



## ARSET

Applied Remote Sensing Training

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

 @NASAARSET

---

# Synthetic Aperture Radar for Rapid Flood Extent Mapping

---

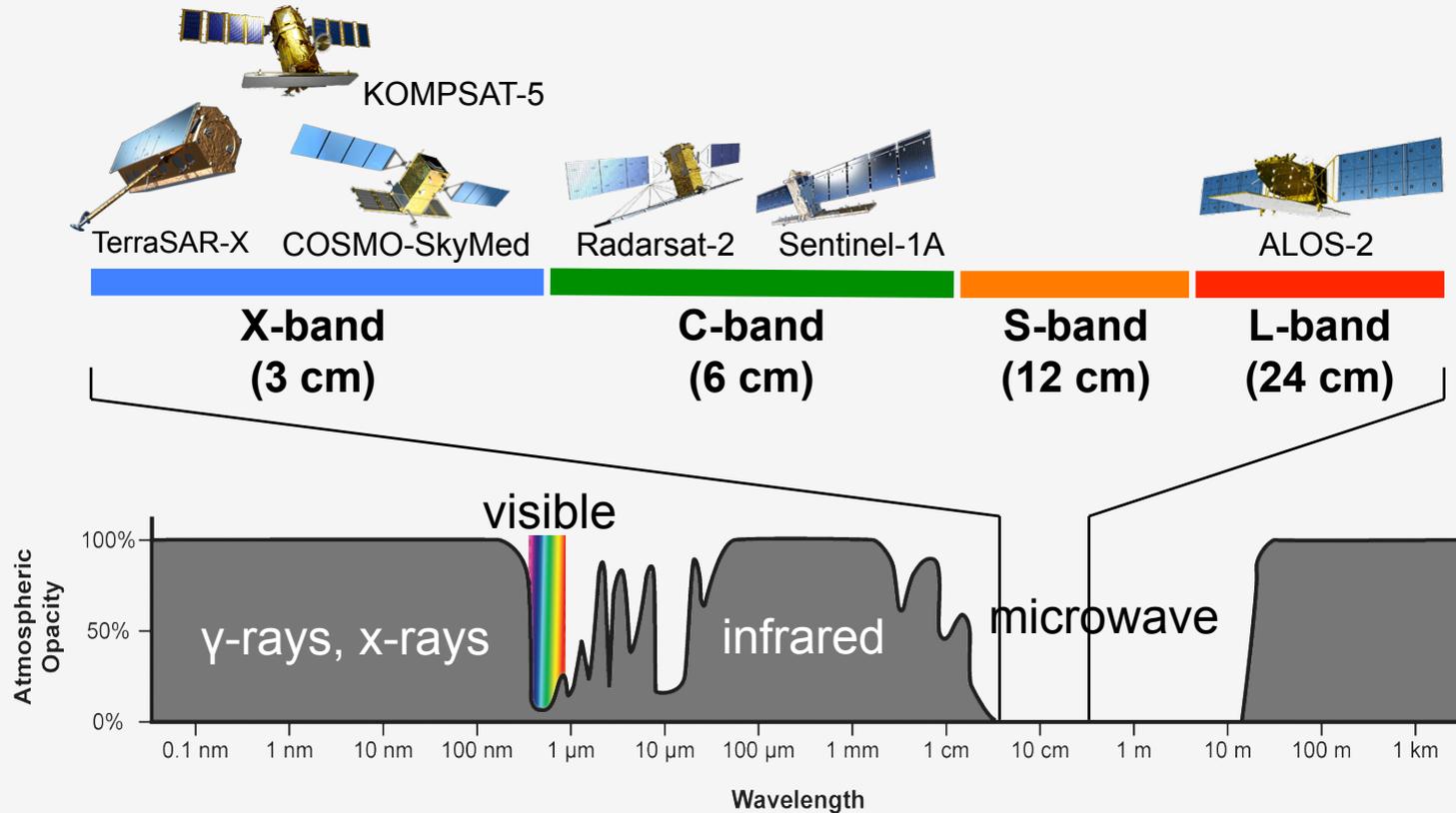
Sang-Ho Yun

ARIA Team

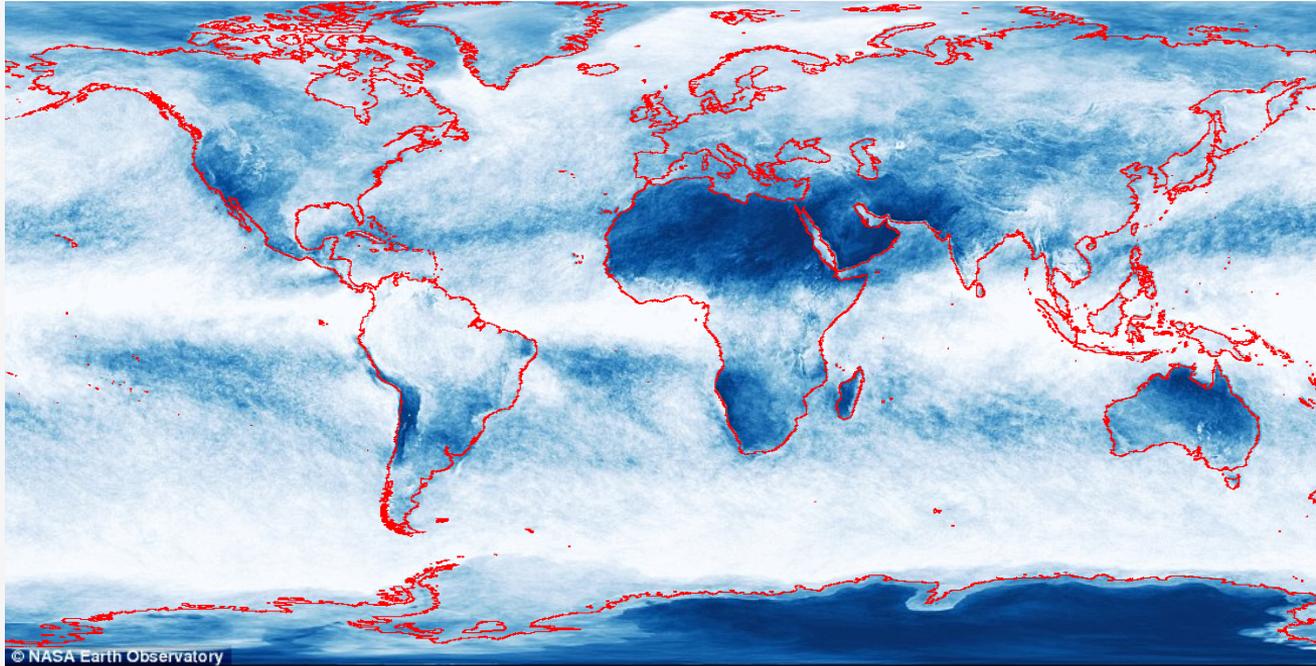
Jet Propulsion Laboratory

California Institute of Technology

# Atmospheric Windows & Current SAR Missions

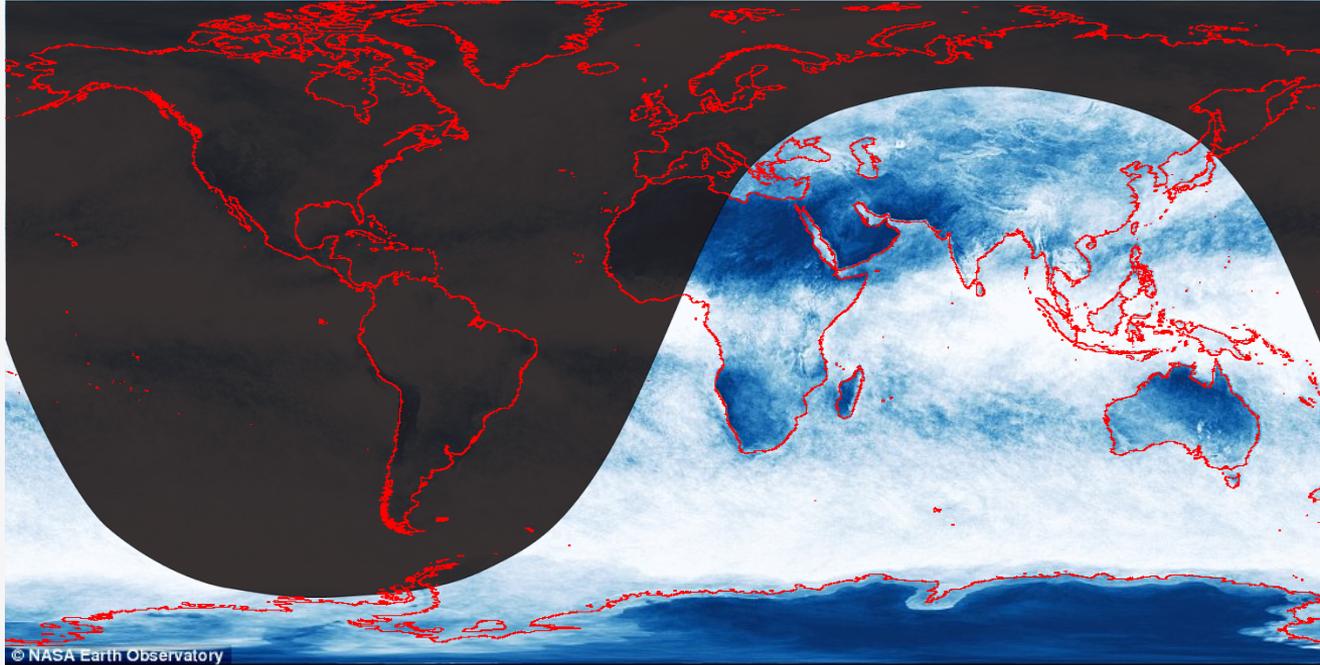


# Earth is Mostly Cloudy



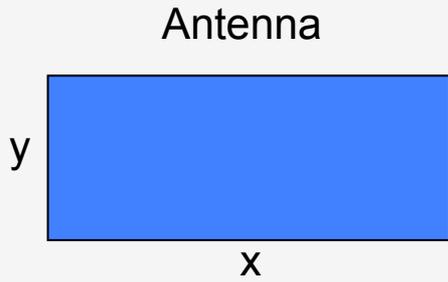
Average cloudiness over Earth in April 2015 seen from Aqua Satellite. At any given time, around 70% of the Earth is covered by clouds.

# And Half Dark

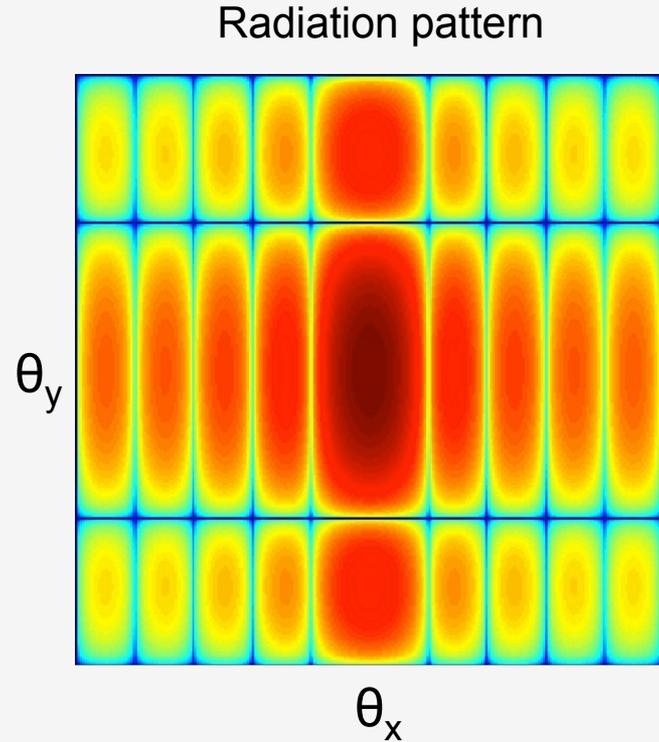


At any given time, 50% of the earth is dark.

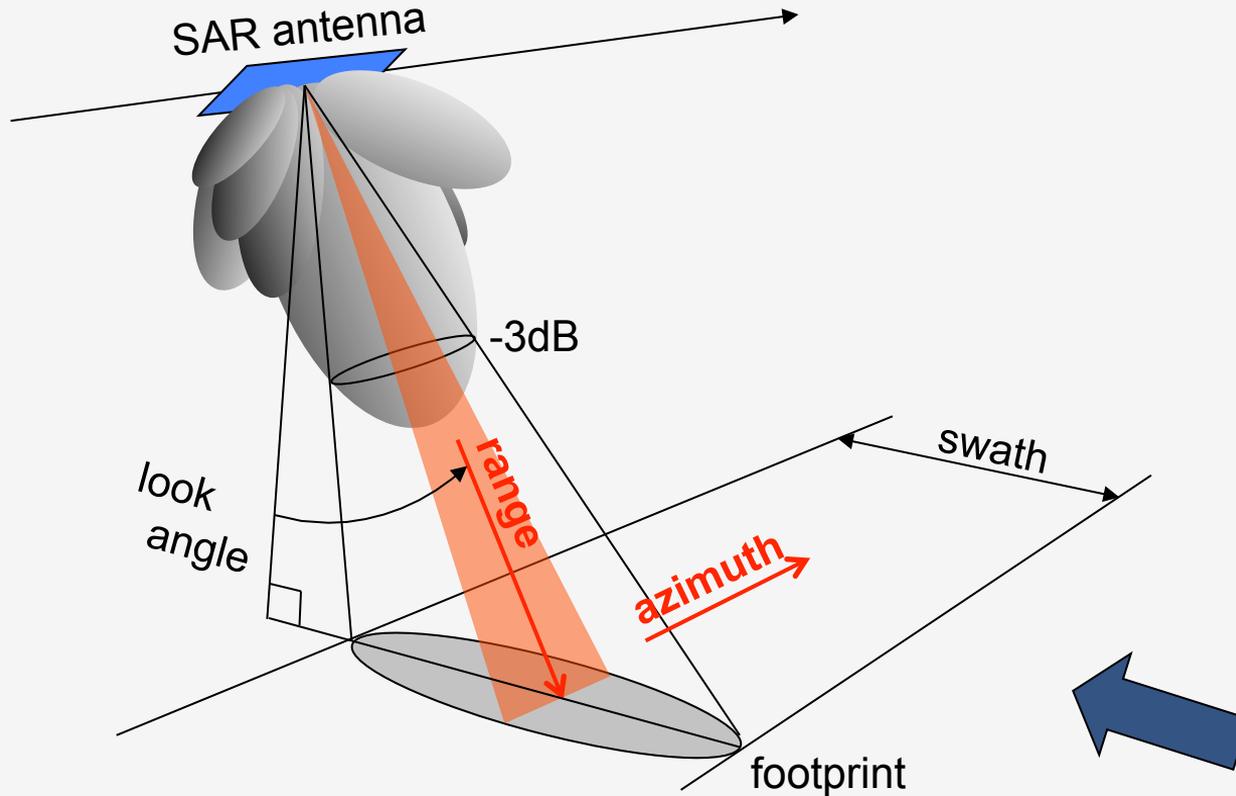
# Radiation Pattern



$\supset$

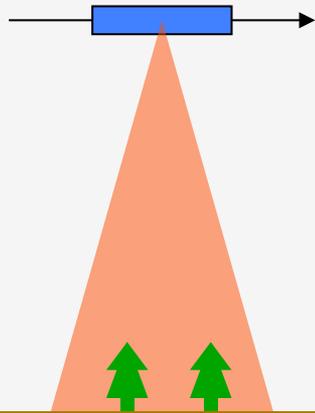


# Some Imaging Radar Jargon

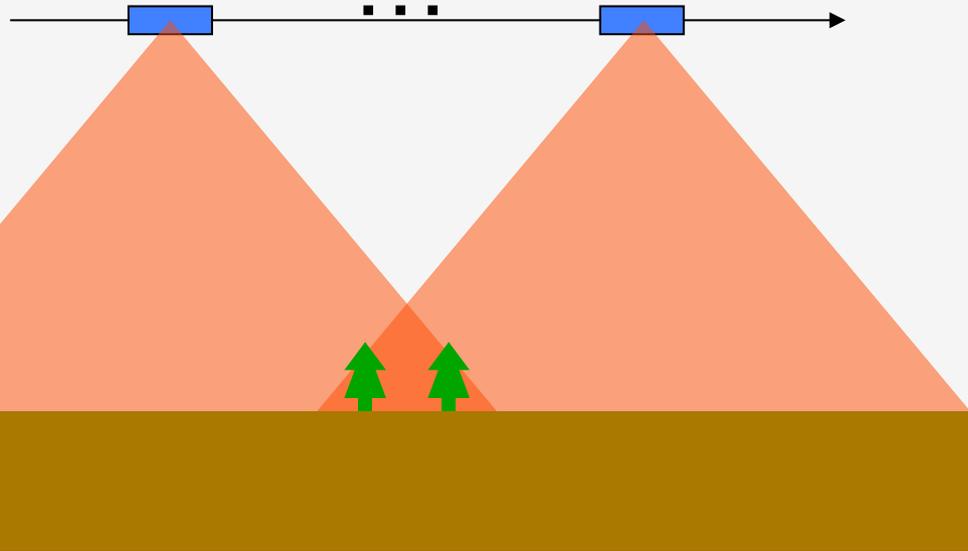


# Synthetic Aperture Radar (SAR)

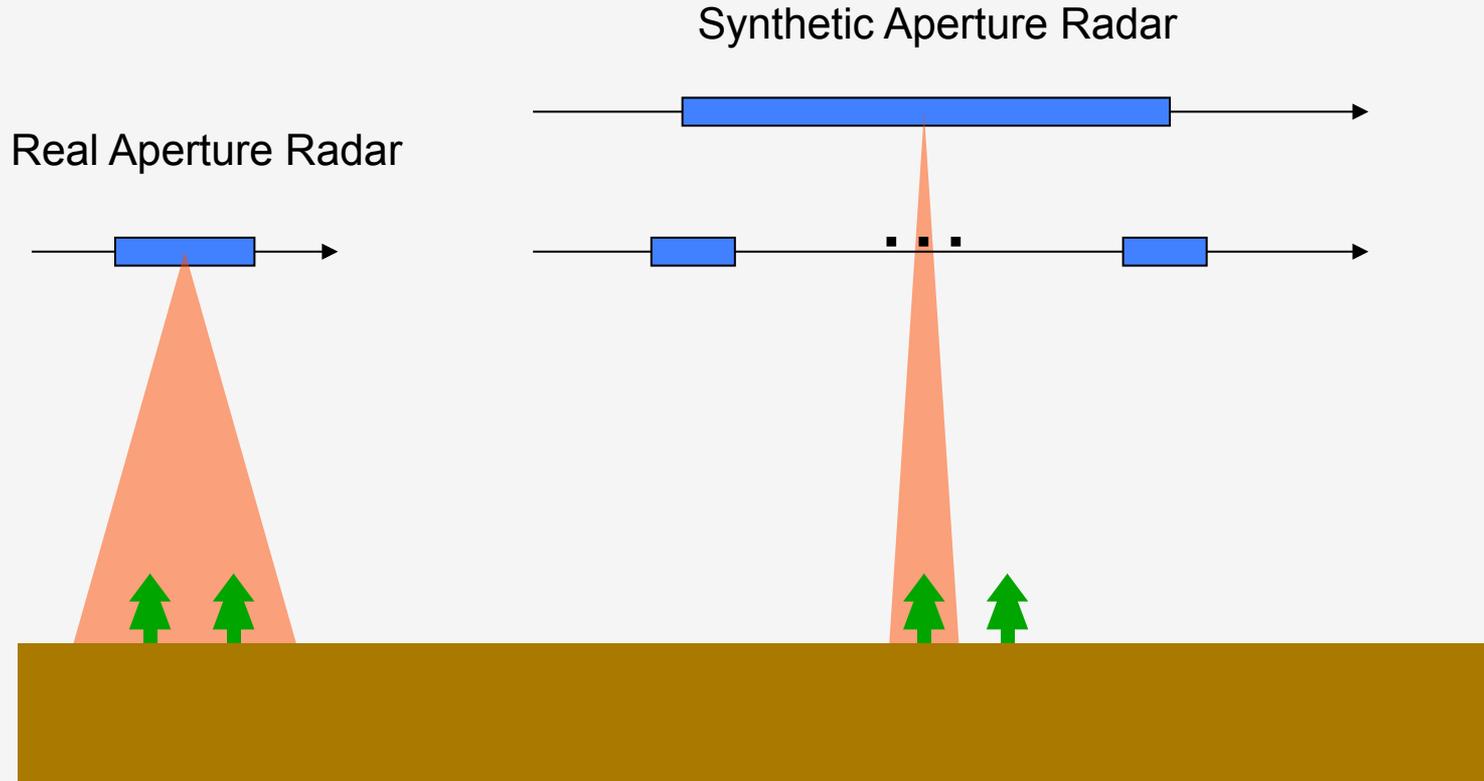
Real Aperture Radar



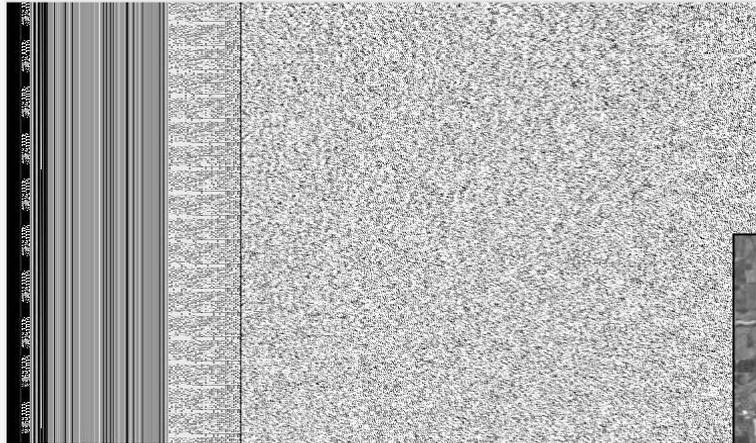
Synthetic Aperture Radar



# Synthetic Aperture Radar (SAR)



# SAR image (amplitude)



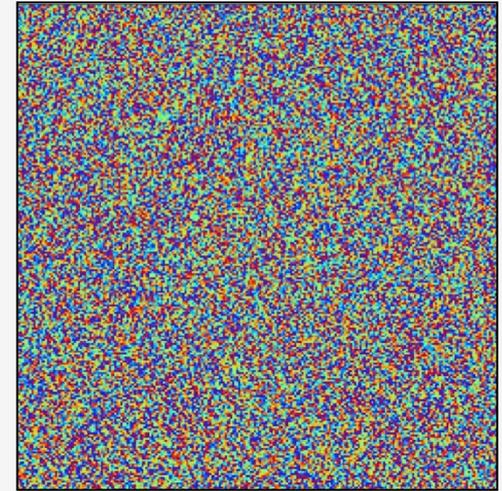
Raw data (complex)



SAR processing

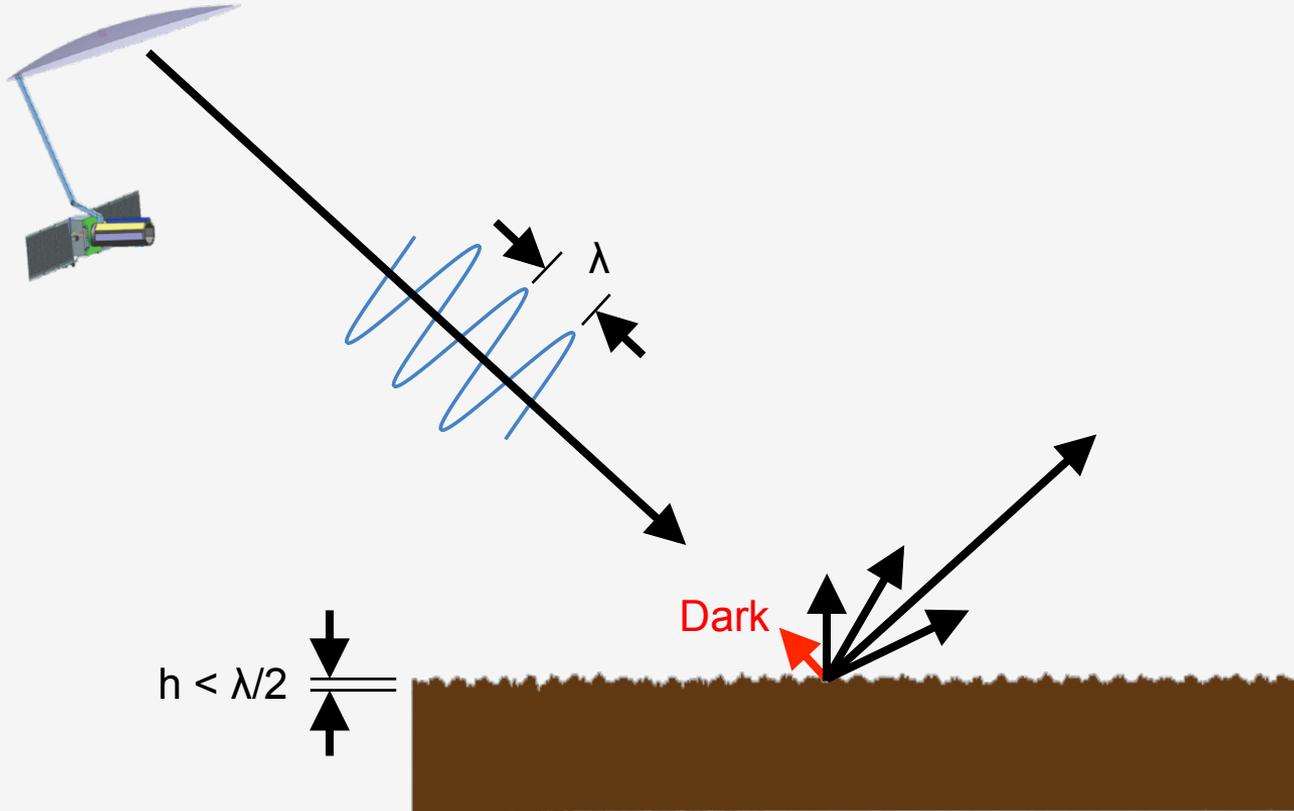


Amplitude

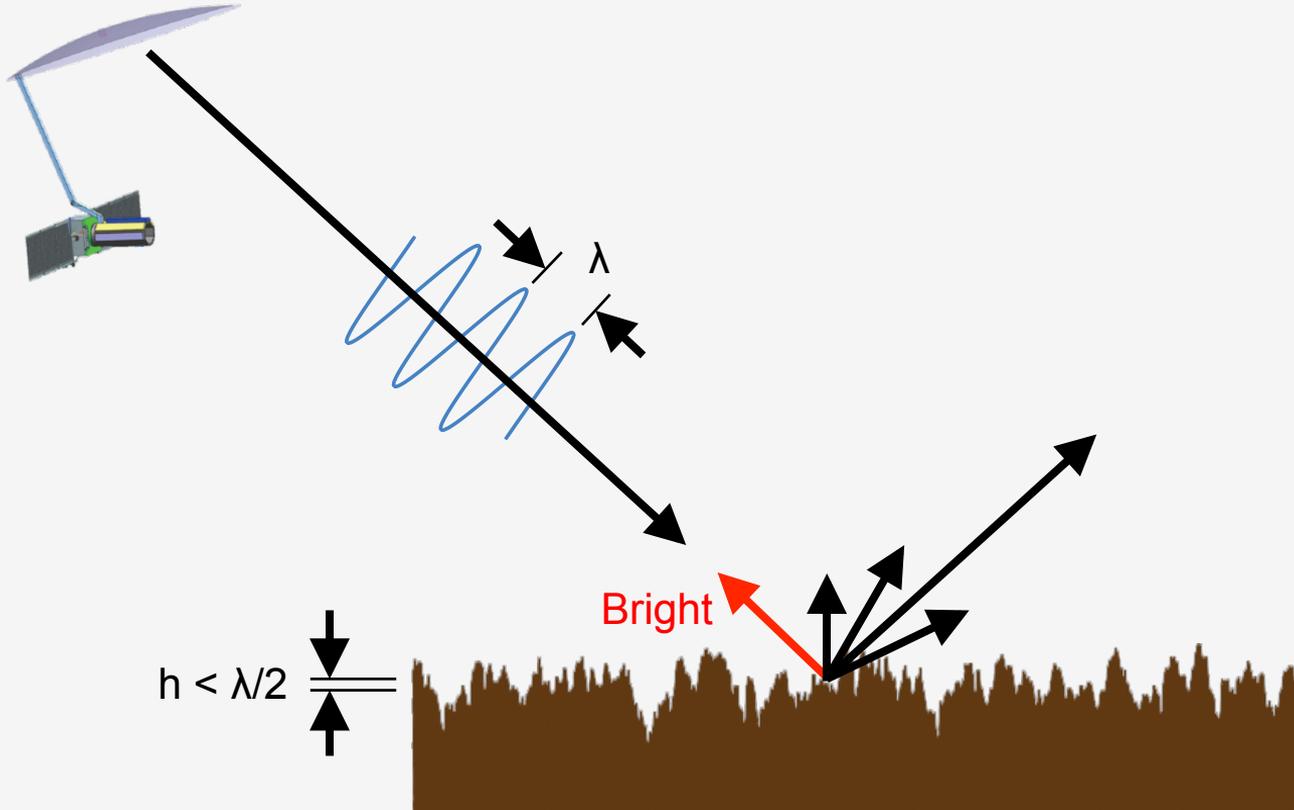


Phase

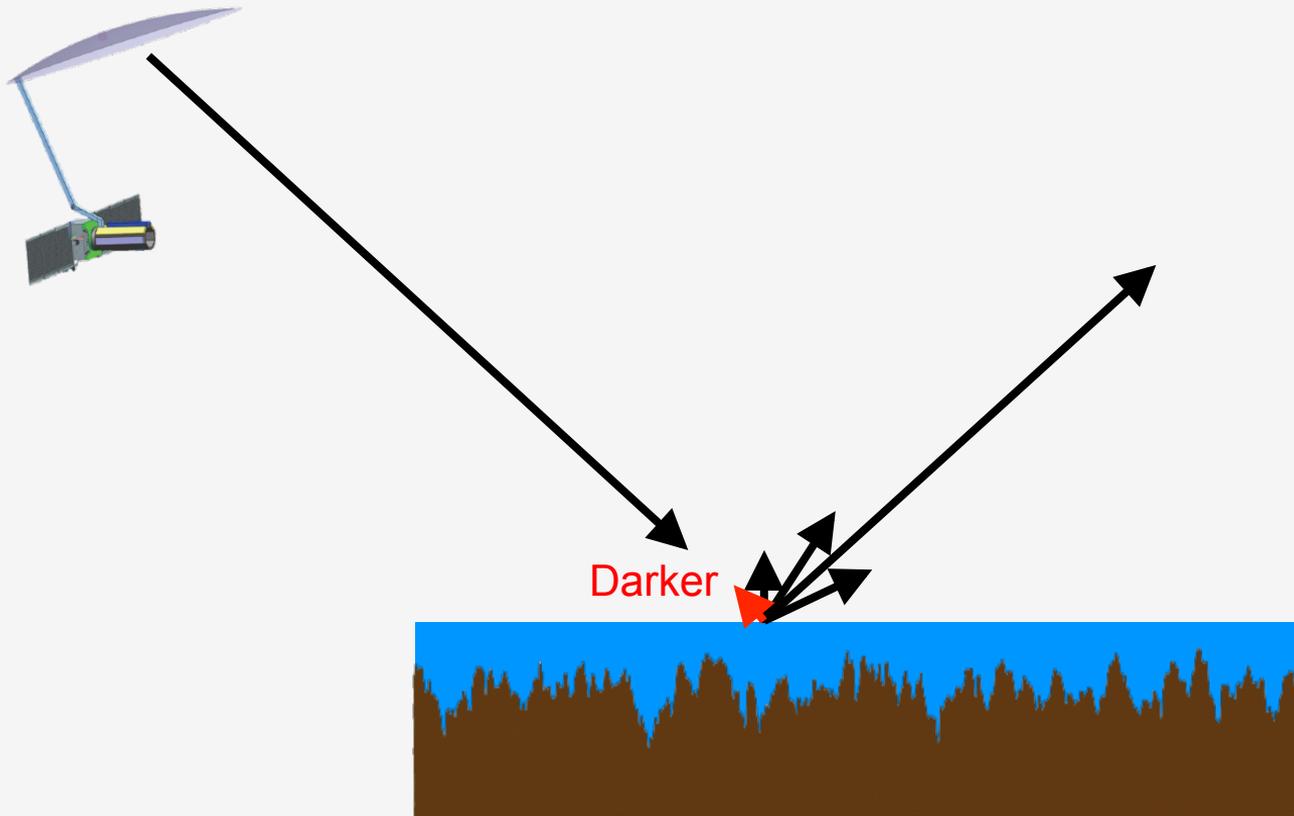
# Microwave Scattering (Smooth)



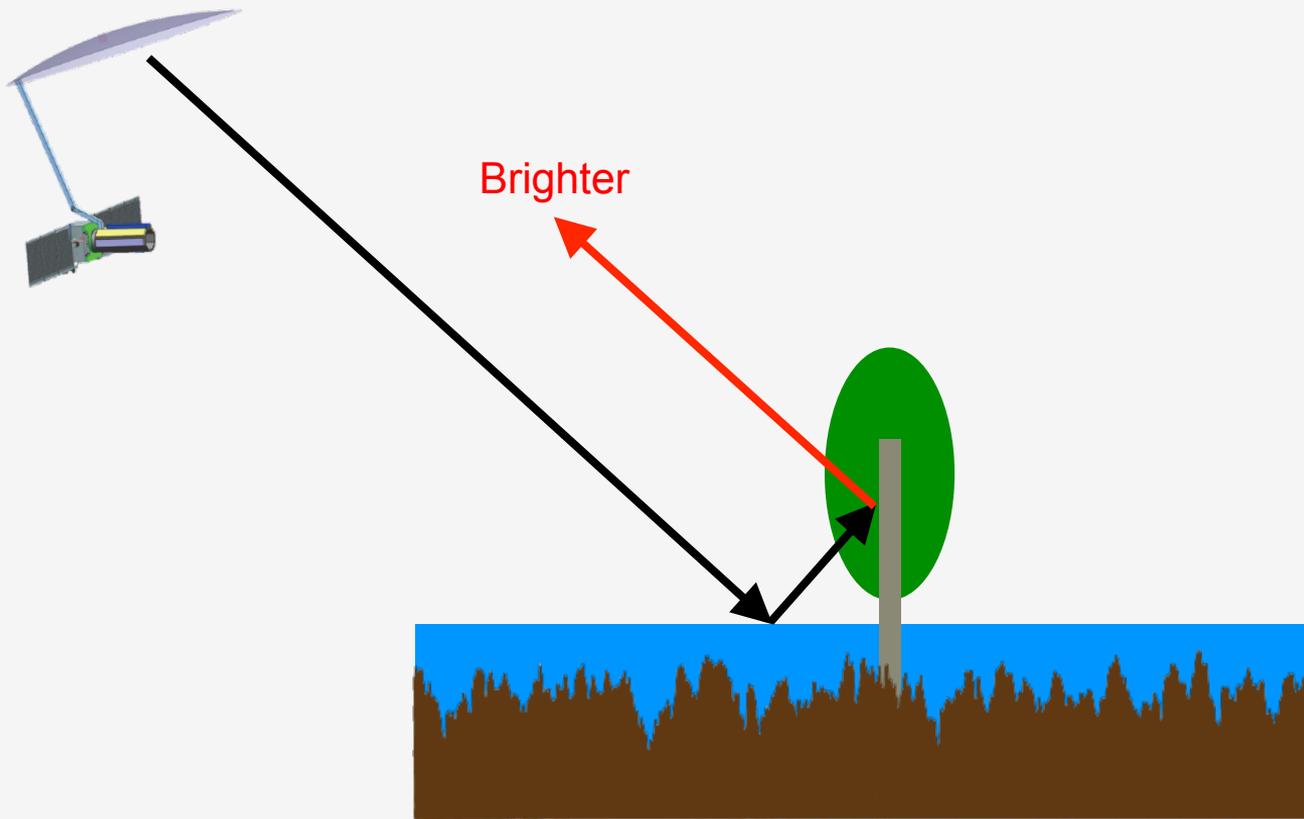
# Microwave Scattering (Rough)



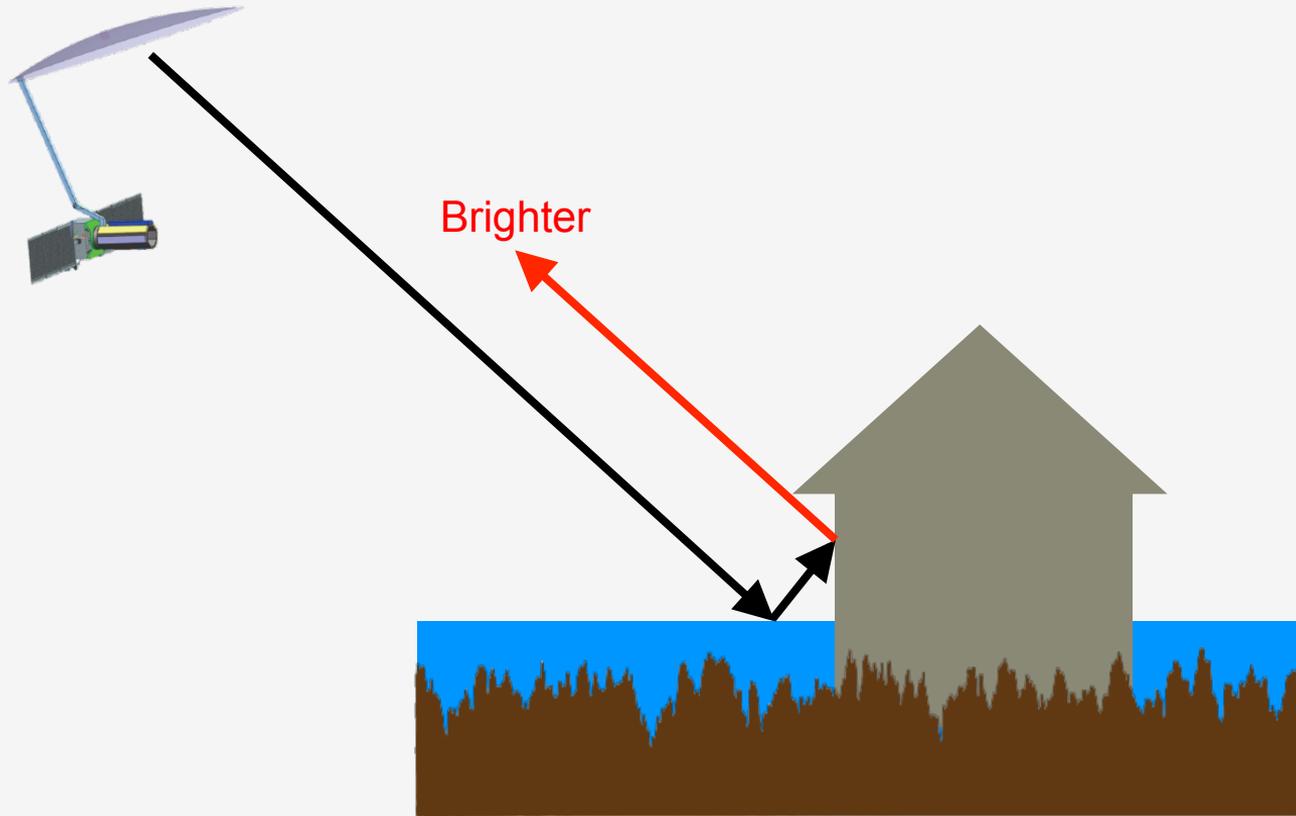
# Floods Form Smooth Surface



# Floods with Tall Vegetation

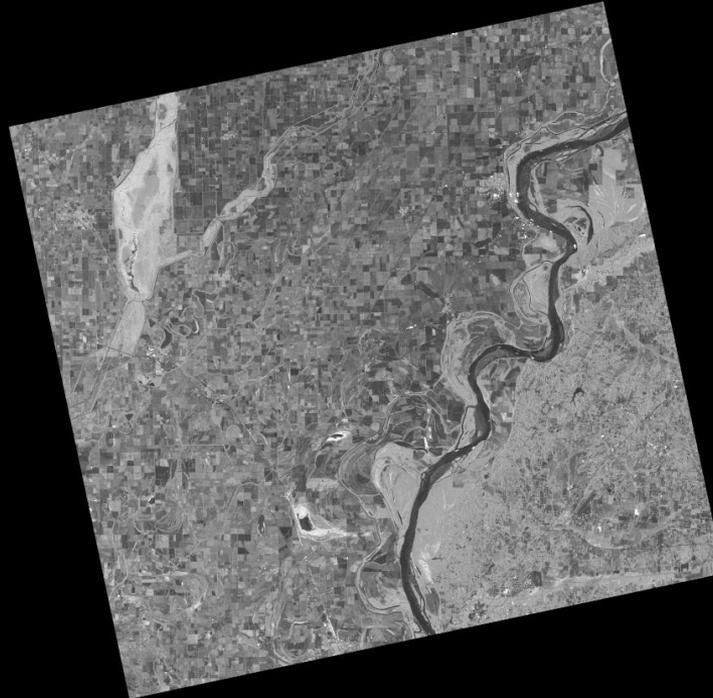


# Floods with Artificial Structure



# SAR Image (Before)

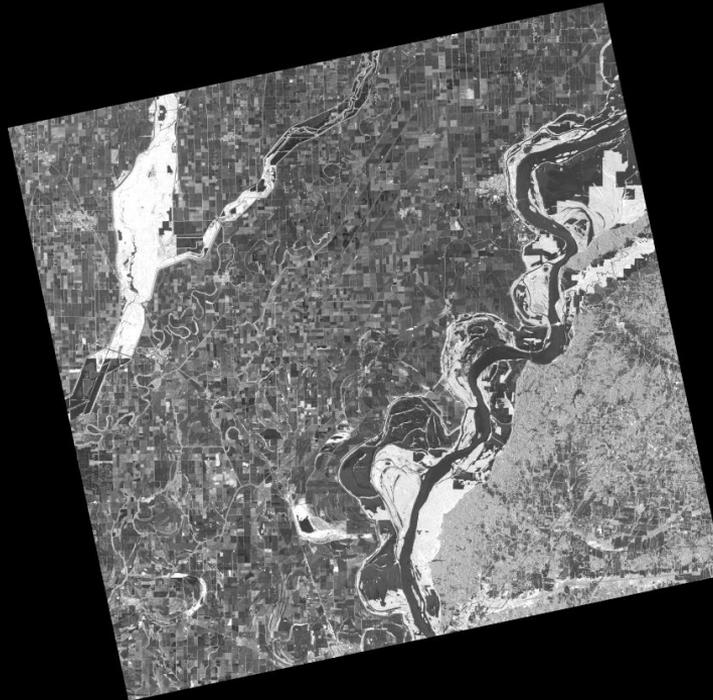
ALOS-2  
2015-09-30



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

# SAR Image (After)

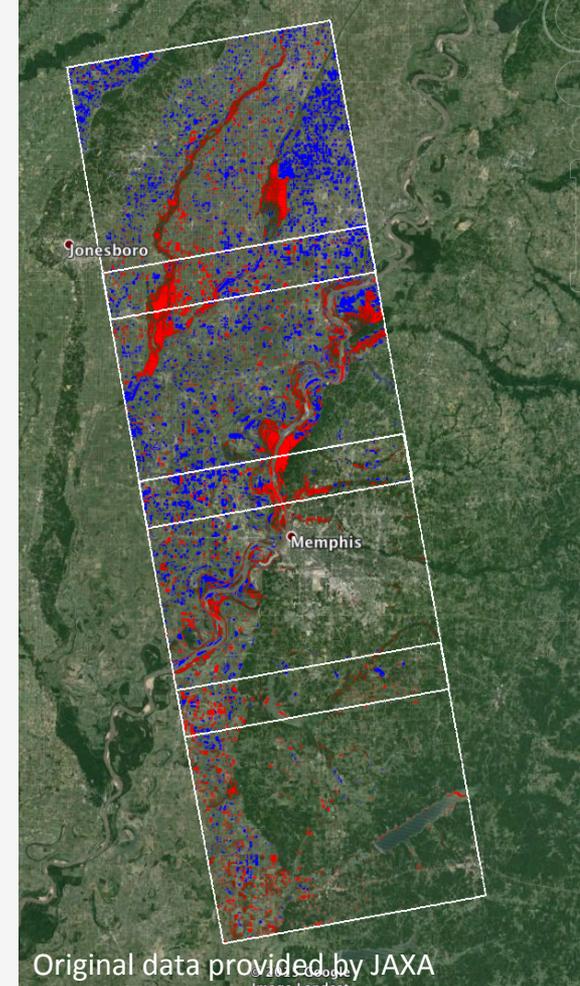
ALOS-2  
2016-01-06



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

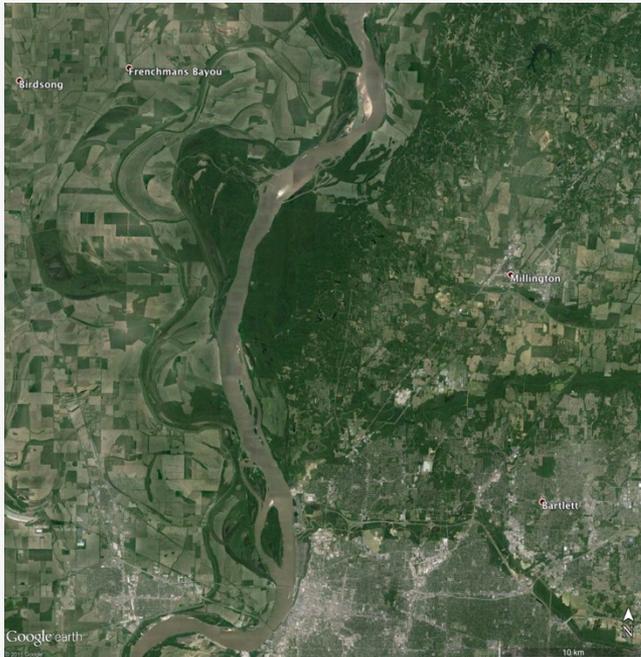
# Flood Extent Maps

- 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/](http://aria-share.jpl.nasa.gov/events/20160111-US_Midwest_Floods/)

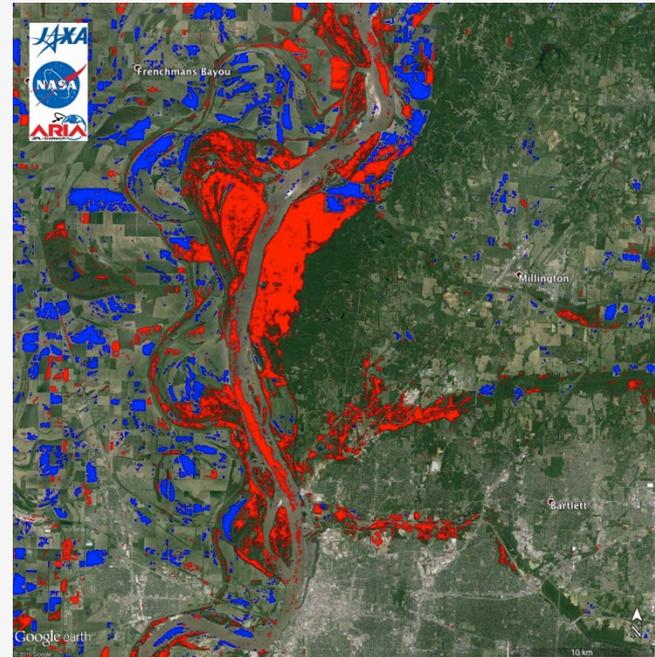


# Flood Extent Map

Google Earth

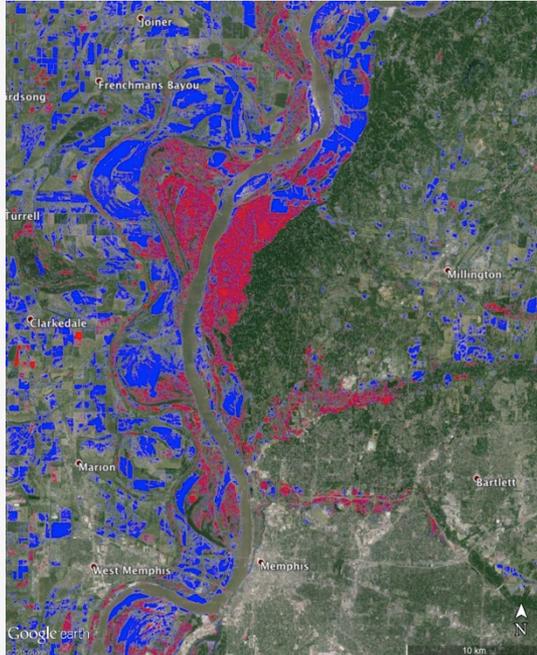


NASA Flood Map

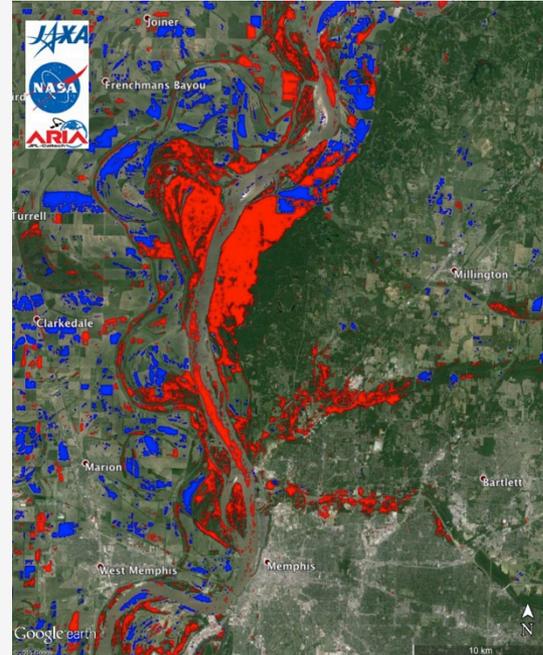


# Flood Extent Map

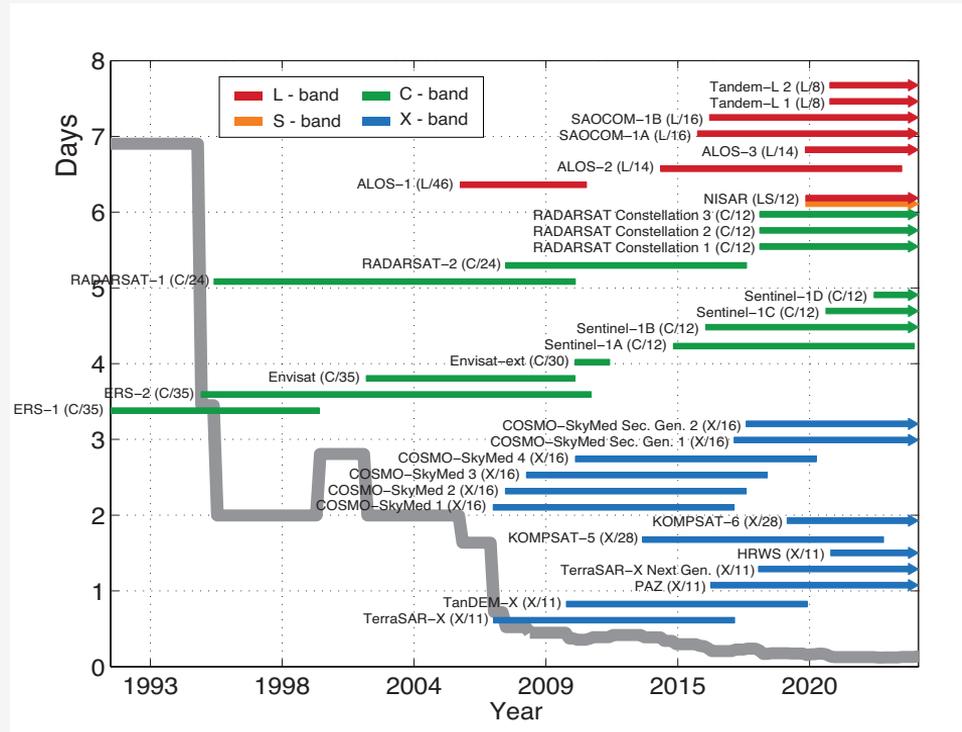
## JAXA Flood Map



## 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.