

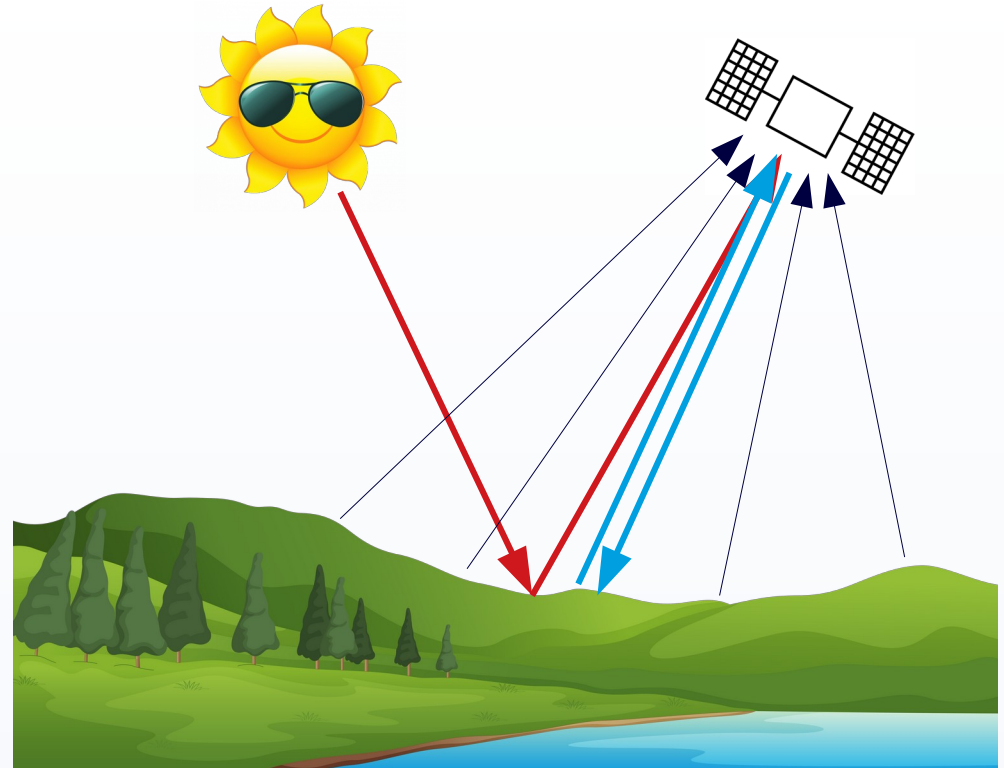
EGM310: GIS and Remote Sensing

Week 10, Part 2: Active Sensors

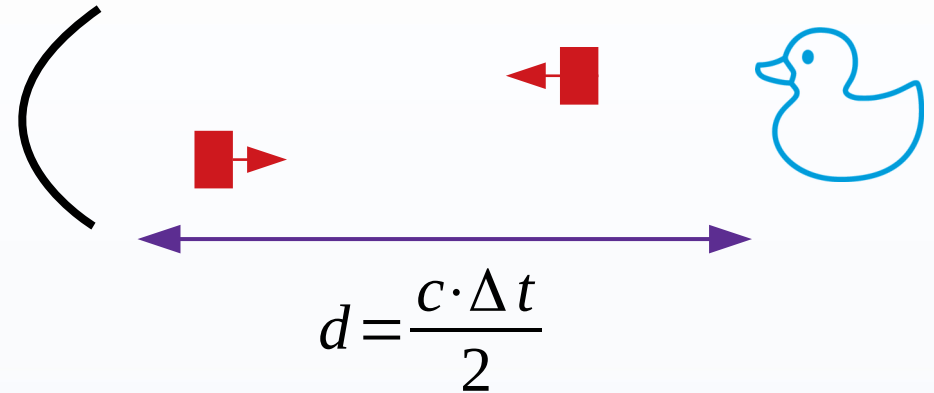
- Remote sensing involves measuring electromagnetic radiation

⇒ Need a **source** of EMR

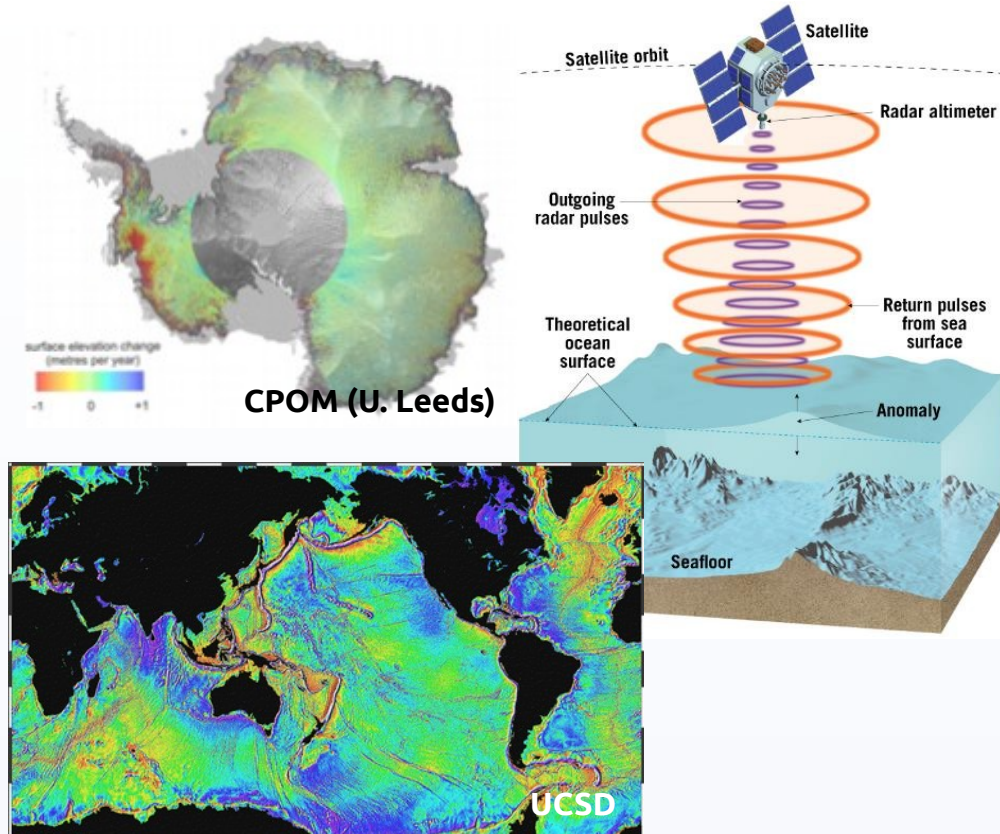
- Sun
- Object
- Sensor (**active**)



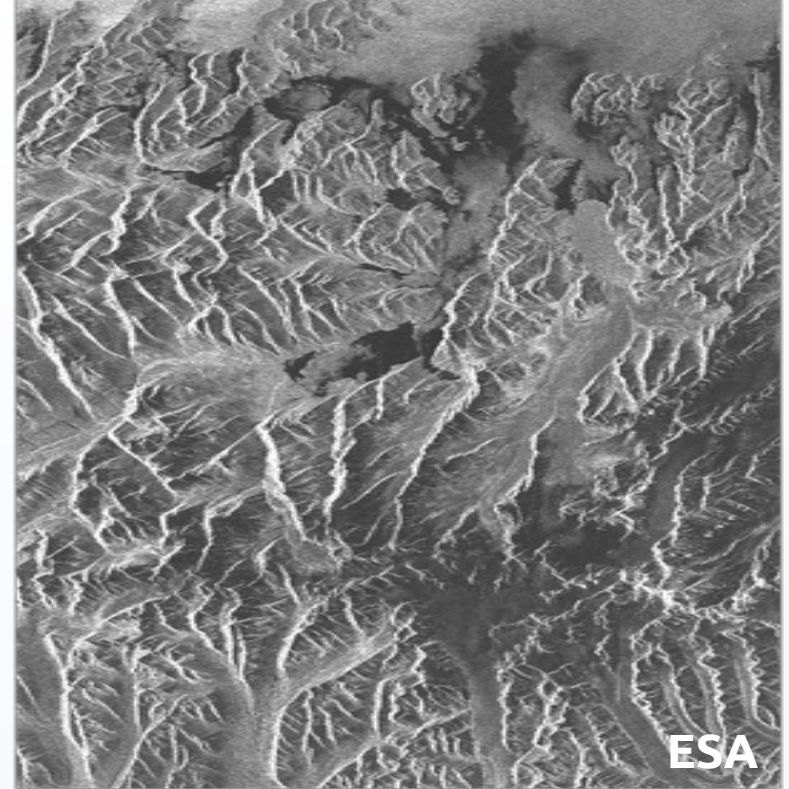
- Radio Detection and Ranging
 - Microwaves ($\lambda \sim 1\text{mm} - 1\text{m}$)
- Send a signal, measure return
 - Travel time
 - Signal strength
 - Polarization
 - Phase
 - Frequency
- Atmosphere largely transparent



- Measure distance between satellite and surface
- Can achieve high accuracy (< 3 cm)
- Large footprint limits application to “flat” surfaces
 - Ocean
 - Ice Sheets

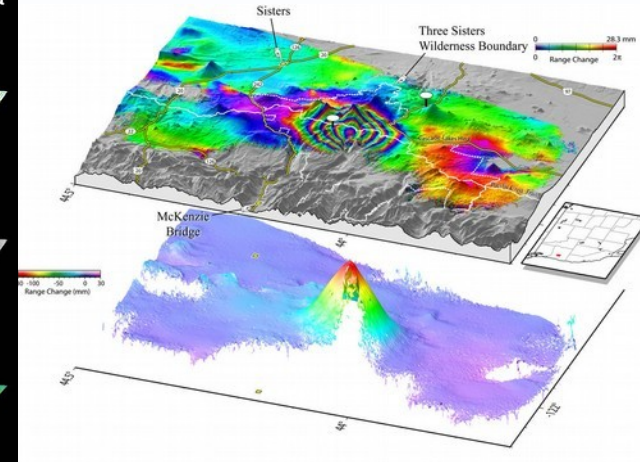
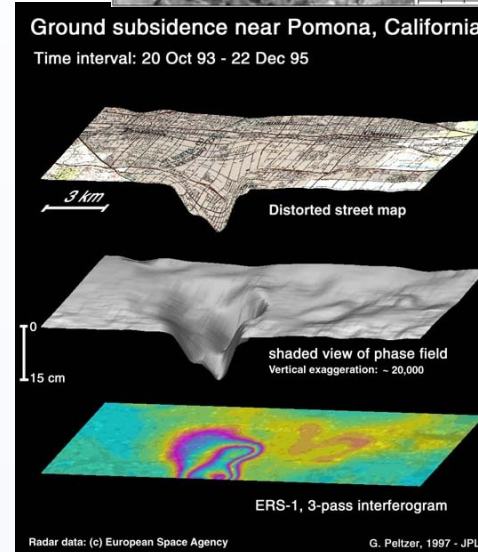
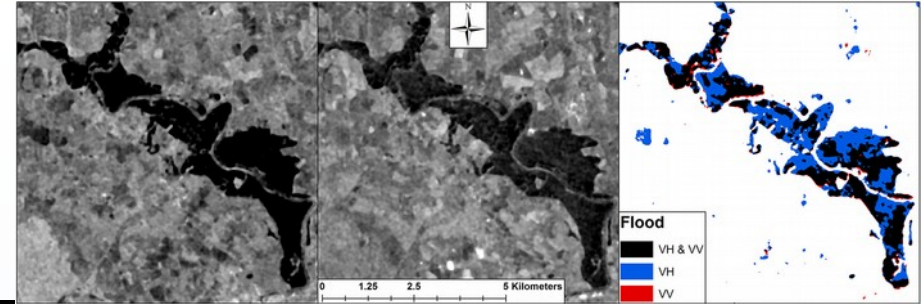


- Radar resolution (ability to separate objects) depends on antenna size, signal λ
- SAR is probably most common form of microwave remote sensing
- Signal characteristics (images) depend heavily on:
 - Signal λ , polarity
 - Surface characteristics (structure, **moisture**)
 - Geometry

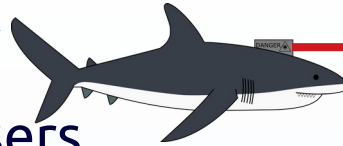


(Some) applications of SAR

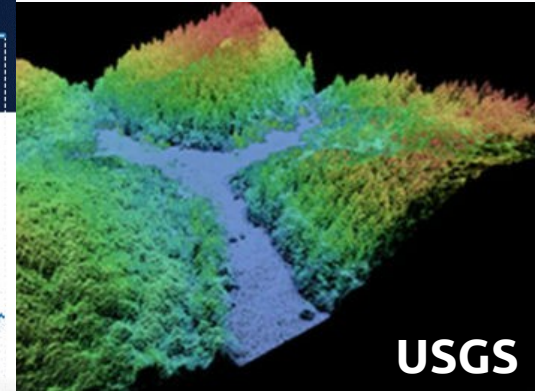
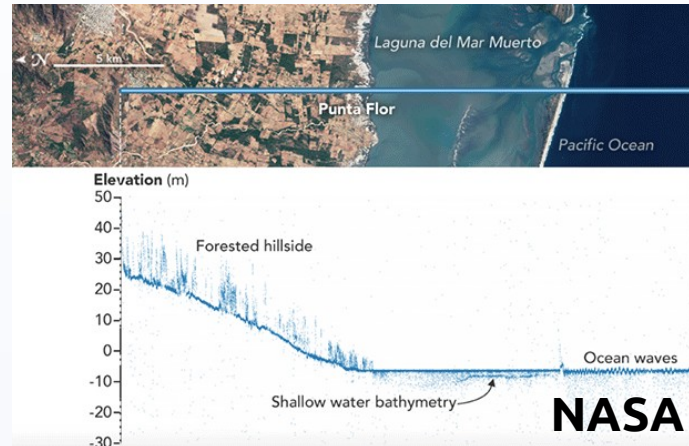
- Depending on surface, λ , signal measures **beneath** surface
- Different λ provide different information (e.g., forestry)
- Track surface moisture
- Flood detection
- Can also use SAR to measure topography, surface motion
 - Interferometric SAR (InSAR)



- Light Detection and Ranging
- Similar principal to radar
 - Typically 600-1000 nm lasers
- Gives information about:
 - Topography
 - Vegetation structure
 - Bathymetry



$$d = \frac{c \cdot \Delta t}{2}$$



- Active sensors:
 - Produce a signal
 - Measure the response of an object
- Altimeters: measure surface height
- Imaging sensors: provide an “image”
- Depending on signal λ , can be (mostly) weather-independent
- Useful for many different applications

- Lillesand, Kiefer & Chipman – Chapter 6
- Campbell & Wynne – Chapters 7, 8
- Natural Resources Canada [Remote Sensing Tutorials](#)
- What is Synthetic Aperture Radar? [[NASA](#)]
- Introduction to LiDAR [[NEON](#)]