GEOG 357

LECTURE 13





Digitised features: Eyjabakkajökull glacier, Iceland

Generated from maps, digital vectors, or image processing - all initially remote sensing



Glaciers

- Glaciers are formed from snow fall.
 - Seasonal snow turns into firn and ice
 - Ablation removes snow through evaporation, runoff and calves of icebergs
- Winter glaciers are covered in snow
 - Summer it is either snow or cover

9/4/20XX

Presentation Title





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The spectral curve explains why glaciers look blue-green on a 5-4-3 composite (why?) .. and enables distinguishing snow/ice from clouds compared to a normal composite.. (why?)



Mid-IR/Near-IR-Red

Red-Green-Blue http://asterweb.jpl.nasa.gov/gallery-detail.asp?name=Aletsch

1. Image classification - **supervised** Accumulation area (snow); Ablation (ice) ... and firn (wet snow)



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Unsupervised classification: McBride OLI image including Kristi Glacier (SW corner)



Image classification - Unsupervised



These orange-pink ones, not the brown one (forefield) - why so many 6?

2. Normalised Difference Snow Index (NDSI)

NDSI (TM) = (2-5)/(2+5)

NDSI (OLI) = (3-6)/(3+6)

Method: use as threshold or input in classification

Note: its impossible to distinguish between snow covering glaciers and late lying snow on land except by size (sieve) and perhaps modelling from location

3. Ratio image - thresholding

.... NIR/MIR band ratio TM 4 / 5 (snow/ice >1.0) Red/MIR TM 3/5 (snow/ice > 2.0) ... 'better' for shadow areas



Snow and ice: very high in visible, very low in Mid-Infrared ('SWIR') **Ratio - Visible (Red) to SWIR** captures snow/ice almost exclusively - Some issues with silt-laden water, shadowed glaciers and debris cover



Puncak Jaya, Indonesia 4°S, 137°E elevation m. asl: 4884m

This is the highest peak in Asia, using distance from the centre of the Earth ...

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Landsat 5, 1988



Landsat 8, 2017



Grasberg gold Mine – largest in the world, diameter 2.3 \mbox{km}



Red/Mid-IR ratio



Threshold value 2.0



Convert bitmap to polygon





Vector smoothing



Overlay of 2017 polygons on 1992 image showing ice loss

Carstenz Glacier sample, 2002 High resolution 1m Digital Globe



Carstenz Glacier, 2015 Pleiades







2007-08: We used 50 Landsat scenes and applied the 3/5 ratio, with threshold >2.0 ~15,000 glaciers covering ~ 25,000 km²



Glacier retreat 1985 - 2015 at Mount Robson



Robson Glacier 1911-2011

Challenges

- 1. mixed pixels ----- lower threshold
- 1. shadows

 I ower threshold
- 1. Misclassified lakes ---- higher threshold
- 1. Debris Cover DEM? Thermal?

