National Aeronautics and Space Administration

Satellite Remote Sensing for Flood Monitoring and Management

Amita Mehta and Erika Podest

18-19 November 2018

Outline: 19 November 2018

Time	Topic	Type	Presenter
	Session 4		
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)	**Hands-on Exercise**	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	**Lunch**		
	Session 5		
2:00-2:30	NRT Flood Monitoring (DFO, GDACS, NASA Disasters Portal)	**Demonstration**	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**		
	Session 6		
3:45-5:00 PM	Flood Monitoring Case Study GFMS, MODIS NRT Flood Mapping, IIRS/NRSC flood cases from ISRO	**Hands-on Exercise**	Amita, Erika, Praveen
5:00-5:45 PM	**Presentation by Participants**		
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

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

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)

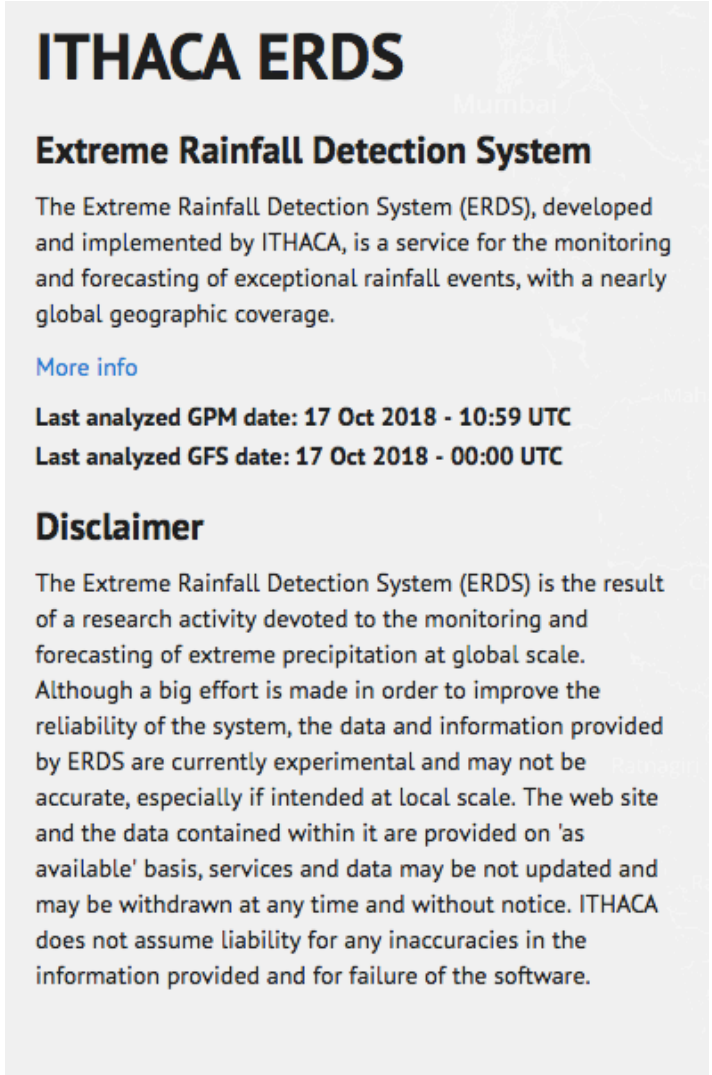
http://erds.ithacaweb.org/

- 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

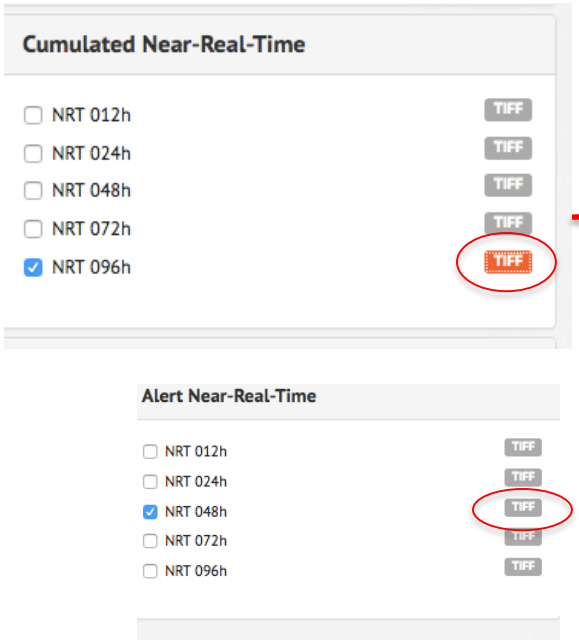


Extreme Rainfall Detection System (ERDS)

http://erds.ithacaweb.org/

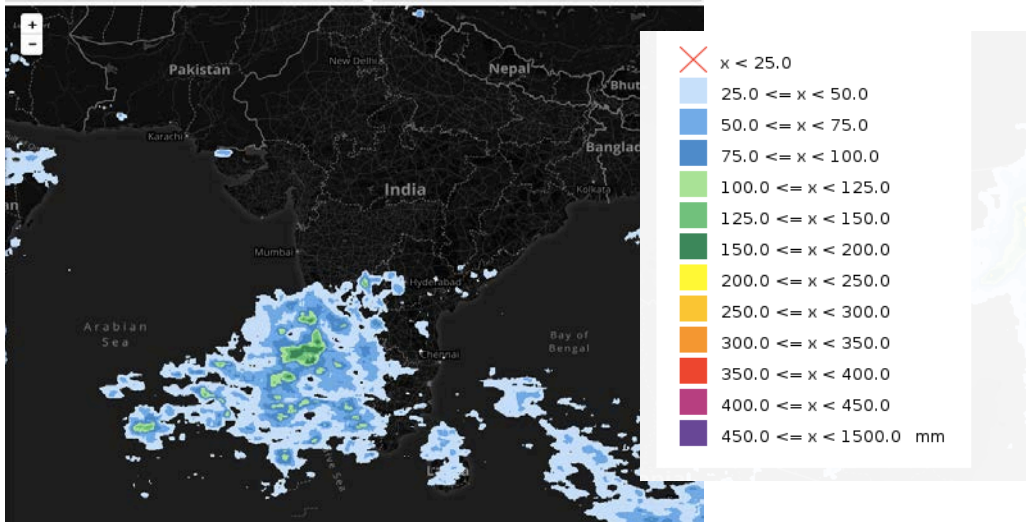
Maps

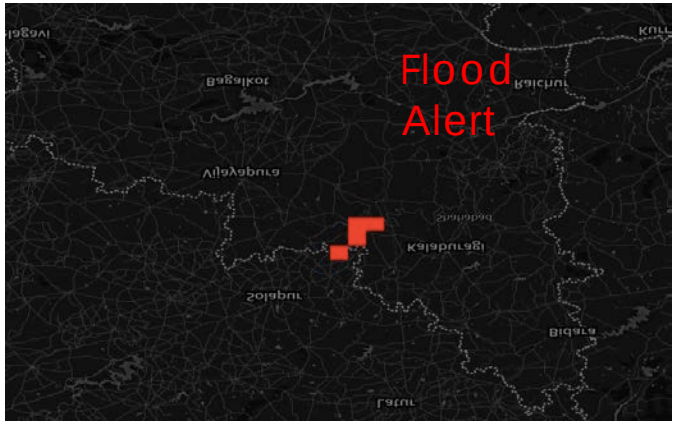
- Provides maps and downloadable tiff images of cumulative precipitation based on near real-time IMERG data and alerts for extreme rainfall and potential for flooding



Download Images

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



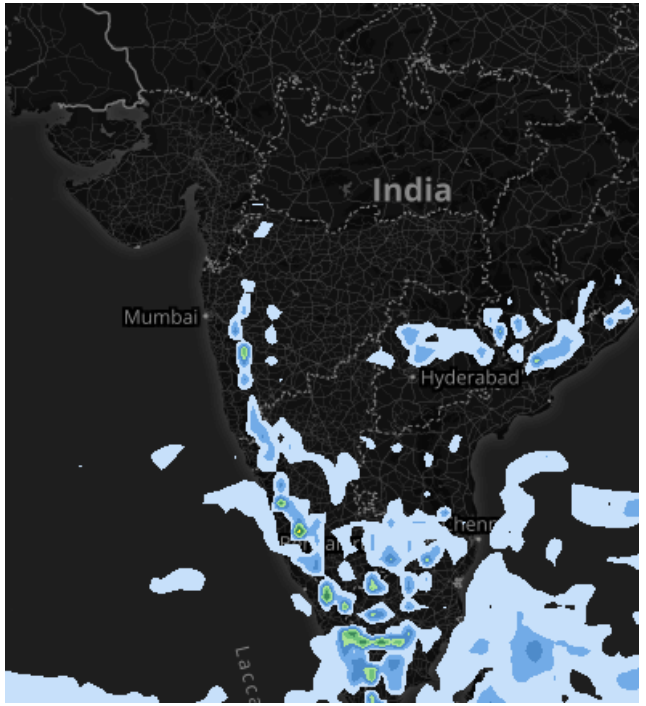


Extreme Rainfall Detection System (ERDS)

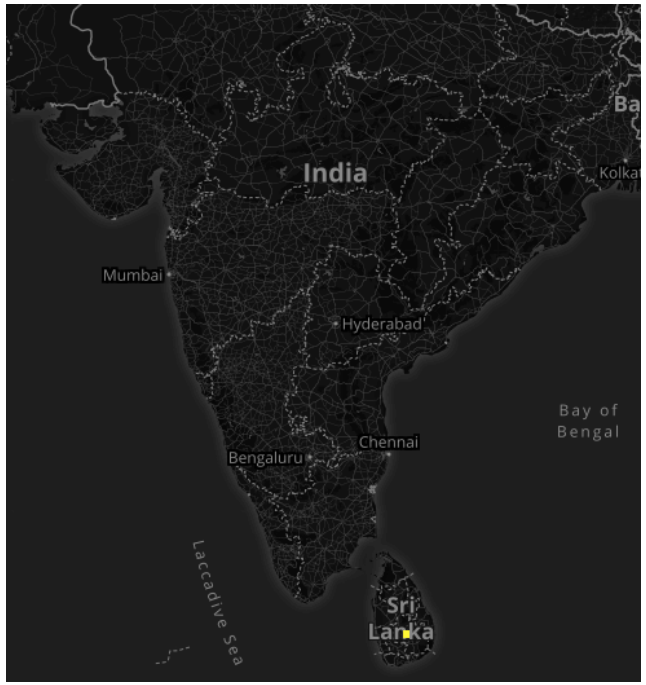
http://erds.ithacaweb.org/

- 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



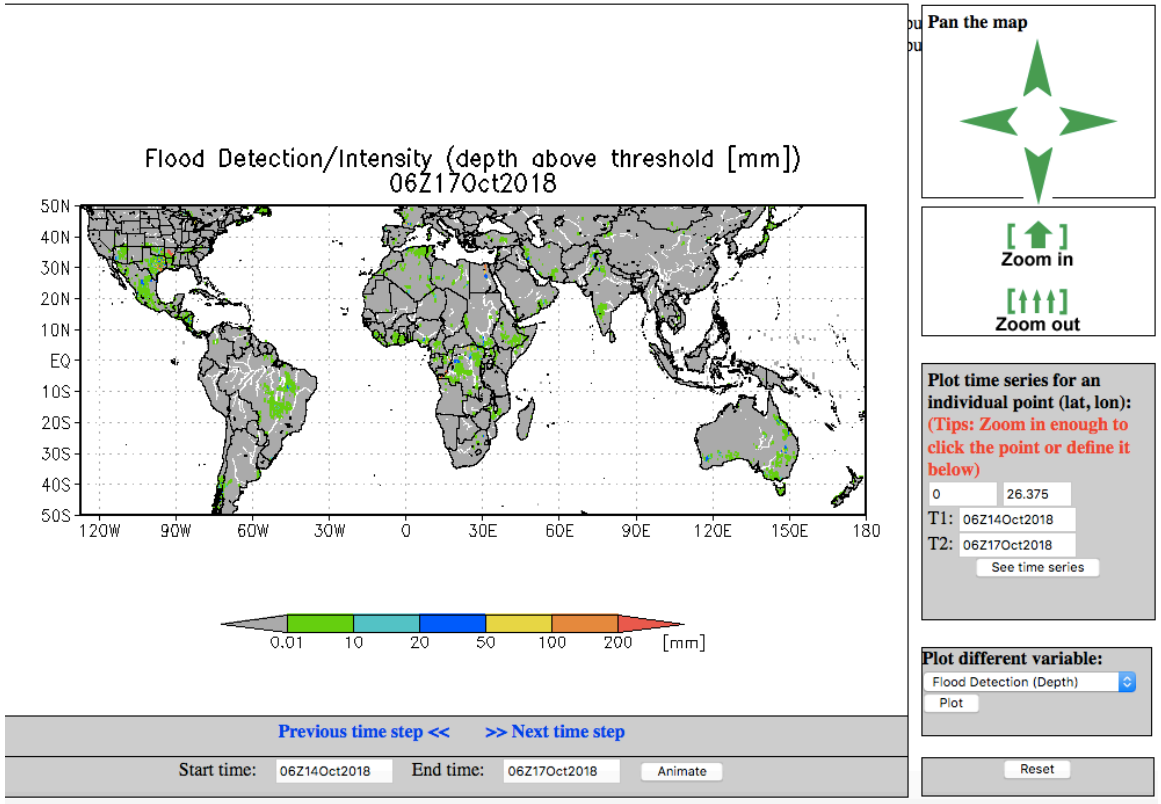
Demonstration: Extreme Rainfall Detection System

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 ⅛th 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

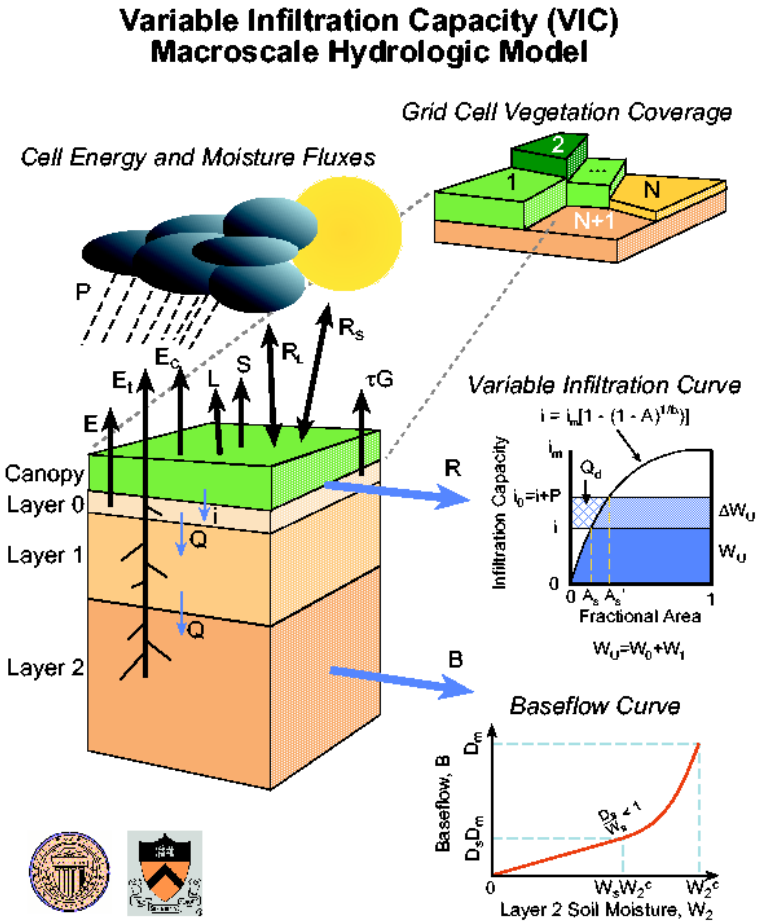
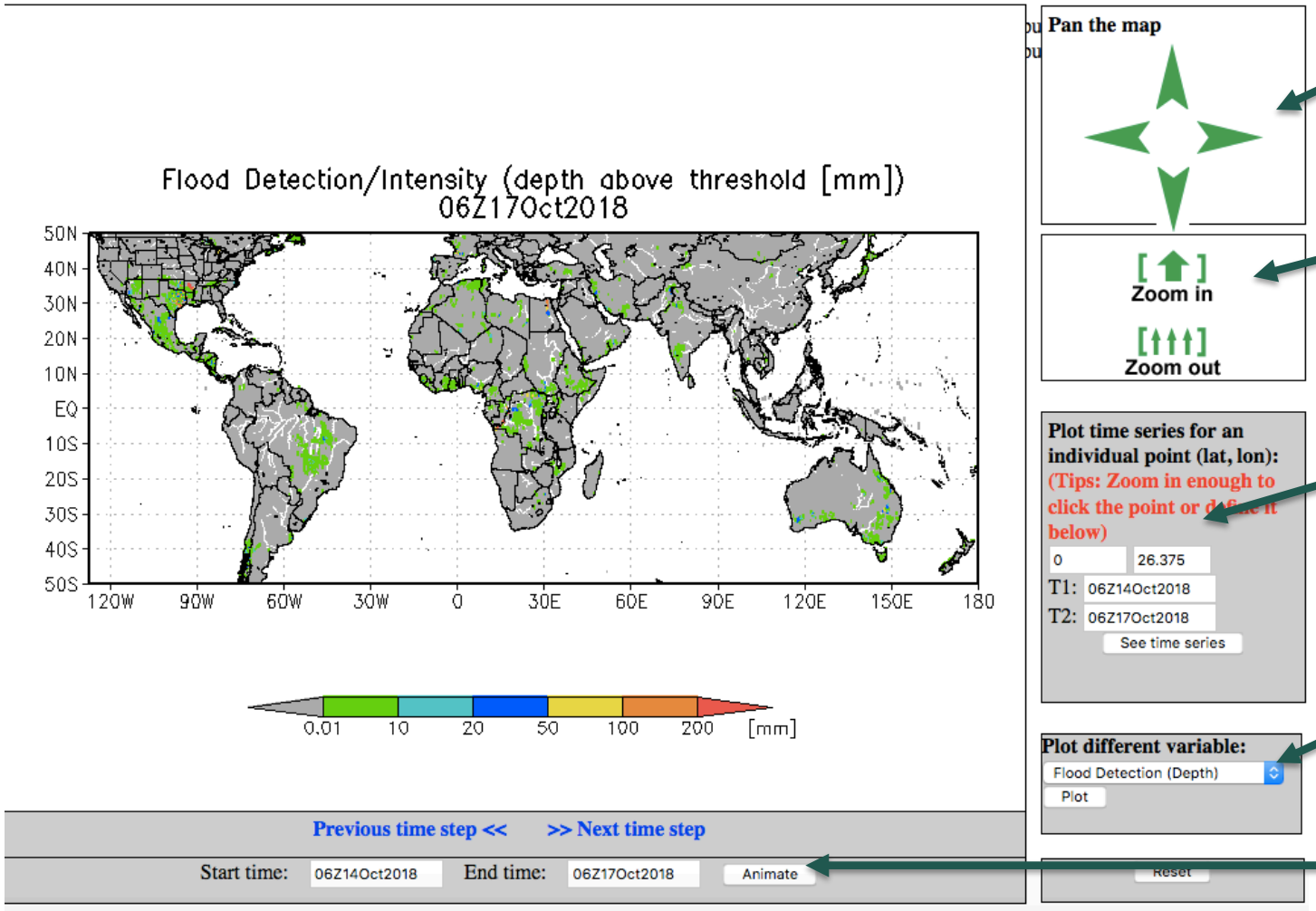


Image Credit: UW VIC Macroscale Hydrologic Model; References: Wu, H., R. F. Adler, Y. Tian, G. J. Huffman, H. Li, and J. Wang (2014), Real-time global flood estimation using satellite-based precipitation and a coupled land surface and routing model, Water Resour. Res., 50, 2693.2717, doi:10.1002/2013WR014710.; 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. Hydrometeor, 13, 1268.1284

GFMS

http://flood.umd.edu/



Map Navigation

Zoom in/out

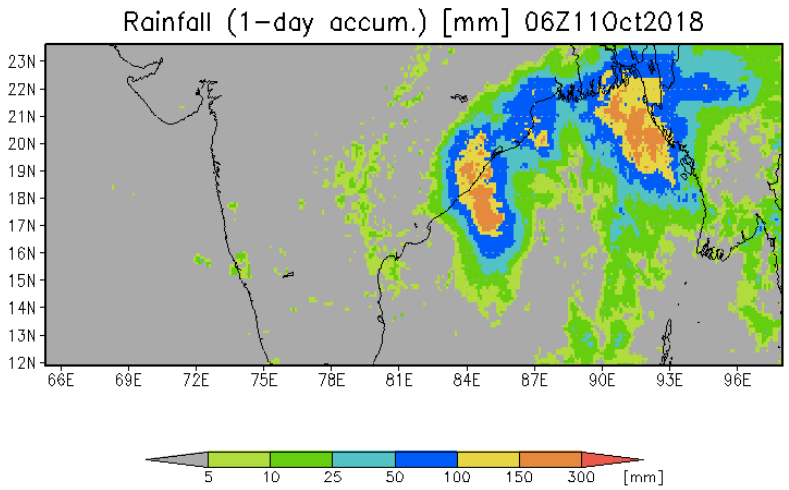
Select individual grid point for time series data

Plot different variables

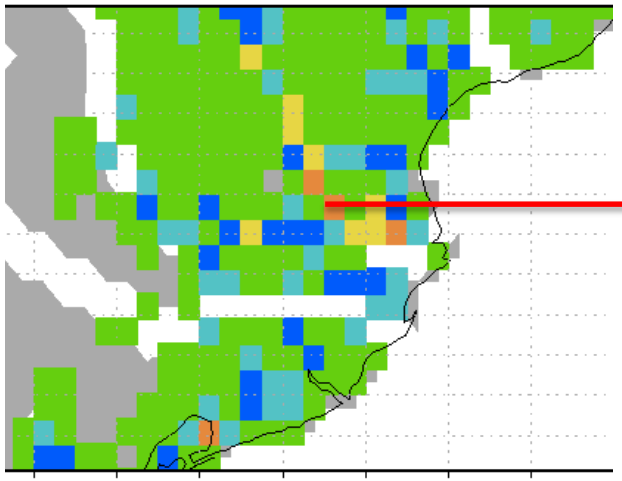
Animation

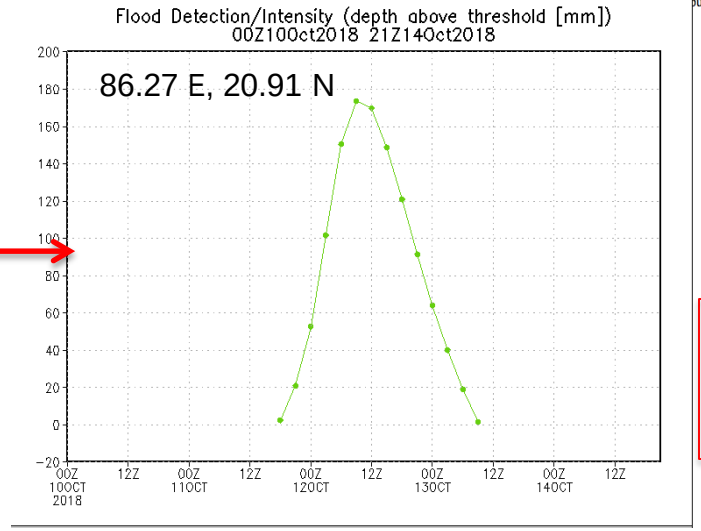
GFMS: Flooding in Eastern India

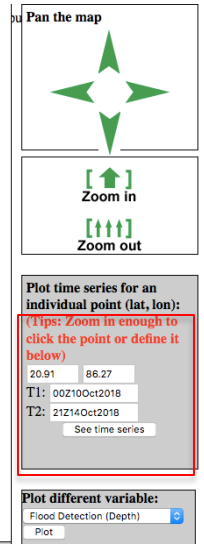
Rainfall Associated with Cyclone Titli
11 October 6 UTC

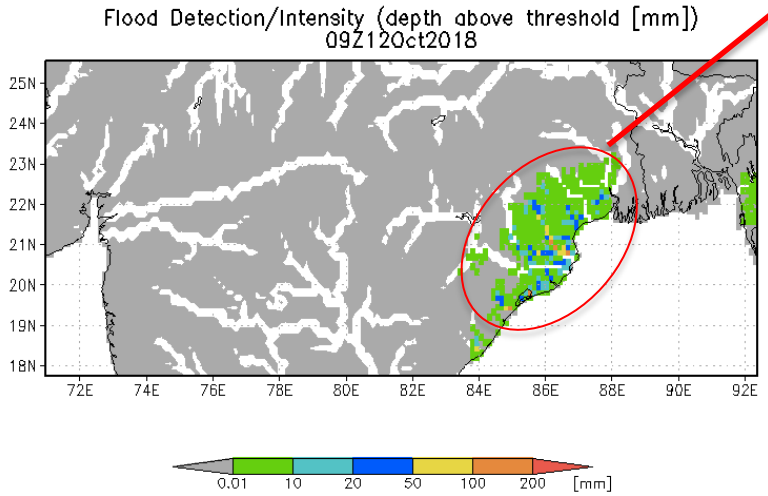


Flood Intensity
12 October 9 UTC









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