National Aeronautics and Space Administration

Flood Monitoring and Analysis

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Objectives

- Learn to use Global Flood Monitoring System (GFMS) and MODIS Near-real Time Flood Mapping (MOIDS-NRT) to monitor flood conditions in various stages
- Conduct analysis of precipitation, flood intensity, surface inundation, terrain, and SEDAC data for the Kerala floods
- Learn to monitor near-real time flood alerts

Requirement

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- QGIS installed on your computer
  - https://arset.gsfc.nasa.gov/sites/default/files/water/drought/Introduction%20to%20QGIS.pdf
- A shapefile of Kerala saved on your computer

Note

This is three-part exercise:

- Part 1 will focus on access and analysis of rainfall, streamflow/runoff and flood intensity for Kerala using GFMS
- Part 2 will focus on accessing MODIS-NRT inundation maps for Kerala
- Part 3 will focus on exploring ERDS, GFMS, and GDACS for flood Forecast and NRT alerts

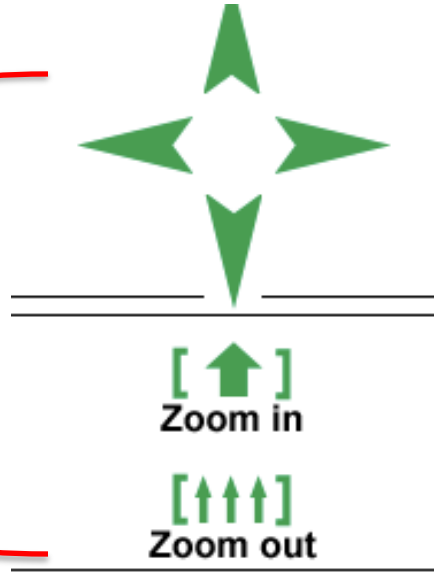
This exercise will be conducted in groups. Based on the Part 3 of the exercise each group will put together a 5-7 minutes presentation and will present in the last session of the day.

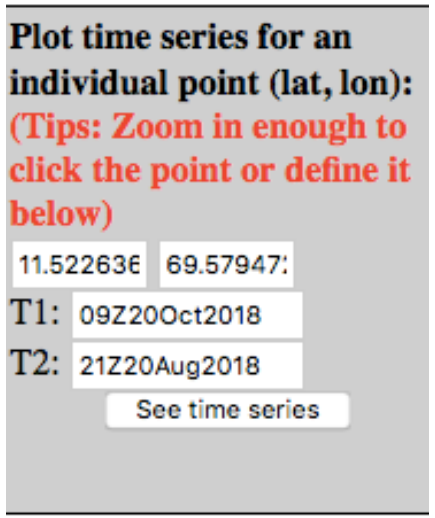
Part 1: Outline

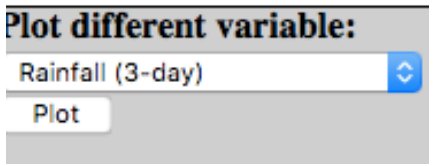
- Animate streamflow and flood intensity during the Kerala flood in August 2018
- Make time series of rainfall, streamflow, and flood intensity/depth

Part 1: Streamflow Animation and Analysis

1. Go to GFMS: http://flood.umd.edu
2. Scroll down and explore the maps
3. The first map would be for **Flood Detection/Intensity (depth above threshold [mm])**
4. Using **Pan the map**, **Zoom in**, and **Zoom out**, zoom in on the Kerala
5. From the dropdown menu in **Plot different variables** select **Streamflow 12km res** and click on **Plot** below

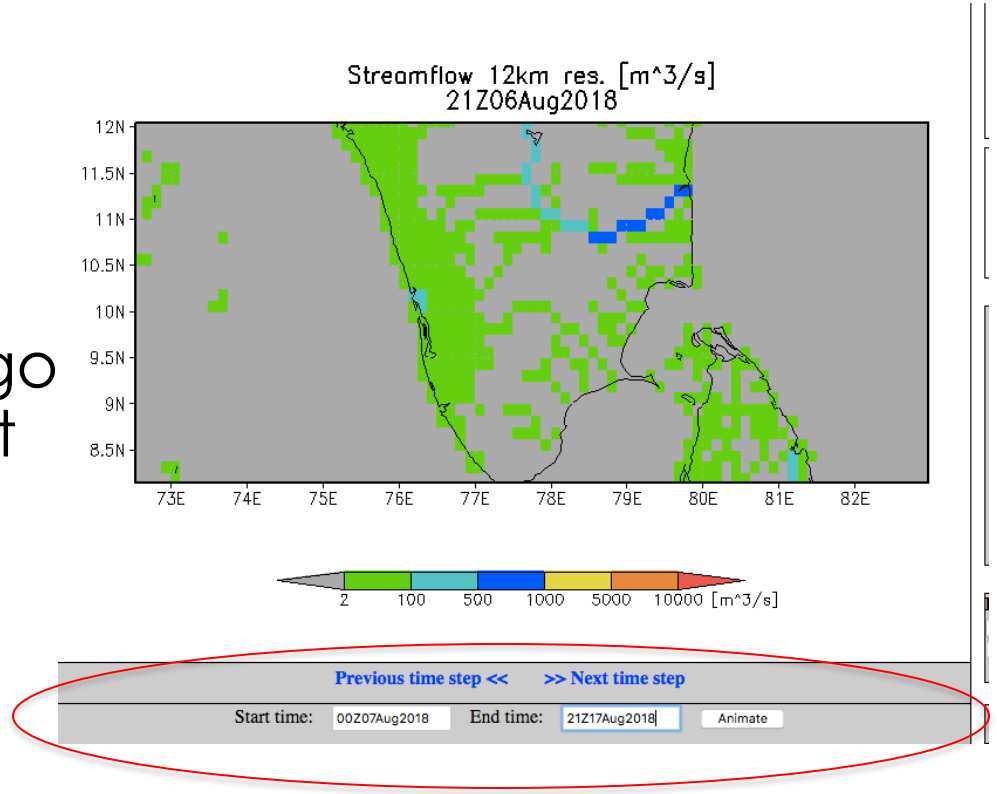






Part 1: Streamflow Animation and Analysis

7. Under the map enter
   - **Start time:** 00Z07Aug2018
   - **End time:** 21Z17Aug2018
8. Click on **Animate** next to the dates
9. Watch animations, you can stop and go back and forward to see streamflow at every 3-hour interval
10. Note: once the animation loop is complete the the dates are reset to current dates – so you may have to re-enter the above dates
11. Watch the animation and answer the questions(next slide)



Part 1: Questions

1. What are the units of streamflow?
2. Based on the animation which days/times and pixel locations(latitudes-longitude) had maximum streamflow?

   [Note: placing your computer pointer on a pixel will show its latitude and longitude in the **Plot time series for an individual point (lat, lon)** window to the right of the map
3. What is the range of maximum streamflow at the above pixels (read the range from the color bar)?

Part 1: Questions

12. Follow all the options from steps 1-11 but in step 5 from the dropdown menu in **Plot different variables select Flood Detection (Depth**) and click on **Plot** below
13. You may further zoom in to the area where you noted maximum streamflow
14. Watch the flood depth animation, do the days/times, pixels of the flooding depth agree with the streamflow animation you just did? Note down a couple pixel lat-lon where maximum flood depth is observed
15. Note down the maximum flood depth observed over Kerala
16. When you see non-zero flood depth outside a stream or river what does it indicate?
17. You can explore other options available froml **Plot different variables** (optional)

Part 1: Time Series

18. Select one of the pixel lat-lon values you noted down in step 14
19. in the **Plot time series for an individual point (lat, lon)** enter the lat-lon values (for example lat-lon of 10.78 and 76.05 are shown).
20. In T1 window enter 00Z01Aug2018 for the start date and in T2 enter 21Z31Aug2018 as the end date for the time series
21. Click on **See time series**
22. You will get the flood depth time series at the above pixel for August
23. From the **Plot different variable** drop down choose **Rainfall (1-day**) and click on **Plot** below
24. Repeat steps 19-21 to get the time series for rainfall.
25. **Question:** based on the time series how many days experienced flood depth > 60 mm? What was the daily rainfall range corresponding to these days?
26. You can explore different pixel lat-lon and other variables to see time series if you have time (optional)

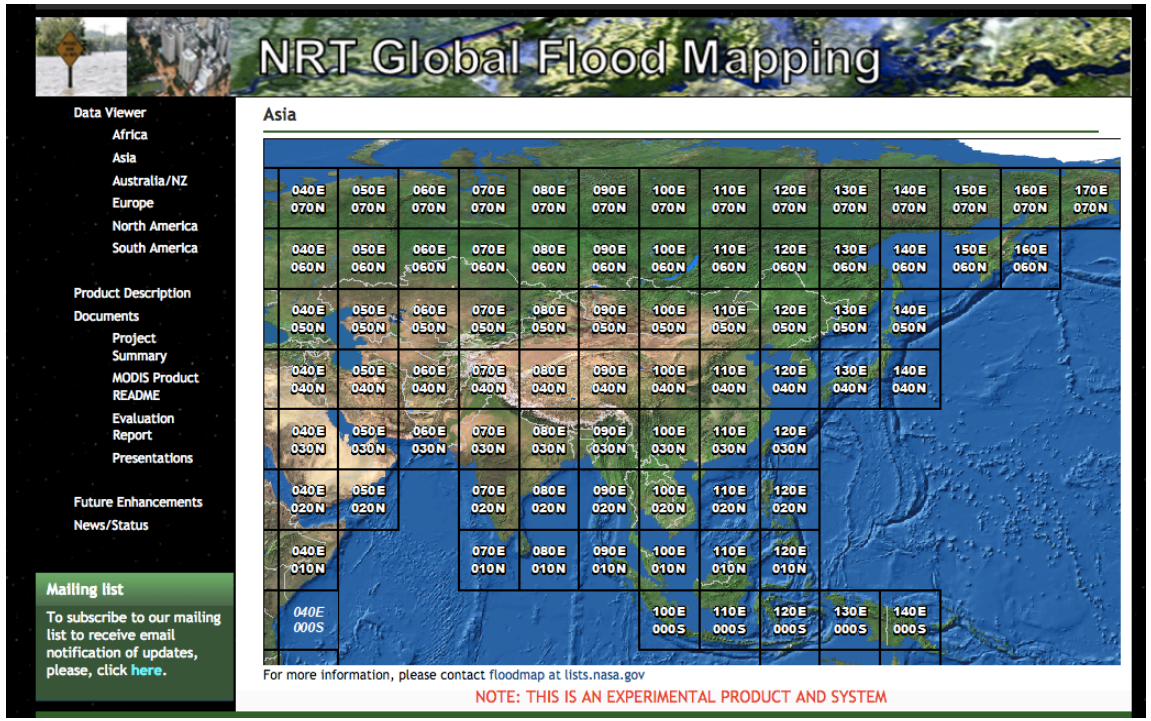
Part 2: Outline

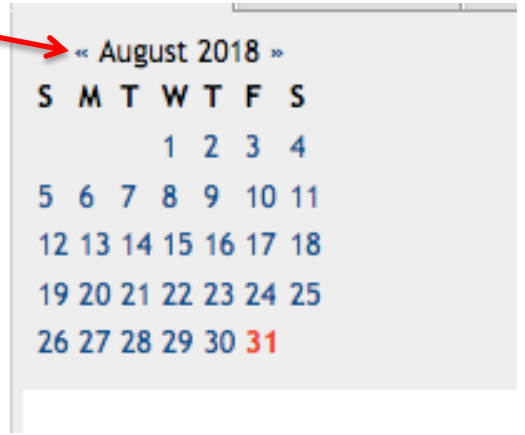
- Examine inundation maps based on MODIS NRT tools
- Analyze inundation maps in QGIS along with population density data

Part 2: inundation Maps From MODIS NRT tools

27. Go to the MODIS Near Real-Time (NRT) Global Flood Mapping Portal: http://oas.gsfc.nasa.gov/floodmap/
28. On the left side of the page, click on **Asia** under **Data Viewer**
29. Click on the grid 70E 20N
30. Using the calendar on the upper left

    go to August 2018 (use the arrows to navigate)





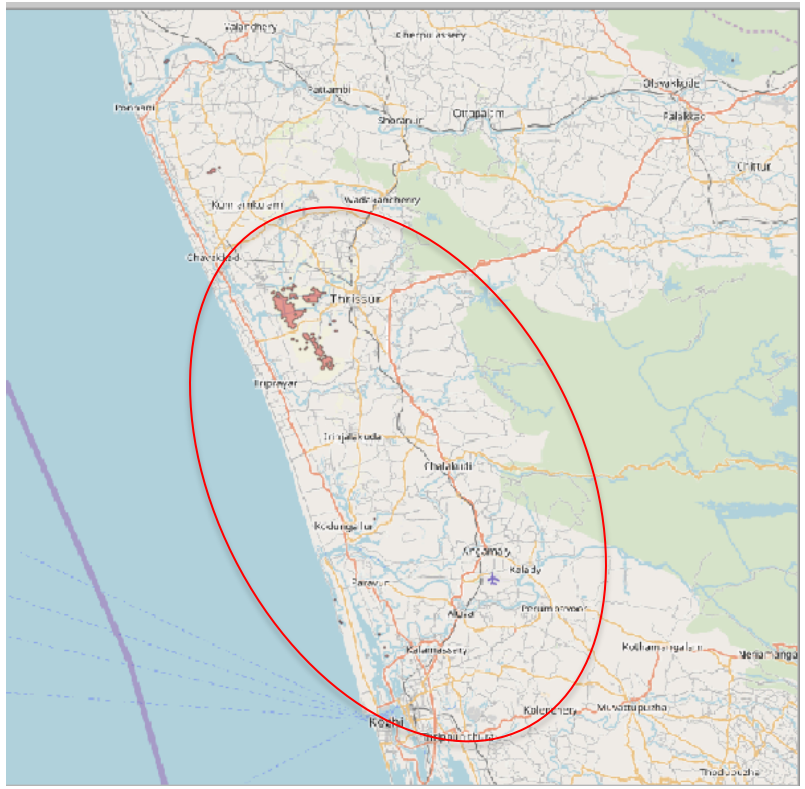
Part 2: inundation Maps From MODIS NRT tools

31. From the top bar select **3 Day Composite**
32. In the calendar, select **August 14**
34. Next examine how the inundation maps change from August 14– August 25 2018 by using the calendar to change the dates
35. Click on the maps to zoom-in and see the surface inundation
36. Do you see any inundation (red shaded areas) where GFMS showed high streamflow/flooding in any day?
37. Download the **MODIS Flood Water shapefile** for for August 25, 2018 (from the product table above the map)

Products		Available Downloads	
MODIS Flood Map	MFM	png	
MODIS Flood Water	MFW	shapefile (.zip)	KMZ
MODIS Surface Water	MSW	shapefile (.zip)	KMZ
MODIS Water Product	MWP	geotiff	
README		pdf	txt

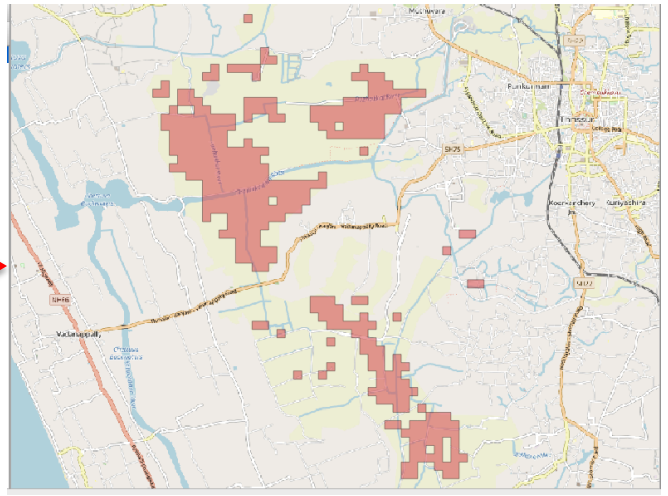
Part 2: MODIS inundation Map in QGIS

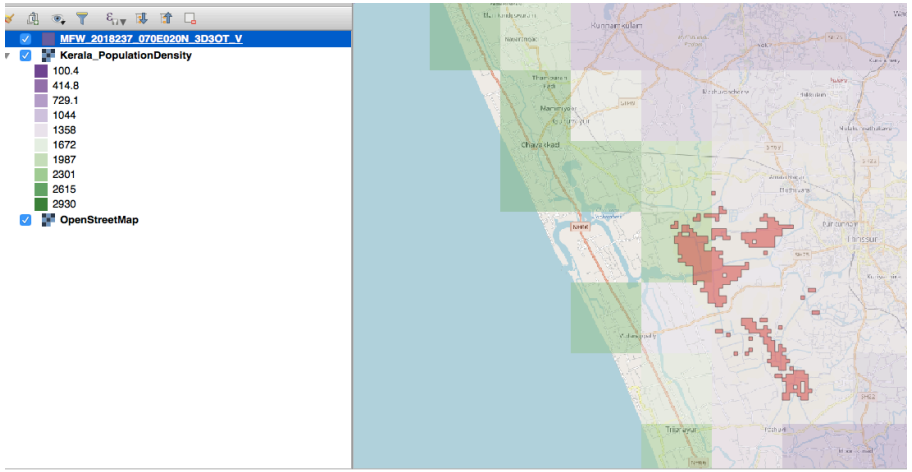
38. You will get a zip file of MODIS Flood Water, click on the file to unzip it
39. Open QGIS and start a new project on your computer
40. On the top menu bar, click on **Web,** select **Open Layer Plugin** and select a background map
41. This exercise uses the plugin **OpenStreetMap**
42. In your QGIS map, click on the **Add Vector** function on the left
43. Navigate to the saved MODIS Flood Water shapefile and click to open
44. Zoom to flooded area



Part 2: MODIS inundation Map in QGIS

44. Right click on the **MFW shapefile layer** and go to **Properties** > **Transparency**
45. Make the **Layer Transparency** to 50% and Click **OK**
46. Click on the **Add Raster** icon
47. Navigate to file Kerala_ClippedSRTM.tif that you copied to your computer earlier.
48. Right click on the clipped file Kerala_ClippedRain_1km and go to **Properties** > **Style**
    - Select the **Render Type** as **Singleband Pseudocolor**
    - Next to **Color**, select the PrGn(RdYlBu) color palette
    - Below the color display, change the **Mode** to **Equal Interval** and **Classes** to 10. Click **Classify**. Click **Apply**
    - Make the layer 50% transparent following 44-45 above





Part 2: MODIS inundation Map in QGIS

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45. Make the **Layer Transparency** to 50% and Click **OK**
46. Click on the **Add Raster** icon
47. Navigate to file Kerala_PopulationDensity.tif that you copied to your computer earlier.
48. Right click on the clipped file Kerala_ClippedRain_1km and go to **Properties** > **Style**
    - Select the **Render Type** as **Singleband Pseudocolor**
    - Next to **Color**, select the PrGn(RdYlBu) color palette
    - Below the color display, change the **Mode** to **Equal Interval** and **Classes** to 10. Click **Classify**. Click **Apply**
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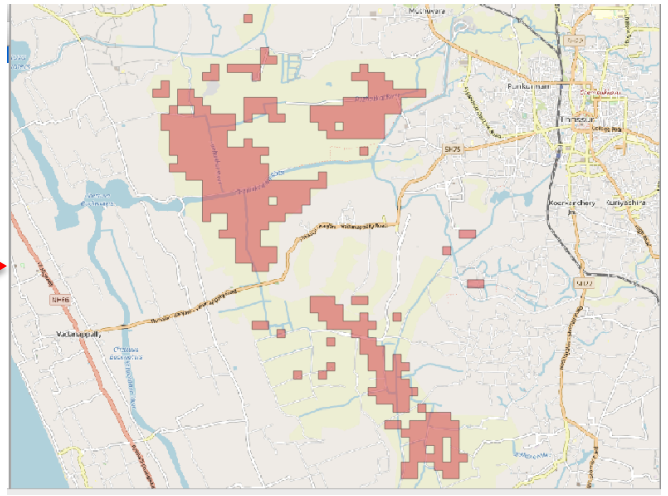
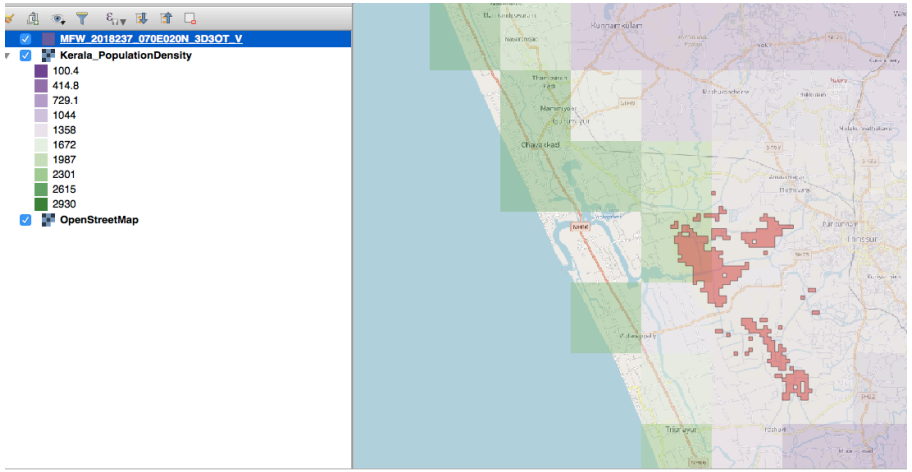




Part 2: Questions

1. Why did the MODIS inundation maps for before 25th August did not show any flooding when as GFMS showed peak flooding?
2. Do you think the flooded areas seen on the MODIS flood map are the only areas where surface post-flood inundation occurred?
3. Note down where the higher population was affected by inundation?

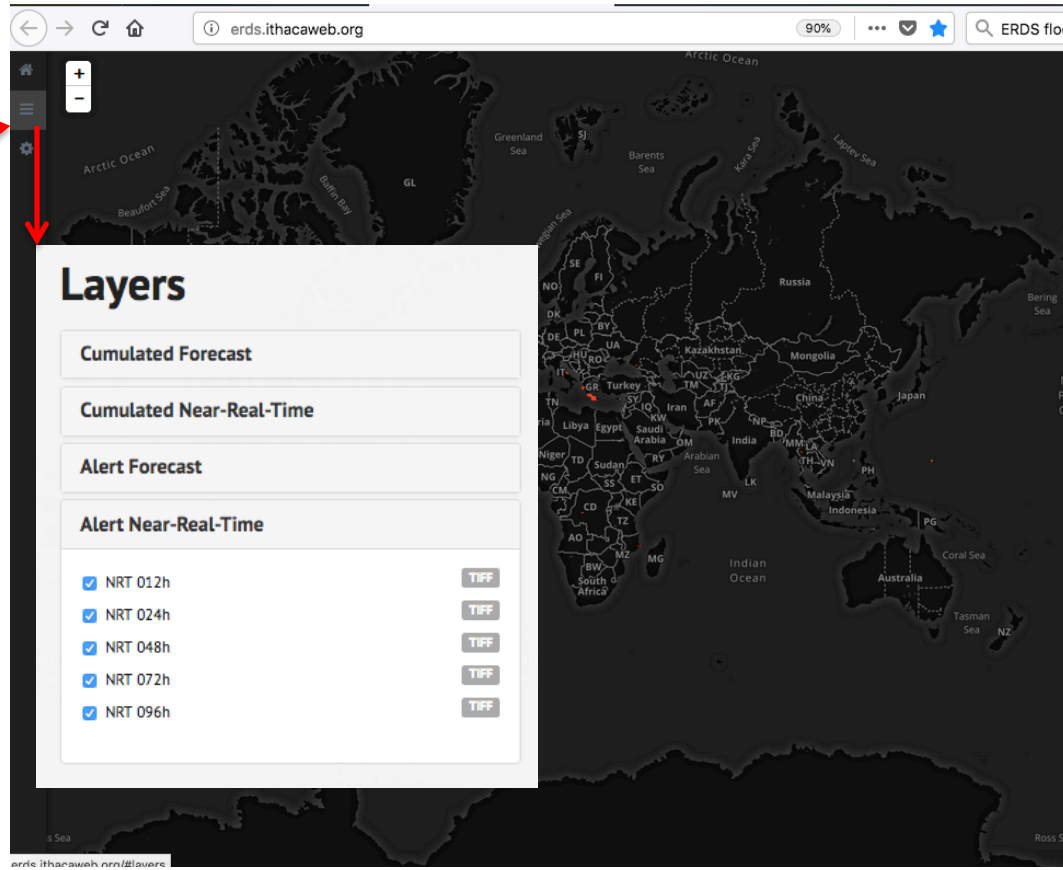
Part 3: Outline

- Explore ERDS for current and forecast flood alerts
- Explore GFMS for flood intensity forecast
- Explore GDACS for current flood information

These tools can be used to monitor likelihood of flooding and can facilitate pre-flood preparedness decisions

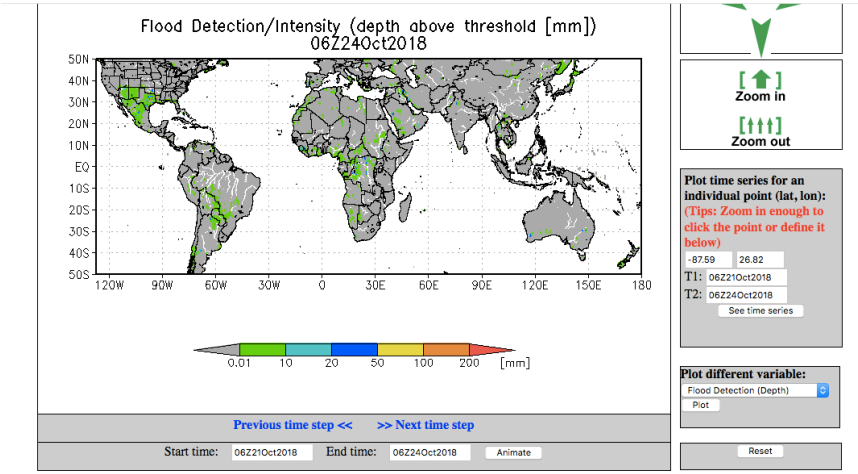
Part 3 Explore ERDS for current and forecast flood alerts

49. Go to http://erds.ithacaweb.org/
50. Click on the layer information
51. Click on the **Alert Near-Real-Time**
52. Click on NRT 012h – NRT 096h and note down where flood alerts (red areas on the map)
53. Click on Alert Forecast and see how the NRT flood conditions will change over next 24 - 144 hours. Note down if new flood areas emerge during this time



Part 3 Explore GFMS for Flood Intensity Forecast

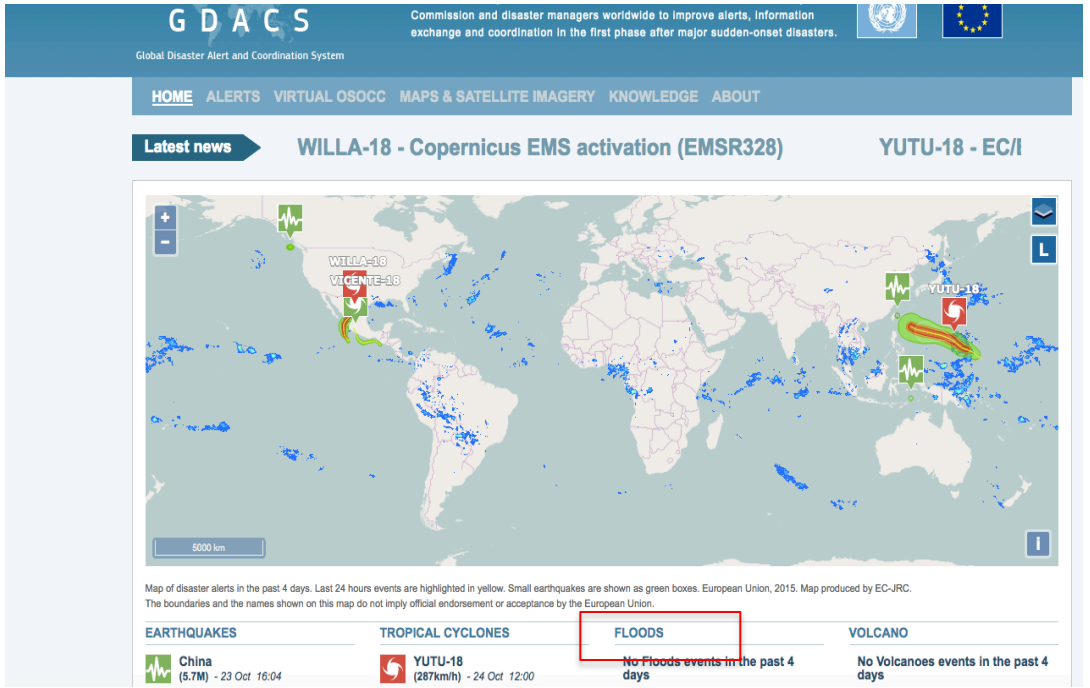
49. Go to http://flood.umd.edu/
50. Zoom in to one of the flood areas where ERDS Showed flood alert
49. Click on the **Next time step >>** and examine the **Flood Detection/Intensity (depth above threshold)**
50. You can examine rainfall and streamflow by selecting them from **Plot different variable:** on the right
52. You may also examine other flood alert areas



SHORT-TERM (4-5 DAYS)FLOOD FORECASTING(at 1/8th deg.): The loading page shows the latest flood simulations using satellite information. One can click ">> Next time step" below each panel or input a future time (into 4-5 days) to view the flood forecasts using the hydrological model based on NWP (i.e.GEOS-5) precipitation.

Part 3 Explore GDACS

53. Go to http://www.gdacs.org/
54. Locate the **Flood** link at the bottom of the map
53. Do you see any current flood information that was seen in ERDS or GFMS?
54. Click on the flood event link under **Flood**
55. You will see the **Event Summary** page
56. On the top you will see links to Impacts, Maps, Media and Resources
57. Explore the links and information about the flood



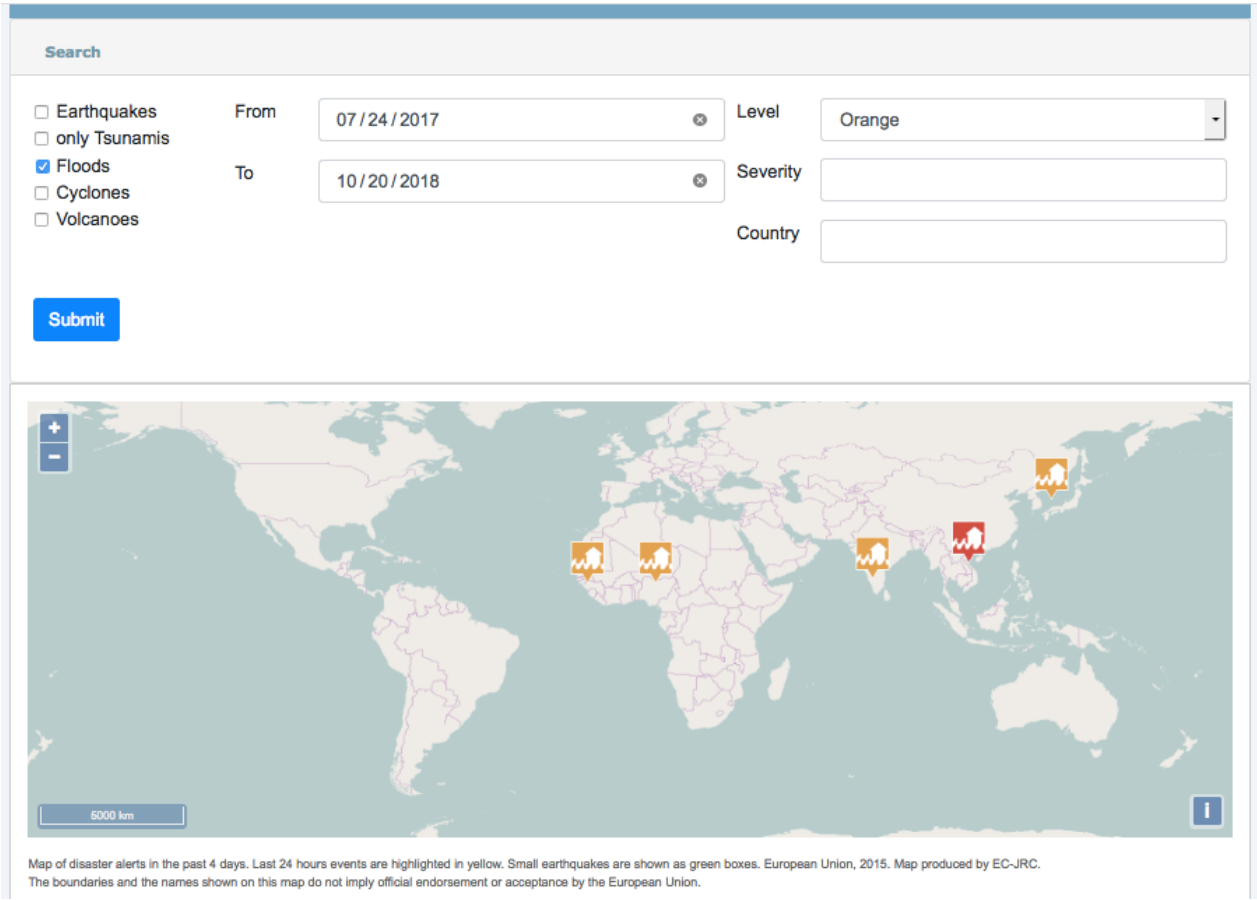
Part 3 Explore GDACS

58. On the GDACS page http://www.gdacs.org/ you will see a link to **ALERTS**

59. Click on **ALERTS** to get the map with current alerts
60. Click on any alert and get more information about it
61. Click on Search (upper left above the map) to select past archives of disaster alerts (next page)

Part 3 Explore GDACS

62. You will see disasters list, dates. and Level (severity) to choose from
63. Select **Floods**, Enter desired dates in **From** and **To**, and **Level** to be **Orange** (medium and above)
64. Click on **Search** to get see the results
65. Click on the flood of your interest and see the summary and other information



Presentation

- Each group will prepare a power point presentation based on part 3
- You may choose to focus on a current or a past flood, or a cyclone case
- Follow the steps you used in Parts 1-3 of these exercise to describe the events:

  i) Go to GDACS http://www.gdacs.org/ and pick a flood/cyclone case

  ii) Use the information from the GDACS summary, impacts, and maps section about this event

  iii) For this case go to GFMS http://flood.umd.edu/ and get rainfall, streamflow, flood intensity

  iv) Go to MODIS NRT http://oas.gsfc.nasa.gov/floodmap/ and examine 3-day and 14-day composite flood maps

- **Your presentation should include slides of these information/images and a story about this events – pre-flood rainfall, flood intensity, post flood inundation and impacts**

Discussion

- How do you plan to use the data and tools you learned in this training for decision making?
  - What types of decisions have to be made in various flood stages?
  - What data and information are required?
  - Which data and tool can be used ? What are the strengths and limitations of using this information?


APPLIED REMOTE SENSING TRAINING PROGRAM
TRAIN - EMPOWER - ADVANCE

Thank You