



ARSET

Applied Remote Sensing Training

<http://arset.gsfc.nasa.gov>

 @NASAARSET

Advanced Webinar on using NASA Remote Sensing for Flood Monitoring and Management

Instructors:

- Amita Mehta (ARSET)
- Kyle Peterson (ARSET)

Guest Speaker:

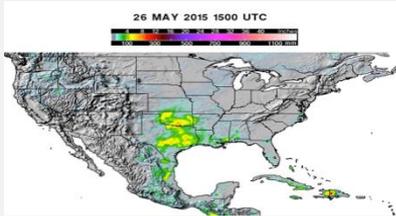
- Sang-Ho Yun (NASA-JPL)

Week-3

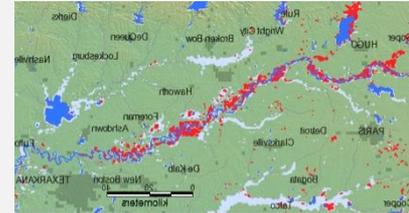


Course Outline

Week 1: Demonstration of Flood Mapping Web Tools Based on NASA Remote Sensing Observations of Rainfall



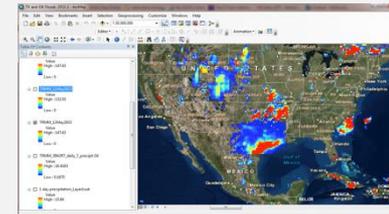
Week 2: Demonstration of Flood Mapping Web Tools Based on NASA Remote Sensing Observations of Land Cover



Week 3: Overview & Access to Ancillary NASA Data for Flood Management



Week 4: Flooding Case Studies Using NASA Web Tools and GIS



Acknowledgements

- **Training Set-up, Coordination, and Website Help**

Tim Sough

Brock Blevins

Elizabeth Hook

- **QGIS Exercise**

Kyle Peterson

Spanish Translation

David Barbato

- **ARSET Manager**

Ana Prados

Course Material

<http://arset.gsfc.nasa.gov/disasters/webinars/advfloodwebinar>

Webinar presentations, exercises, homework assignments, and recordings

Earth Sciences Division Applied Sciences ASP Water Resources

NASA ARSET
Applied Remote Sensing Training

DISASTERS ECO FORECASTING HEALTH & AIR QUALITY WATER RESOURCES

Disasters
Disasters Webinars
Disasters Workshops

Fundamentals of Remote Sensing
On-Demand Training on Fundamentals of Remote Sensing

Upcoming Training
Ecoforecasting
Advanced Webinar: Creating and Using Normalized Difference Vegetation Index (NDVI) from Satellite Imagery
02/10/2016 to 03/02/2016

Advanced Webinar on Using NASA Remote Sensing for Flood Monitoring and Management
03/16/2016 to 04/06/2016
Times: 8:00 a.m. - 9:00 a.m. EDT (UTC-4) and 4:00 - 5:00 p.m. EDT (UTC-4)

2006 2011

This webinar will provide demonstrations and hands-on experience in using NASA remote sensing observations and flood mapping tools useful for flood management. Participants will learn to access rainfall, streamflow, and surface inundation extent data for regional flood cases. In addition, participants will learn to access digital elevation and terrain data, as well as socioeconomic data, to facilitate flood risk assessment and post-flood relief planning using a GIS framework.

Links will be available here

Course Materials

Date	Title	Materials
March 15, 2016	View Week 1, Week 2, and Week 3 of NASA Remote Sensing Observations for Flood Management	Homework - due March 15
March 16, 2016	Demonstration of Flood Mapping Web Tools Based on NASA Remote Sensing Observations of Rainfall	Recording Slides Homework
March 23, 2016	Demonstration of Flood Mapping Web Tools Based on NASA Remote Sensing Observations of Land Cover	Recording Slides Homework
March 30, 2016	Overview and Access to Ancillary NASA Data for Flood Management	Recording Slides Homework
April 6, 2016	Flooding Case Studies Using NASA Web Tools and GIS	Recording Slides Homework

Homework and Certificate

- **Homework**

- Hands-on exercises
- Answers to homework questions via Google form
- Available at <http://arset.gsfc.nasa.gov/disasters/webinars/advfloodwebinar>

- **Certificate of Completion**

- Attend all 4 webinar sessions
- Complete all 4 homework assignments
- Certificates will be emailed approx. 2 months after the course finishes by Marines Martins (marines.martins@ssaihq.com)

Agenda: Week 3

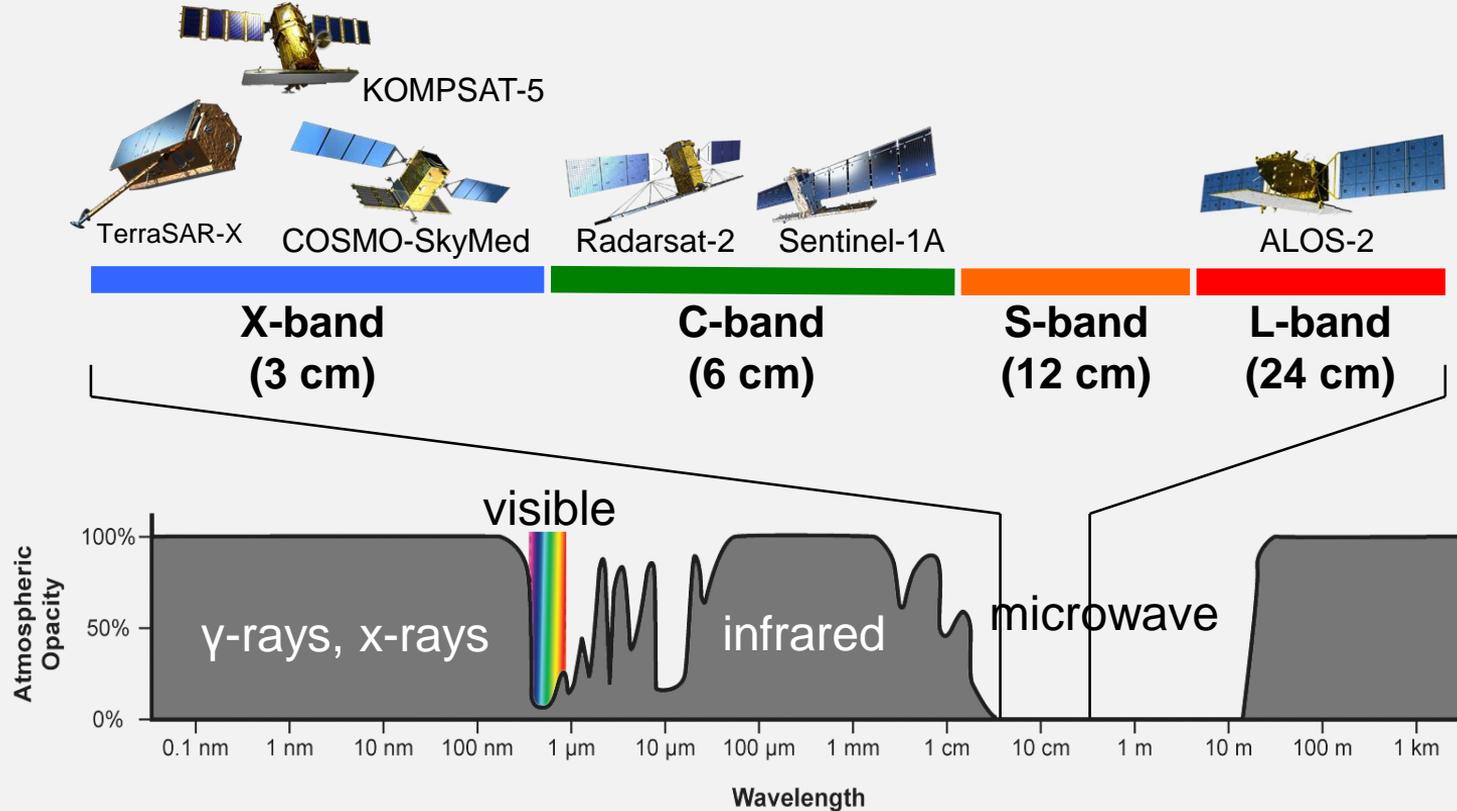
- Synthetic Aperture Radar data and application for flood monitoring
- Overview and Demonstration of Data Access and import into QGIS:
 - Shuttle Radar Topography Mission terrain data access relevant for flood plain identification
 - NASA Socio-economics data access useful for flood preparedness and relief planning

Synthetic Aperture Radar for Rapid Flood Extent Mapping

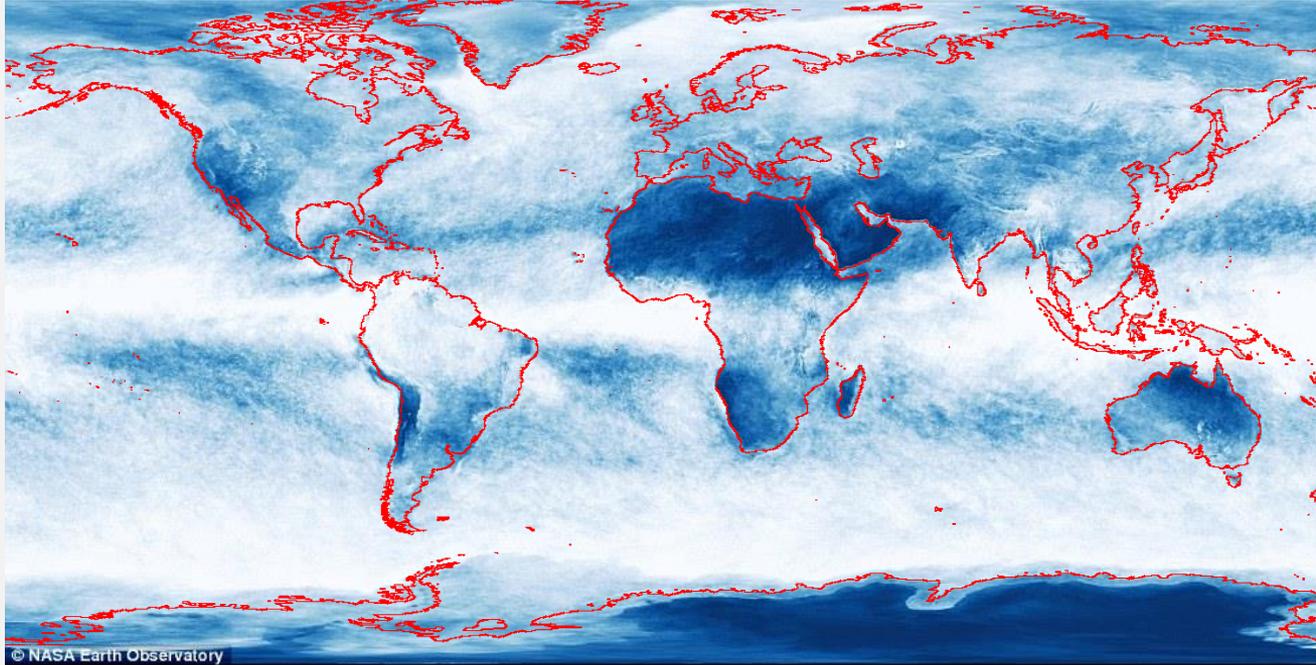
Sang-Ho Yun
ARIA Team
Jet Propulsion Laboratory
California Institute of Technology



Atmospheric Windows & Current SAR Missions

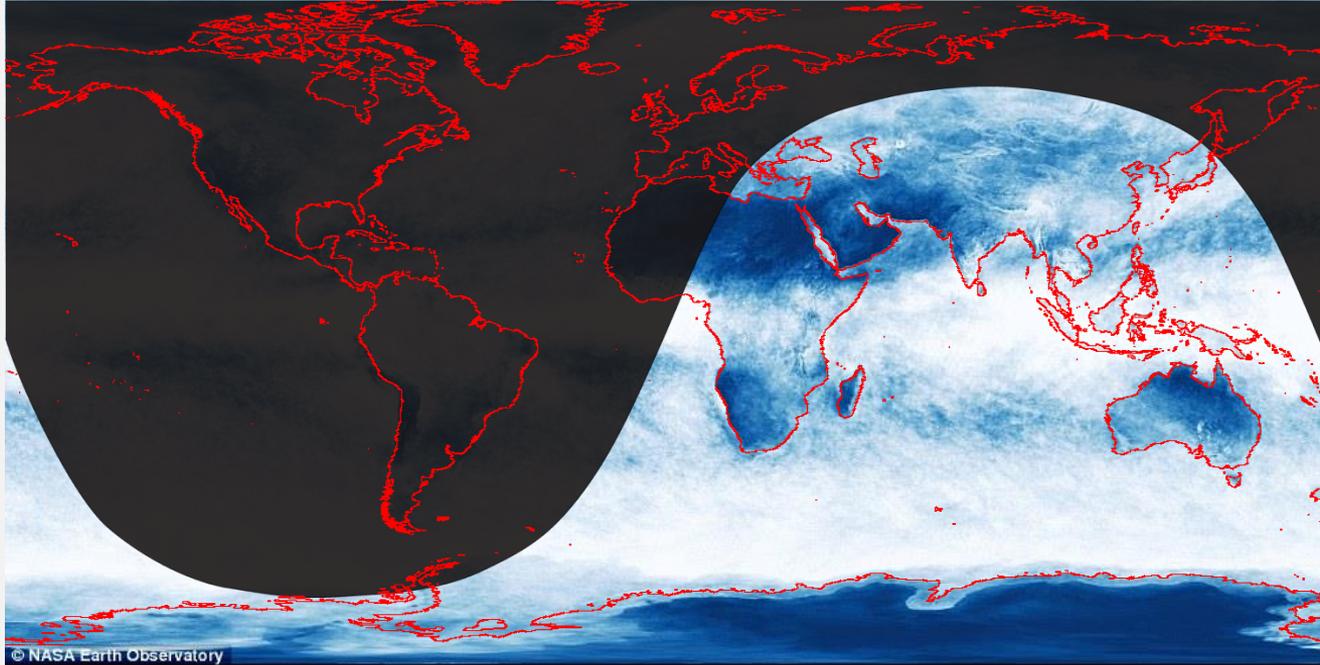


Earth is Mostly Cloudy



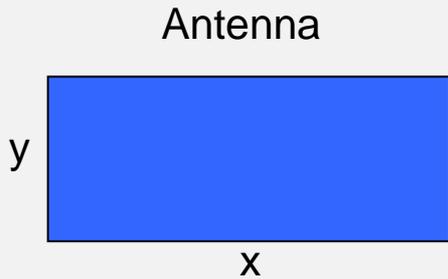
Average cloudiness over Earth in April 2015 seen from Aqua Satellite. At any given time, around 70% of the Earth is covered by clouds.

And Half Dark

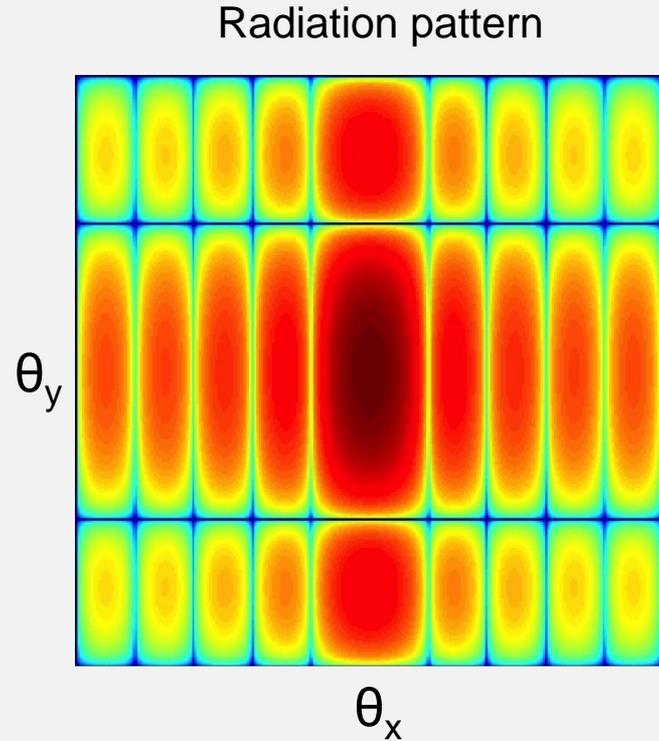


At any given time, 50% of the earth is dark.

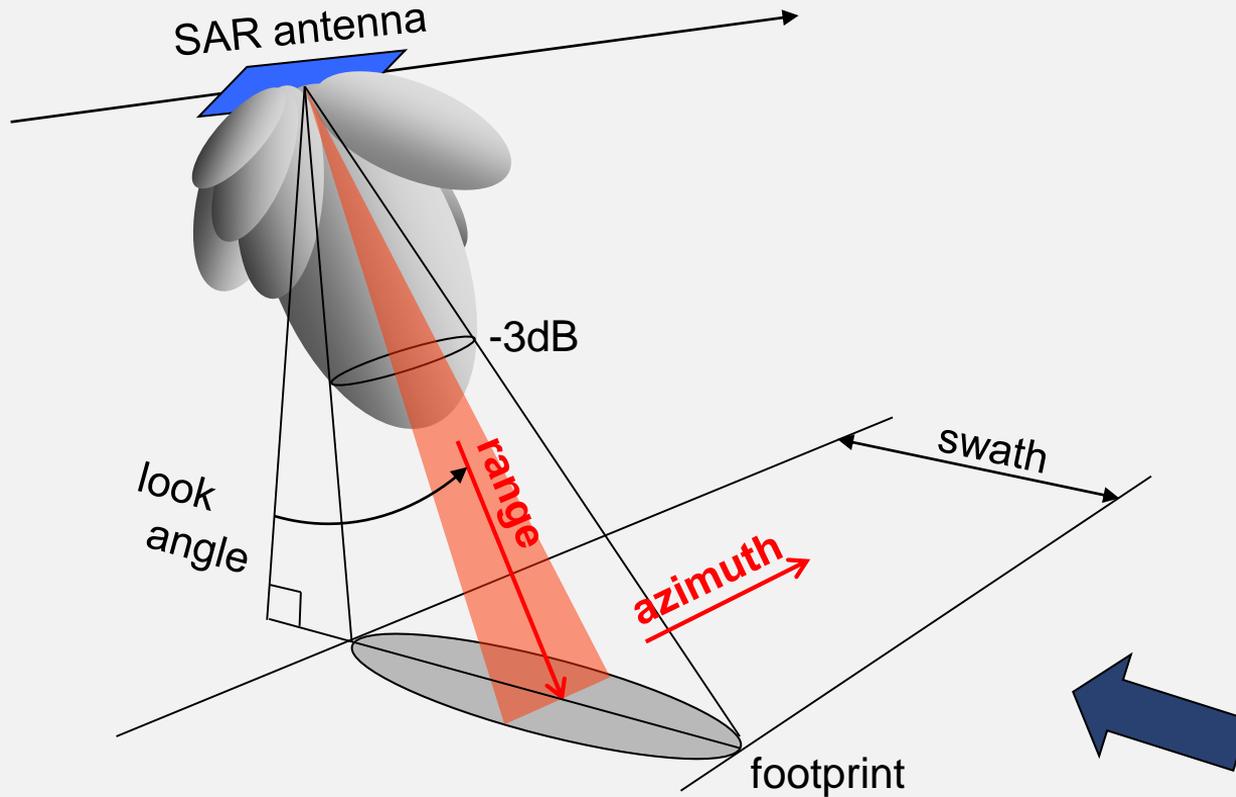
Radiation Pattern



\supset

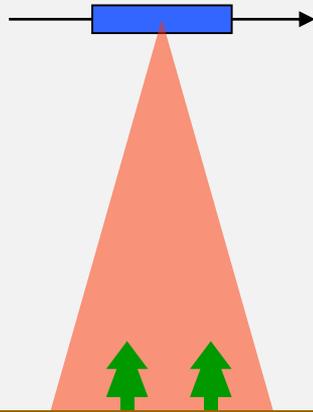


Some Imaging Radar Jargon

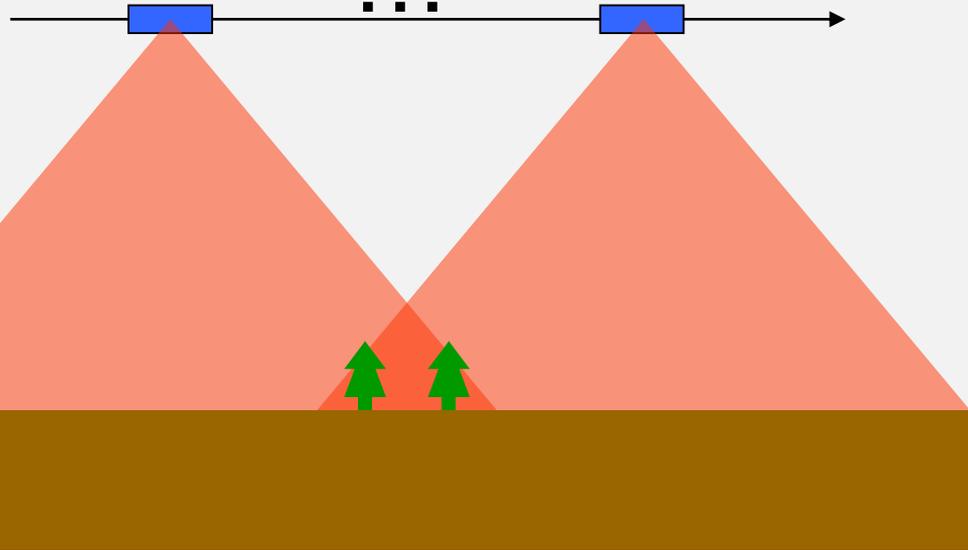


Synthetic Aperture Radar (SAR)

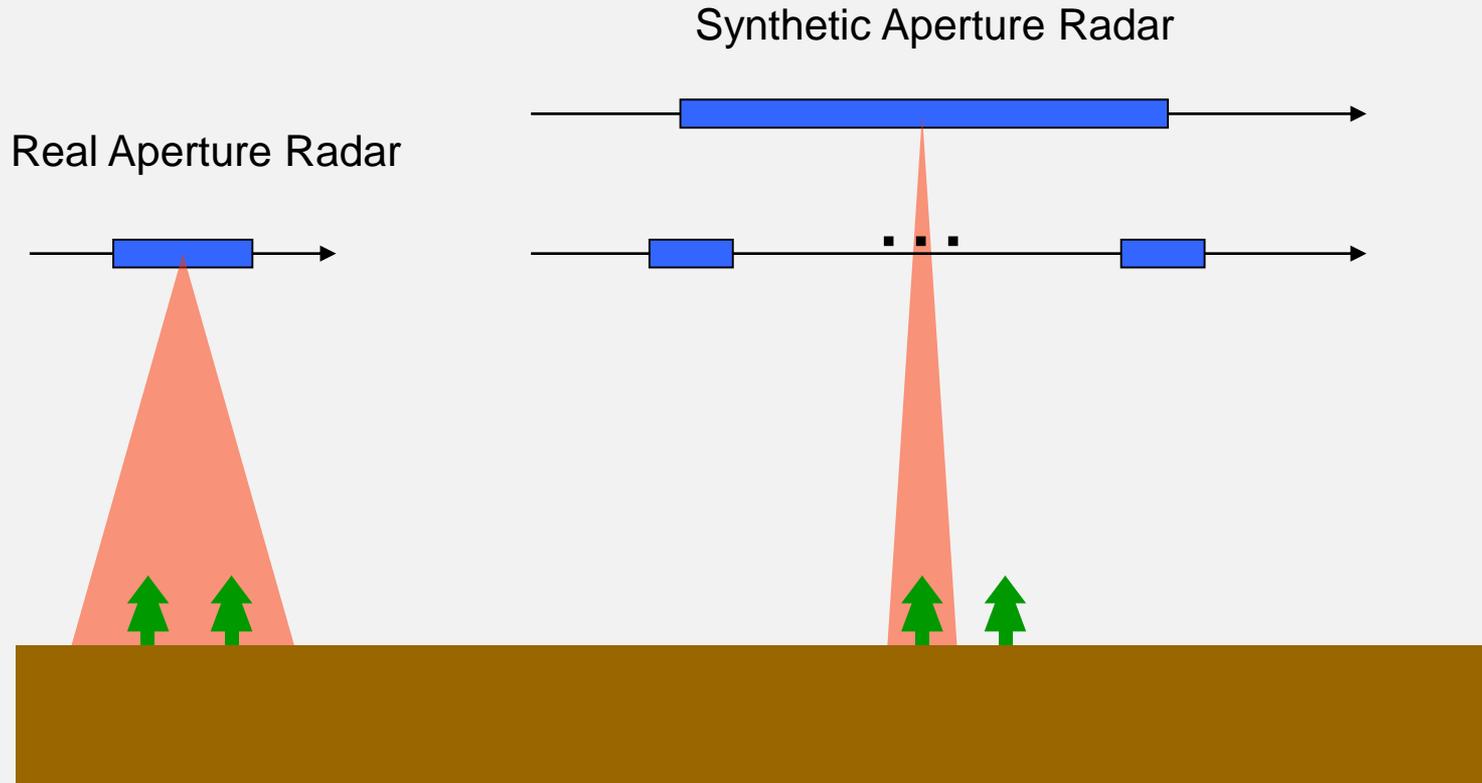
Real Aperture Radar



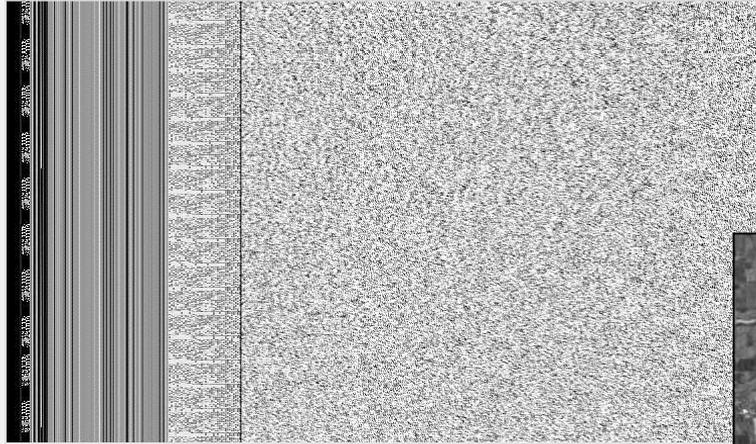
Synthetic Aperture Radar



Synthetic Aperture Radar (SAR)



SAR image (amplitude)



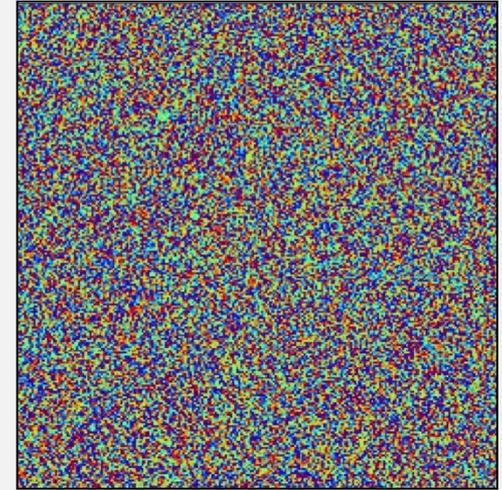
Raw data (complex)



SAR processing

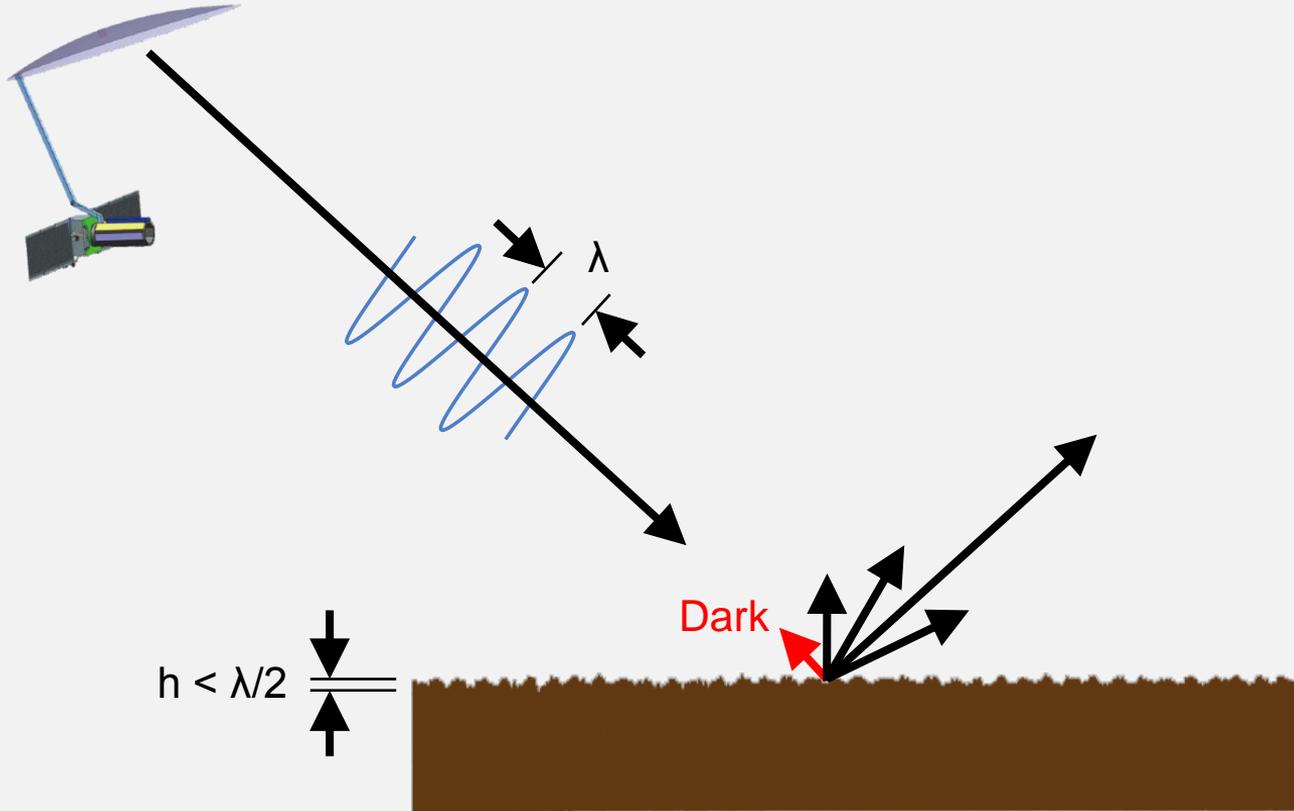


Amplitude

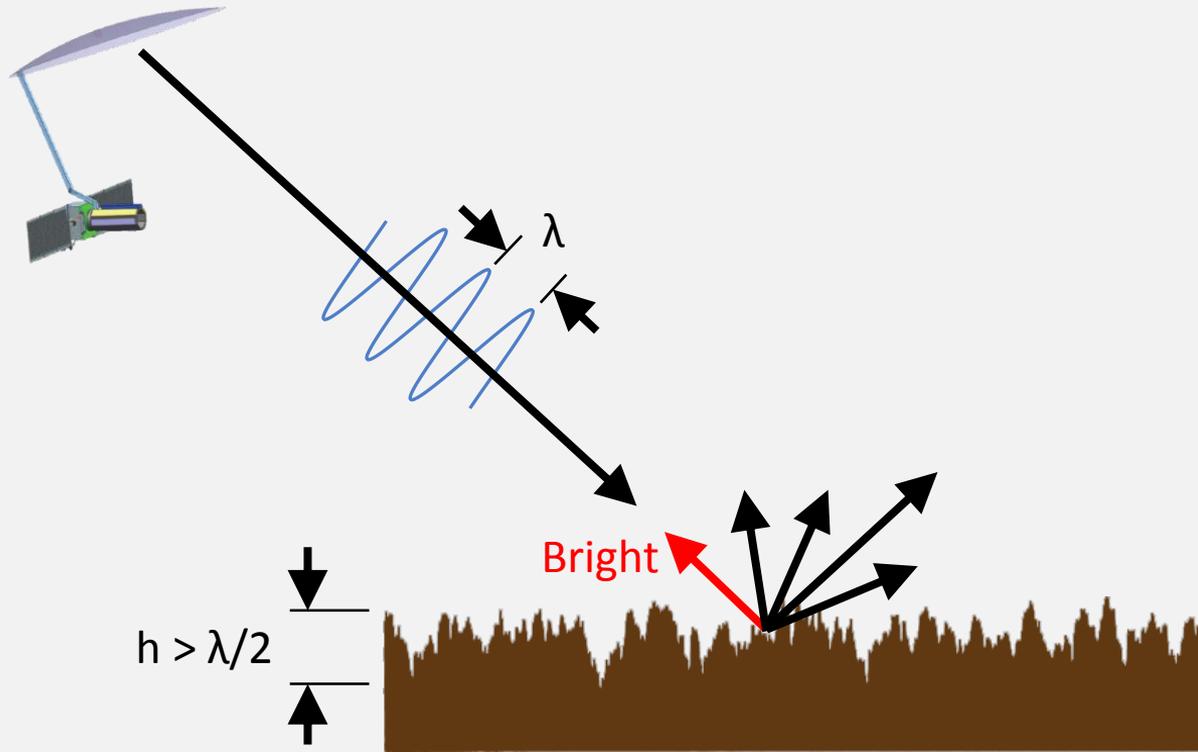


Phase

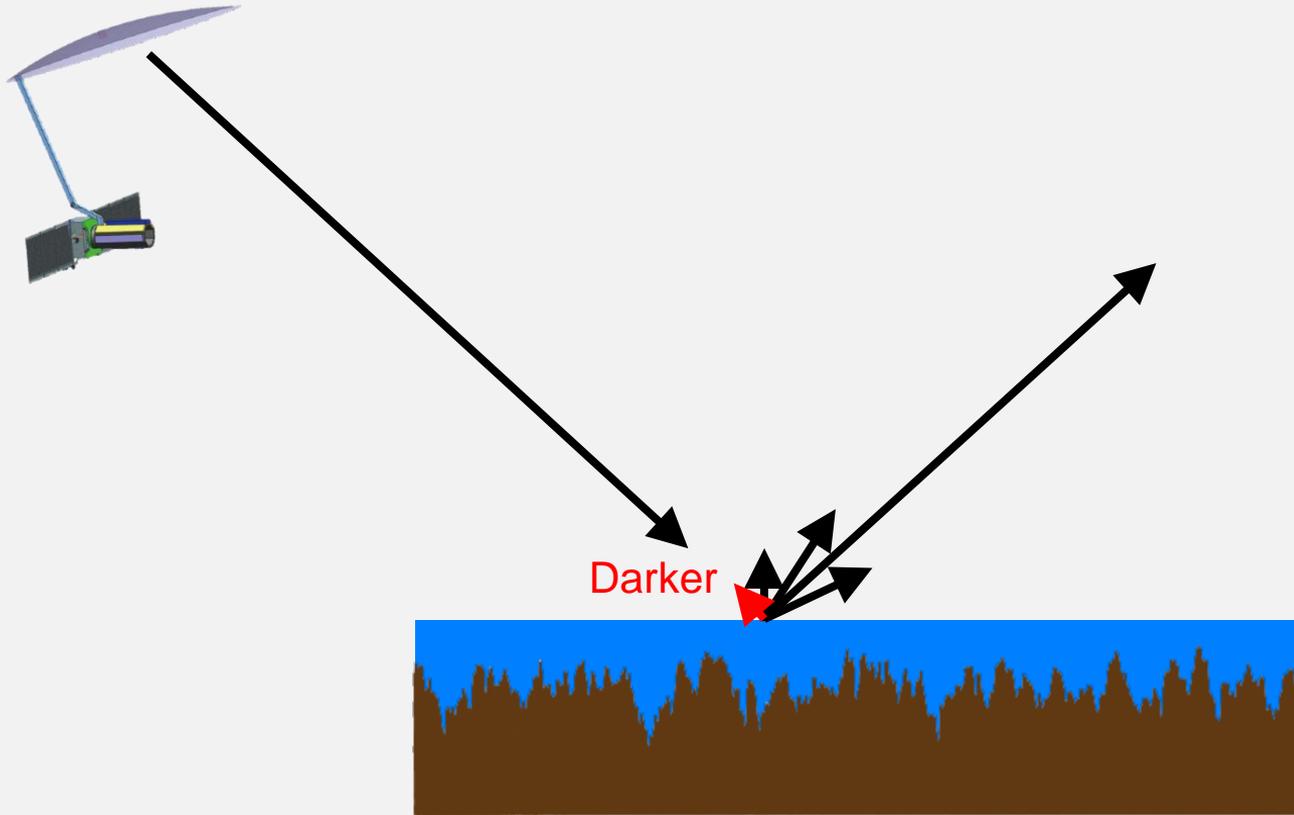
Microwave Scattering (Smooth)



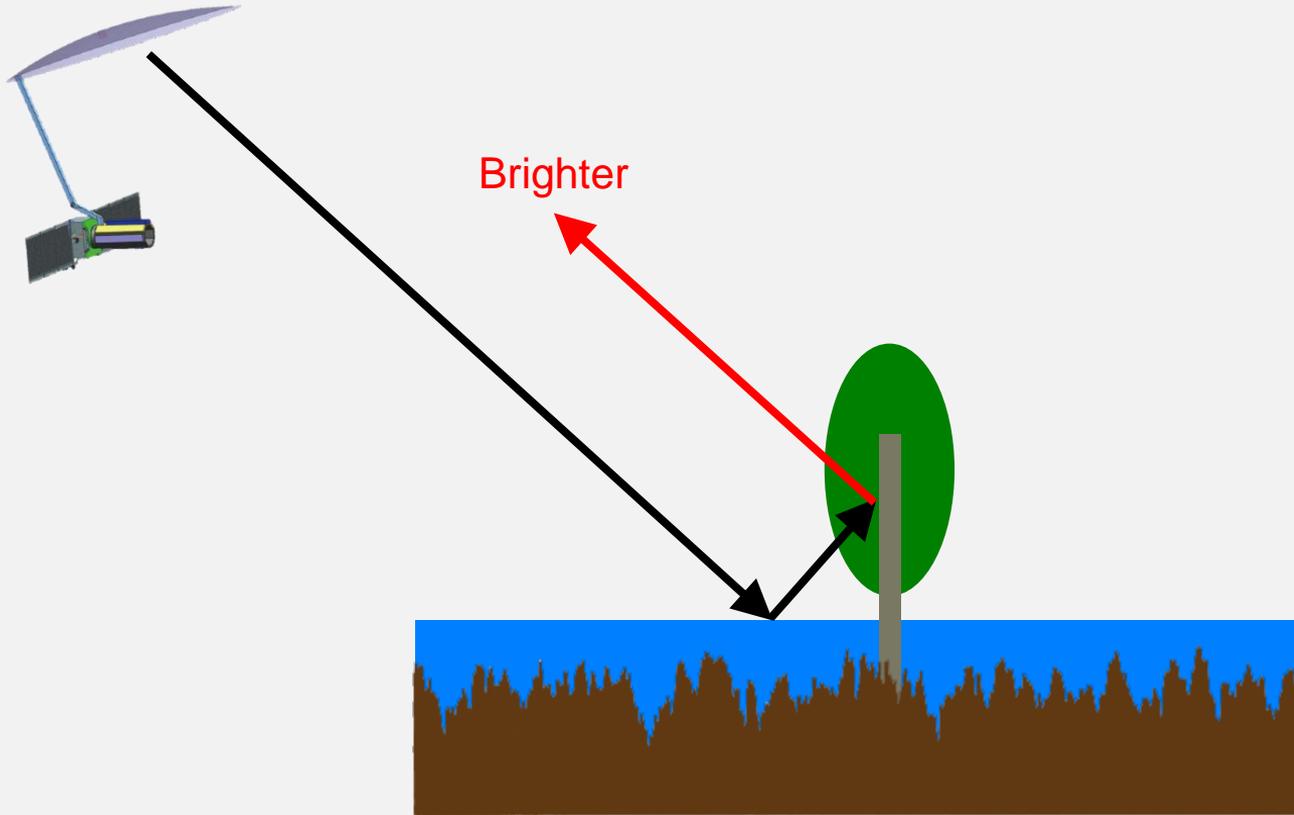
Microwave Scattering (Rough)



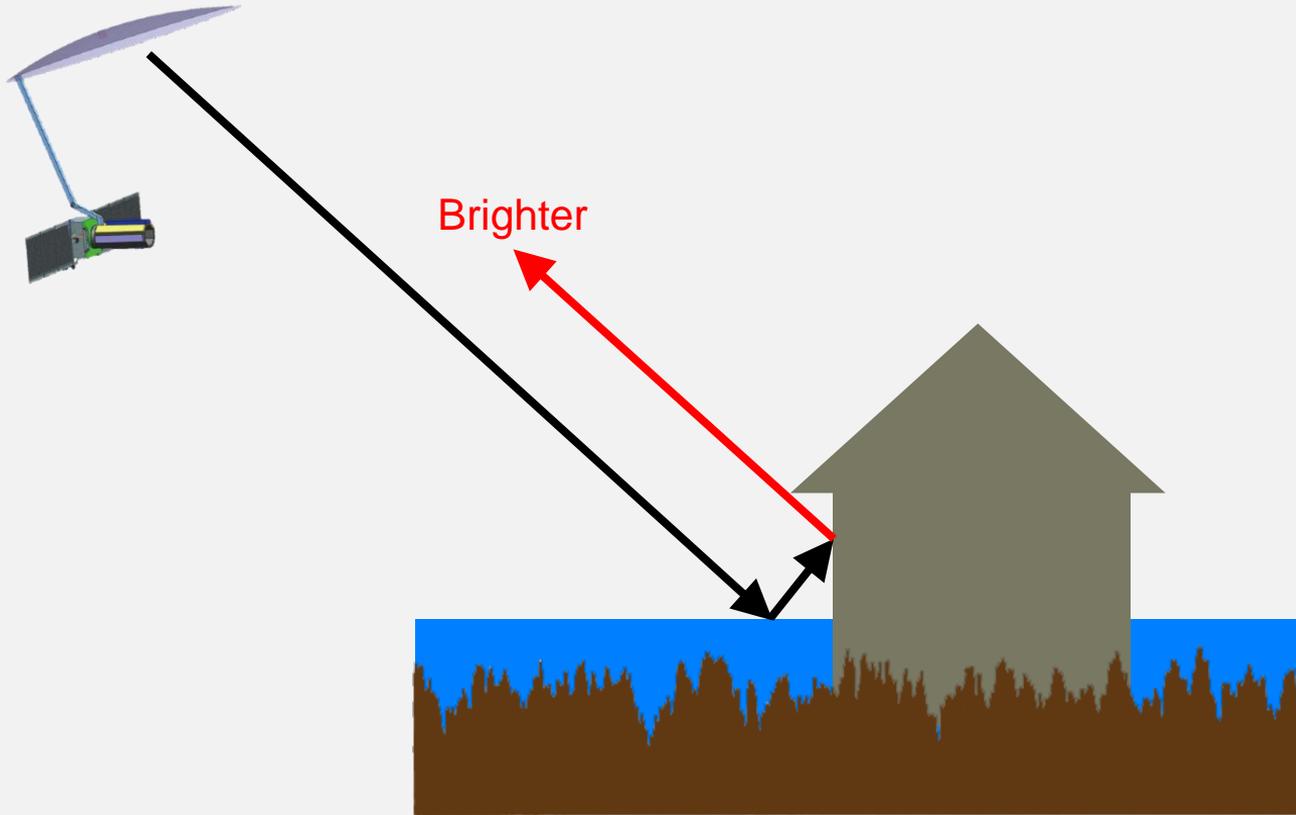
Floods Form Smooth Surface



Floods with Tall Vegetation

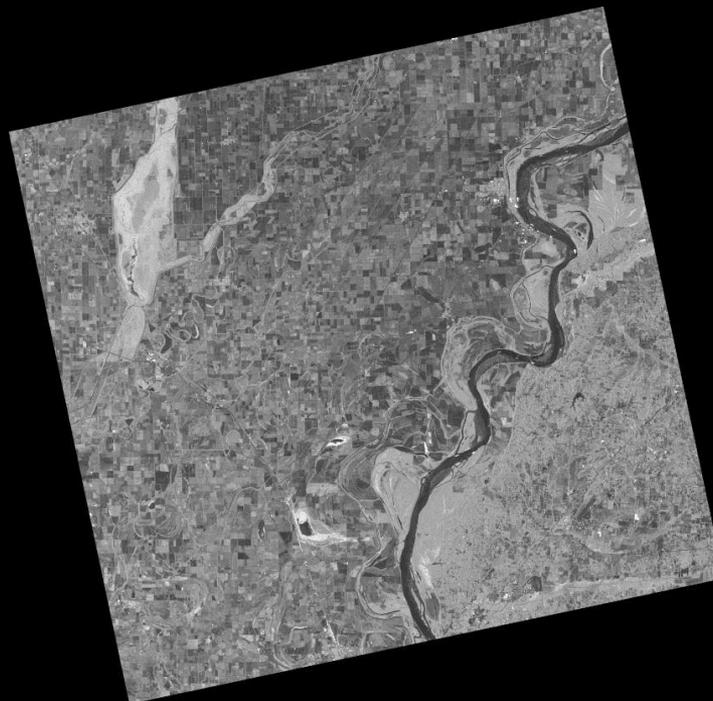


Floods with Artificial Structure



SAR Image (Before)

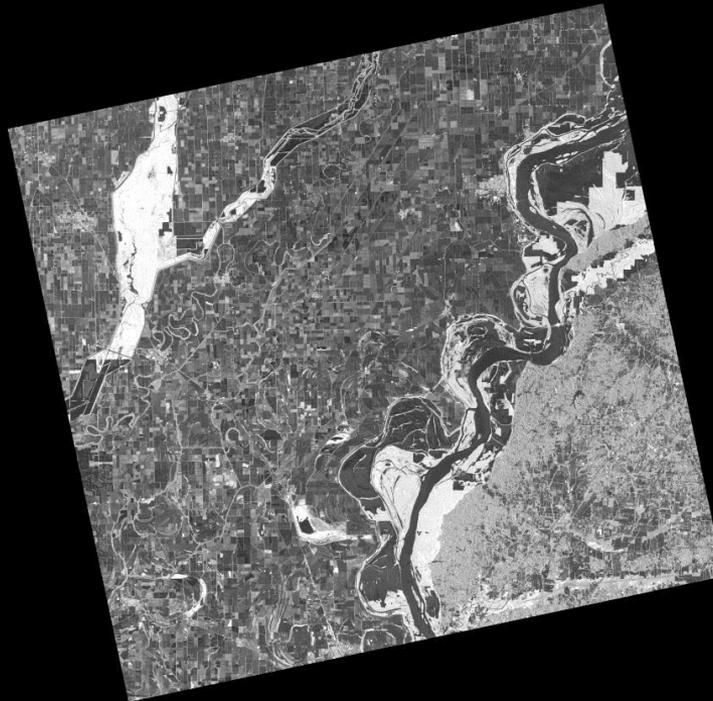
ALOS-2
2015-09-30



©ALOS-2 Operation and Data
Distribution Consortium, Original Data
provided by JAXA

SAR Image (After)

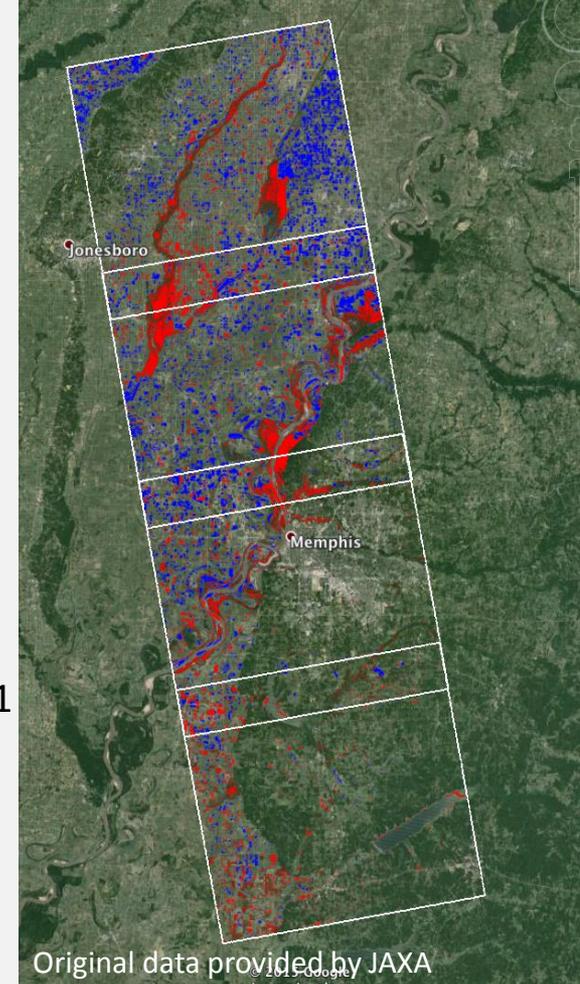
ALOS-2
2016-01-06



©ALOS-2 Operation and Data
Distribution Consortium, Original Data
provided by JAXA

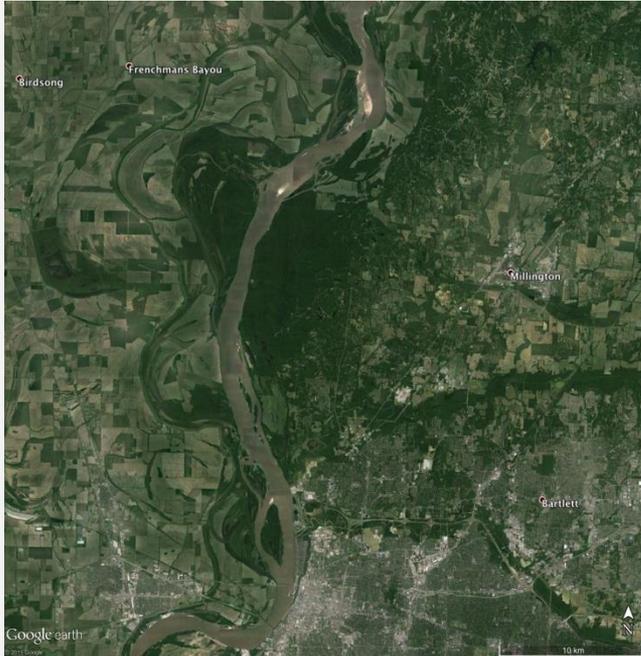
Flood Extent Maps

- Derived from ALOS-2 SAR Data
- 2016-01-06 data compared to 2015-09-30
- Processing Level: 1.5
- Coverage: 70 km x 240 km
- Resolution: ~12 m
- Area of potential floods: Blue + Red
- Blue polygons: Floods with smooth surface
- Red polygons: Floods with tall vegetation
- Product formats
 - KMZ (Polygons)
 - KMZ (PNG image)
 - GeoTiff
 - Shapefile
- Available to download at http://aria-share.jpl.nasa.gov/events/20160111-US_Midwest_Floods/

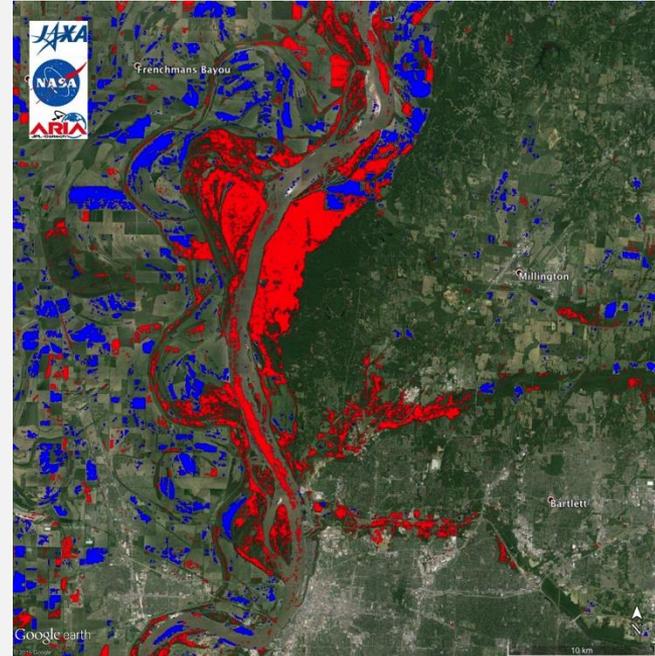


Flood Extent Map

Google Earth

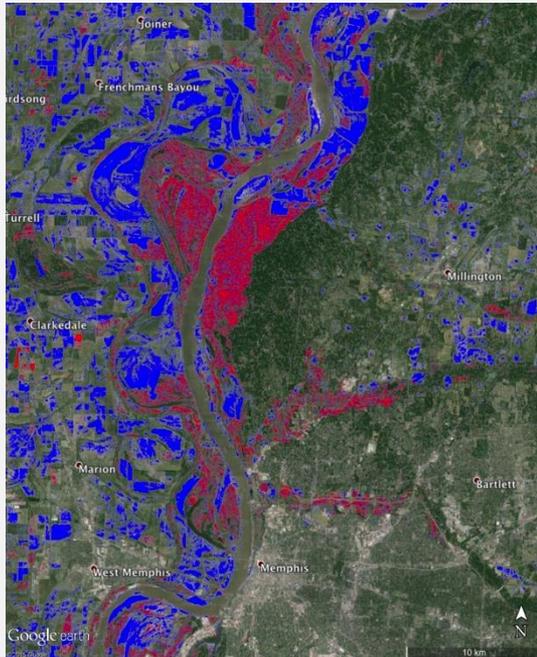


NASA Flood Map

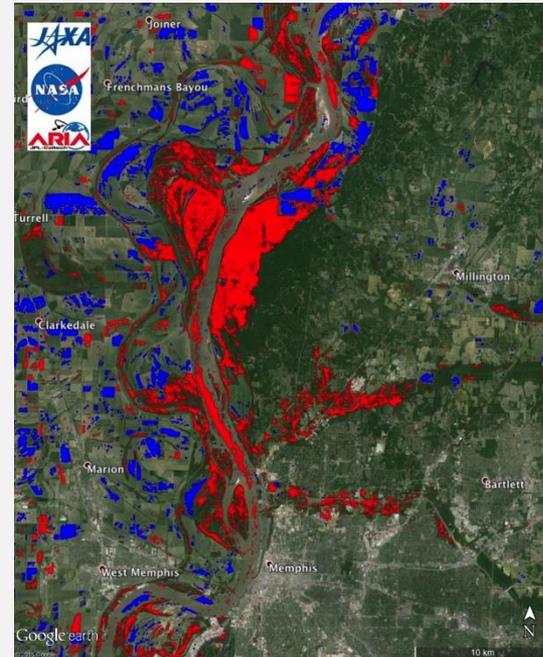


Flood Extent Map

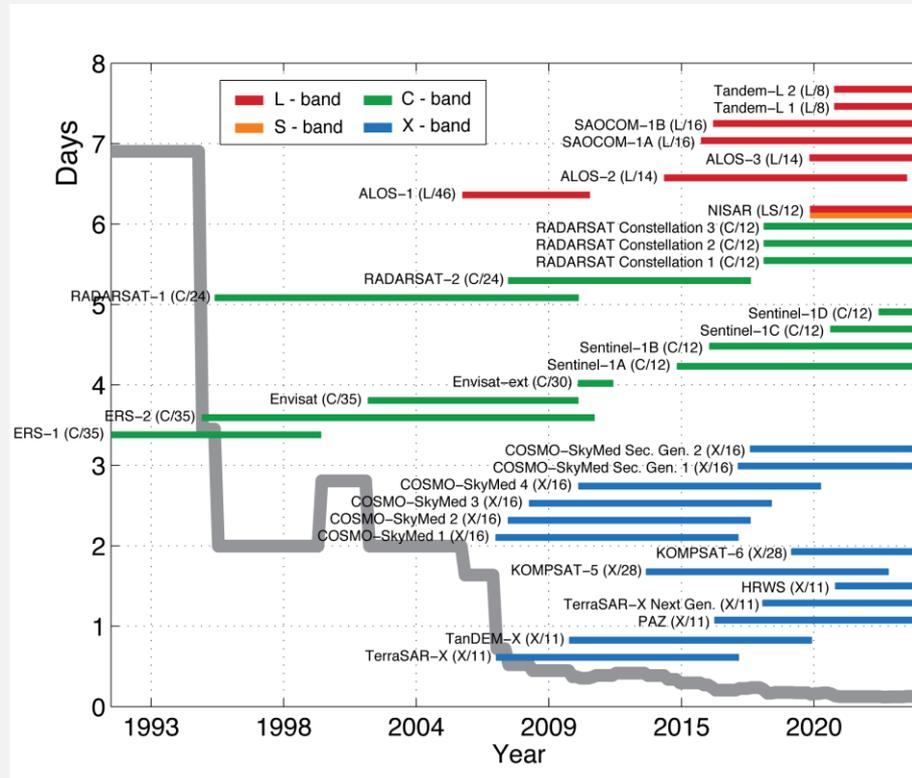
JAXA Flood Map



NASA Flood Map



SAR Data Acquisition Latency



Summary

- Radar sensors see through clouds day and night.
- Synthetic Aperture Radar achieves high resolution (3 – 20 m) over a wide swath (50 – 250 km).
- SAR amplitude is sensitive to floods, with pixel values becoming either darker or brighter.
- Achievable SAR data acquisition latency is already less than a day

Copyright 2016 California Institute of Technology. Government sponsorship acknowledged.

A satellite-style map of the Southeastern United States, showing terrain, rivers, and cities. A semi-transparent white box is overlaid on the map, containing the title and credits. The map shows the Gulf of Mexico coastline, major rivers like the Mississippi and Alabama, and cities such as Houston, New Orleans, and Atlanta. The overlay box is centered over the Southeastern region.

Shuttle Radar Topography Mission (SRTM)

Courtesy: Cynthia Schmidt (NASA-ARSET)
Lindsey Harriman (USGS), Kelly Lemig (USGS)

What is SRTM?

- A Radar mission, carried by NASA Space Shuttle Endeavour, Was completed in February 2000
- Consisted of 176 orbits around Earth in 11 days
- Acquired Digital Elevation Model (DEM) of all land between 60°N and 56°S latitude, about 80% of Earth's total land mass



Useful for Mapping

Hazardous terrain

Calculating

Slope and aspect

Catchment area

Forest canopy height

Modeling

Runoff

Stream networks

Landslides

SRTM v3 Data Product

Tile size	1° by 1°	<div style="border: 1px solid black; background-color: #e6f2ff; padding: 5px;"> New version released in 2014 has high resolution </div>
Pixel size	1 arc second (~30 meters) or 3 arc seconds (~90 meters)	
Geographic coordinates	Geographic latitude and longitude	
Output format	DEMS: .HGT, 16-bit signed integer, in units of vertical meters Number: .NUM	
Geoid reference	WGS84/EGM96	
Special DN values	N/A - No voids in v3	
Coverage	60°N to 56°S latitude U.S. and Territories Africa	

How to Access SRTM v3 Terrain data

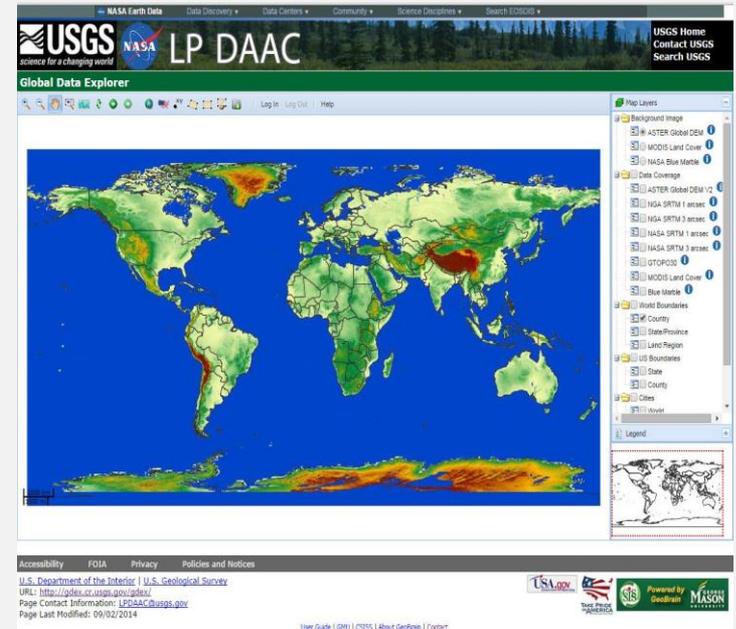
- Reverb:
<http://reverb.echo.nasa.gov/reverb>
- GDEx:
<http://gdex.cr.usgs.gov/gdex/>
- CGIAR-CSI
<http://srtm.csi.cgiar.org>
- Data Pool and DAAC2Disk: https://lpdaac.usgs.gov/data_access/data_pool
- More information: SRTM v3 User Guide
https://lpdaac.usgs.gov/sites/default/files/public/measures/docs/NASA_SRTM_V3.pdf

Interactive Data Access Tools

GDEx

<http://gdex.cr.usgs.gov/gdex/>

- A seamless data viewer providing access to multiple sources of digital elevation data sets
- Users can subset and download data by area of interest in multiple formats and projections
- NASA ECHO/Reverb user account required to download data
- Product documentation and User Guide
- Square or polygonal area of interest
- Pre-defined areas of interest (state, county)
 - Advanced, on-the-fly processing
 - Mosaic tiles coverage clipped to area of interest
 - Reformat to GeoTIFF, ArcASCII, or JPEGuniversal transverse Mercator (UTM) or LAT/LON projection

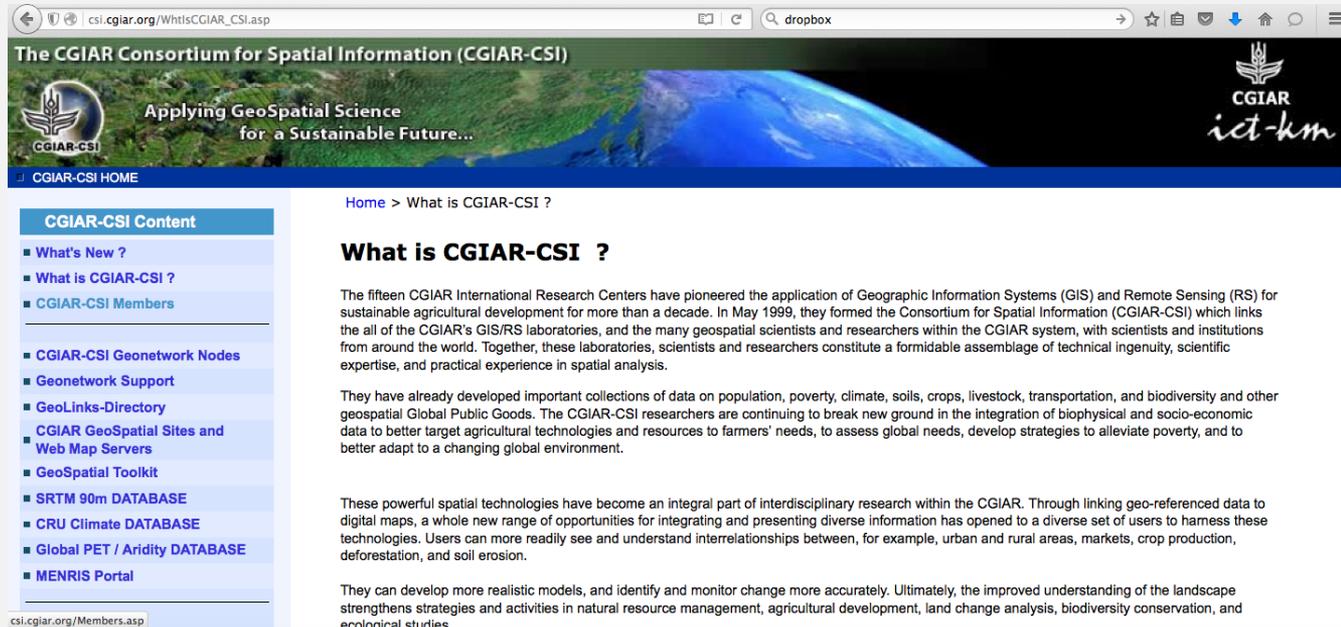


Data can be previewed before download

CGIAR-CSI

http://csi.cgiar.org/WhltsCGIAR_CSI.asp

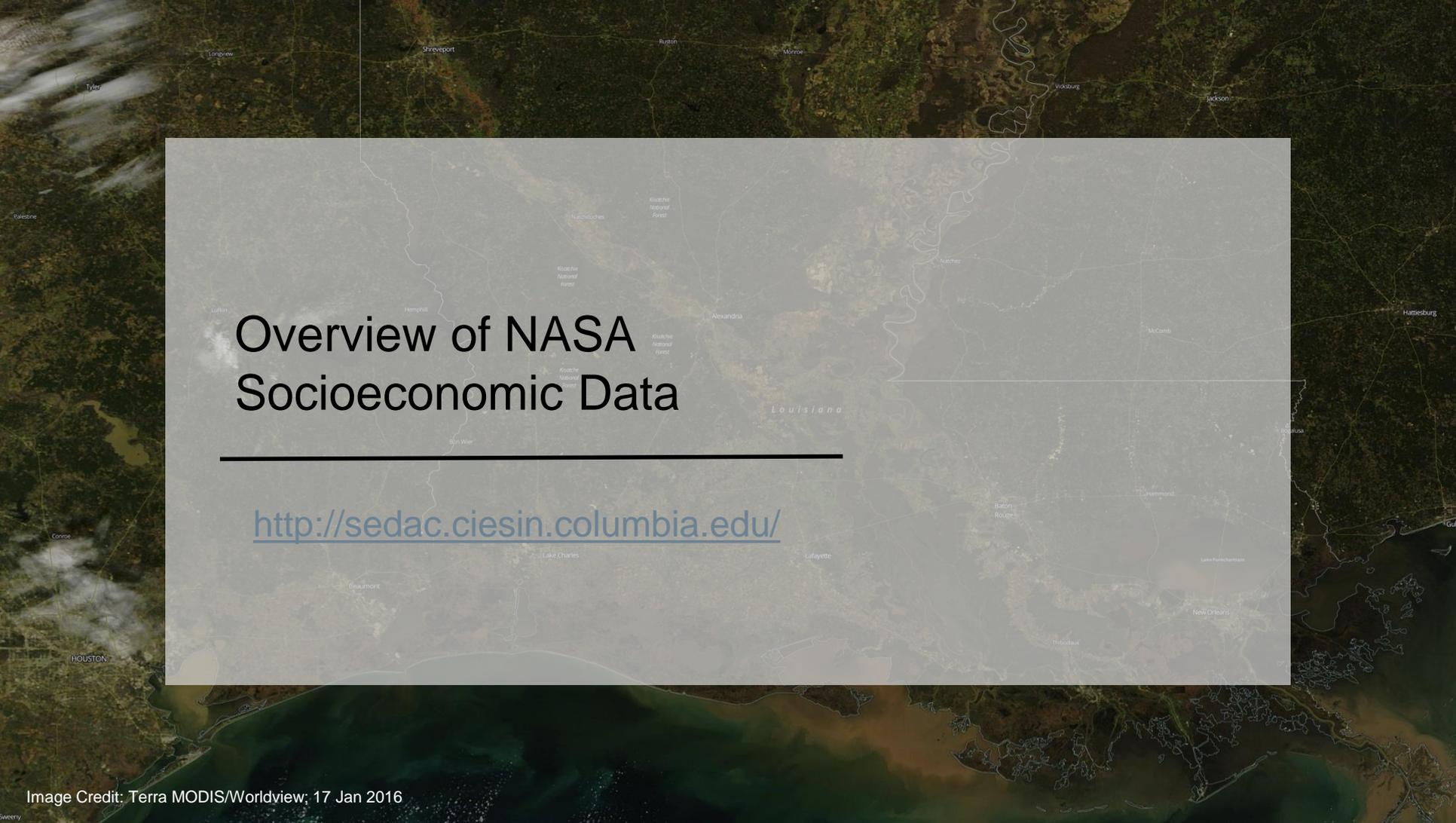
Consultative Group for International Agricultural Research/Consortium of Spatial Information



The screenshot shows a web browser window displaying the CGIAR-CSI website. The browser's address bar shows the URL csi.cgiar.org/WhltsCGIAR_CSI.asp. The website header features a banner with the text "The CGIAR Consortium for Spatial Information (CGIAR-CSI)" and "Applying GeoSpatial Science for a Sustainable Future...". The CGIAR logo and "ict-km" are also visible. A navigation menu on the left lists various content categories, including "What's New?", "What is CGIAR-CSI?", "CGIAR-CSI Members", "CGIAR-CSI Geonetwork Nodes", "Geonetwork Support", "GeoLinks-Directory", "CGIAR GeoSpatial Sites and Web Map Servers", "GeoSpatial Toolkit", "SRTM 90m DATABASE", "CRU Climate DATABASE", "Global PET / Aridity DATABASE", and "MENRIS Portal". The main content area displays the page title "Home > What is CGIAR-CSI ?" and the heading "What is CGIAR-CSI ?". The text below explains that the fifteen CGIAR International Research Centers have pioneered the application of Geographic Information Systems (GIS) and Remote Sensing (RS) for sustainable agricultural development. It mentions that in May 1999, they formed the Consortium for Spatial Information (CGIAR-CSI), which links all the CGIAR's GIS/RS laboratories and many geospatial scientists and researchers within the CGIAR system. The text further states that they have already developed important collections of data on population, poverty, climate, soils, crops, livestock, transportation, and biodiversity, and that they are continuing to break new ground in the integration of biophysical and socio-economic data to better target agricultural technologies and resources to farmers' needs. The text concludes by stating that these powerful spatial technologies have become an integral part of interdisciplinary research within the CGIAR, and that they can develop more realistic models and identify and monitor change more accurately.

SRTM Data



A satellite-style map of Louisiana is shown in the background. A semi-transparent white rectangular box is overlaid on the map, containing the title and a URL. The map shows various geographical features like rivers, lakes, and land cover. Labels for various locations are visible on the map, including Tyler, Greveport, Ruston, Monroe, Wicksburg, Jackson, Natchez, Alexandria, McComb, Hammond, Lake Charles, Lafayette, Thibodaux, New Orleans, Lake Fouchon, Baton Rouge, and Lake de Cade.

Overview of NASA Socioeconomic Data

<http://sedac.ciesin.columbia.edu/>

Socioeconomic Data and Applications Center (SEDAC)

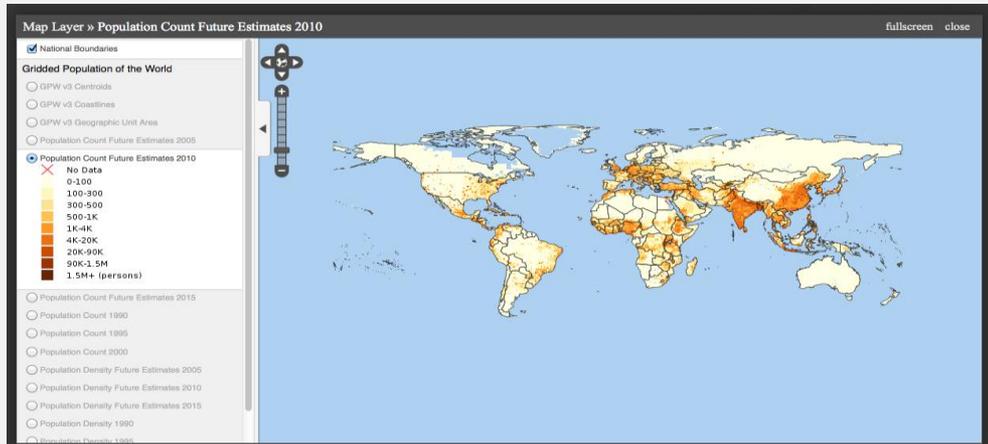
<http://sedac.ciesin.columbia.edu/>

The screenshot shows the SEDAC website interface. At the top, there is a NASA logo and the text 'SOCIOECONOMIC DATA AND APPLICATIONS CENTER (SEDAC)'. Below this is a navigation bar with links for DATA, MAPS, THEMES, RESOURCES, SOCIAL MEDIA, ABOUT, and HELP. A search bar and a 'Logon' button are also present. The main content area is titled 'Data Sets (196)' and features a search filter on the left and a grid of data set cards on the right. A red circle highlights the search and theme filter section on the left, and a red arrow points to the 'Logon' button in the top navigation bar.

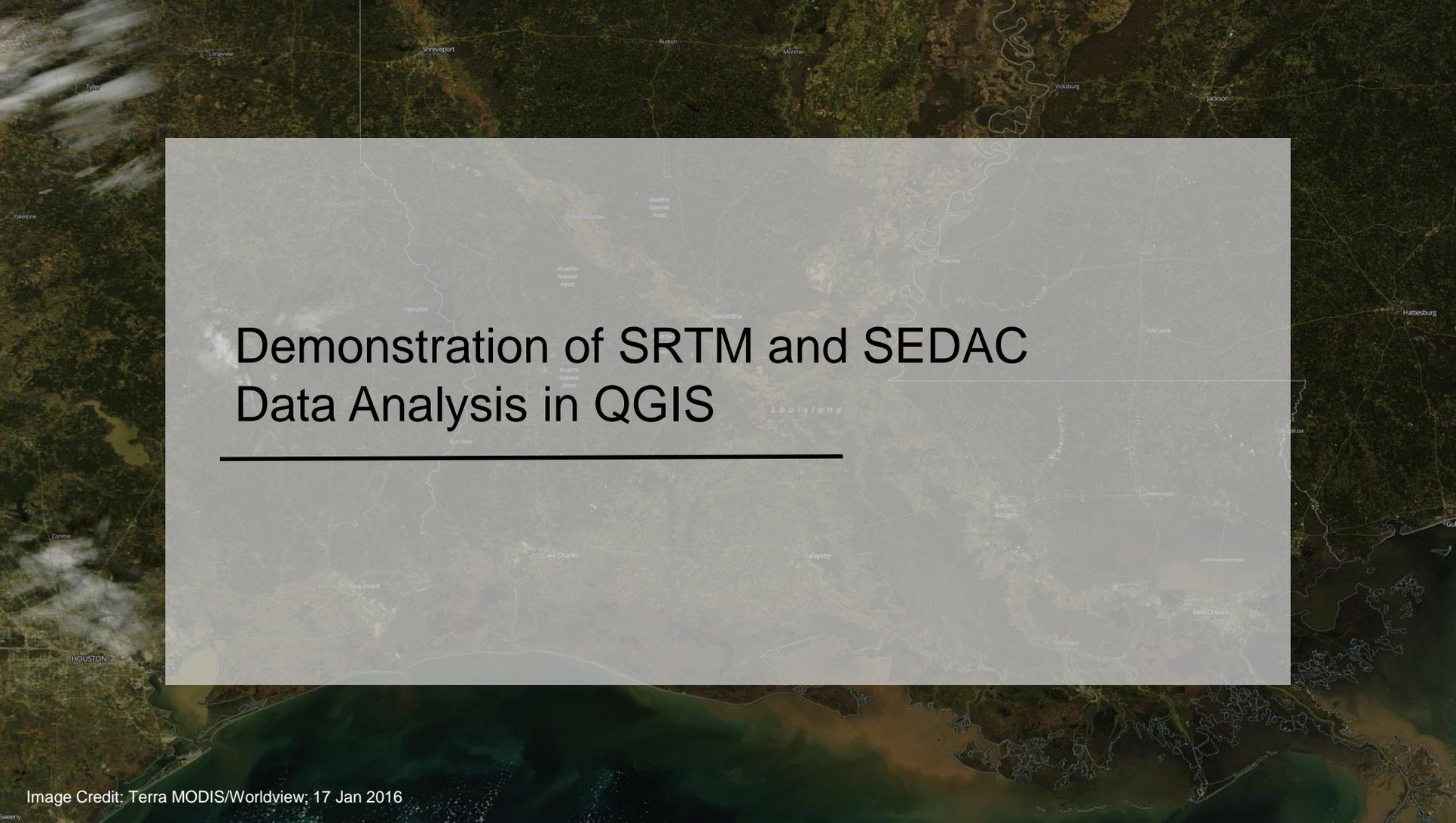
- User registration required
- There are 196 data sets from 16 thematic areas
- Information and documents about the data sets available on-line
- Multiple options for data formats and download
- Interactive mapping and visualization possible

Socioeconomic Data and Applications Center (SEDAC)

<http://sedac.ciesin.columbia.edu/>



- A number of socioeconomic data available that be used along with the flood monitoring tools to facilitate the post-flooding rescue and recovery phases such as:
- Global Urban Areas and Population Density
- Global Roads and Dams
- Nuclear Power Plant Locations and Population Exposure Estimates in the Proximity

A satellite-style map of Louisiana is shown in the background. A semi-transparent white rectangular box is overlaid on the map, containing the title text. The map shows various geographical features, including the Mississippi River and several National Forests. Labels for various locations are visible on the map, such as Greenvale, Ruston, Monroe, Natchez, Alexandria, Lake Charles, and New Orleans. The word "Louisiana" is also written in a small font within the white box.

Demonstration of SRTM and SEDAC Data Analysis in QGIS

Coming Up Next Week

Flooding Case Studies

- Flood Monitoring and Mapping Using GFMS, ERDS, MODIS NRT, DFO
- Using SRTM and SEDAC data for Flood Management and Relief Planning
 - Mississippi Flooding January 2016
 - India Flooding November 2015
- Course Summary

Thank You

The recording of today's session will be available shortly at
<http://arset.gsfc.nasa.gov/disasters/webinars/advfloodwebinar>