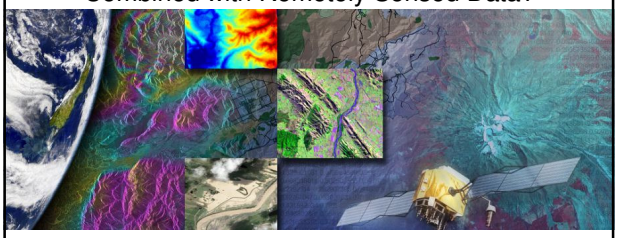
Lecture 7 – How Can Field Data be Combined with Remotely Sensed Data?



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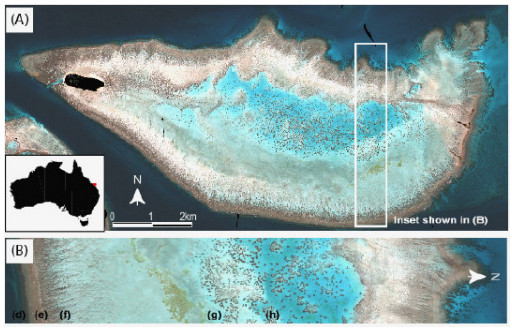
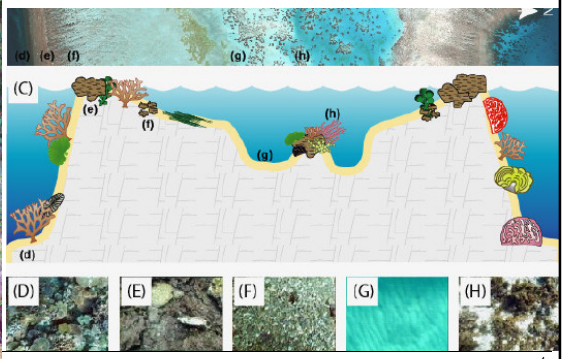
Revision / Discussion Questions

- Discuss the trade offs that exist between different sensor imaging dimensions
- Discuss the controlling factors of spectral reflectance and absorption in vegetation
- Discuss the controlling factors of spectral reflectance and absorption in marine environments
- What aspects of volcanic eruptions could be monitored using remote sensing
- What are the benefits of remote sensing
- Compare the different types of applications that are appropriate for the following sensors based on their spatial, spectral, and temporal dimensions: Worldview2, Landsat, Hyperion, MODIS
- What are the image interpretation cues - give an example for each
- Discuss the different characteristics of active and passive sensors, and the types of applications that are associated with them
- Discuss the difference between GIS and remote sensing
- What is the electromagnetic spectrum? Discuss its role in remote sensing and earth observation

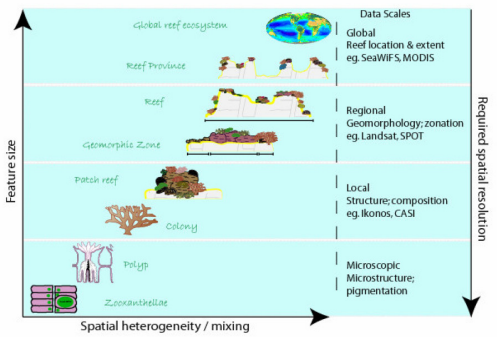
Study Site – Where is the Area of Interest



Reef Structure – What are the features to be mapped?



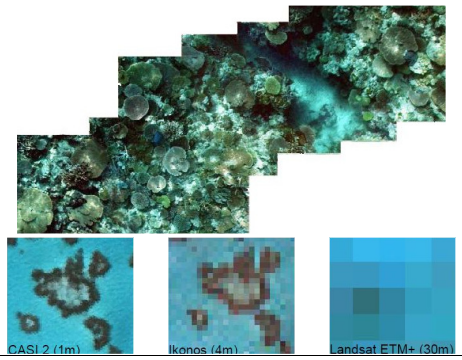
Spatial Complexity – What are the scales of interest?



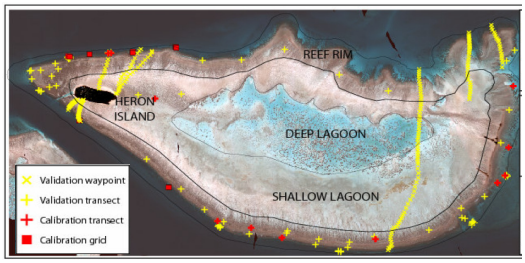
What Are You Trying to Map / Monitor?

- Field spectrometry – characterising spectral profiles for features of interest
- Ground survey – GPS located
  - Thematic
    - Reef Geomorphology
    - Benthic habitat type
    - Coral bleaching
  - Continuous
    - Live coral cover
    - Chlorophyll content
    - Temperature
    - Suspended sediment
- Data for calibration and validation

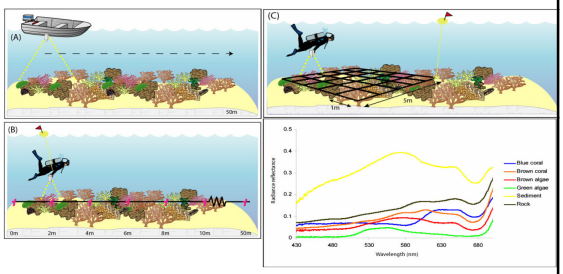
Image Acquisition and Spatial Complexity



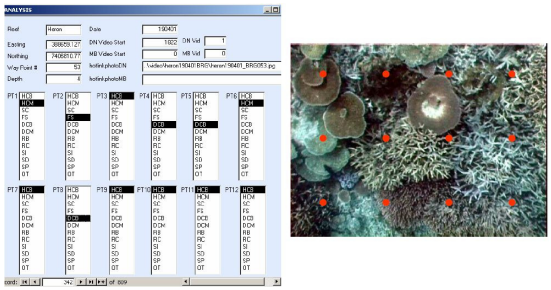
Field Calibration and Validation



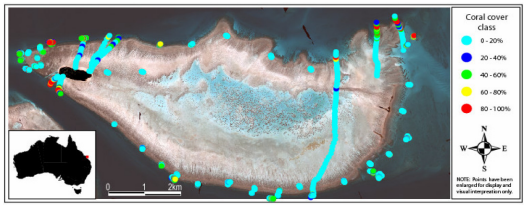
Field Data Collection – Thematic and / or Spectral



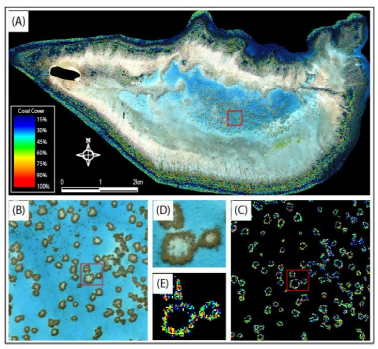
Determining Substrate Cover



Field Validation – Substrate Cover from Field Sites



Mapping Output



Your Job

- Revisit your Scoopit page and consider your application topic.
- Refine this to become a little more specific. E.g instead of 'Coral reef monitoring' try 'mapping coral reef benthic habitats'
- Revise your scoops, delete, add more... Don't forget to write your insight
- What sorts of products are generated to answer your application question
- What sort of field data is required to support or answer the question
- What equipment is used?
- How are the data collected?
- Answer these questions as part of your insight

Your Job

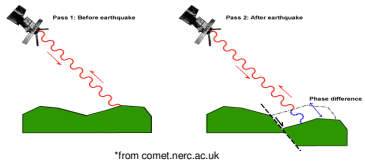
Scoop	Product	Field Data	Equipment	Technique
Karen's Coral example	Continuous map of live coral cover	Categorical estimates	Dive gear, boat; camera, measuring tapes	Transects, grids, photo estimates

Student Choice – Mapping Subsidence

- Problem – Ground water extraction is leading to land subsidence. How can remote sensing be used to map / monitor this? http://inhabitat.com/california-is-pumping-water-that-rained-on-earth-20000-years-ago/
  - What is subsidence?
  - What is the physical attribute that we want to measure?
  - What are some tools that allow us to do this?

Interferometry - InSAR

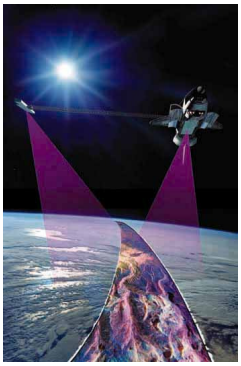
- Interferometric SAR (InSAR) measures phase difference of two SAR images
- Phase difference can be related to ground deformation
  - Earthquakes, volcanic activity, ground water extraction

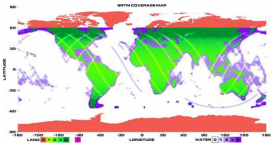


*from comet.nerc.ac.uk

Source: S.Samsonov

Shuttle RADAR Topography Mission

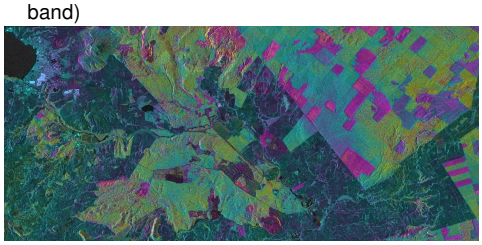




Source: http://www2.jpl.nasa.gov/srtm/index.html

Advantages of InSAR

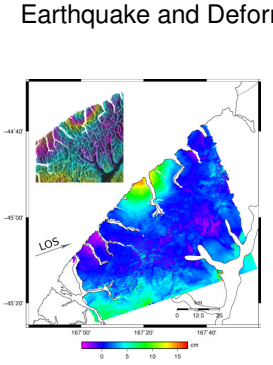
- High spatial resolution, 1 m – 1 km
- Large spatial coverage, 25x25 – 500x500 km
- High precision, ~λ/4, ~1.5 cm (C-band), ~6 cm (L-band)



Example: ALOS PALSAR interferogram, 20070113-20070228 (Bp=827 m). Full color range corresponds to ~12 cm of line-of-sight deformation.

Source: S.Samsonov

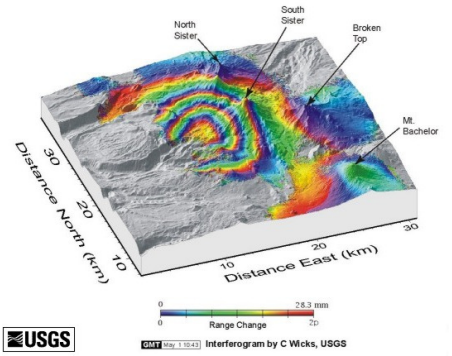
Earthquake and Deformation Mapping



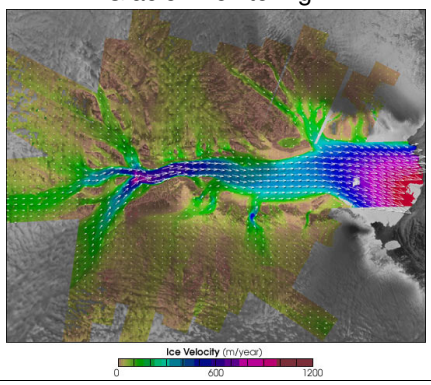
- M 6.7 George Sound earthquake 16 Oct 2007
- ALOS PALSAR interferogram 20070906-20071022
- Max displacement about 15 cm

Source: S.Samsonov

Volcano Deformation



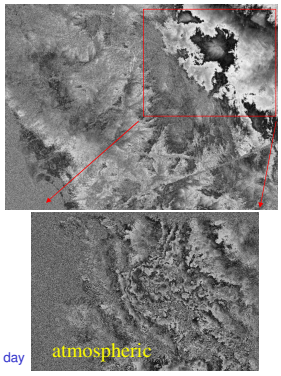
Glacier Monitoring



Source: CSA/NASA

InSAR Problems

- Decorrelation
  - Vegetation growth, farming, wind-blown sand, snow…..
  - Increases with time
  - Worse at shorter wavelengths.
- Atmospheric
  - Water vapour in atmosphere causes phase delay.
  - Can be significant (up to several fringes).
  - Assumed random (like clouds)
- Groundwater
  - Usually vertical
  - Persists over time
- Steep or unknown topographic gradients
  - Good DEM helps

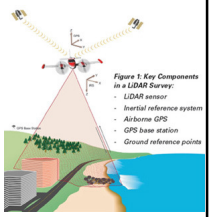


Same area, different day

Source: S.Samsonov

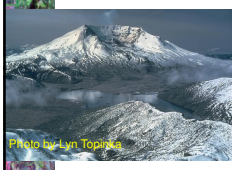
Laser Altimeter (LiDAR) Systems

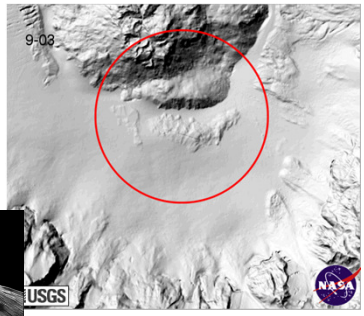
- Light Detection and Ranging
- Active system
- Pulsed laser sent down from platform at regular intervals – position of aircraft is measured precisely
- Receiver records all or a portion reflected waveform
- Time between signal transmission and reception is known, as is the speed of the pulse
- Calculate elevation of canopy and ground



Source: AAM

LiDAR Topographic Change





Mt St Helens