

May 24, 2017

# Satellite Remote Sensing for Flood Monitoring and Management

Amita Mehta and Erika Podest

18-19 November 2018



# Outline: 19 November 2018

<b>Time</b>	<b>Topic</b>	<b>Type</b>	<b>Presenter</b>
	<b>Session 4</b>		
9:30-10:00 AM	Overview of Flood Monitoring and Mapping Based on Remote Sensing of Land Cover	Presentation	Amita Mehta
10:00-11:00 AM	Overview and Applications of Synthetic Aperture Radar (SAR)	Presentation	Erika Podest
11:00-11:15 AM	Break		
11:15 AM-12:30 PM	SAR Application for Flood Mapping (SNAP)	<b>Hands-on Exercise</b>	Erika Podest, Praveen K. Thakur, Amita Mehta
12:30-1:00 PM	Overview of Flood Monitoring and Mapping Based on Precipitation Data	Presentation	Amita Mehta
1:00-2:00 PM	<b>Lunch</b>		
	<b>Session 5</b>		
2:00-2:30	NRT Flood Monitoring (DFO, GDACS, NASA Disasters Portal)	<b>Demonstration</b>	Amita Mehta
2:30-3:30 PM	ISRO Flood Monitoring and Modeling Tools (Altimeter & Hydro models)	Presentation	Praveen K. Thakur
3:30-3:45 PM	Break		
	<b>Session 6</b>		
3:45-5:00 PM	Flood Monitoring Case Study GFMS, MODIS NRT Flood Mapping, IIRS/NRSC flood cases from ISRO	<b>Hands-on Exercise</b>	Amita, Erika, Praveen
5:00-5:45 PM	<b>Presentation by Participants</b>		
5:45-6:30 PM	Summary, Q/A, & Survey		



# Remote Sensing-Based Flood Detection

There are three approaches to using remote sensing observations for flood monitoring:

1. Detecting flood water on previously dry land surfaces using satellite-derived land cover observations
2. Hydrology models that derive streamflow and runoff using precipitation and weather data from satellites and models
3. Inferring flooding conditions using satellite-derived precipitation

Note: Each flooding tool also uses model and/or surface-based data in addition to satellite data



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Precipitation-based Flood Monitoring





# Overview of Flood Monitoring and Mapping Based on Precipitation Data

# Learning Objective

By the end of this presentation, you will be able to:

- Understand inundation tools based on remote sensing of precipitation

# Outline

- Flooding Tools Based on Precipitation
  - Extreme Rainfall Detection System (ERDS)
  - Global Flood Monitoring System (GFMS)

# Extreme Rainfall Detection System (ERDS)

<http://erds.ithacaweb.org/>

- Uses GPM IMERG precipitation data for monitoring accumulated rainfall for the past 12, 24, 48, 72, and 96 hours
- Uses NOAA Global Forecasting System (GFS) rainfall to forecast accumulated rainfall every 24 hours up to 144 hours
- Global Precipitation Climatology Center (GPCC) land-based rain gauge mean data are used as a reference to calculate extreme rainfall thresholds
- ERDS is one of the tools used by the UN World Food Programme (WFP) Emergency Preparedness Unit





# Extreme Rainfall Detection System (ERDS)

<http://erds.ithacaweb.org/>

- A quick look at forecast flood alert maps facilitates early warning and helps prepare for flooding
- Near-real time flood maps help in planning relief operations
- Experimental product – verification on a local scale is recommended

## ITHACA ERDS

### Extreme Rainfall Detection System

The Extreme Rainfall Detection System (ERDS), developed and implemented by ITHACA, is a service for the monitoring and forecasting of exceptional rainfall events, with a nearly global geographic coverage.

[More info](#)

**Last analyzed GPM date: 17 Oct 2018 - 10:59 UTC**

**Last analyzed GFS date: 17 Oct 2018 - 00:00 UTC**

### Disclaimer

The Extreme Rainfall Detection System (ERDS) is the result of a research activity devoted to the monitoring and forecasting of extreme precipitation at global scale. Although a big effort is made in order to improve the reliability of the system, the data and information provided by ERDS are currently experimental and may not be accurate, especially if intended at local scale. The web site and the data contained within it are provided on 'as available' basis, services and data may be not updated and may be withdrawn at any time and without notice. ITHACA does not assume liability for any inaccuracies in the information provided and for failure of the software.



# Extreme Rainfall Detection System (ERDS)

<http://erds.ithacaweb.org/>

Maps

- Provides maps and downloadable tiff images of cumulative precipitation based on near real-time IMERG data and alerts for extreme rainfall and potential for flooding

**Cumulated Near-Real-Time**

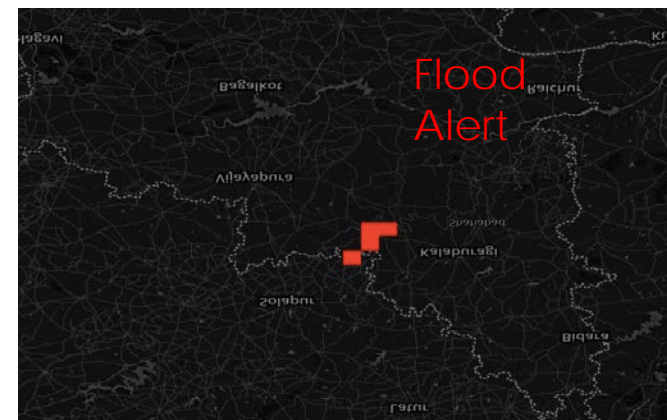
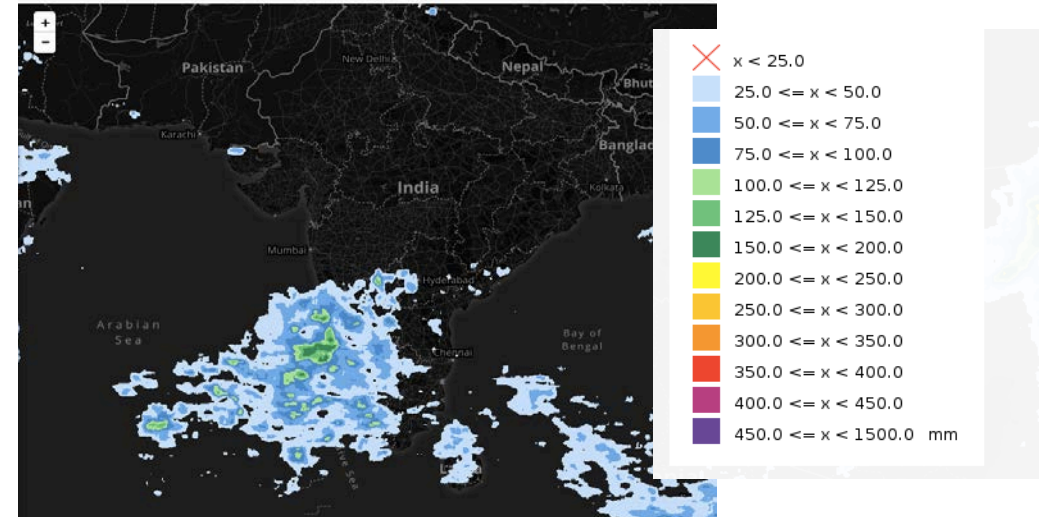
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<input checked="" type="checkbox"/> NRT 096h	TIFF

**Alert Near-Real-Time**

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<input type="checkbox"/> NRT 024h	TIFF
<input checked="" type="checkbox"/> NRT 048h	TIFF
<input type="checkbox"/> NRT 072h	TIFF
<input type="checkbox"/> NRT 096h	TIFF

Download Images

96-hour accumulated rainfall from GPM-IMERG on 17 October 2018

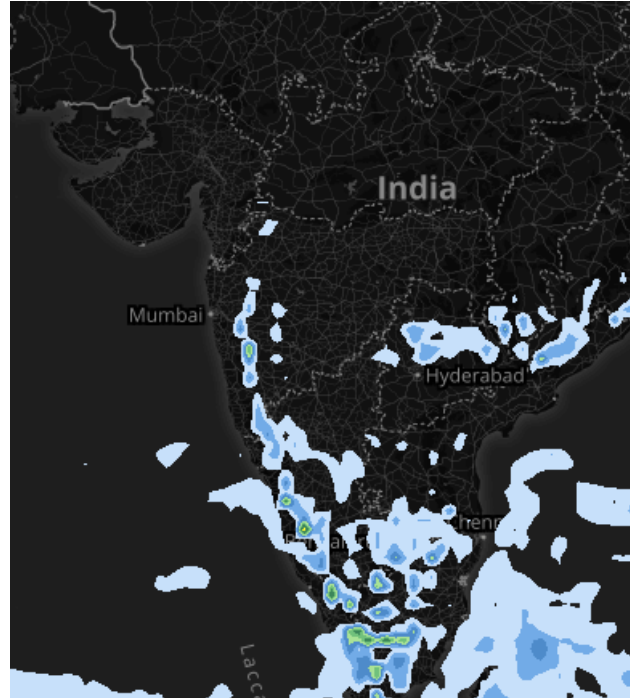


# Extreme Rainfall Detection System (ERDS)

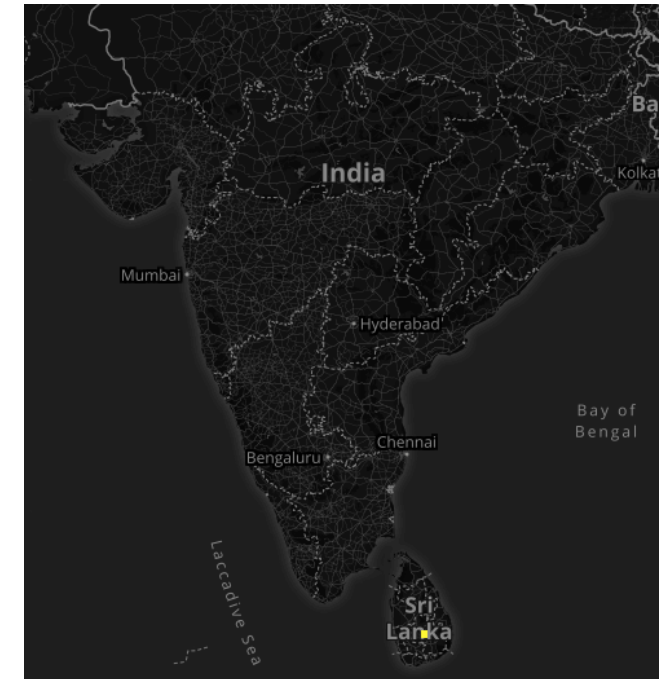
<http://erds.ithacaweb.org/>

- Provides cumulative precipitation and alerts for extreme rainfall and potential for flooding based on NOAA-GFS

6-day accumulated forecast rainfall for 23 October 2018



No flood alert in India but present in Sri Lanka





Demonstration: Extreme Rainfall Detection System  
<http://erds.ithacaweb.org/>

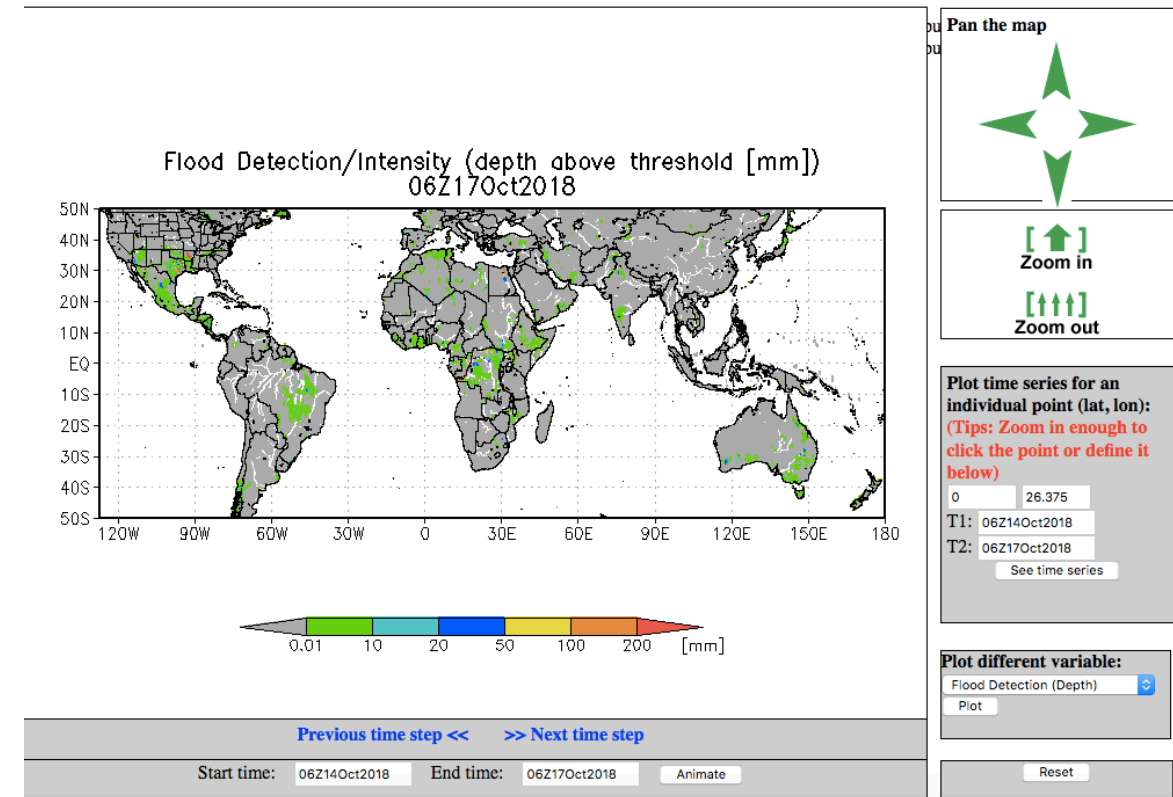
# Global Flood Monitoring System (GFMS)

<http://flood.umd.edu/>

- Provides global maps, time series, and animations (50°S-50°N) of:
  - instantaneous rain rate every 3 hrs
  - accumulated rain over 24, 72, and 168 hrs
  - streamflow rates and flood intensity at  $\frac{1}{8}$ <sup>th</sup> degree (~12 km) and 1 km
  - Near real-time and archives since 2013

Note: TRMM is no longer flying, but TRMM-based calibration is used to provide near real-time rainfall from a constellation of national & international satellites for flooding applications. Near real-time IMERG data available from:

<ftp://jsimpson.pps.eosdis.nasa.gov>



# GFMS

<http://flood.umd.edu/>

- Uses a hydrological model together with:
  - TMPA
  - Surface temperature and winds from NASA reanalysis model, Modern Era Retrospective Analysis for Research and Applications (MERRA)
  - Runoff generation from the UW Variable Infiltration Capacity (VIC) model
  - Runoff routing model from UMD

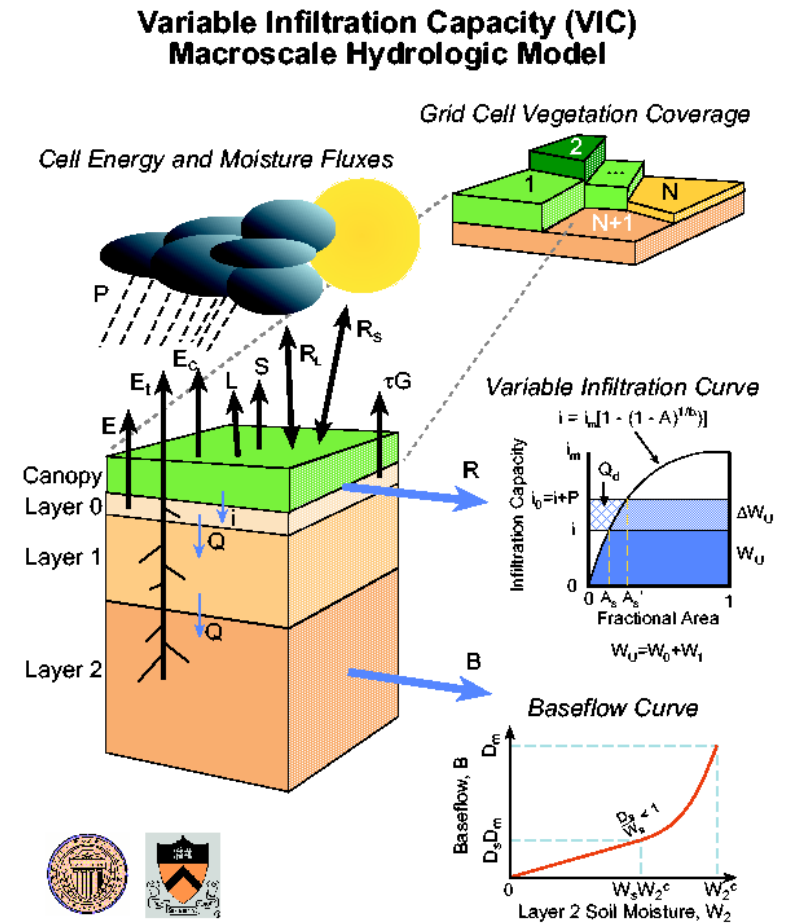
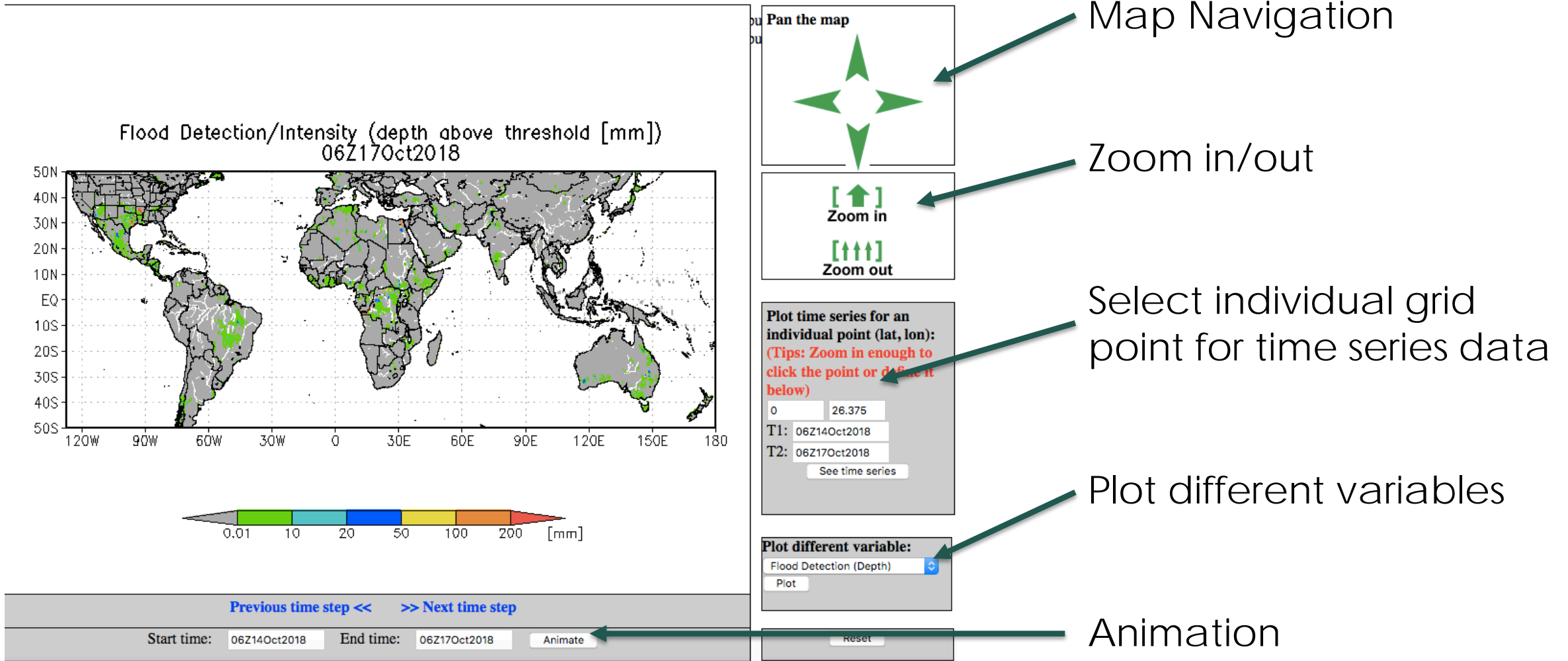


Image Credit: [UW VIC Macroscale Hydrologic Model](#); References: Wu, H., R. F. Adler, Y. Tian, G. J. Huffman, H. Li, and J. Wang (2014), Real-time global flood estimation using satellite-based precipitation and a coupled land surface and routing model, *Water Resour. Res.*, 50, 2693-2717, doi:10.1002/2013WR014710.; Wu H., R. F. Adler, Y. Hong, Y. Tian, and F. Policelli (2012), Evaluation of Global Flood Detection Using Satellite-Based Rainfall and a Hydrologic Model. *J. Hydrometeorol.*, 13, 1268-1284



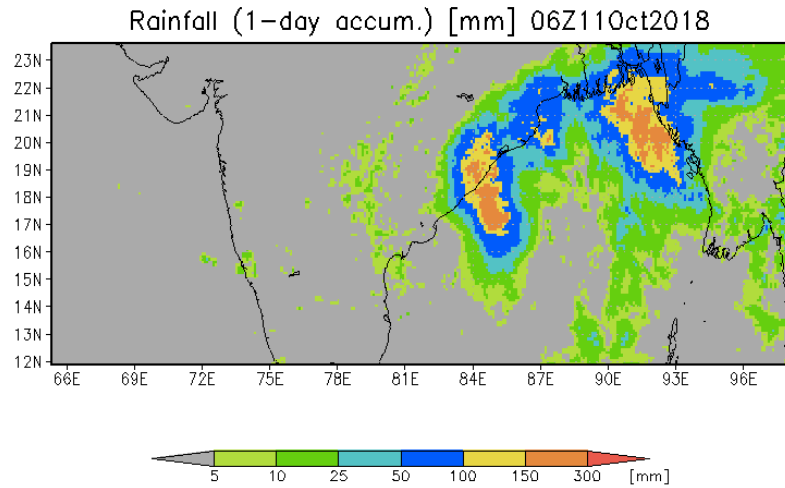
# GFMS

<http://flood.umd.edu/>

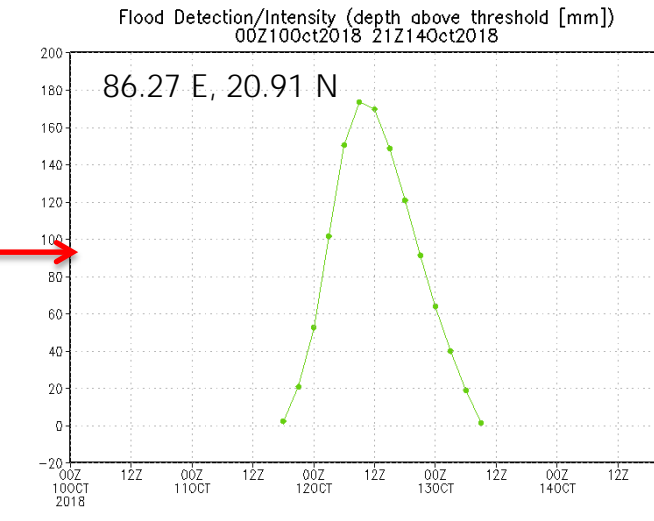
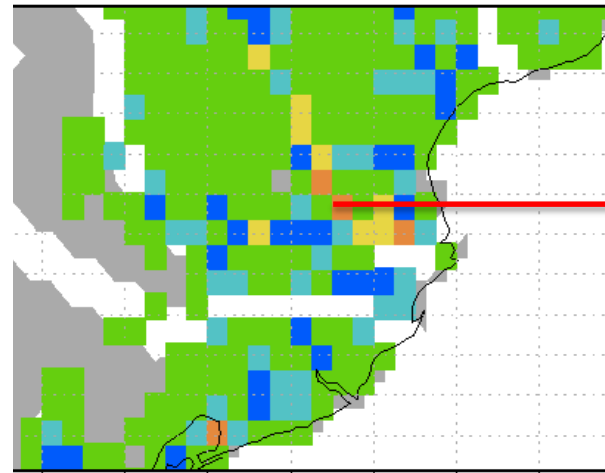


# GFMS: Flooding in Eastern India

Rainfall Associated with Cyclone Titli  
11 October 6 UTC



Flood Intensity  
12 October 9 UTC



Pan the map

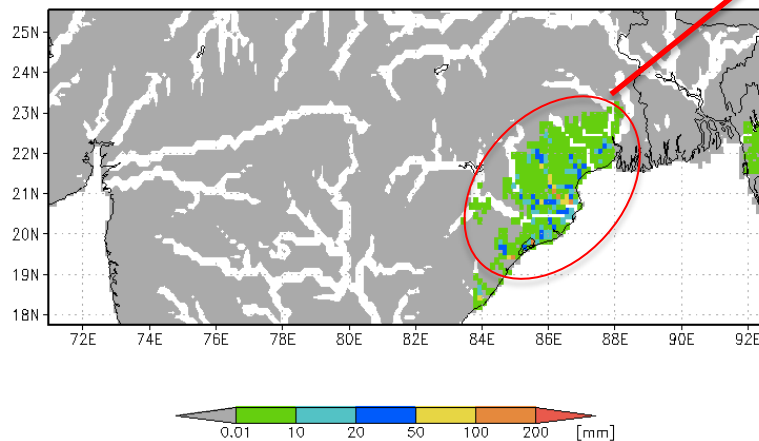
Zoom in  
Zoom out

Plot time series for an individual point (lat, lon):  
(Tips: Zoom in enough to click the point or define it below)

20.91 86.27  
T1: 00Z10Oct2018  
T2: 21Z14Oct2018  
See time series

Plot different variable:  
Flood Detection (Depth) [v]  
Plot

Flood Detection/Intensity (depth above threshold [mm])  
09Z12Oct2018



Cyclone Titli made landfall on 11 October and subsequently flooded several regions in Odisha







Demonstration: Global Flood Monitoring System  
<http://flood.umd.edu/>



Next: Demonstration of DFO, GDACS (GFDS2),  
NASA Disasters Portal