



Introduction to Dartmouth Flood Observatory (DFO)



Objective

To provide an overview of DFO for Flood Mapping
and River Discharge Monitoring

Outline

- About the DFO
- *Global and Regional Flooding Information*
- DFO River Watch
- Case study: Colombia Flood Event

About the Dartmouth Flood Observatory (DFO)

DFO Objectives

An Interactive Web-tool Developed for Humanitarian, Water Resources Management Research and Applications

The DFO Goals are to:

- Conduct global remote sensing-based fresh water measurement and mapping in “near real time” and record such information into a permanent archive.
- Collaborate with humanitarian and water organizations in partnerships for enabling the maximum utility of such information.
- Perform hydrological research in the area of surface water variability, using both remote sensing and modeling, and continue to develop new methods of measuring the Earth’s water.

Supported by: NASA, the U.S. Geological Survey, the World Bank, the Development Bank of Latin America, the UNISDR, and from the European Commission’s Global Disaster Alert and Coordination System (GDACS) at the Joint Research Centre

NASA Remote Sensing Observations Used by the DFO

The DFO uses:

- the MODIS Inundation Mapping Information
- TRMM-TMI (and in the future GPM GMI) Observations, together with a model to derive river discharge
- Terrain data from Shuttle Radar Topography Mission (SRTM)

Selected End-Users of the DFO

- [Flood Control 2015](#)
- [Global Risk Information Platform](#)
- [Malawi Spatial Data Portal](#)
- [PreventionWeb](#)
- [European Environment Agency](#)
- [Humanitarian Early Warning Service](#)
- [GeoSUR](#)

GeoSUR Uses DFO River Discharge and Flood Mapping Tools

<http://www.geosur.info/geosur/index.php/en/flood-mapping-in-near-real-time>

The screenshot shows the GeoSUR website interface. At the top, there is a navigation bar with links for HOME, SEARCH FOR DATA, REGIONAL MAP VIEWER, NEWS, and CONTACT US. The main content area is titled "Flood Mapping in near-real-time". It features a map of Latin America and the Caribbean showing flood areas. To the right of the map, there is text explaining the project and its capabilities. A legend at the bottom identifies the symbols used in the maps: Satellite Discharge (black line), Low Flow (yellow line), 1.33 yr Flood (blue line), and 5 yr Flood (red line). The sidebar on the left contains sections for "GEOSERVICES" and "GEOSUR PROGRAM" with various links.

GEOSERVICES

- Map Viewers
- WMS Services
- WFS Services
- CSW Services
- Topographic Service
- Hydro-Electric Potential Assessments
- Flood mapping in near-real-time

GEOSUR PROGRAM

- About the Program
- Technical Assistance
- Participants
- GeoSUR's Library
- Frequently Asked Questions
- GeoSUR Blog
- Available Data

WHO'S ONLINE

We have 212 guests and no members online

Flood Mapping in near-real-time

In 2013 CAF's GeoSUR Program and the Dartmouth Flooding Observatory (DFO) of the University of Colorado started a project to map floods in Latin America and the Caribbean.

The new system will enable users to:

- Visualize and download a digital and regional map of current floods in near real time
- Have access to a geo-referenced registry of the historic floods in the region,
- Estimate river discharge using remote sensors in selected sites.

The DFO has the capacity to generate near-real-time flood maps with global coverage on a daily basis. The MODIS sensor used by this service offers global coverage twice per day, with a spatial resolution of 250 meters, and two optic bands used to map water rises.

Specialists from Latin America and the Caribbean, selected by the GeoSUR Program, will be in charge of monitoring the internet for the occurrence of floods in the region. The approximate coordinates of each event will be registered in an automatic system that will allow for the mapping of the complete cycle of floods in a specific area. The data relating to floods that are under way will be available in the DFO web site and may be accessed from the GeoSUR web site. The daily maps will be consolidated into annual and historical maps which will be available to be visualized, analyzed, and downloaded in GeoSUR's Regional Map Service.

The project will also generate daily estimates of river flow using remote sensing for selected sites in the Latin American and Caribbean river network. For this end, the network of measuring points of river flow, maintained by the River Watch system operated by the DFO, will be increased. Currently, River Watch monitors the flow of approximately 120 points in the region. With the project, the network will increase to cover more than 1,500 points.

River Watch can identify and display watersheds that are experiencing a river flow which is unusually low (drought) or unusually high (possible flooding), in addition to generating a daily series of flows that goes back to 1998 in each measurement site.

The whole system will continue to be operated by the DFO, and access to its data will be offered from the GeoSUR regional map viewer in order to integrate the information on near-real-time floods and river flow with the geospatial datasets maintained by GeoSUR.

Legend:

- Satellite Discharge
- Low Flow
- 1.33 yr Flood
- 5 yr Flood

Global and Regional Flooding Information from the DFO

The DFO Website

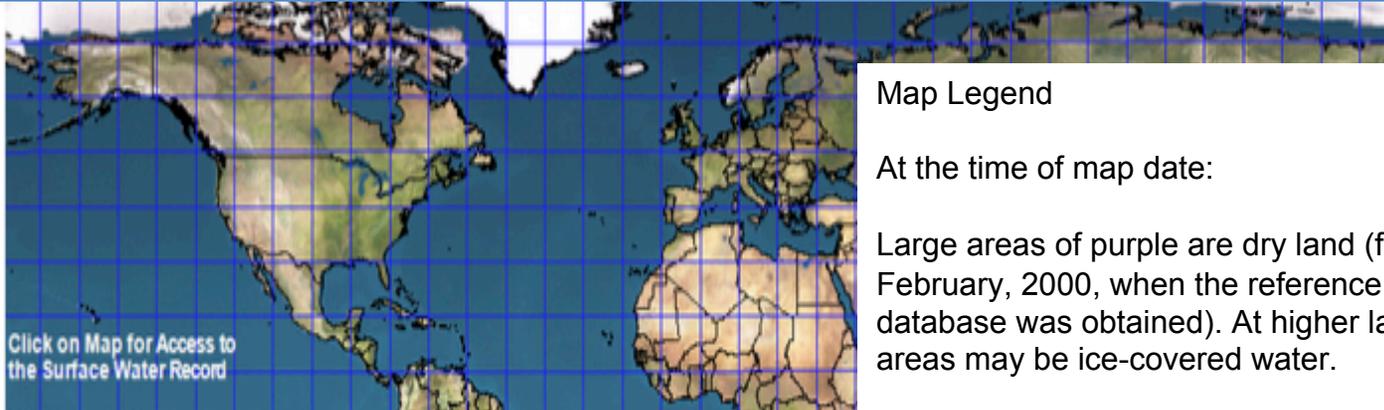
<http://floodobservatory.colorado.edu/>

The screenshot shows the website's navigation menu on the left, which includes links for Home, Active Archive of Large Floods, 1985-Present, Global and Regional Analyses, Master Index of Inundation Maps, The Surface Water Record, River Watch, Other Flood Detection Tools, Sample Images and Maps, Staff, and Publications. The main content area features the Darimouth Flood Observatory logo, a mission statement, and a featured flood event map for 04/21/2015. The map shows flooded areas in red and blue over a geographic region in the Ohio and Wabash valleys, with various cities and towns labeled. A red box highlights the 'Other Flood Detection Tools' and 'Sample Images and Maps' links in the navigation menu.

Featured Event of Regional Flooding - Updated Daily

Global Flood Events Using MODIS Inundation

<http://floodobservatory.colorado.edu/>



Map Legend

At the time of map date:

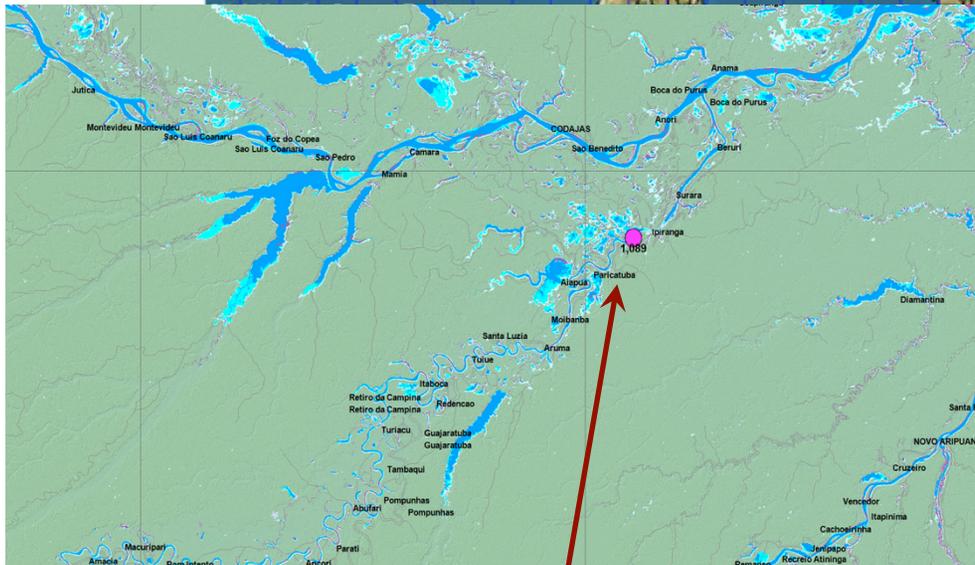
Large areas of purple are dry land (formerly water in February, 2000, when the reference SWBD water database was obtained). At higher latitudes, such areas may be ice-covered water.

Small areas of purple are water SWBD, mapped by but are too small to be mappable by MODIS.

Dark blue is current water, imaged by MODIS and by SWBD in 2000 ("permanent" water).

Bright blue is flooding: expanded water areas mapped by MODIS compared to reference water. Any post-2000 reservoir or new water body is also depicted in bright blue.

Light blue-gray is all previous flooding imaged and mapped by the Flood Observatory (now dry land). Note: in mountainous areas, local shadows are commonly mis-classified as water.



Select the
Flood Event

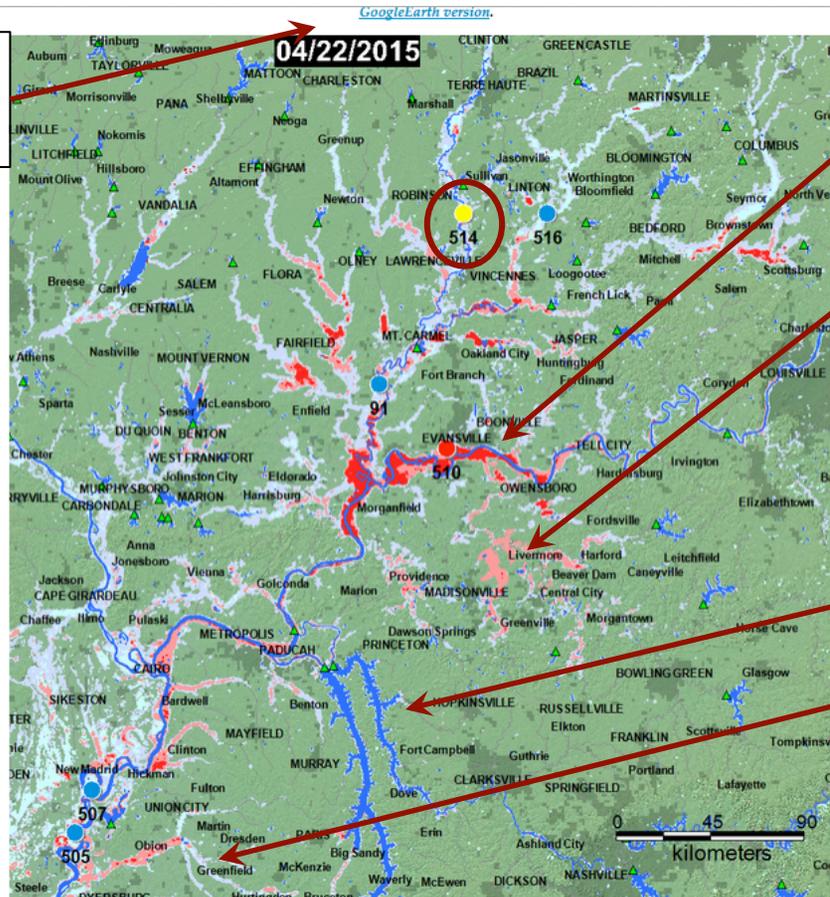
Regional Flooding Event Using the NASA MODIS Inundation Mapping Tool

<http://floodobservatory.colorado.edu/>

Click for more information

[Featured Flood Event: #4230, Ohio and Wabash Valleys, USA](#)

View in
Google Earth



Red: Flooding within the past 14 days (MODIS automated product)
Light Red: Flooded during this event, from earlier MODIS coverage or non-automated MODIS mapping.
Darker Red: Flooded areas from high resolution Sentinel 1 or Landsat 8 data.
Dark blue, Permanent water, February, 2000 (SWBD).
Very light blue, All flooding mapped by DFO since year 2000.

CLICK on the colored dots to
access River Watch Site

Featured Event of Regional Flooding – Updated Daily

DFO: River Watch

- TRMM Microwave Imager, GPM Microwave Imager, and Advanced Microwave Scanning Radiometer-2 from GCOM-W (a Japanese Space Agency mission) observations are sensitive to the proportion of water and dry land.
- **These Microwave observations are converted to actual river discharge** (similar to streamflow, cubic meter of water flowing per second) by combining them with surface discharge measurements and then to runoff by using a Water Balance Model (WBM).
- Runoff calculations are available starting in 2003, seven-day runoff deviation starts in 2003-2007. Mean runoff is mapped to indicate low, normal, moderate flooding, and major flooding.

DFO: River Watch for a Flood Event

Proceed to version 2

Click here to view the river watch tool

Select a dot to view information

For example, select this dot

You can now view current and historical information about this site

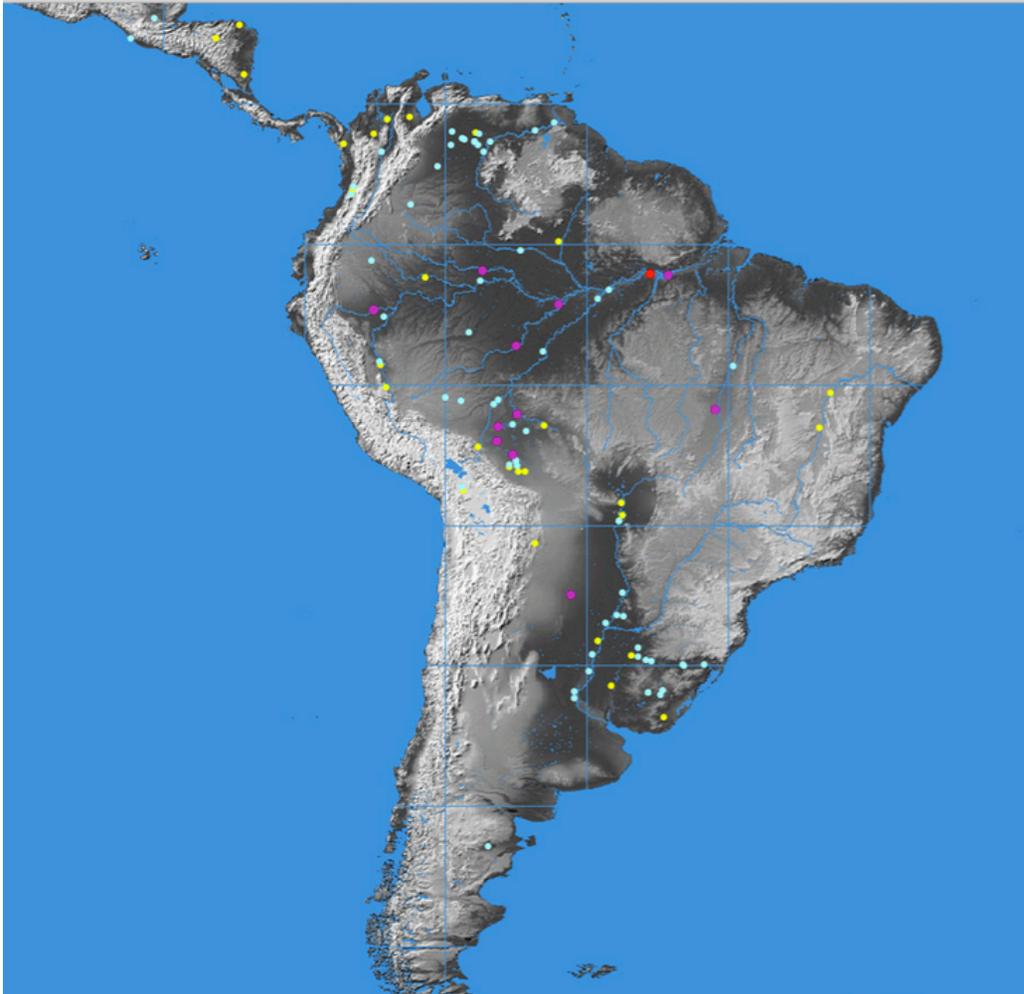
The screenshot shows the Dartmouth Flood Observatory website. The header includes the logo and the text "Space-based Measurement, Mapping, and Modeling of Surface Water For Research, Humanitarian, and Water Management Applications". The navigation menu on the left includes links for Home, Active Archive of Large Floods, Global and Regional Analyses, Master Index of Inundation Maps, The Surface Water Record, River Watch, Other Flood Detection Tools, Sample Images and Maps, Staff, and Publications. The main content area features a "Featured Flood Event: #4230, Ohio and Wabash Valleys, USA" with a date of "04/21/2015". Below this is a map showing flood events with various colored overlays: red for flooding within the past 14 days, light red for earlier MODIS coverage, dark blue for permanent water, and very light blue for all flooding mapped by DFO since 2000. A legend on the right explains these colors and provides a link to a high-resolution Sentinel-1 or trial Google Earth version. A red arrow points to a specific dot on the map, and a text box indicates that clicking this dot will allow users to view current and historical information about the site.

Dartmouth Flood Observatory
Space-based Measurement, Mapping, and Modeling of Surface Water
For Research, Humanitarian, and Water Management Applications
Flood Observatory Director
Mission Statement
Community Surface Dynamics Modeling System
University of Colorado, Campus Box 450, Boulder, CO 80309 USA
New: example of Inundation Prediction Maps using combined microwave and optical remote sensing
Featured Flood Event: #4230, Ohio and Wabash Valleys, USA
Red: Flooding within past 14 days (MODIS automated product). Light Red: Flooded during this event, from earlier MODIS coverage or non-automated Landsat 8 data. Dark blue, Permanent water, February, 2000 (SWBD). Very light blue, All flooding mapped by DFO since yr 2000. Also, CLICK on a dot to view information about this site. [high resolution Sentinel 1 or trial GoogleEarth version.](#)

04/21/2015

high resolution Sentinel 1 or trial GoogleEarth version.

DFO: River Watch



Updated Daily at 14:00 MDT

1) In early 2014, many new sites are being added for Latin America in cooperation with local water ministries and the [GeoSUR project](#).

2) New data from JAXA's AMSR-2 aboard GCOM-W and from NASA's GPM is allowing re-establishment of river measurement sites at higher latitudes.

White triangles: ice covered.

Yellow dots: low flow (<5th percentile mean daily runoff for this date, 1998-2012)

Blue dots: normal flow;

Purple dots: moderate flooding (>1.33 yr recurrence)

Red dots: major flooding (> 5 yr recurrence)

More Information on Flooding

Global Flood Archives

The screenshot shows the Dartmouth Flood Observatory website. On the left is a navigation menu with links such as Home, Active Archive of Large Floods, 1985-Present, Global and Regional Analyses, Master Index of Inundation Maps, The Surface Water Record, River Watch, Other Flood Detection Tools, Sample Images and Maps, Staff, and Publications. Below the menu is a 'Live Traffic Feed' showing recent visitors from various locations like Silver Spring, Maryland and College Park, Maryland.

The main content area features the Dartmouth Flood Observatory logo and the following text:
Dartmouth Flood Observatory
*Space-based Measurement, Mapping, and Modeling of Surface Water
For Research, Humanitarian, and Water Management Applications*
[Flood Observatory Director](#)
[Mission Statement](#)
[Community Surface Dynamics Modeling System](#)
University of Colorado, Campus Box 450, Boulder, CO 80309 USA
[New: example of Inundation Prediction Maps using combined microwave and optical remote sensing](#)
[Featured Flood Event: #4230, Ohio and Wabash Valleys, USA](#)

A red-bordered box highlights the 'Active Archive of Large Floods, 1985-Present' link with the text: 'Click here to see the flood archive data'.

Below the text is a legend for a flood map dated 04/21/2015. The legend text is: **Red:** Flooding within past 14 days (MODIS automated product). **Light Red:** Flooded during this event, from earlier MODIS coverage or non-automated MODIS mapping. **Darker Red:** Flooded areas from high resolution Sentinel 1 or Landsat 8 data. **Dark blue:** Permanent water, February, 2000 (SWBD). **Very light blue:** All flooding mapped by DFO since yr 2000. Also, **CLICK** on the colored dots to access River Watch sites. See also [trial GoogleEarth version](#).

The map shows the Ohio and Wabash river valleys with various towns labeled, including Columbus, Evansville, and Louisville. The map displays different colors representing flood status according to the legend.

DFO: Flood Archive Information

Global Active Archive of Large Flood Events

Citation for the data:
G.R.Brakenridge, "Global Active Archive of Large Flood Events", Dartmouth Flood Observatory, University of Colorado, <http://floodobservatory.colorado.edu/Archives/index.html>.

The information presented in this Archive is derived from news, governmental, instrumental, and remote sensing sources. The archive is "active" because current events are added immediately.

Each entry in the table and related "area affected" map outline represents a discrete flood event. However, repeat flooding in some regions is a complex phenomenon and may require a compromise between aggregating and dividing such events. The listing is comprehensive and global in scope. Deaths and damage estimates for tropical storms are totals from all causes, but tropical storms without significant river flooding are not included.

The Archive includes: 1) [an online .html table of recent events](#), only; 2) [Excel .xls](#) and [.xml](#) files for all events, 1985-present, updated as the recent events html is updated; 3) a GIS (MapInfo format) file set ([1,2,3,4,5](#)) and 4) a [.shp](#) format file set ([1,2,3,4](#)), each providing flood catalog numbers, centroids, area affected outlines, and other attribute information and updated as the recent events html is updated. The [.shp](#) files are generated from the MapInfo files).

Many floods have now been imaged by satellite and translated at the Dartmouth Flood Observatory into individual maps of inundation extents. To view these maps, follow any hyperlinks in the Archive [.html](#), [.xls](#), or [.xml](#) files in the "Country" column for a specific event.. Many other floods have been imaged and mapped but are instead shown as current or past flooding areas in the [Global Surface Water Record](#).

See Also: [Master Index of Rapid Response Inundation Maps](#)

You can visualize an [Interactive Map of the Global Flood Events 1985-2002](#). (If the on the Macromedia web site).

For additional information concerning how these maps and tables are created, please see [this page](#).

Below: Geographic Centers of floods in the FloodArchive GIS file, 1985-2010

Geographic Centers of Floods in Archive, 1985-2010, n = 9713

Real-time view - Get Feed

Click here to view recent flood events

Click here to download the full archive as an excel file

Click here for an interactive map

Here is a map of flooding events in the archive

Show flood events by checking a box

Flood Analysis

Flood Archive Atlas

floodobservatory.colorado.edu/archivatlas/index.htm

World Atlas of Large Flood Events 1985-2002

The displays presented below are based on data derived from a wide variety of news, governmental, instrumental, and remote sensing source. They were produced by [Dr. Sebastien Caquard](#). For additional information concerning how these maps and tables are created, please review the [Archive Notes](#).

Contents of the Atlas

Part I - Evolution of the floods since 1985

Flood Number	Interannual evolution Map of the floods number
Flood Duration	Interannual evolution Seasonal evolution Map of the flood duration
Flood Seasonality	Interannual and Seasonal evolution Map of the flood seasonality
Flood Causes	The different causes Interannual evolution Map of the flood causes
Recurrence interval	Map of recurrence interval anecdotal
Severity class	by YEAR

Part II - Consequences of these floods

Fatalities	Interannual average evolution or Sum/Max Seasonal evolution total or Average/Median Map of the flood fatalities
------------	---

For example, select interannual evolution

Select a type of analysis

Global and Regional Analyses

Master Index of Inundation Maps

Global Surface Water Record

River Watch

Other Flood Detection Tools

Sample Images and Maps

Staff

Publications

Flood Event Example

Chocó, Colombia

11/1/14-12/20/14

The Flood event in the recent flood archive

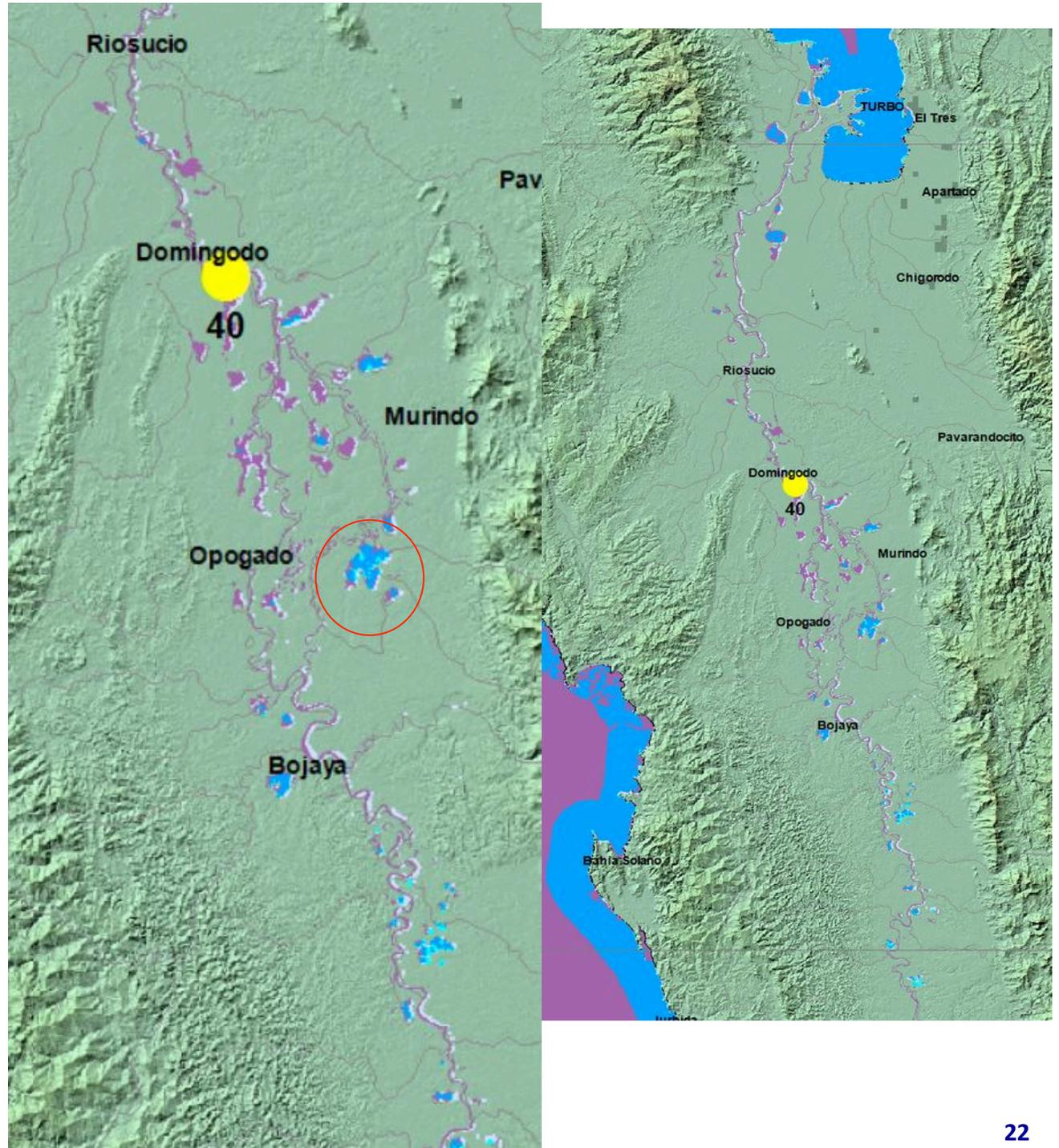
http://floodobs...sterListrev.htm x +

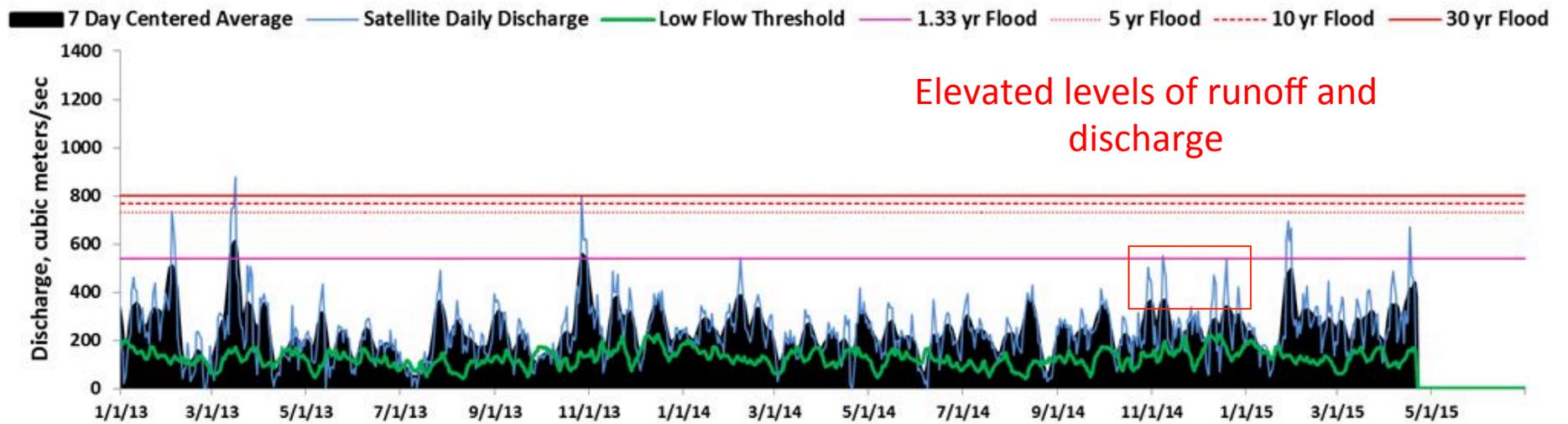
floodobservatory.colorado.edu/Archives/MasterListrev.htm south american countries

4222	0	Indonesia	0	#N/A	#N/A	Gorontalo Province	News	5-Feb-15	9-Feb-15	5	0	300		Heavy Rain	1	18063.44	5.0	122.862	0.686073	News	0	4	1	5
4221	FL-2015-000009-ALB	Greece	Albania	#N/A	#N/A	Northeastern Greece	News	1-Feb-15	9-Feb-15	9	3	500		Heavy Rain	1.5	151104.52	6.3	26.5972	41.4571	News	1	4	1	4
4220	FL-2015-000008-BOL	Bolivia	0	#N/A	#N/A	Departments of La Paz, Santa Cruz, Chuquisaca, Potosi, Oruro and Cochabamba	News	5-Jan-15	9-Feb-15	36	23	1000		Heavy Rain	1.5	137829.71	6.9	-63.7661	-16.4638	News	1	3	1	3
4219	FL-2015-000006-MWI	Malawi	Mozambique	#N/A	#N/A	Southern Malawi and Mozambique	News	1-Jan-15	9-Feb-15	40	276	336000		Heavy Rain	2	485939.39	7.6	35.3564	-18.7946	News	1	2	1	2
4218	0	Australia	0	#N/A	#N/A	Western Australia, Fitzroy, Alice Springs	News	5-Jan-15	11-Jan-15	7	1	0		Heavy Rain	1.5	1519623.5	7.2	127.056	-19.1672	News	1	1	1	1
4217	0	Philippines	0	#N/A	#N/A	Southern Philippines, Samar, other locations	News	10-Dec-14	1-Jan-15	23	53	80186		Tropical Storm Jangmai	1.5	63967.39	6.3	124.903	8.65608	News	1	100	1	20
4216	FL-2014-000168-MYS	Malaysia	Thailand	#N/A	#N/A	Kelantan State; Malaysia-Thailand border; northeastern Malaysia	News	20-Dec-14	1-Jan-15	13	34	215000		Monsoonal Rain	2	90680.38	6.4	102.164	4.72508	News	1	99	1	20
4215	0	Sri Lanka	0	#N/A	#N/A	Northern, northcentral and eastern provinces; Batticaloa district, Anuradhapura district	News	20-Dec-14	1-Jan-15	13	39	1000000		Monsoonal Rain	1.5	50316.81	6.0	80.9834	7.90972	News	0	98	1	2
4214	FL-2014-000163-COL	Colombia	0	#N/A	#N/A	Chocó	News	1-Nov-14	20-Dec-14	50	44	0		Heavy Rain	1.5	406009.51	7.5	-75.544	4.59198	News	1	98	1	19
4213	0	USA	0	#N/A	#N/A	Bay Area, and Sacramento, north coastal California	News	11-Dec-14	14-Dec-14	4	3	0		Torrential Rain	1	70255.56	5.4	-123.101	39.7967	News	0	97	1	19
4212	0	Brazil	0	#N/A	#N/A	Eastern Sao Paulo	News	10-Dec-14	14-Dec-14	5	0	0		Torrential Rain	1	199807.2	6.0	-49.2145	-24.8513	News	0	97	1	19
4211	0	Bulgaria	Greece	#N/A	#N/A	Northern Greece and along the country's northeastern borders with Turkey; Bulgaria	News	4-Dec-14	14-Dec-14	11	40	1000		Heavy Rain	1.5	147816.57	6.4	27.7106	41.4579	News	1	97	1	19
4210	0	Palestine	0	#N/A	#N/A	Gaza	News	26-Nov-14	5-Dec-14	10	0	300		Torrential Rain	1.5	2861.66	4.6	34.4532	31.3378	News	0	96	1	19
4209	0	France	0	#N/A	#N/A	Southern France; Pyrenees-Orientales region	News	29-Nov-14	5-Dec-14	7	5	3000		Torrential Rain	1.5	123269.25	6.1	0.863937	43.999	News	1	96	1	19
4208	0	USA	0	#N/A	#N/A	Southern California	News	1-Dec-14	5-Dec-14	5	0	40		Torrential Rain	1	202666.27	6.0	-117.212	35.4299	News	1	95	1	19
4207	FL-2014-000159-MAR	Morocco	0	#N/A	#N/A	Southern Morocco, Marrakesh	News	24-Nov-14	5-Dec-14	12	40	0		Heavy Rain	2	273693.63	6.8	-5.61886	31.5566	News	1	94	1	19
4206	0	Thailand	0	#N/A	#N/A	Southern Thailand, Trang Province	News	7-Nov-14	16-Nov-14	10	0	1000		Monsoonal Rain	1	31653.08	5.5	99.5163	8.02409	News	0	93	1	19

surface water
record for the
event

Flooding is
represented by
bright blue





These are the flood event time frames

Monthly Runoff (total of daily runoff for each month; mm)	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Comparison		Annual Total	Annual Mean Discharge (m3/sec)	% of 2002-2013	Annual Mean Discharge 2002-2013
													Total (mm)	Station Total (mm)				
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	490974.0	188	0.83	226
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	491118.0	178	0.79	
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	491262.0	126	0.56	
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	5.1	491406.0	190	0.84		
2002	57.0	41.1	57.2	60.2	45.6	50.6	28.6	24.3	31.3	32.7	30.2	31.7	490.4	491550.0	219	0.97		
2003	35.5	35.7	39.3	46.5	21.1	37.8	20.7	27.4	32.6	42.0	79.4	47.1	465.1	491694.0	255	1.13		
2004	53.9	32.8	26.2	19.4	18.0	29.7	19.2	32.0	20.3	30.7	23.6	23.2	329.1	491838.0	306	1.36		
2005	43.4	32.6	29.0	36.0	55.4	49.2	41.9	32.8	23.0	35.8	52.3	63.0	494.2	491982.0	167	0.74		
2006	50.9	26.3	59.0	55.1	64.8	48.9	42.8	34.3	50.5	42.9	39.3	56.9	571.7	492126.0	205	0.91		
2007	48.1	64.1	41.7	38.1	52.1	41.9	32.2	38.5	53.9	81.6	76.5	100.0	668.7	492270.0	319	1.41		
2008	75.2	57.3	81.6	66.6	93.1	88.7	53.4	33.2	35.1	53.0	56.9	101.2	795.2	492414.0	327	1.45		
2009	44.6	42.0	36.8	58.0	25.6	16.7	35.9	33.3	42.1	38.1	35.5	35.5	444.1	492558.0	228	1.01		
2010	30.8	17.4	26.4	24.8	37.9	30.1	35.2	31.7	45.9	29.0	88.8	136.9	534.9	492702.0	231	1.02		
2011	61.6	30.2	71.3	100.6	109.6	31.5	31.2	40.4	40.4	81.6	75.2	166.2	839.7	492846.0	272	1.21		
2012	128.1	137.3	90.6	83.5	101.5	62.3	43.3	25.5	35.3	46.4	61.4	55.8	870.8	492990.0	228	1.01		
2013	64.6	47.5	73.6	41.5	43.4	38.0	33.3	46.8	43.8	58.3	62.3	53.2	606.4	493134.0	231	1.02		
2014	53.4	59.1	40.7	45.7	47.9	38.0	48.2	45.5	53.6	52.0	58.5	59.0	601.7	493278.0	272	1.21		
2015	51.4	58.1	56.6	49.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	215.7	493290.0				

Next:

Hands-on Activity using MODIS Inundation Mapping