

Geography 12: Maps and Spatial Reasoning

Lecture 24: *Remote Sensing and Mapping*

Professor Keith Clarke

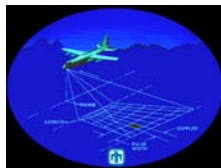


Remote sensing

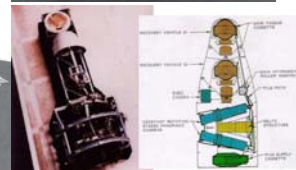
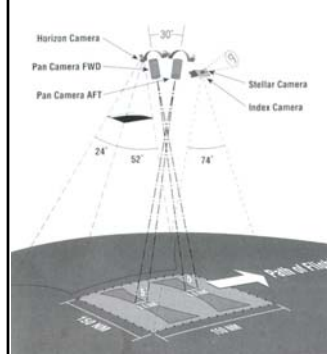
- Charles Elachi in *Introduction to the Physics and Techniques of Remote Sensing*
- "**Remote Sensing** is defined as the acquisition of information about an object without being in physical contact with it."

Remote sensing

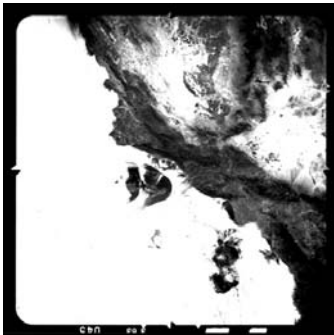
- Active
 - LiDAR
 - RADAR
- Passive
 - Optical
 - Air photos
 - Multispectral
 - Hyperspectral



CORONA



KH-5 Argon Santa Barbara Channel



Santa Rosa Island in 1967

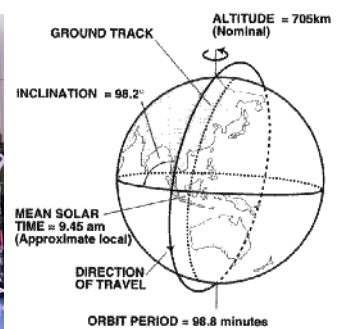
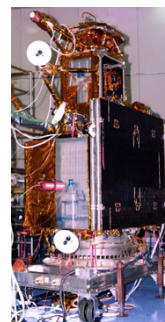


Civil Remote Sensing in the US

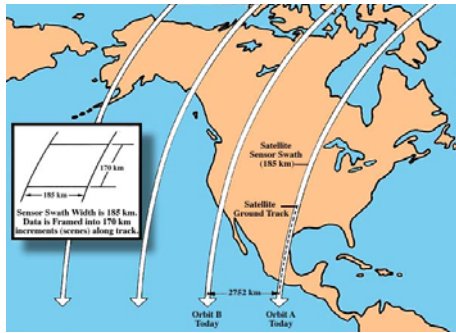
- ERTS-1 August 1972
- Return beam vidicon
- Multispectral Scanner
- Renamed Landsat 1 when series began
- DMSP, GOES etc. at about the same time
- Commercial entities after early 1980s
- Massive expansion in late 1990s



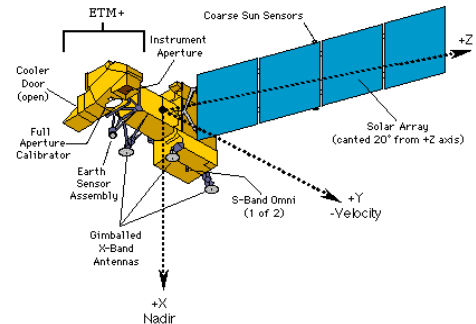
Landsat basics



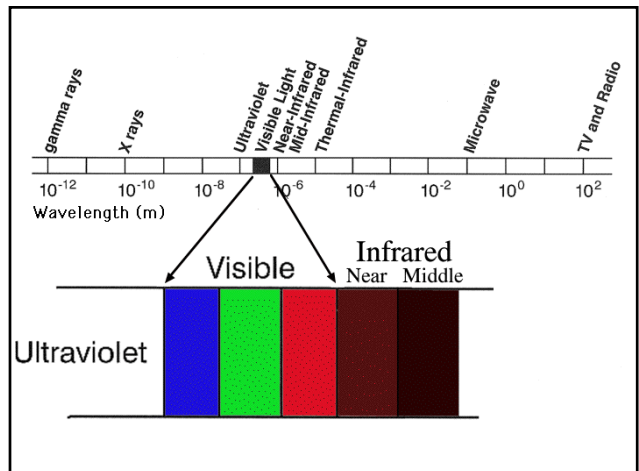
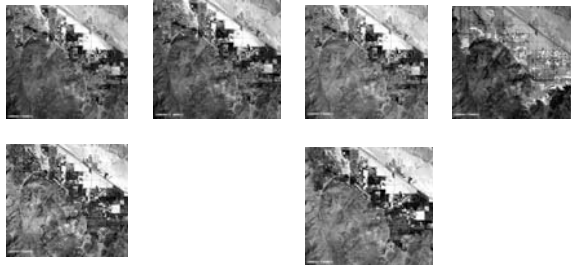
Swaths and repeat

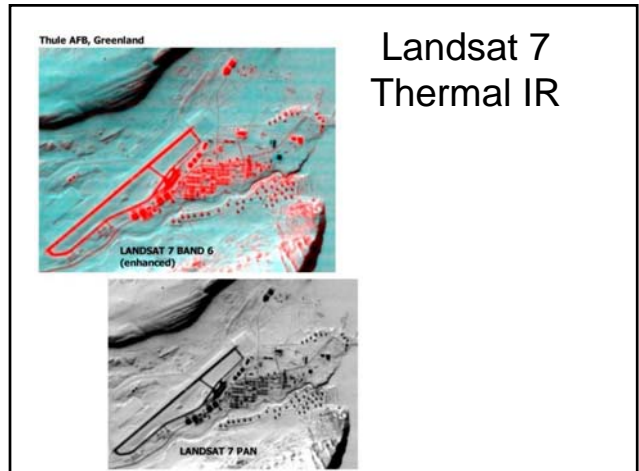
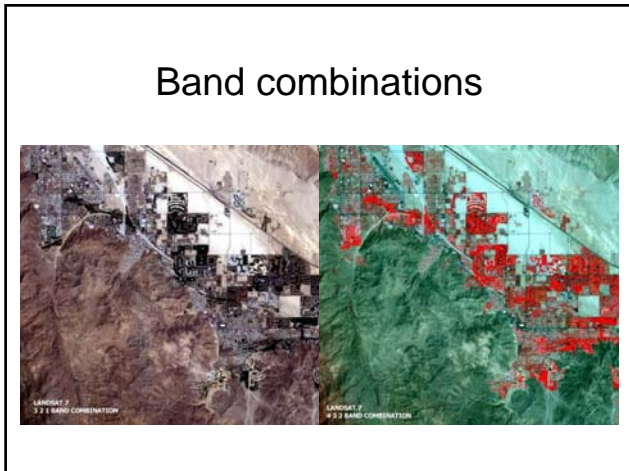
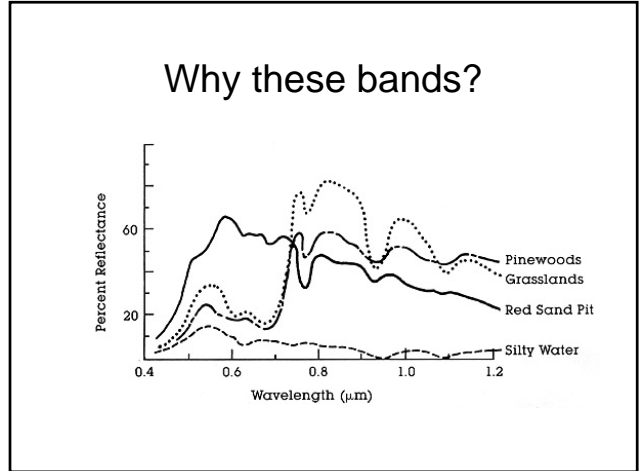
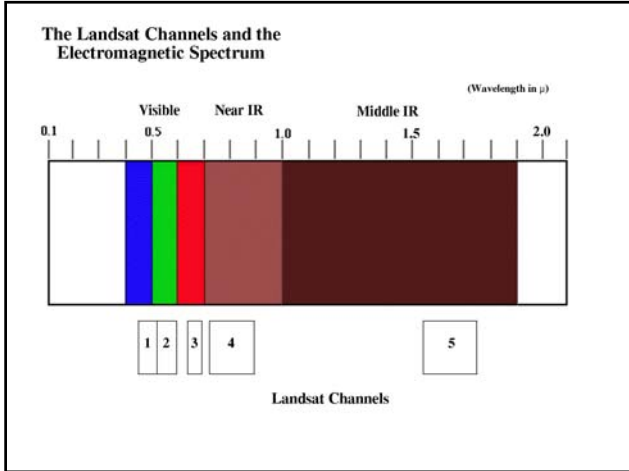


Landsat 7 ETM+

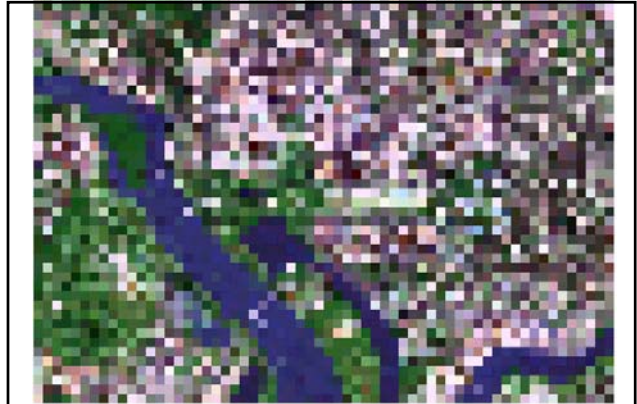
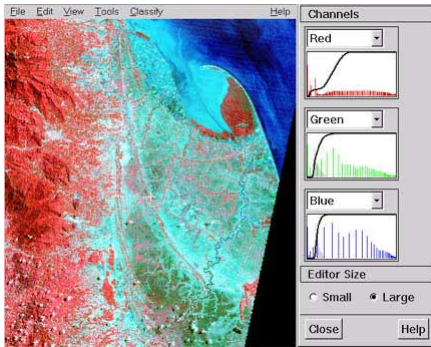


Landsat bands





Band histograms



100 meter resolution



30 meter resolution

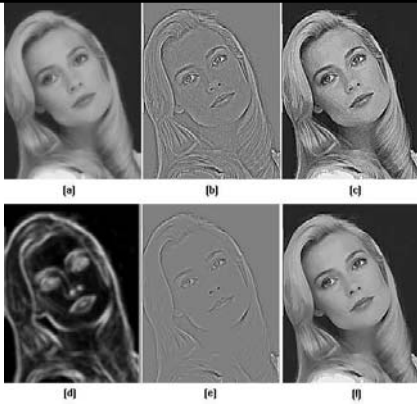
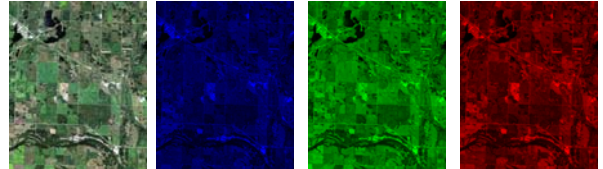


5 meter resolution

Multiresolution merge



Color image bands



- Simple Linear Combination Filtering: (a) Input image; (b) Laplacian of (a); (c) Spatially invariant high-pass filtering [sum of (a) and (b)]; (d) Mask image [Sobel gradient of (a) smoothed by a 5x5 box filter]; (e) Product of (b) and (d); (f) Space-variant enhancement [sum of (a) and (e)].

Landsat 7: Mount St. Helens



Image brightening

Landsat 7: Mount St. Helens



Histogram equalization

Landsat 7: Mount St. Helens



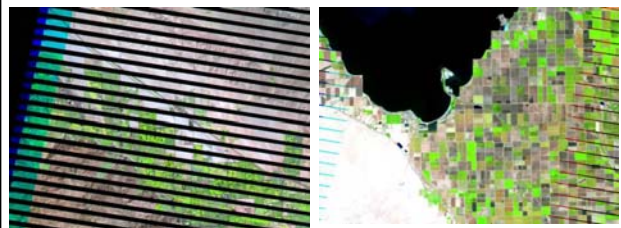
Image normalization

Landsat 7: Mount St. Helens



Image sharpening

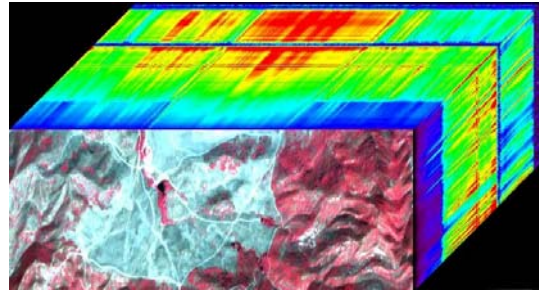
Landsat 7: Failure of the Scan-line corrector: May 2003



Taking up the gap

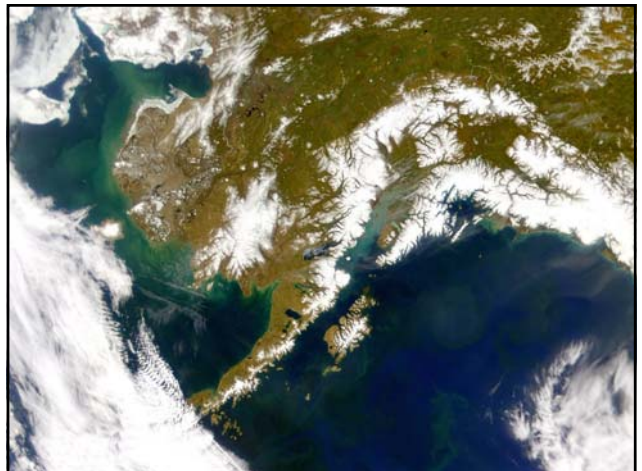
- ASTER
- MODIS
- AVHRR
- SPOT
- Digital Globe
- IKONOS
- Landsat follow-on mission
- Etc...

Hyperspectral Remote Sensing



Slide show

- Where?
- What?
- When?

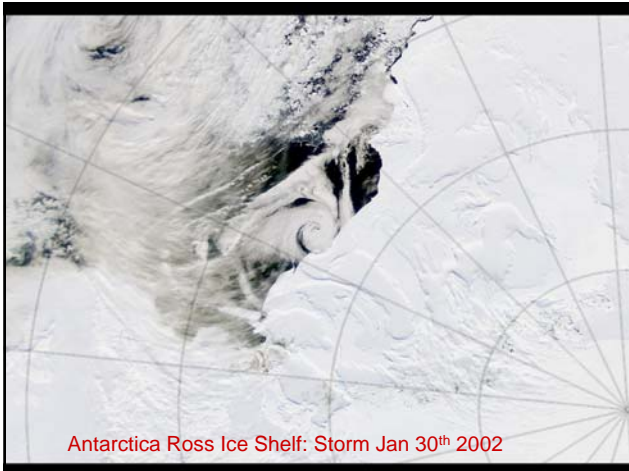




North Pole Storm (March 1997)



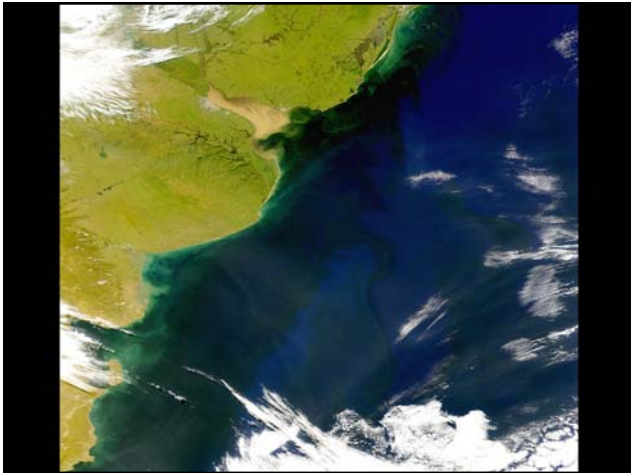
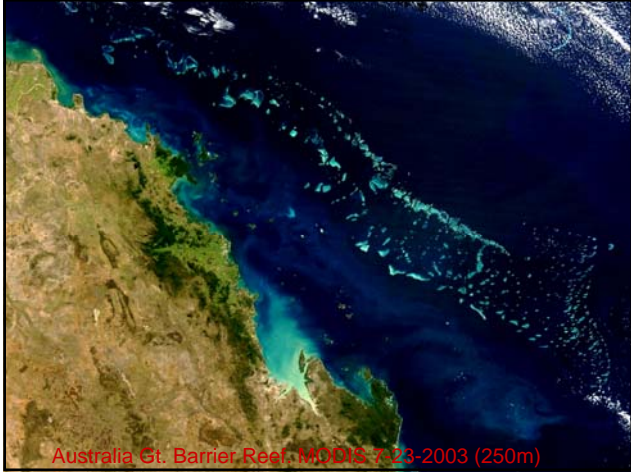
Lake Effect (Gt. Lakes)

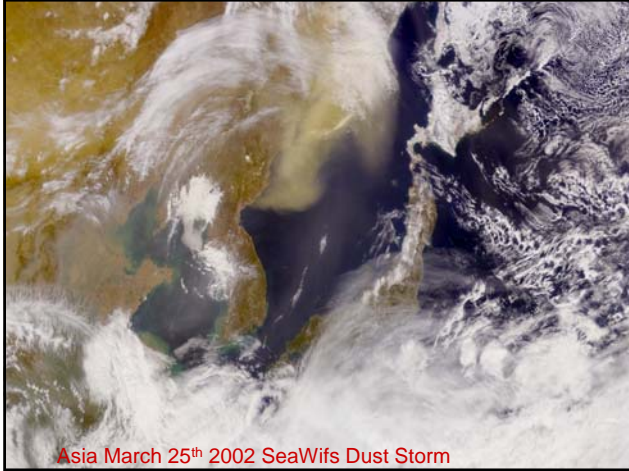


Antarctica Ross Ice Shelf: Storm Jan 30th 2002

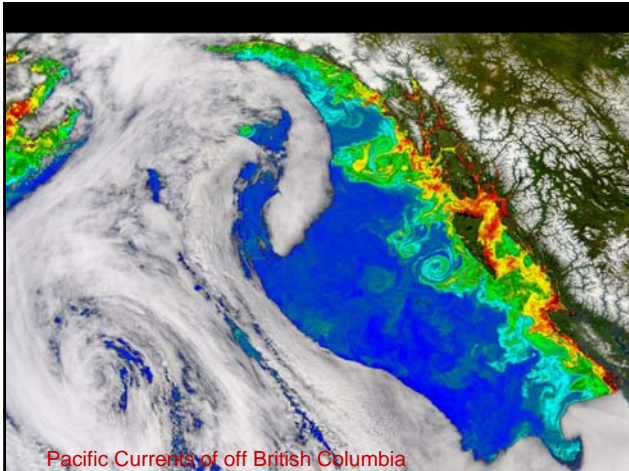


Storm (Pacific Ocean)

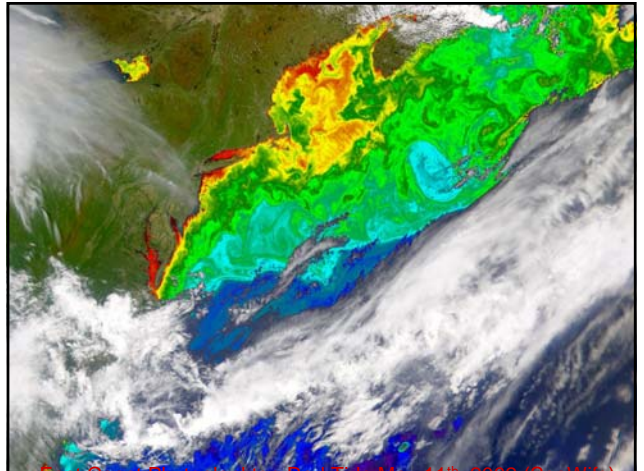




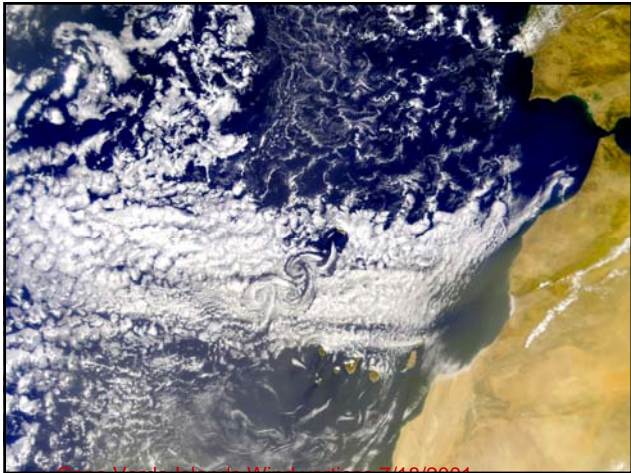
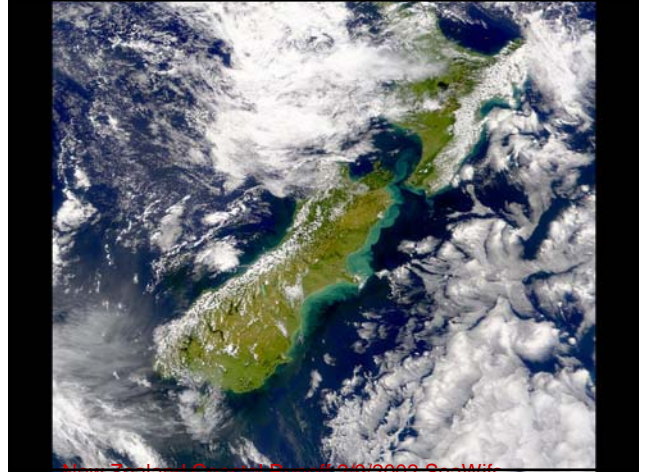
Asia March 25th 2002 SeaWiifs Dust Storm

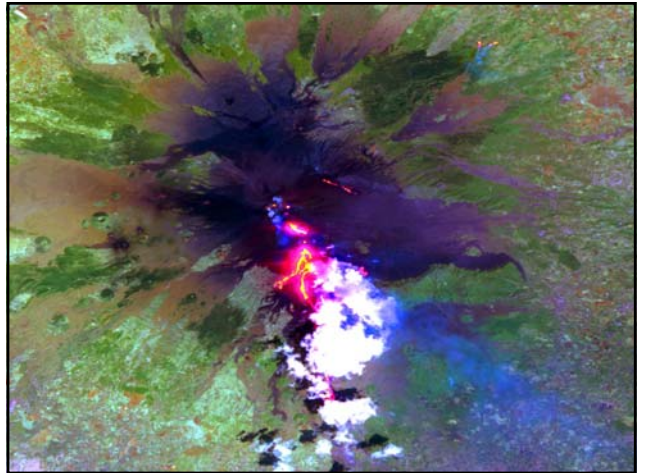


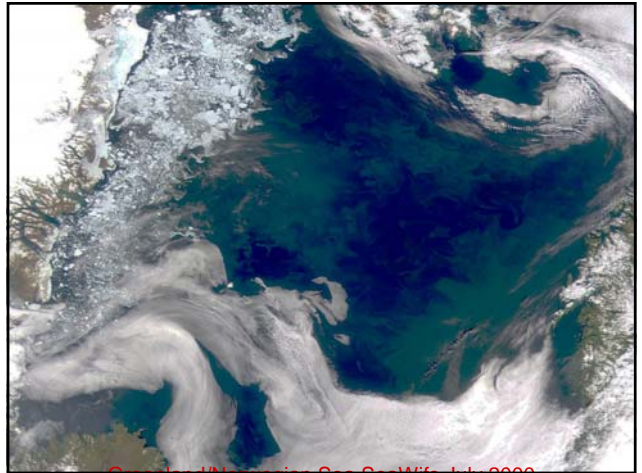
Pacific Currents of off British Columbia



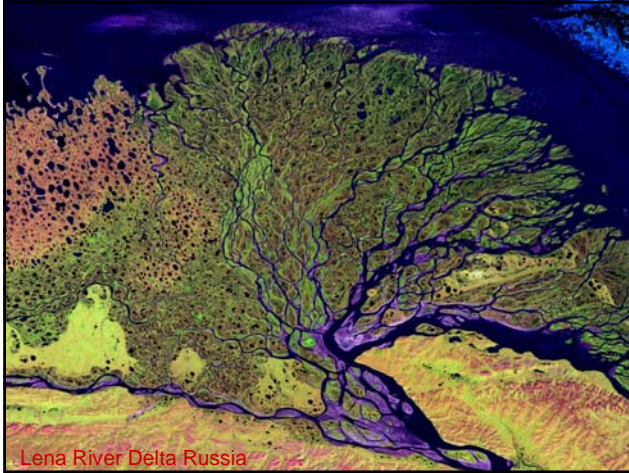
Pacific Currents of off British Columbia











Summary

- Remote sensing measures objects without being in contact with them
- Major NASA/NOAA public domain programs with plenty of data available
- Earliest satellite program 1958-
- Image processing can reveal information