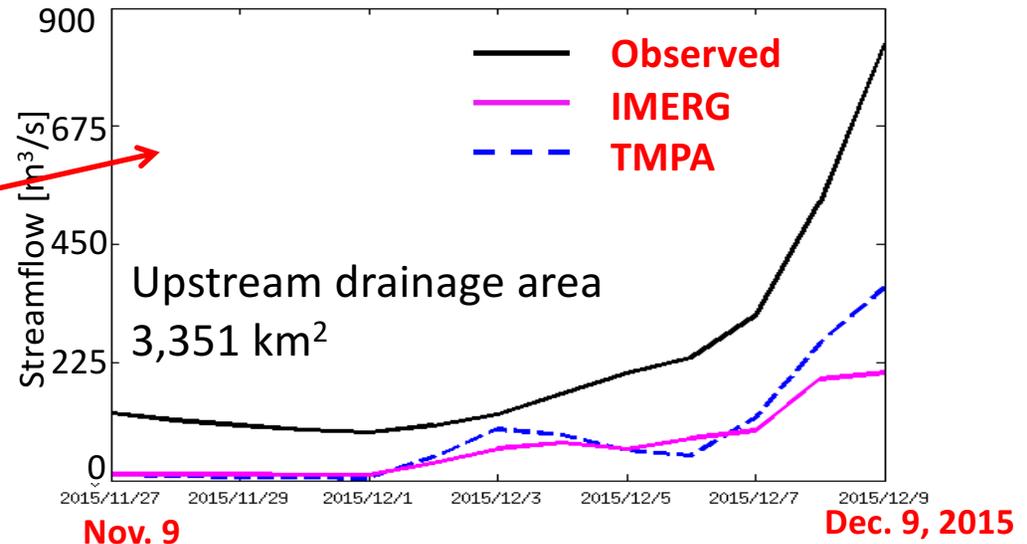


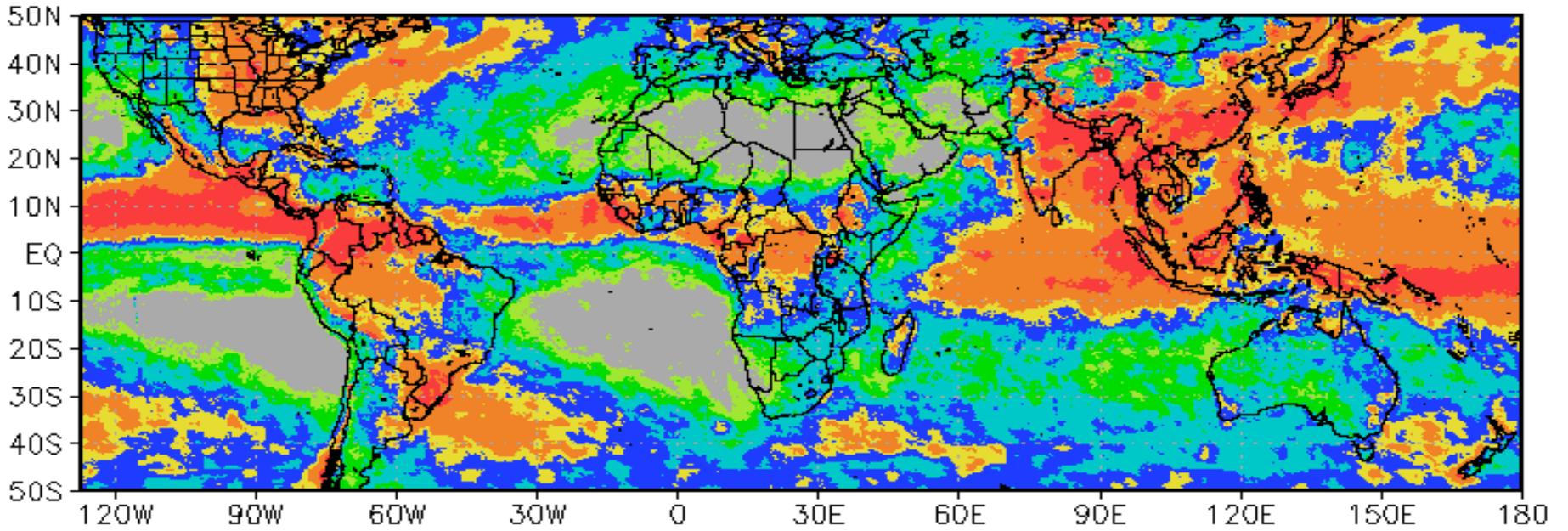
Recent Flood Case 2: Washington (Dec, 2015)

24-hr Precipitation ending 12 GMT, 9
December 2015

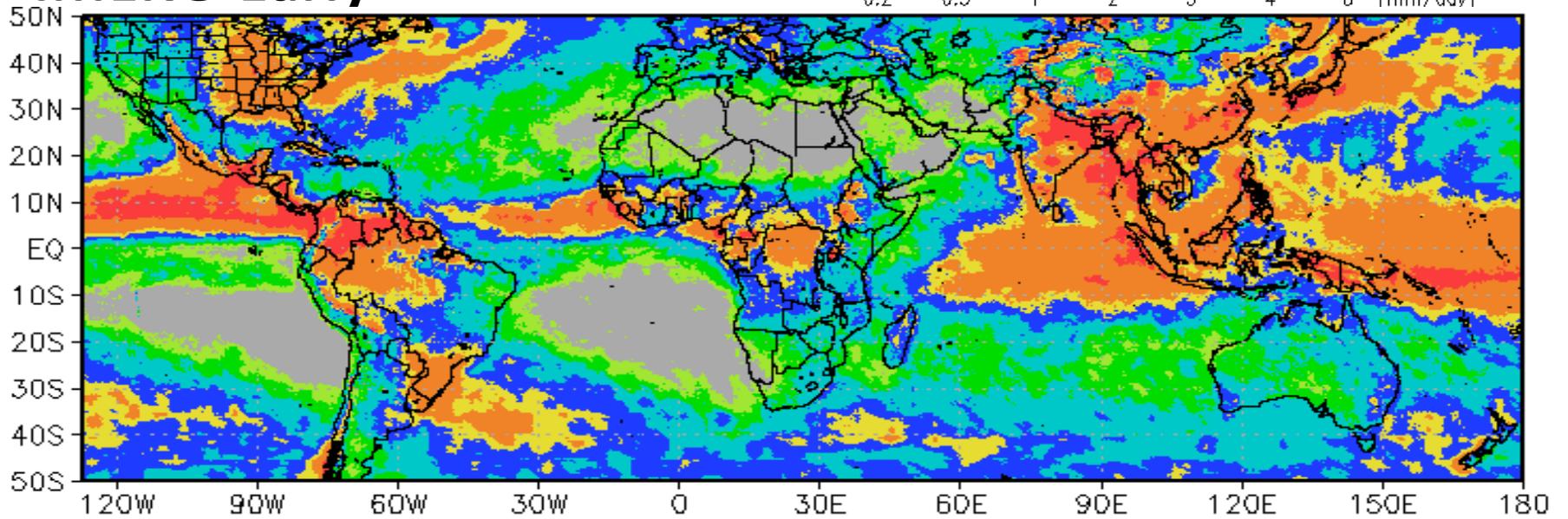


Chehalis R. at Porter, WA





IMERG-Early

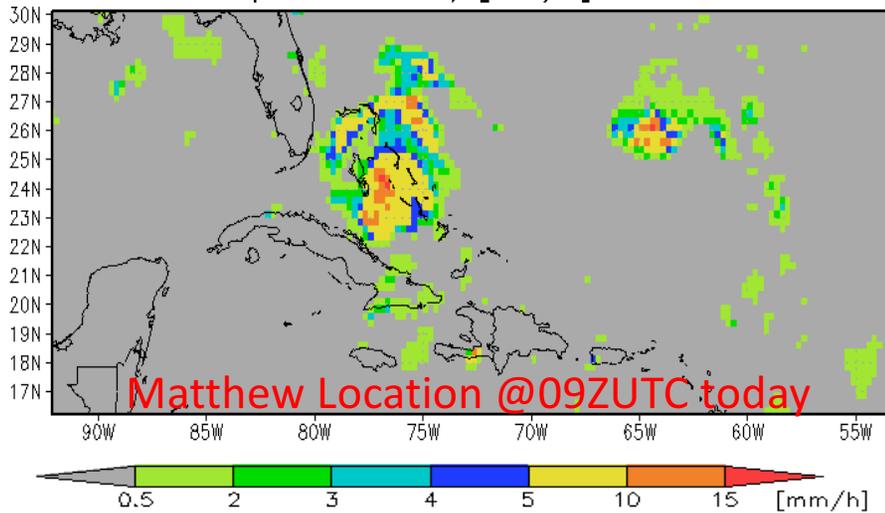


IMERG-Early-ad

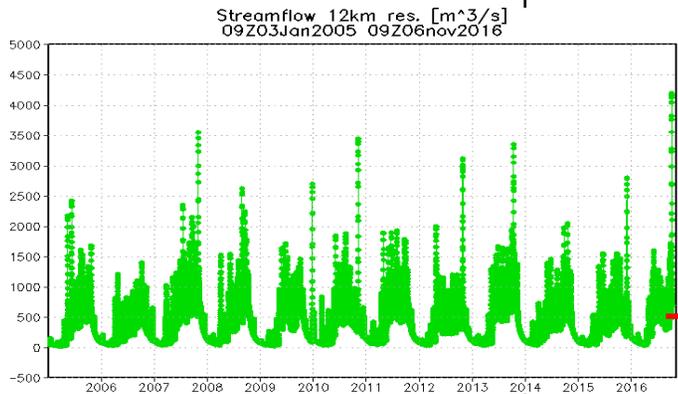
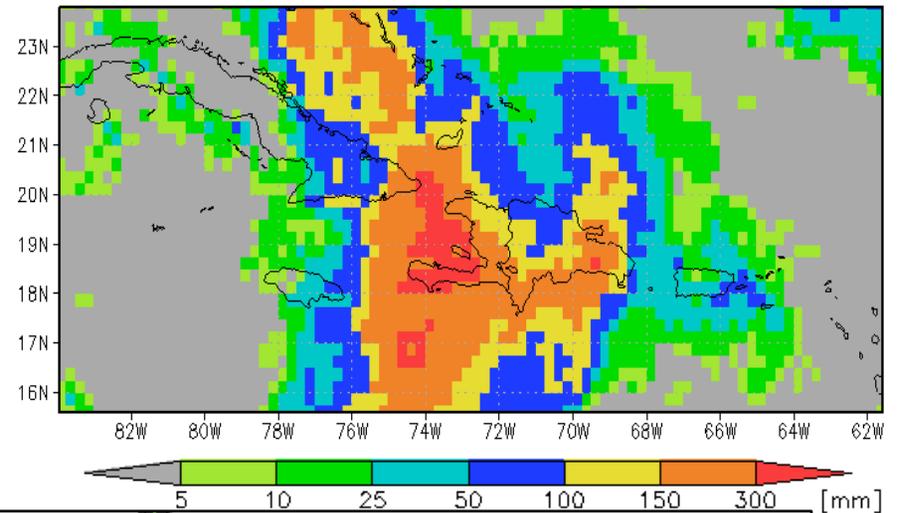
Averaged daily precipitation of May 1, 2015- Oct. 15, 2016

GFMS update @09z UTC, Oct 6/Haiti flood (<http://flood.umd.edu>)

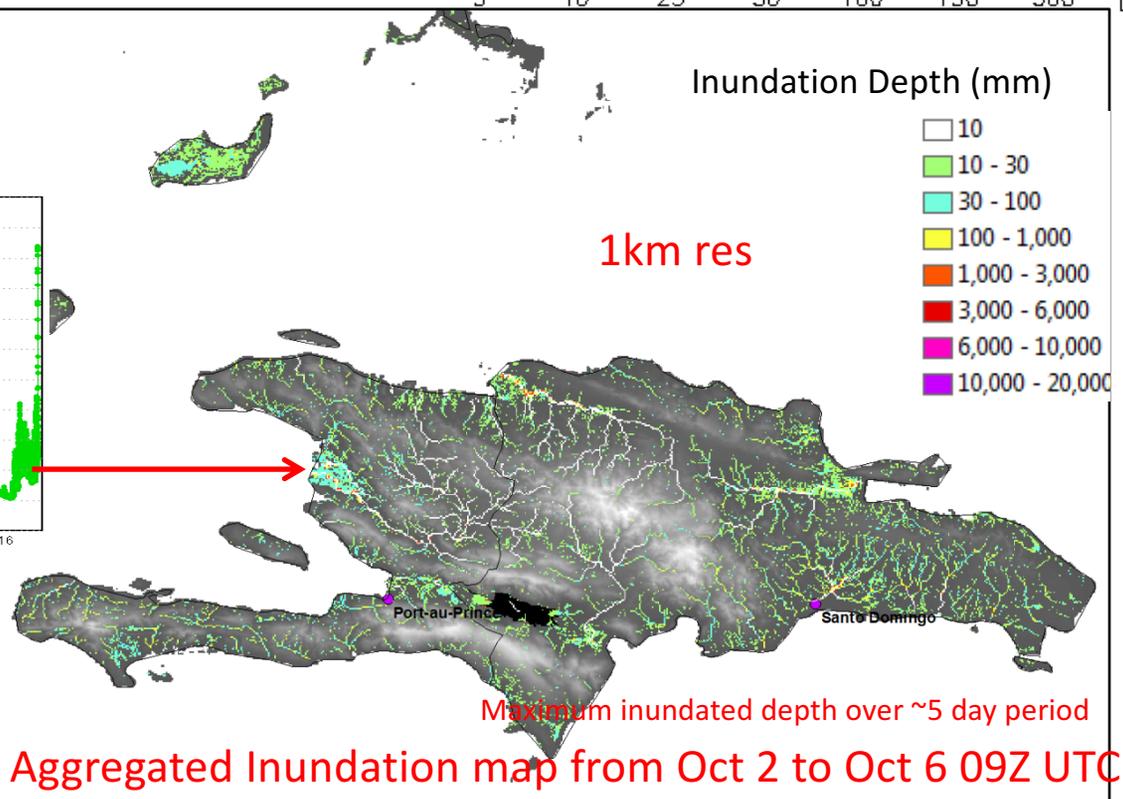
Rainfall (Instantaneous) [mm/h] 09Z06Oct2016

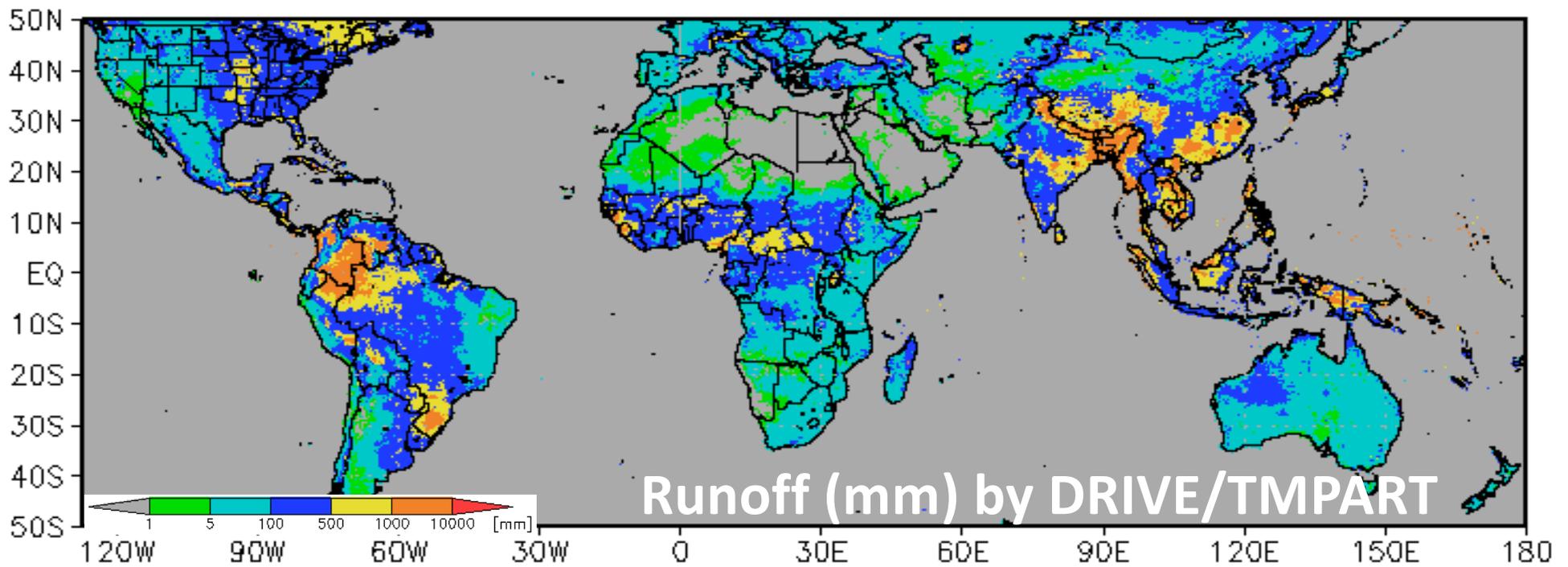
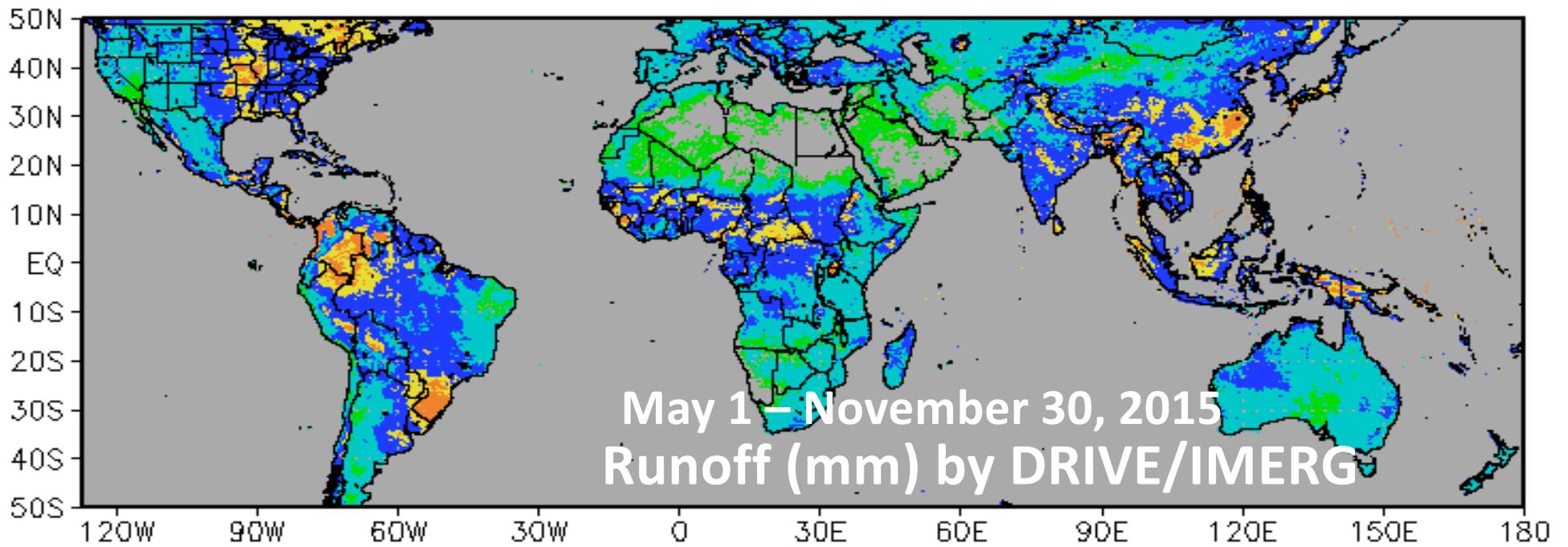


Rainfall (3-day accum.) [mm] 09Z06Oct2016

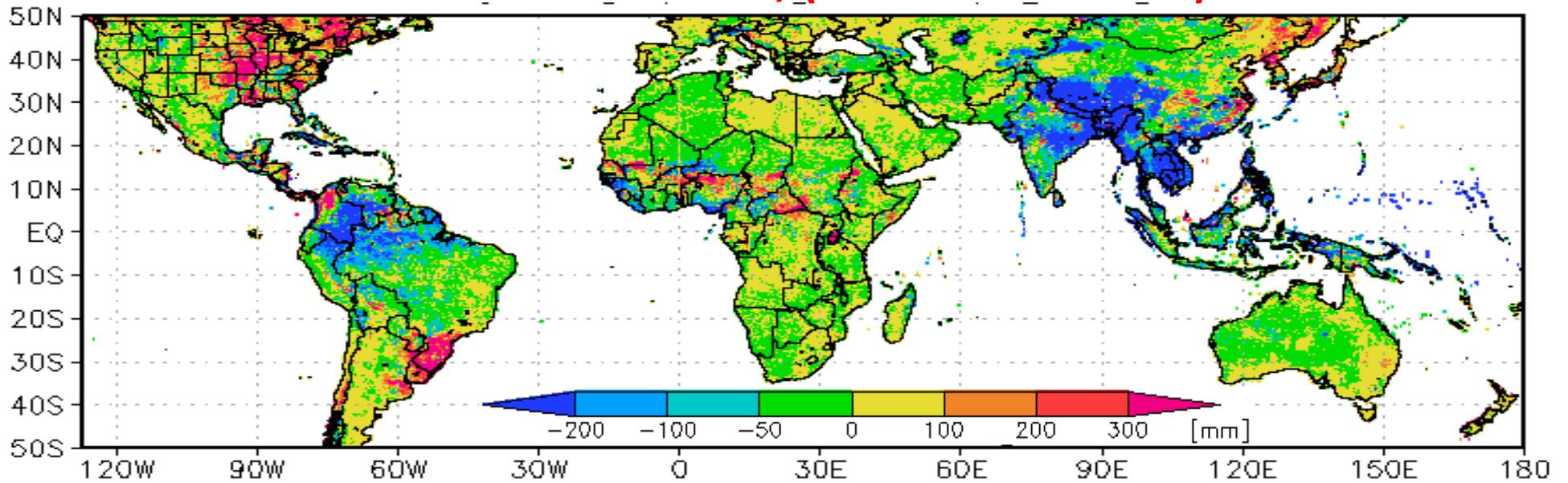


Largest peak discharge since 2005
@ La Artibonite River mouth

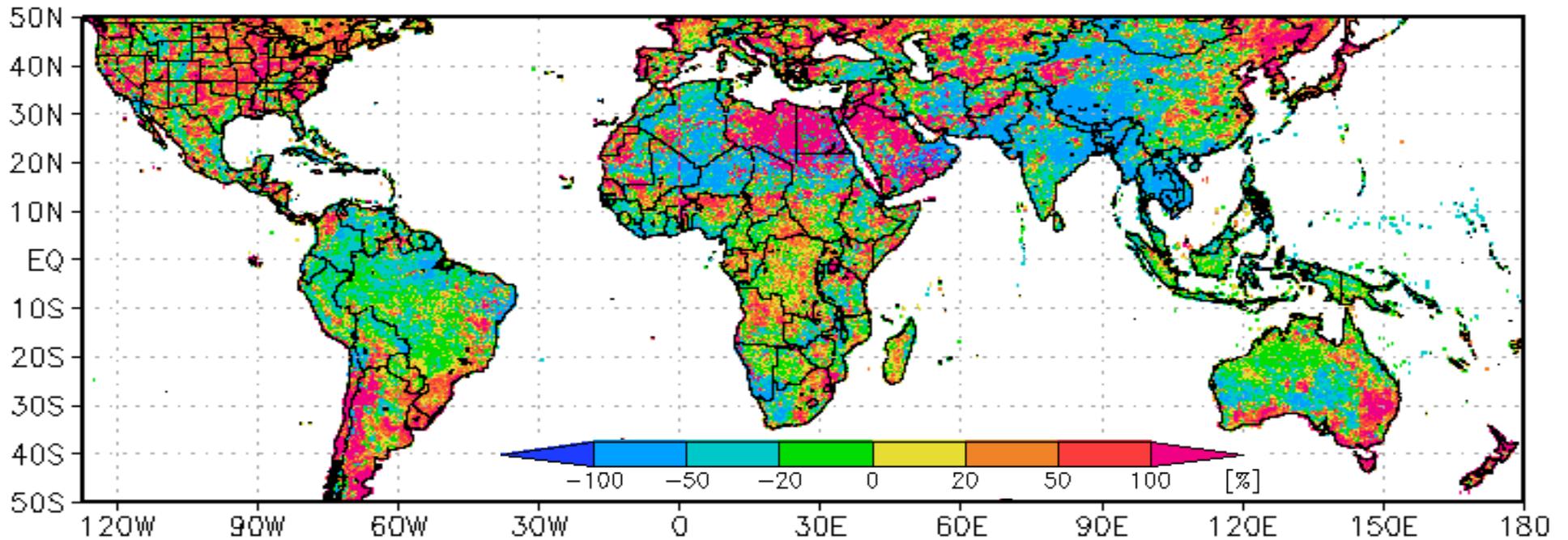


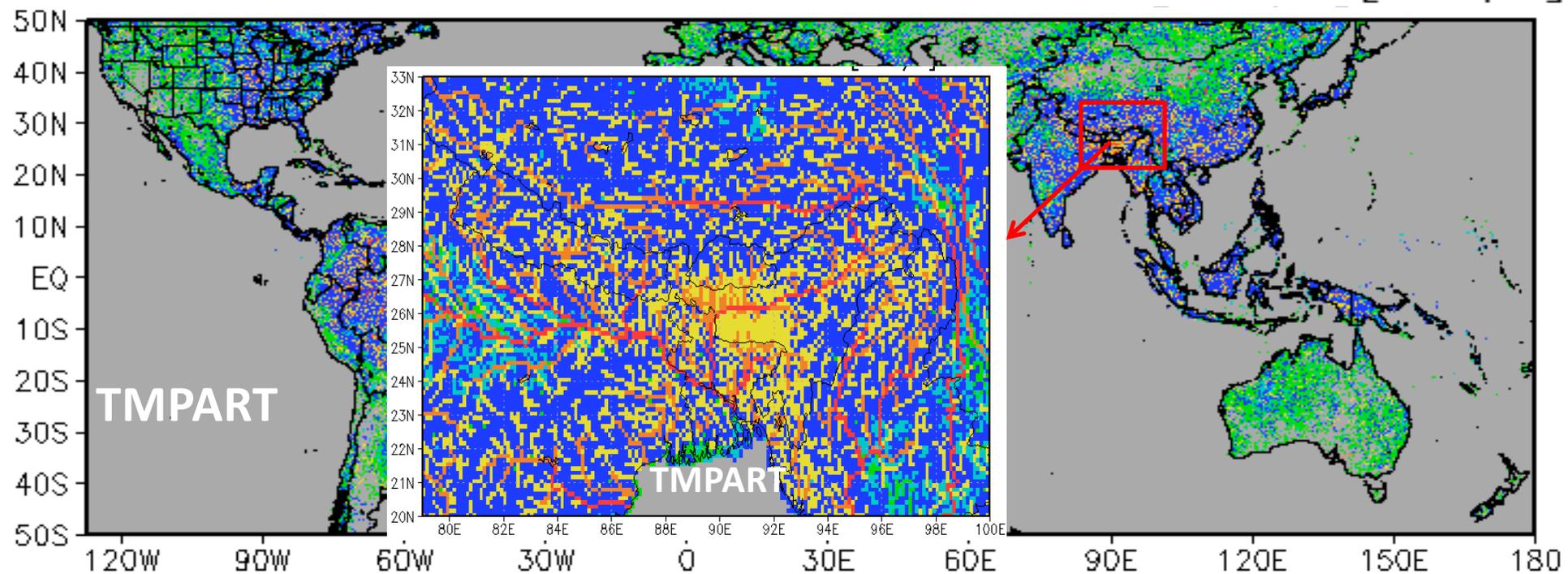
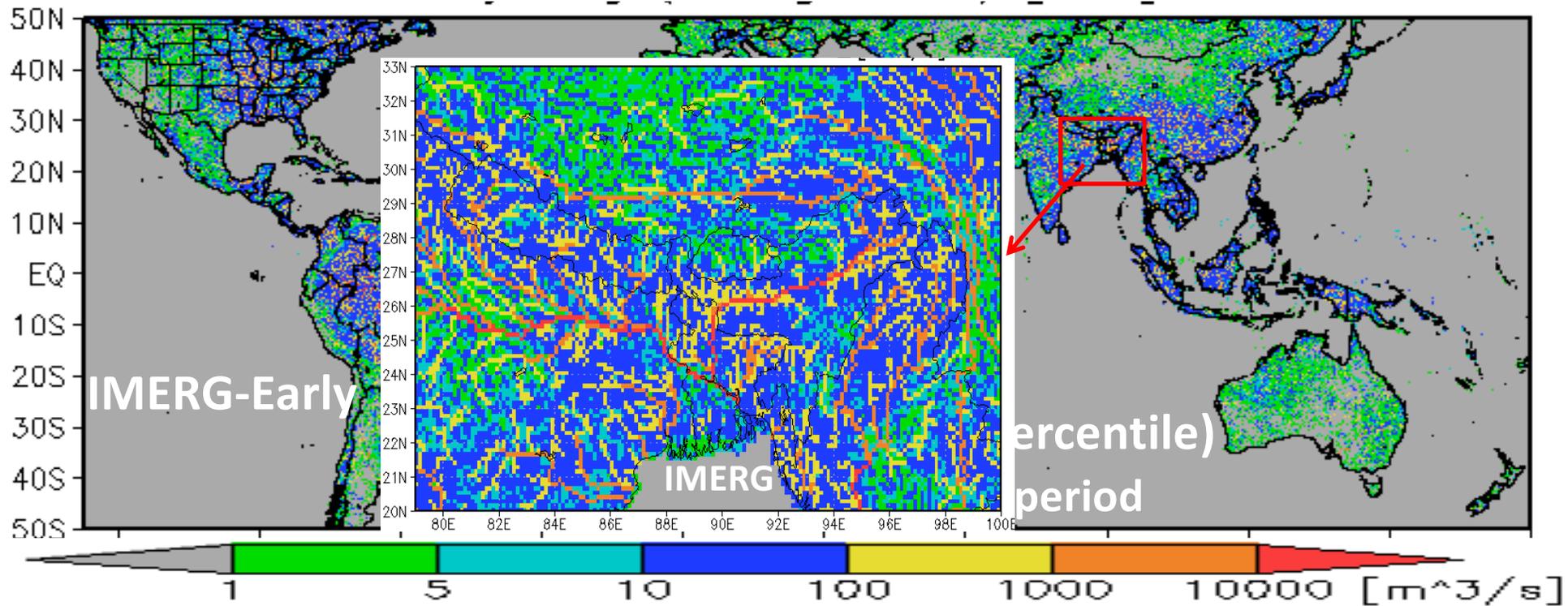


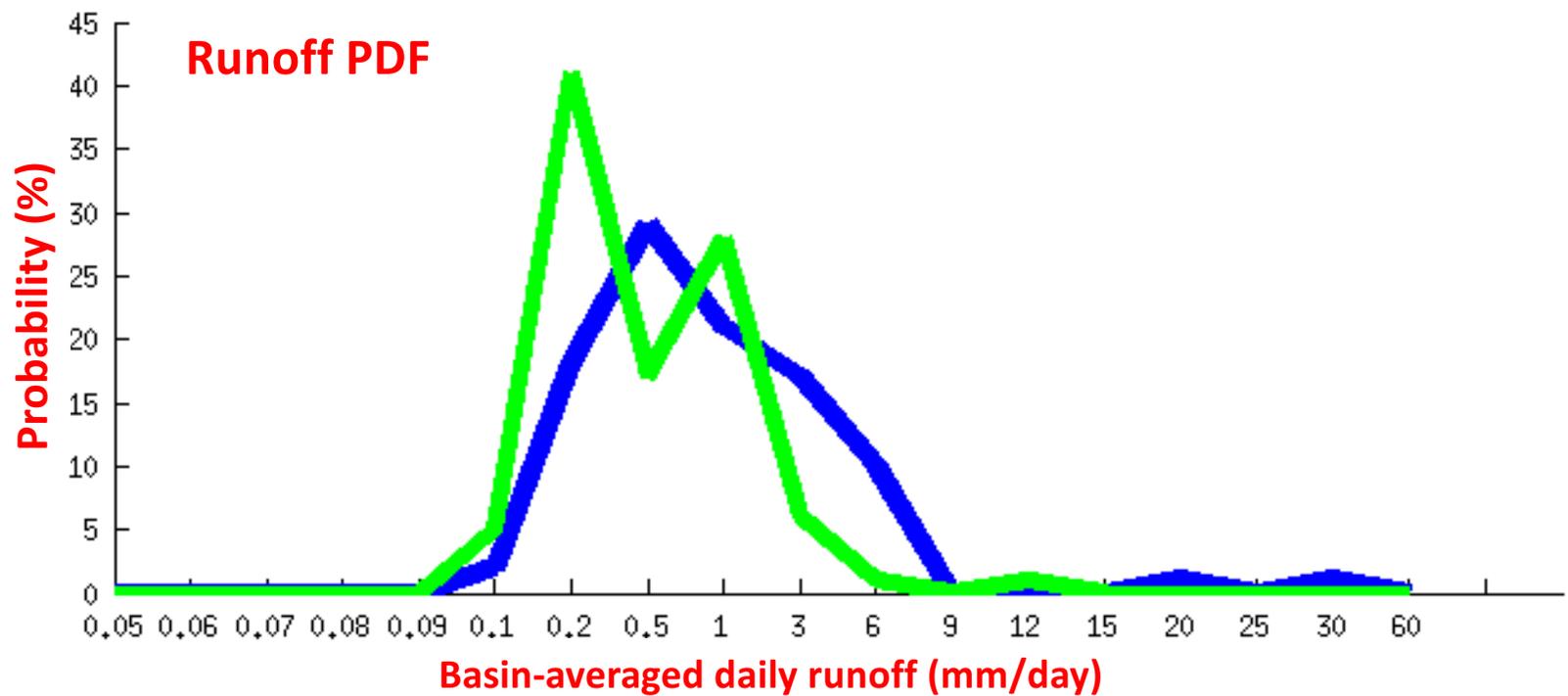
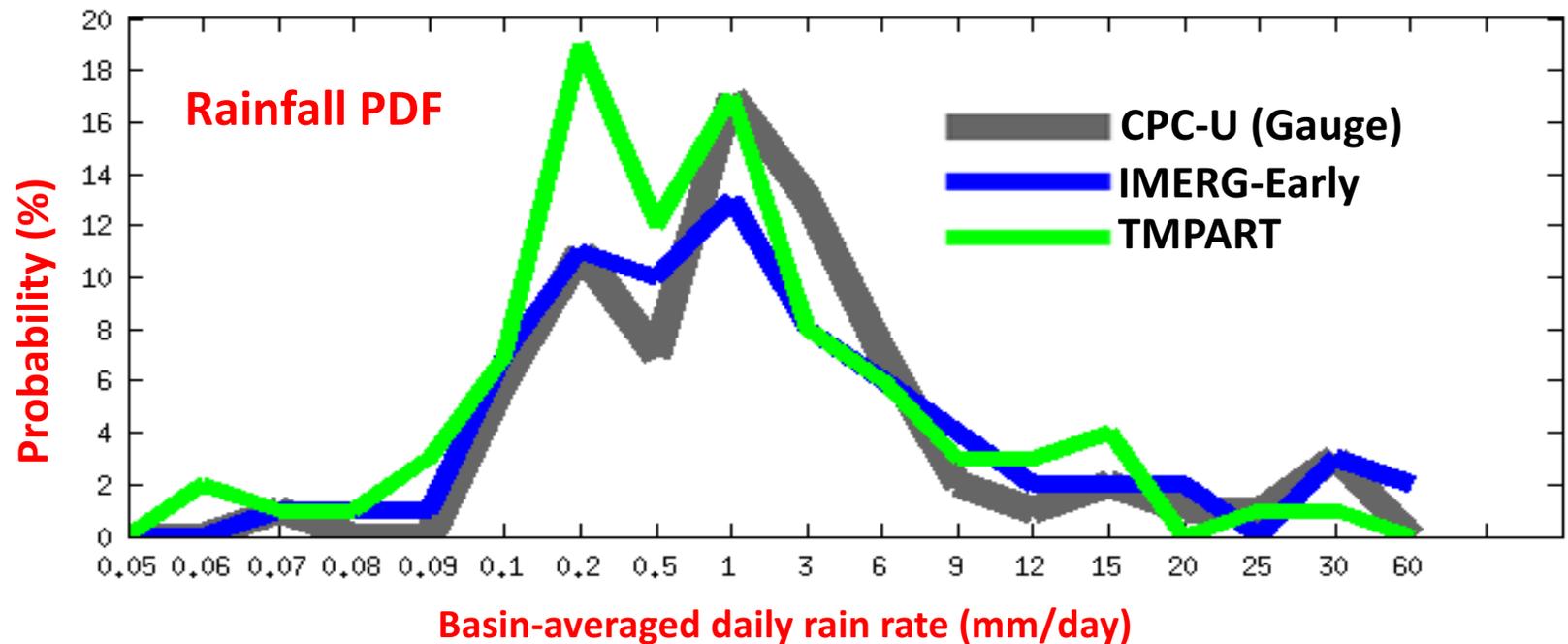
Runoff difference in mm, (IMERG – TMPART)



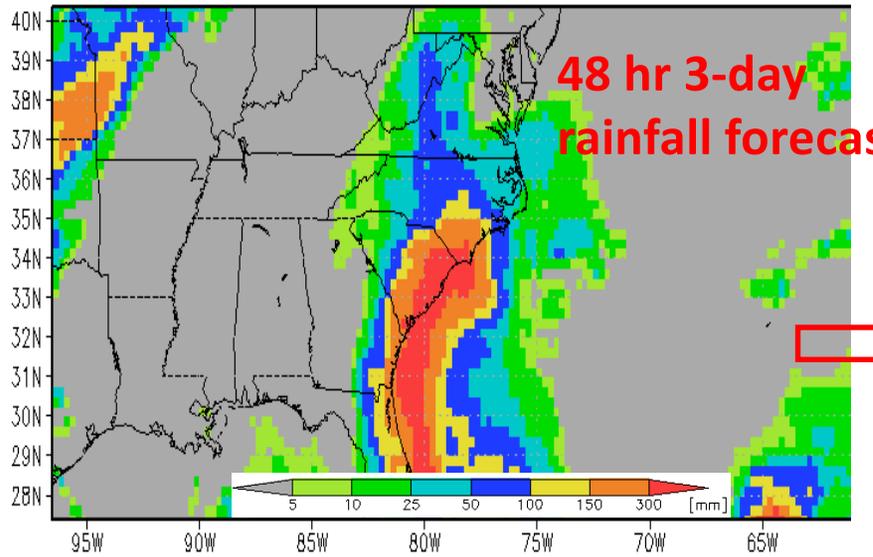
Runoff difference in %, (IMERG – TMPART) / TMPART



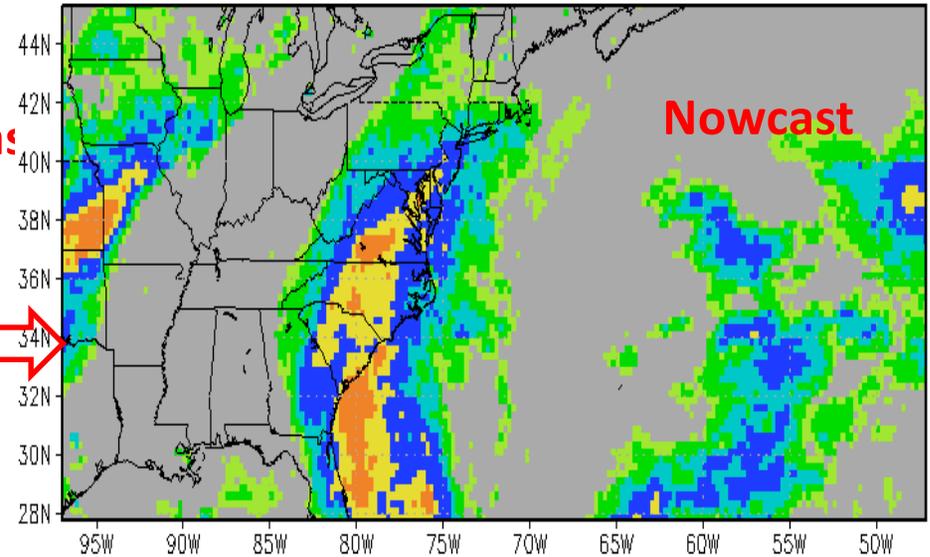




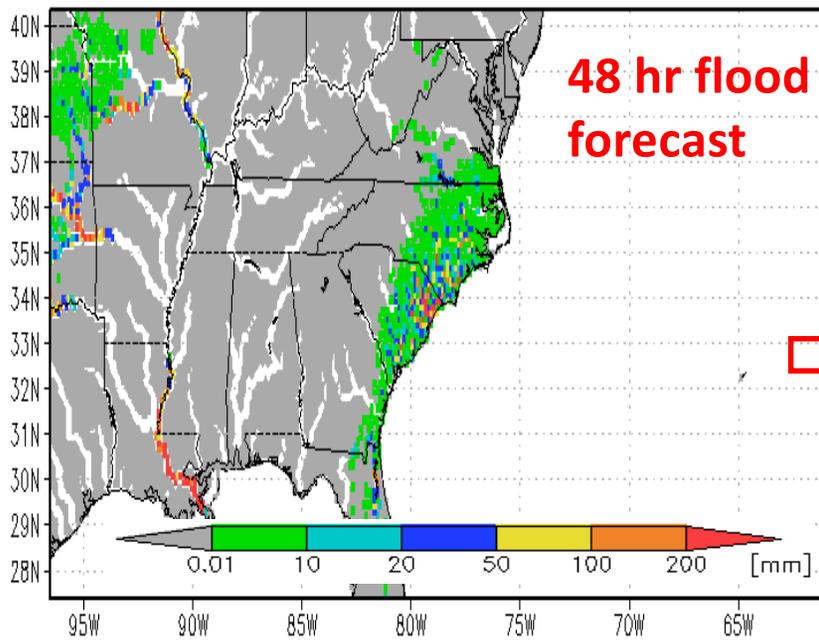
Rainfall (3-day accum.) [mm] 09Z09Oct2016



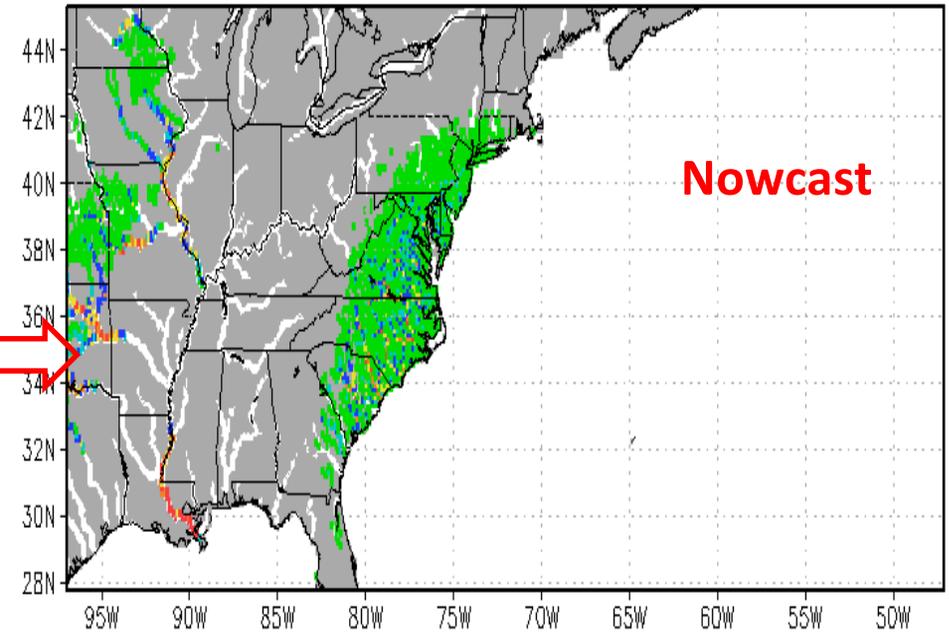
Rainfall (3-day accum.) [mm] 09Z09Oct2016



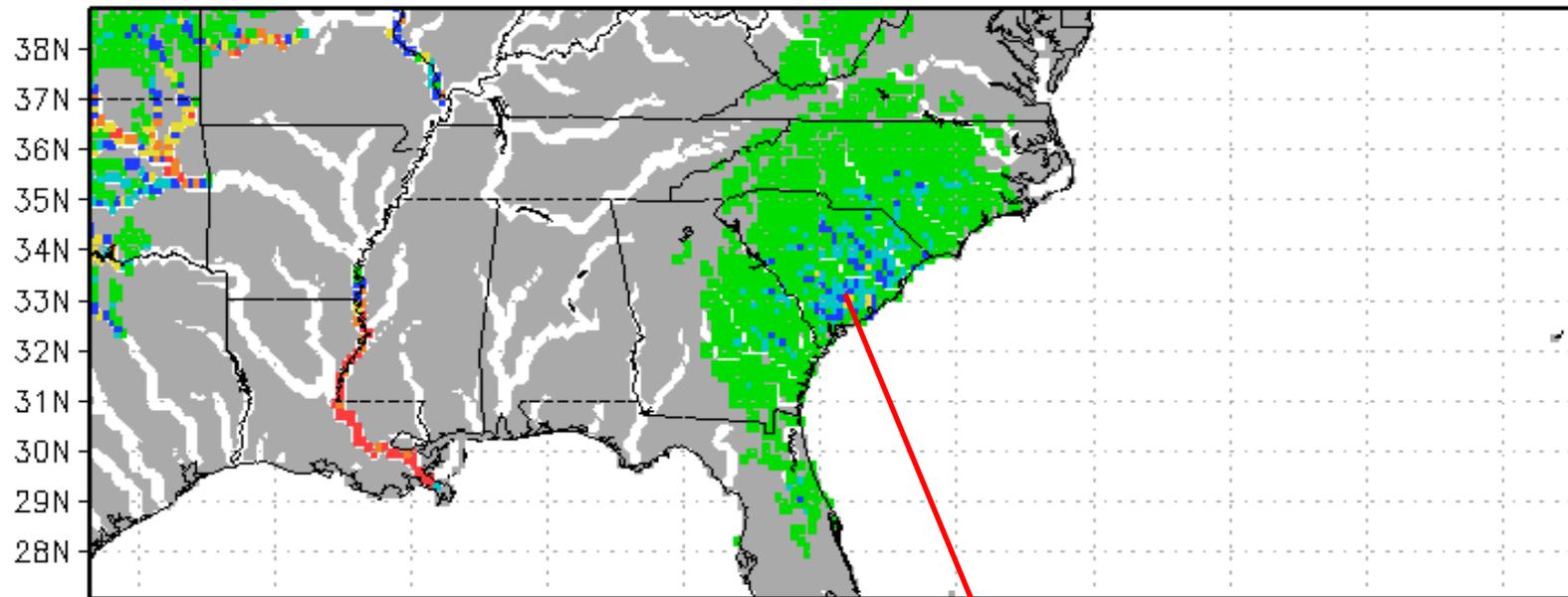
Flood Detection/Intensity (depth above threshold [mm])
12Z09Oct2016



Flood Detection/Intensity (depth above threshold [mm])
09Z09Oct2016



Flood Detection/Intensity (depth above threshold [mm])
12Z08Oct2016



Inundation map 1km res. [mm]
09Z08Oct2016

