



Introduction to SAR

Jeremy Nicoll



Outline

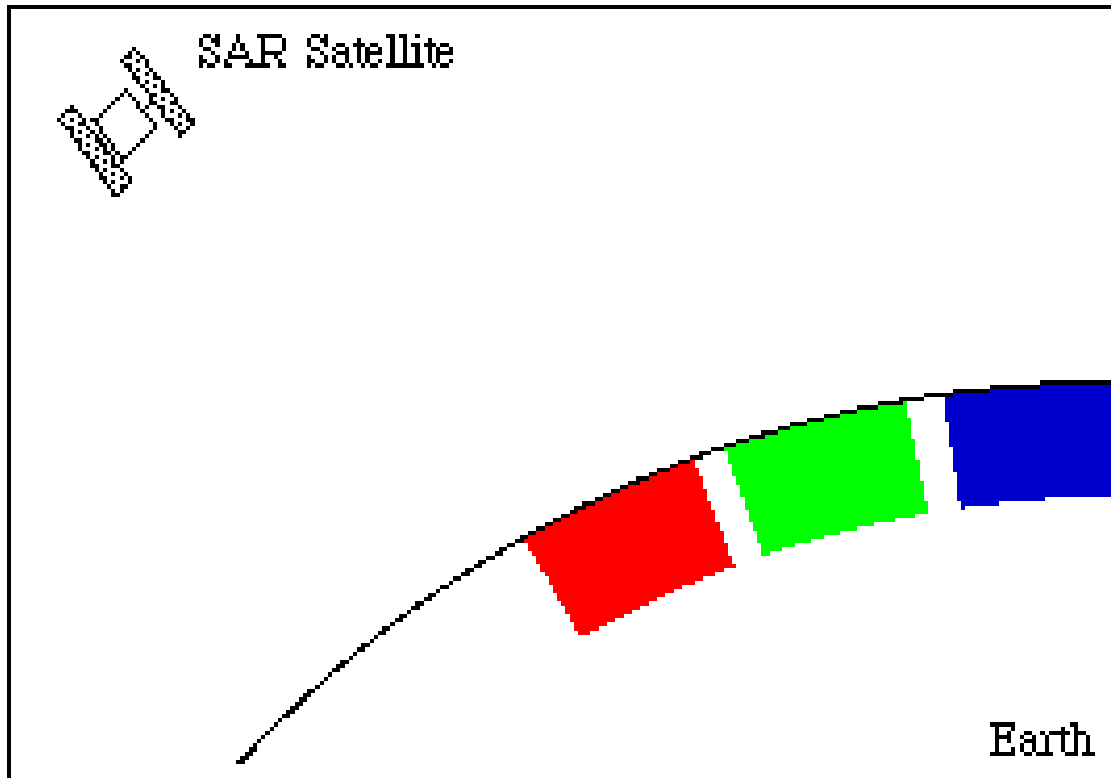
- What is SAR?
- What does SAR “see”?
- What can we do with SAR?
- What are the advantages of SAR?
- What are the sources of SAR data?
- What flavors of SAR are there?



What is SAR?

- Synthetic Aperture **Radar**
 - Radio detection and ranging

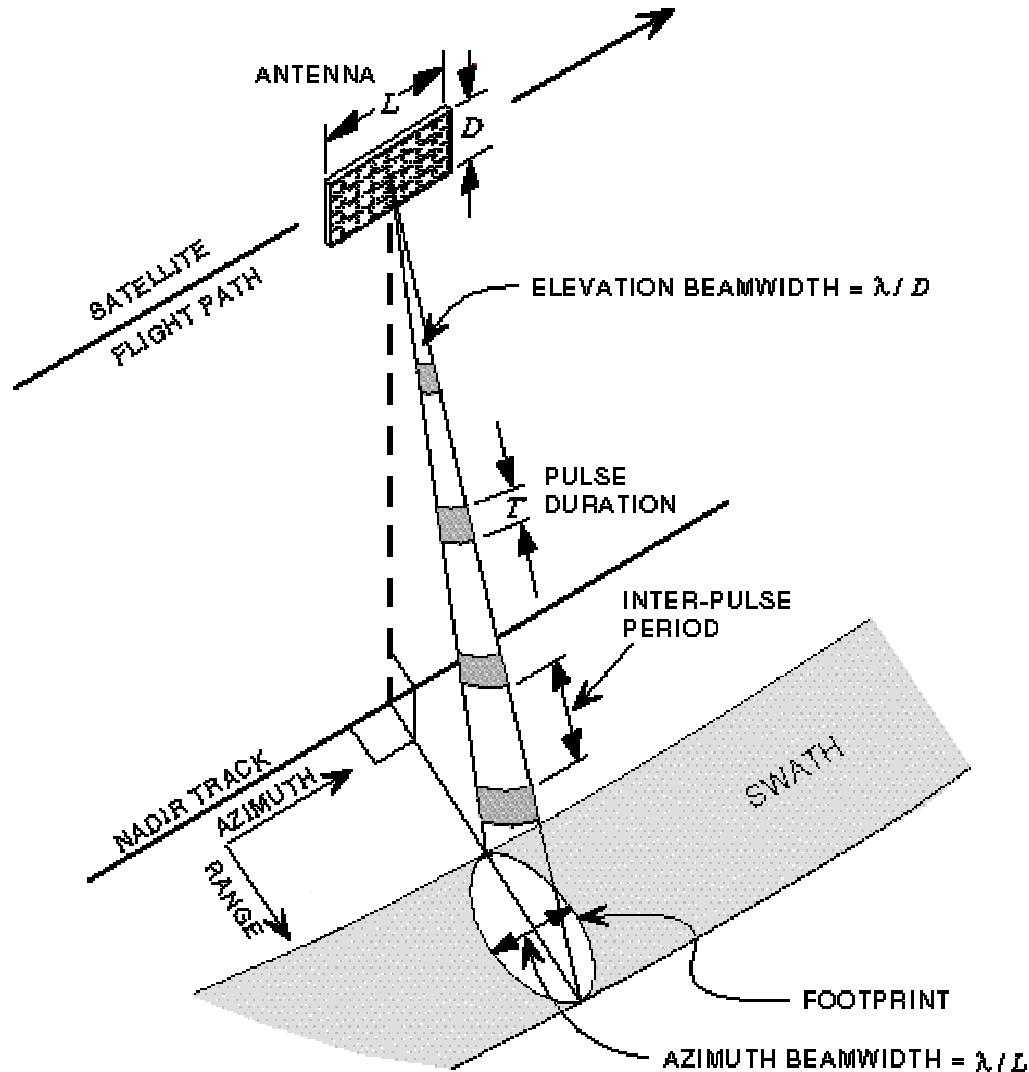
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What is SAR?

- Synthetic Aperture Radar

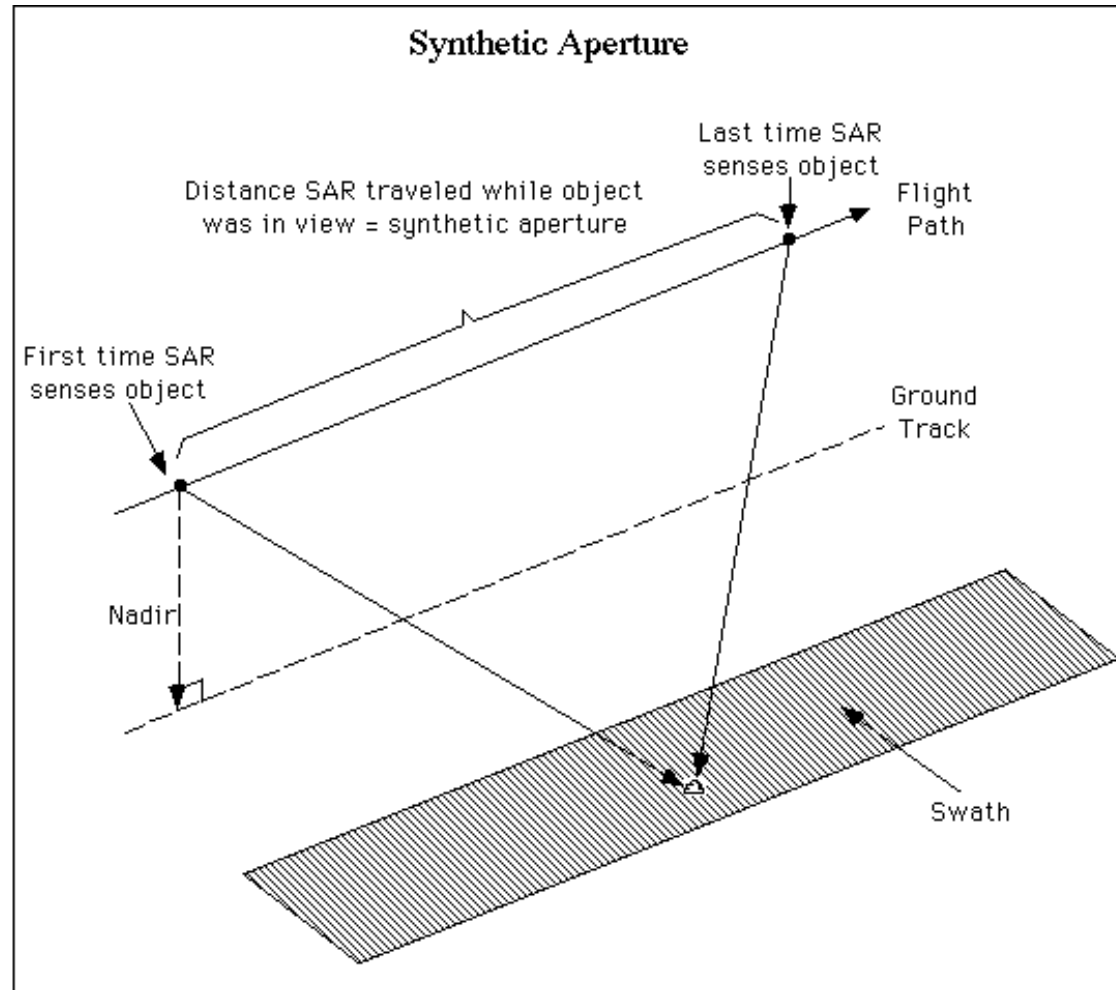


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What is SAR?

- Synthetic Aperture Radar

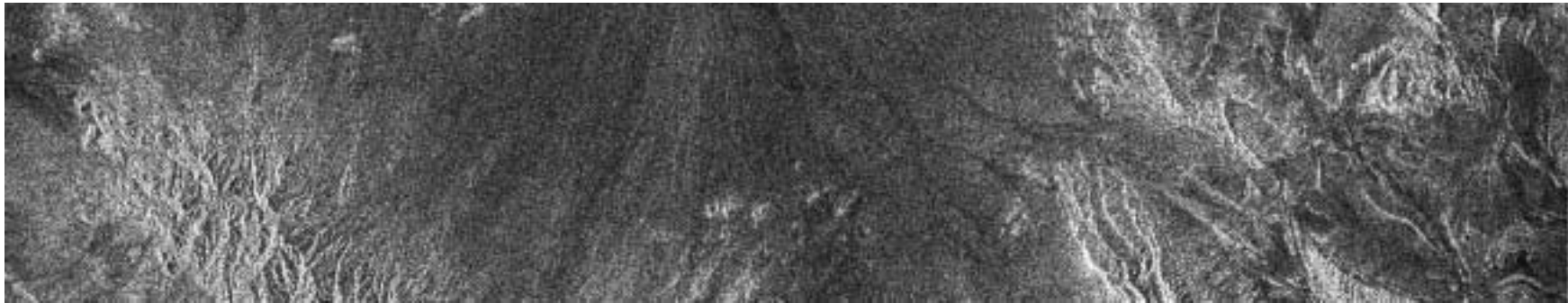
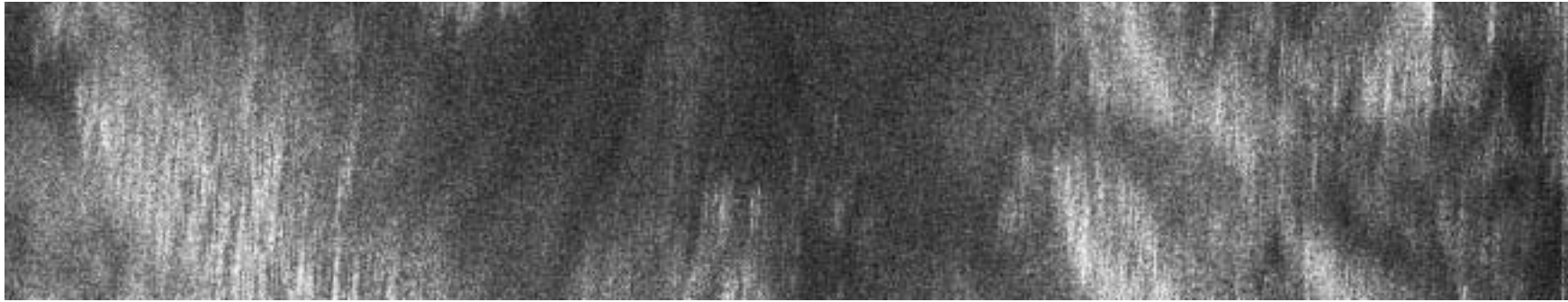




What is SAR?

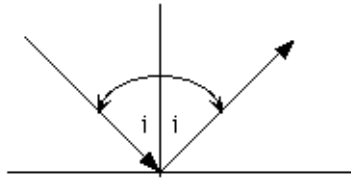
- Real Aperture vs. Synthetic

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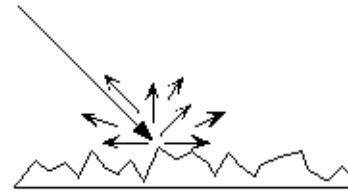




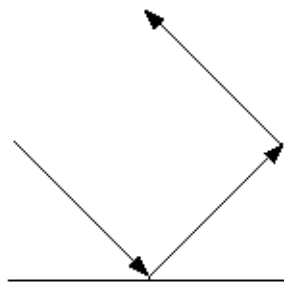
Scattering Mechanisms



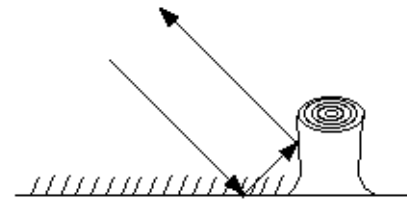
Reflection off a smooth surface
The angle of incidence, i , equals the angle of reflection.



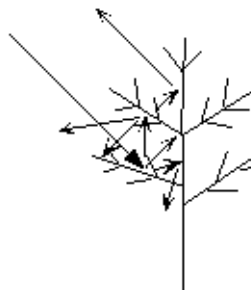
Scattering off a rough surface
The variation in surface height is on the order of the incoming signal's wavelength.



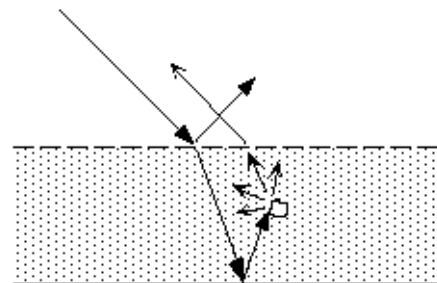
Double Bounce
(Corner Reflector)



Double Bounce
One possible natural occurrence - reflecting off two smooth surfaces, grass and a freshly-cut tree's stump



Volumetric Scattering
Example scattering in a tree



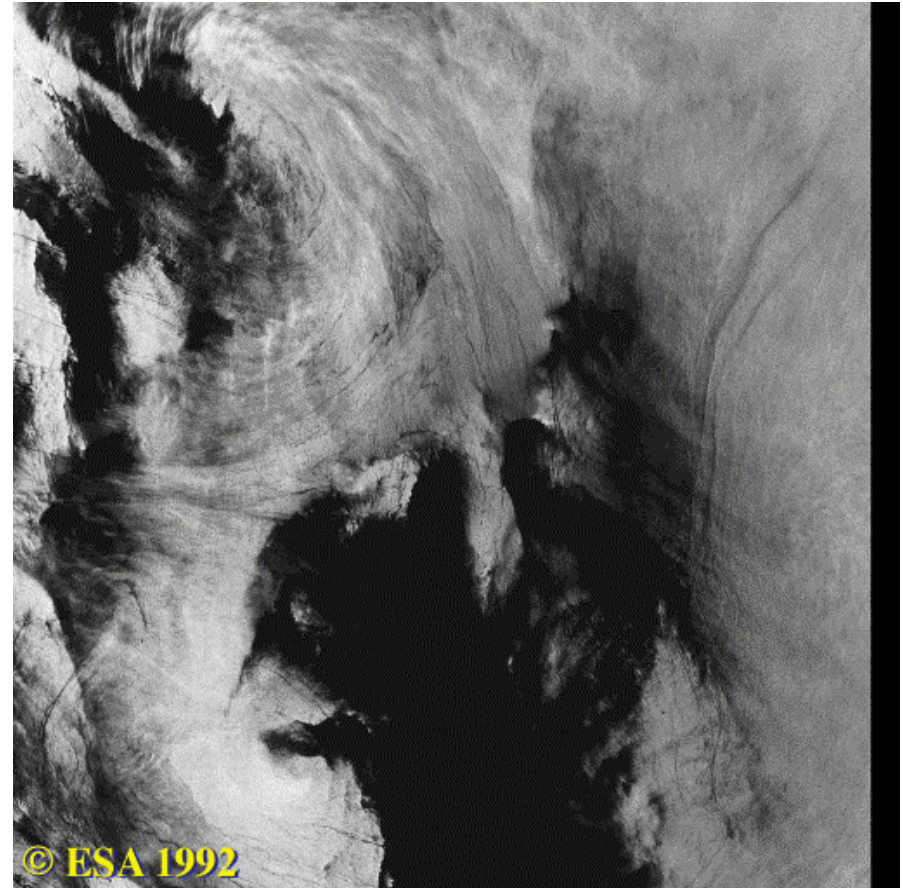
Volumetric Scattering
In this example the incident radiation is both reflected and refracted/transmitted through a layer of dry snow. The refracted radiation then reflects off underlying ice, scatters off a chunk of ice in the snow, and finally refracts back toward the receiver.

What does SAR "see"?



What can we do with SAR?

- Imagery
 - Geology
 - Volcanoes
 - Glaciers
 - Hydrology
 - Fires
 - Seasons
 - Human impact
 - Ice
 - Open ocean





What can we do with SAR?

- Derived Products
 - Interferometry
 - Change detection
 - Digital Elevation Mapping
 - Ice motion
 - Data fusion products
 - Wind speed, ship detection
 - Mosaics
 - Simulations



What can we do with SAR?

- Change detection

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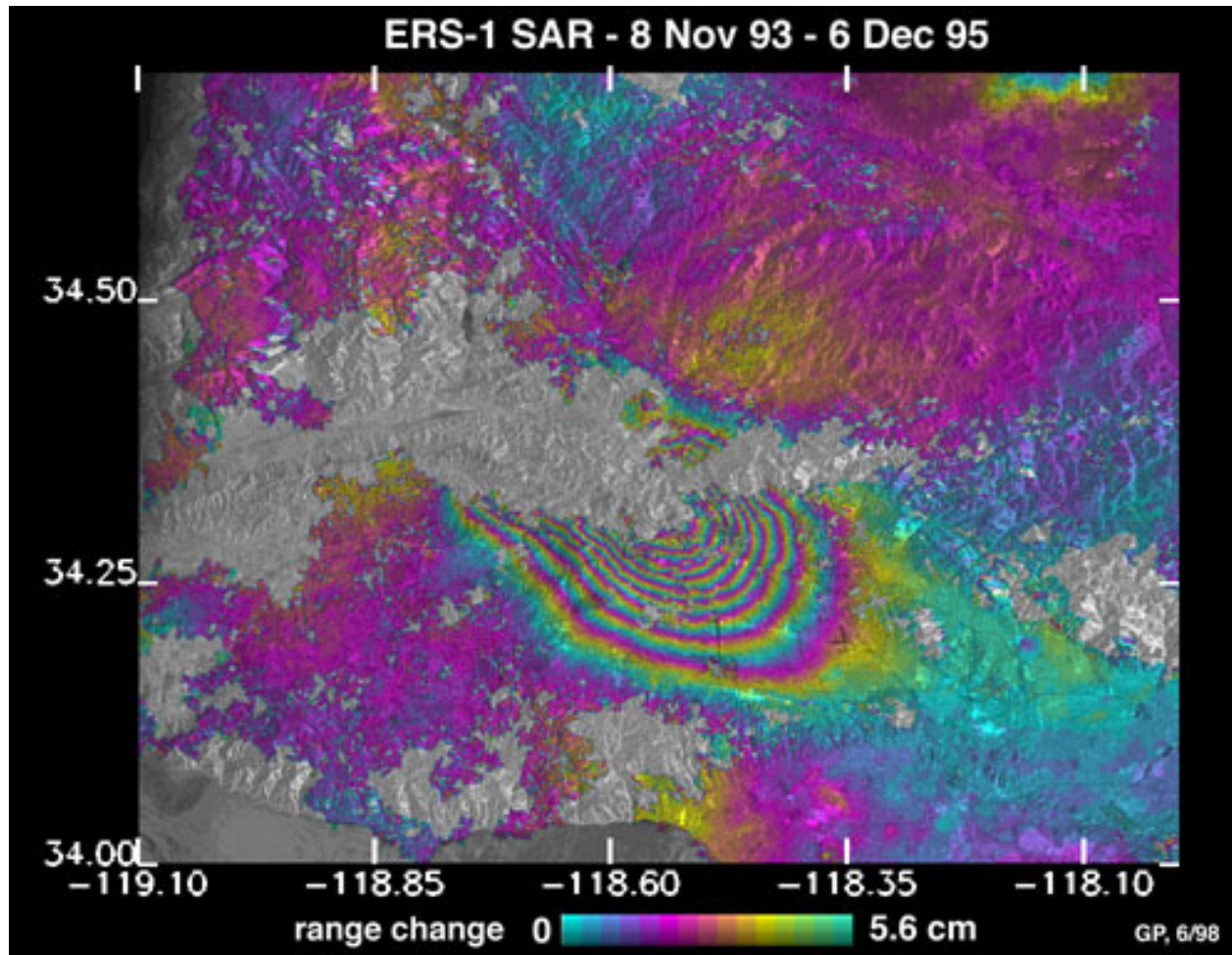
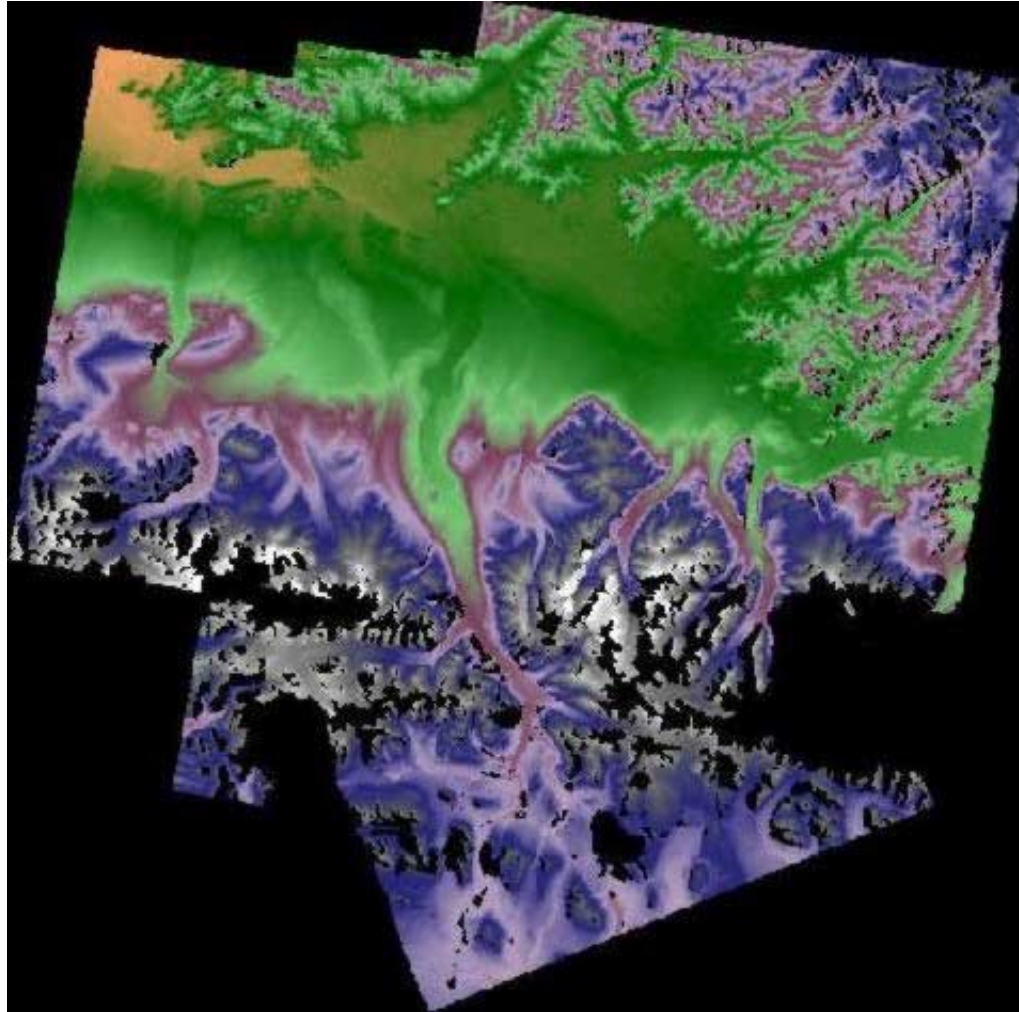


Image from JPL website at
<http://geodynamics.jpl.nasa.gov/northridge/nr7.htm>



What can we do with SAR?

- Digital Elevation Mapping



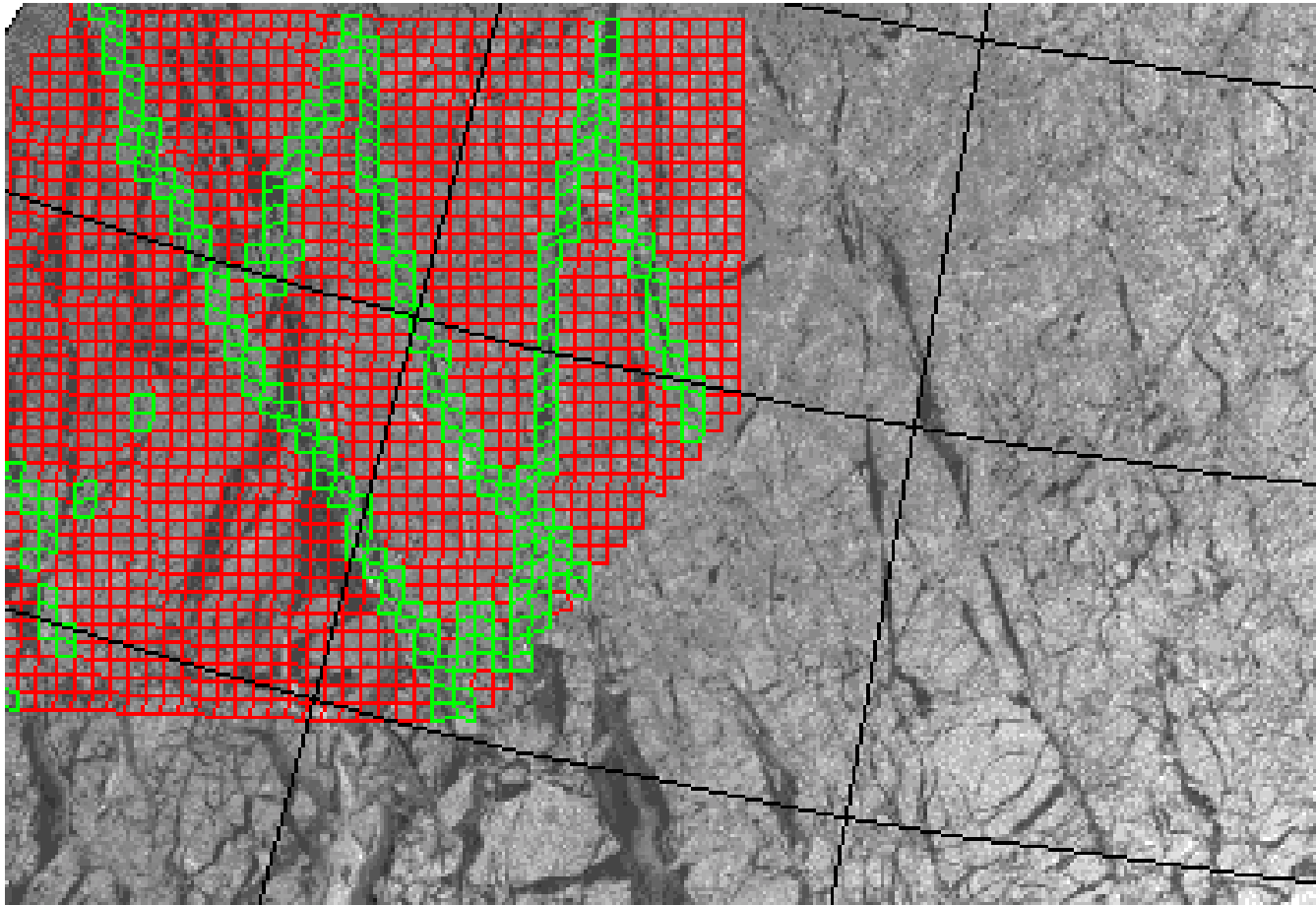
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What can we do with SAR?

- Ice motion

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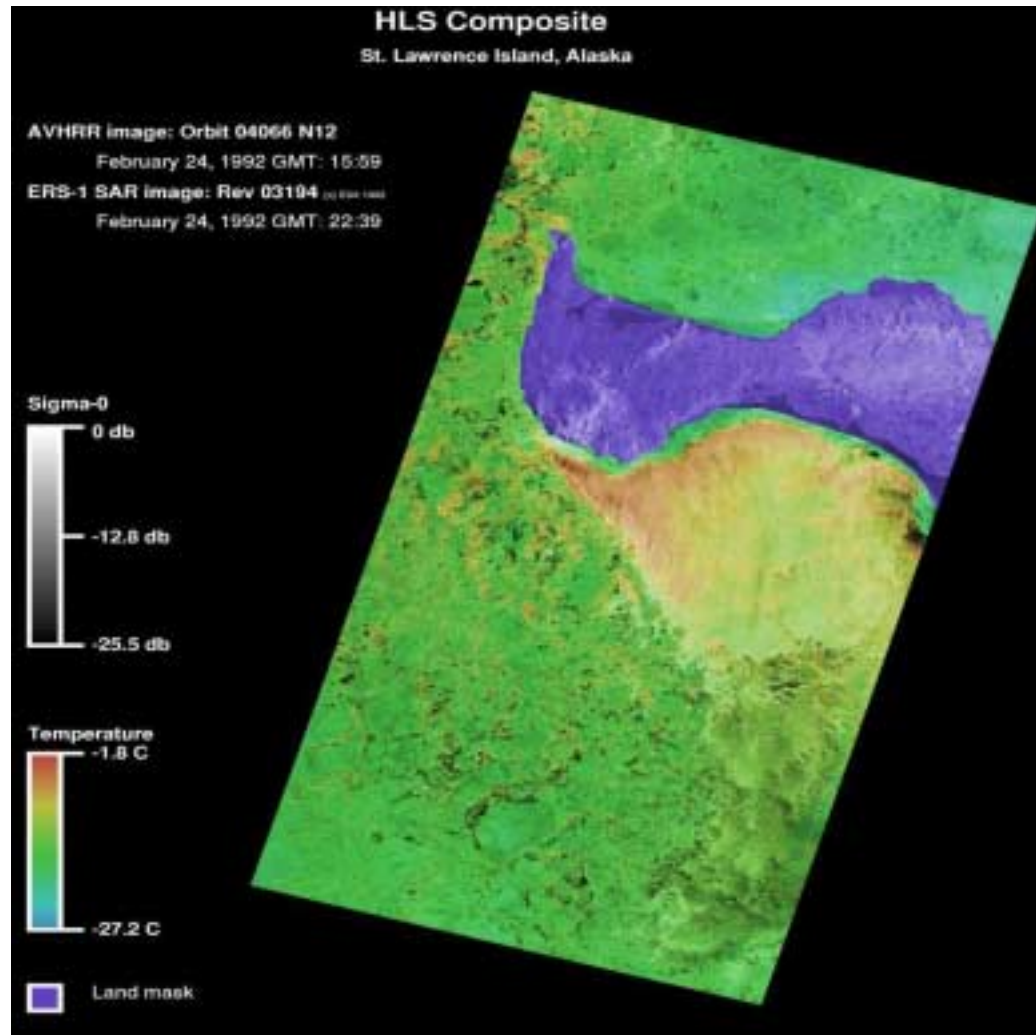




What can we do with SAR?

- Data fusion products

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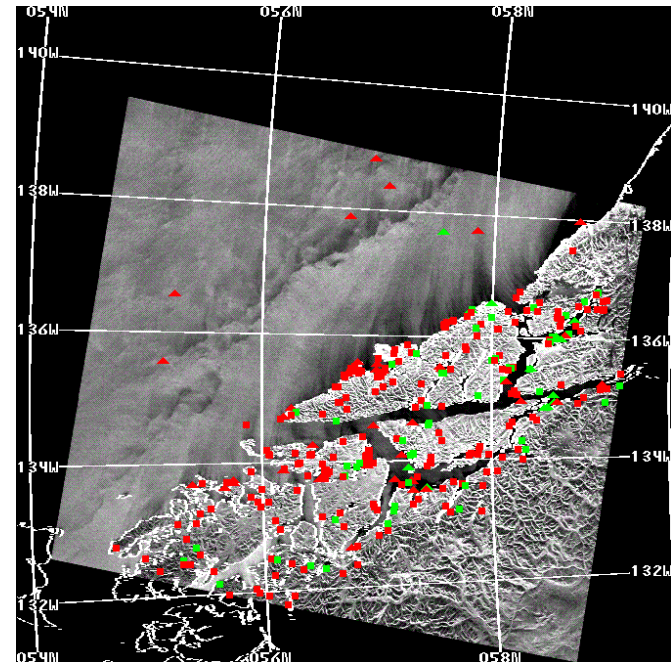
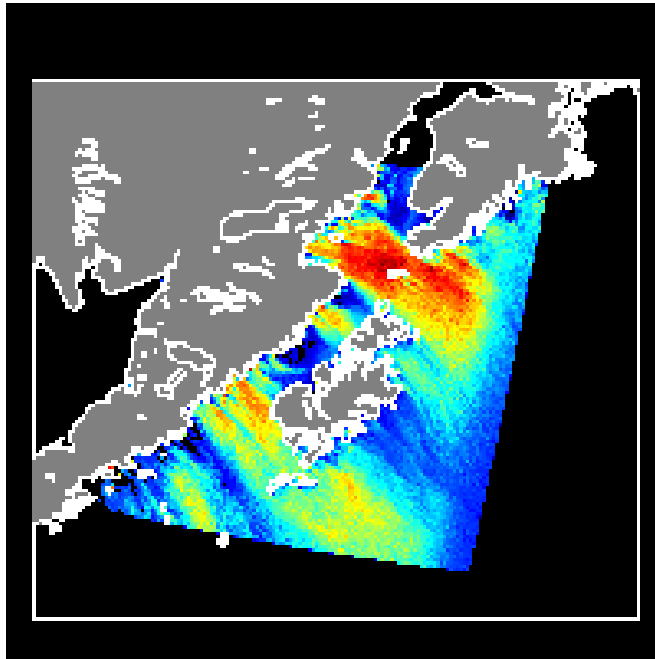




What can we do with SAR?

- Wind speed, ship detection

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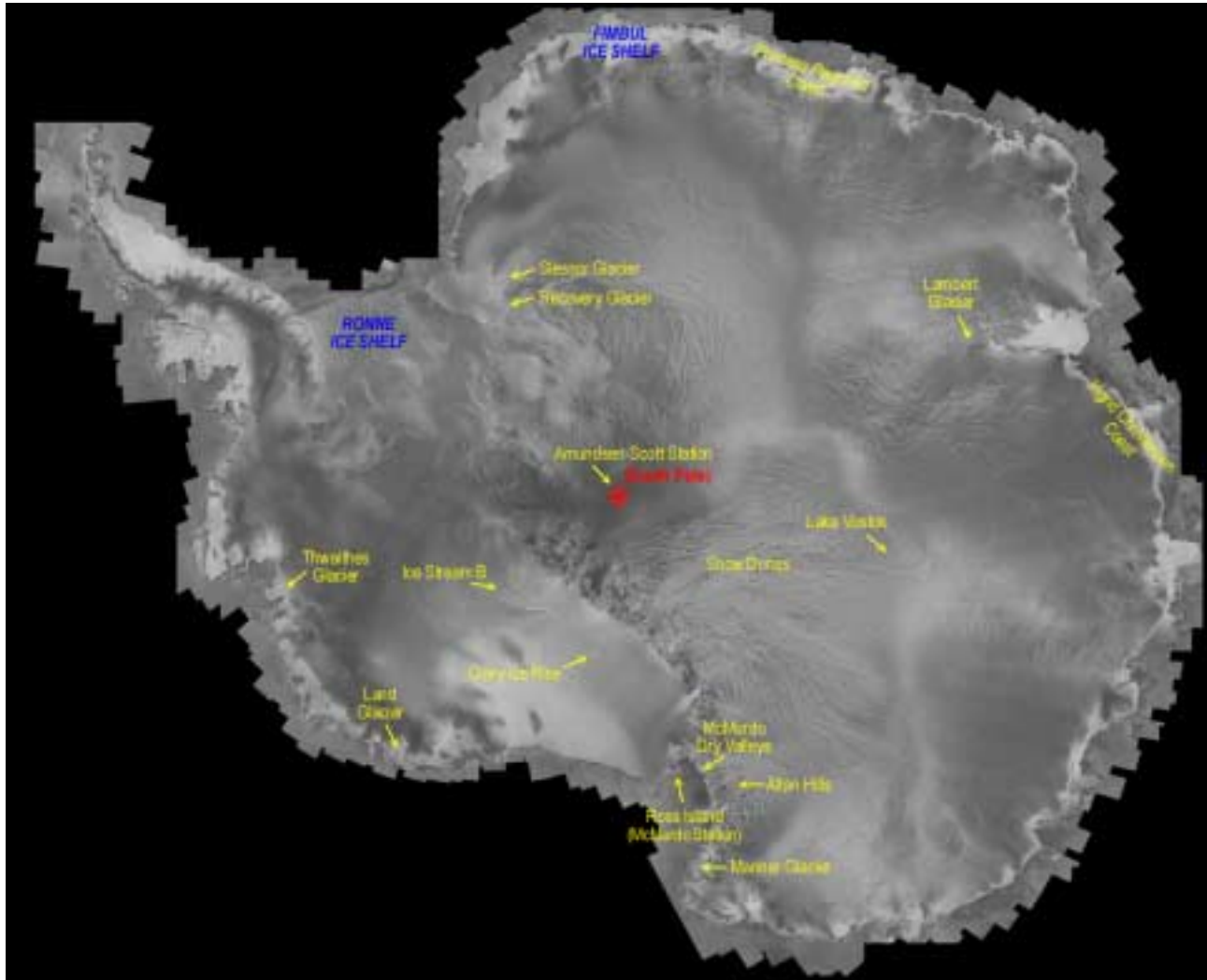
Images from Alaska SAR Demo at <http://orbit35i.nesdis.noaa.gov/orad/sar/sarproducts.html>



What can we do with SAR?

- Mosaics

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What can we do with SAR?

- Simulations

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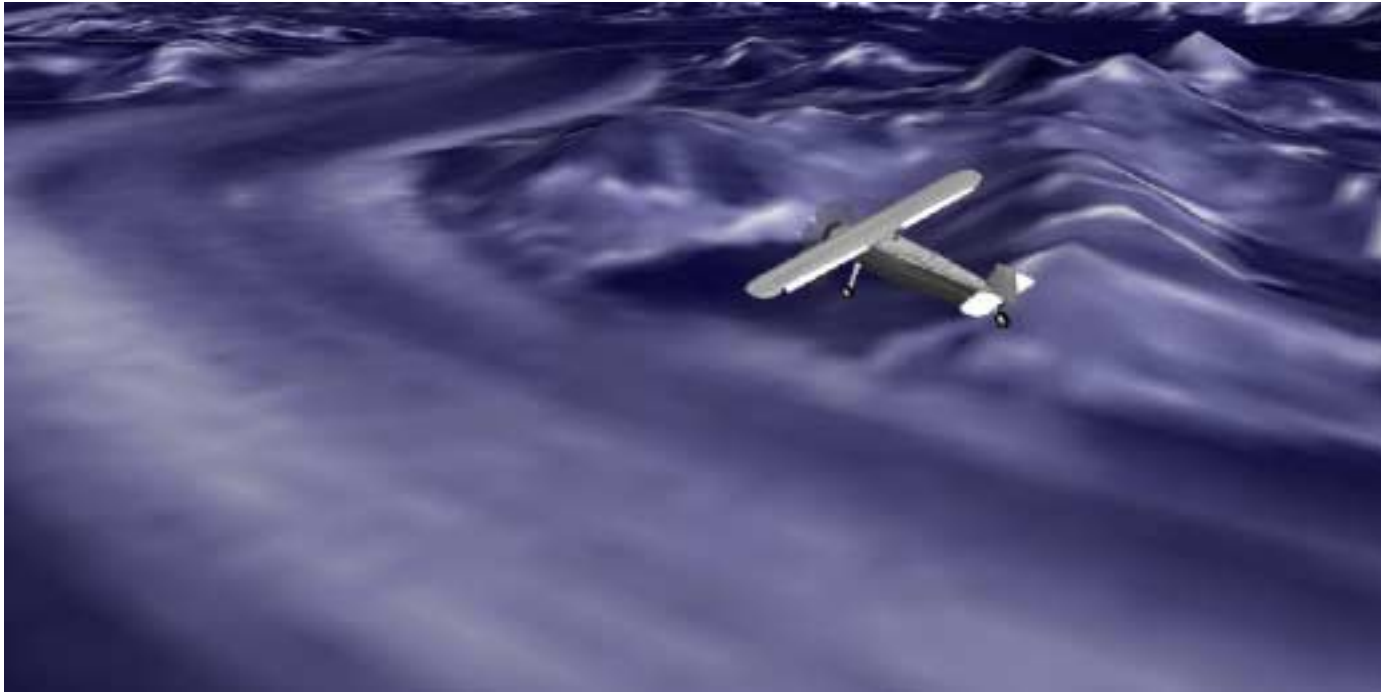


Image from NASA Goddard Space Flight Center Scientific Visualization Studio
<http://svs.gsfc.nasa.gov/vis/a000000/a001000/a001001/index.html>



What are the sources of SAR data?

- Airplane
- Space Shuttle
 - SIR-C
 - SRTM
- Satellites
 - ERS
 - JERS
 - RADARSAT
 - ENVISAT



<http://www.esa.int/export/esaCP/index.htm>



www.eorc.nasda.go.jp/JERS-1/

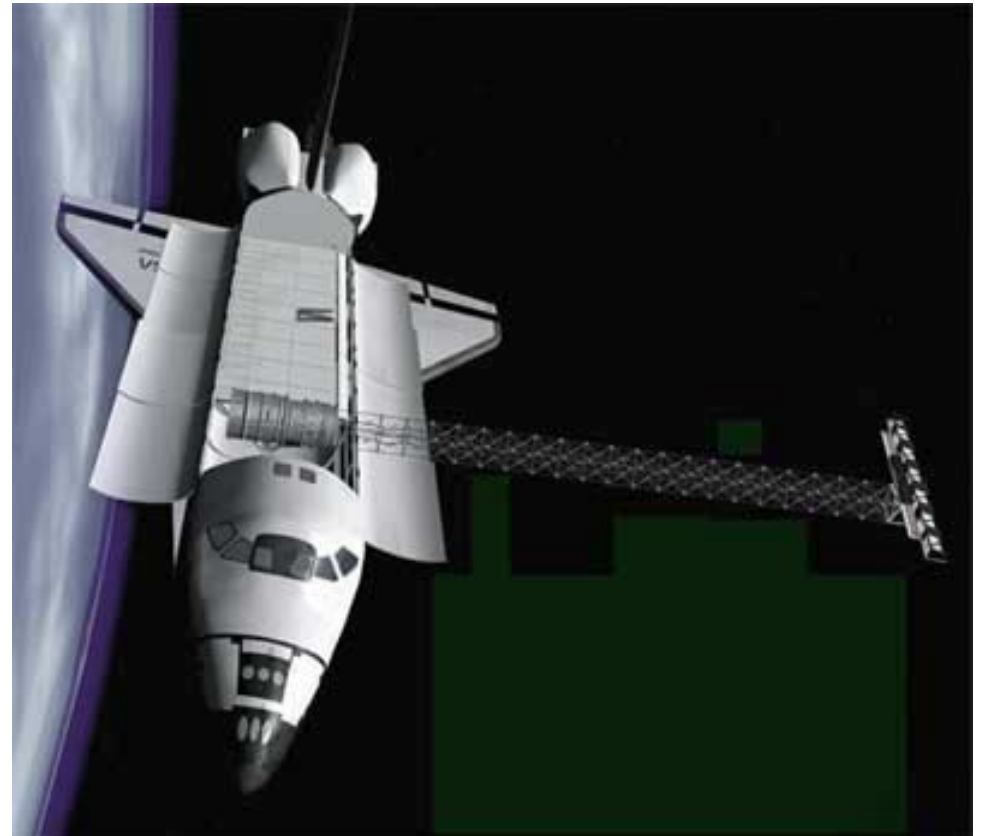


<http://svs.gsfc.nasa.gov/stories/antarctica/>



How many flavors does SAR come in?

- Plane – polarized
 - HH
 - VV
- Multipolarization
- Dual antenna
 - Along-track
 - Across-track
- ScanSAR
- Spotlight



<http://www.jpl.nasa.gov/srtm/missionoverview.html>



What are the advantages of SAR?

- Use day and night
 - Active sensor
- Sees through clouds (mostly)
 - wavelength of microwaves vs. light
- Repeat coverage
- Good for physical feature detection
- Resolution



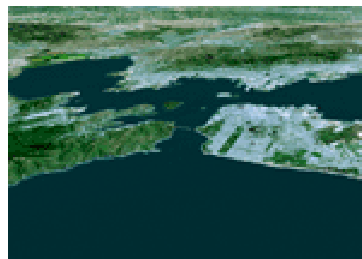
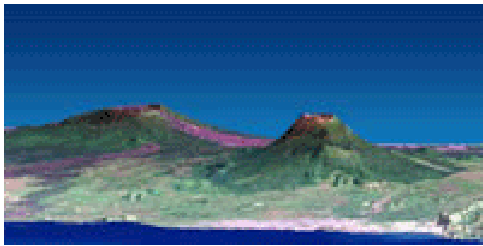
Disadvantages

- It's not a picture, dang it!
 - Calibration
 - Interpretation
- Extensive computer processing
 - Time delays
 - Data quality issues
- Few platforms
 - Continuity of data
 - Competition for data
- Resolution



Questions?

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Images from SRTM website at <http://www.jpl.nasa.gov/srtm/>