

GEOG 357 Fall 2023: Lab 9

DIGITAL ELEVATION MODELS

In this lab, we will include non-spectral ‘ancillary’ DEM data.
Many of the tasks below could also be completed using GIS software options.

Four DEMs have been extracted to match the extent of the ‘Resthaven’ area from the last two labs in the Willmore Wilderness. Copy over this file to your folder:
L:\GEOG357\resthaven-dems.pix

1. Viewing your DEMs

In Catalyst:

Open your copy of rh2023.pix ... edit the RGB Mapper to bands 654 (enhance)

Open the DEM file – by default, it will show channels 1,2,3 in RGB

- 1: NTDB 1960 generated from contour lines mapped from air photos
 - 2: SRTM 2000 from Shuttle RADAR
 - 3: ALOS 2010 from Panchromatic imagery 2006-2011
 - 4: GLO-30 2015 from TanDEM (Radar) .. I forgot to include this in class *
- See Q5 at end of the Lab

They are similar so the ‘composite’ displayed is mostly grayscale. The histograms will confirm this – maybe the glaciers have downwasted a bit, notably in recent years; note that the earliest DEM does not include canopy height while the latter two do, so there can be some apparent elevation gain in the valleys. Most variation is within the precision of the DEMs.

Display each DEM separately:

Layer-> Add-> Grayscale-> select the DEM file and first channel 1 (NTDB)

In RGB Mapper, flip the RGB to channel 2 (SRTM), then 3 and 4

1a. Using the most recent DEM, what is the elevation of Ptarmigan Lake (in the NW image area) and Twintree Lake (SE corner) ? This is most easily done by viewing the band composite, but highlighting the elevation layer which should be ticked off (to see the colour image).

DEM differencing

Use the Raster Calculator to subtract GLO30 from NTDB and display to viewer, using 16-bit signed layer – this will remove unlikely elevation gains and show only loss (due to ice melt). surprisingly perhaps NTDB is not too different despite the 50 years, but there was little retreat 1960-80. Now do the same for SRTM – GLO30.

1b. What is the maximum difference 2000-2015 (= ice elevation lost) ?

Which is the best DEM layer to use for further analysis ?

– we need to view the shaded relief versions to see their respective qualities:

All tasks below are found in Algorithm Library -> Analysis -> DEM Analysis

Resulting output image layers may be to the viewer- grayscale (unless we need to keep them, and then we'd also write to your PIX file

In all cases, you are inputting the DEM channel as this is the mother for other layers

2. Shaded Relief (REL)

Use Algorithm Library -> Analysis -> DEM Analysis to find tool REL

Input: DEM file, channel 1 (NTDB)

Output Ports: Select Viewer-Grayscale (will display in Focus)

INPUT PARAMS TAB

Pixel X Size: 30

Pixel Y Size: 30

Elevation Step Size: 1 (= the 'step' between adjacent integer values)

Azimuth Angle of Light Source: 315 - note that it's not the default as in GIS software

Elevation Angle of Light Source: 45

Select LOG tab and run

This will display the shaded relief (hillshade) for the earliest DEM (1960)

It's not great, interpolated from contours – if you view the area in the SW corner, it's better as this is in BC and from the 1980s TRIM digital data.

Repeat REL for the other 3 DEMs and view display – you can flicker between them (turn on/off)

You should find DEM 4 is the best – the most recent and derived from higher resolution data, with 1-2 decimal places justifiable.

Viewing the shaded relief as a grey-scale image (BW). What do the DN's represent (0-255) ?

The numbers are simply on a comparative scale relative to lighting from the NW. You can read lake elevations more easily by viewing the hillshade but highlighting the elevation layer.

3. Transfer the Resthaven 2015 DEM into the image file

We will want the best DEM in our Landsat image file – highlight the DEM file

File-> utility-> TRANSFER

source: the DEM file (it should already be listed if you just opened and highlighted it)

destination: your rh2023.pix file

select channel 4 -> add-> transfer layers

Close

Check it is there: switch from maps to files tab

Expand the Rasters list -> the DEM should be the bottom layer / channel in the rh2023.pix file

Rename it properly if needed: right-click -> properties and type its name as the label e.g. DEM

SLASP Slope gradient and ASPECT: We are NOT going to use this option in today's lab

4. Incidence: ANG le of Incidence

Remember from lecture notes, we can get around the issue with Aspect that it is circular but still retain a layer that indicates different lighting i.e. Incidence

Input is the DEM channel

Light source: we have the sun's azimuth and elevation angle from the scene metadata which is included whenever you download image data from the EarthExplorer website.

This will be the only text file (.txt) in the folder.

View it – you don't need any software for a text file and look for these two parameters:

Sun Azimuth = 160 and Sun elevation = 40.5

'Distance' is technically 150 million km (the sun) but 100000000 is good enough

Output to grayscale AND your image pix file

Run ANG

What are the resulting DN values ?.. incidence values are always between 0-90

How are the DNs different to the hillshading ? – quantitatively they are now meaningful

Q2a. What are the minimum and maximum incidence values

*Q2b: what is the incidence value for flat terrain (lakes): why is this obvious in hindsight ?
(given how Incidence is created ...)*

5. Classification

One reason to create these DEM channels is to improve classification in mountain areas.

You will need all these input layers in the same file (rh2023.pix)

OLI bands 4,5,6, NDVI, DEM and Incidence

You have NDVI from last week, but in a different file (rh-ndvi.pix) . You can transfer it over in the same way you did in step 3 above (with the DEM layer) from rh-ndvi to rh2023

File->Utility->Transfer the NDVI 2023 layer from rh-ndvi.pix to rh2023.pix

Try an unsupervised classification – you will need to add 4 new layers – see if it accepts 8 bit

a. use as input bands 6,5,4 and NDVI

b. repeat with bands 6,5,4, NDVI plus DEM (elevation) and Incidence ...

- does adding DEM channels help ? Likely not due to the strong shadows

Run a supervised classification with the same 6 input layers as in b. above – use two empty layers for the training channel and classification output. See lab 3 if you need a reminder on the process. I suggest these training classes /seeding:

water - both clear lakes and silty meltwater glacier lakes

glacier - accumulation (snow) and ablation (ice) areas

bare-rock - sunlit and shaded, and different shades of red in the composite

fires - the two regenerating fire areas

coniferous - green areas in the valleys

pine - these show as brown-green in the valleys, discoloured by pine beetle attack

alpine - looks yellow-green, above the tree line

avalanches - not as prominent here compared to Bowron – look for their distinctive shape

meadows - riparian un-treed areas in the valley bottoms usually next to rivers

sub-alpine - these show as a brighter green within or next to the alpine, more sparsely treed

Review your signature separation report for reference to see if you seeded and trained well 😊

Preview and then Run the classification – Maximum Likelihood (no null class).
Save the classification report.

Q3-4. Please attach the classification report – but only down as far as the line with KAPPA COEFFICIENT - Mine was 0.898 ... can you do better ? 😊

6. FLY (like an eagle) – optional ‘fun’

It’s like Google Earth, with a better band combination, but basic Landsat pixel resolution
Run the flight simulator from the Catalyst menu bar options .. (‘eye in the sky’)

When it starts pick: file-> Load DEM + RGB

in the next window, .. select the DEM channel (navigate to it, select and close) and then select 6-5-4 in your copy of the 2023 image (select and close)

The defaults fly you **too low**, and the window is small, so change using edit -> options
edit-> perspective->position/speed/direction - change vertical position to 5000, angle to 50

Need more vertical exaggeration: edit-> perspective-> change height magnification to 2

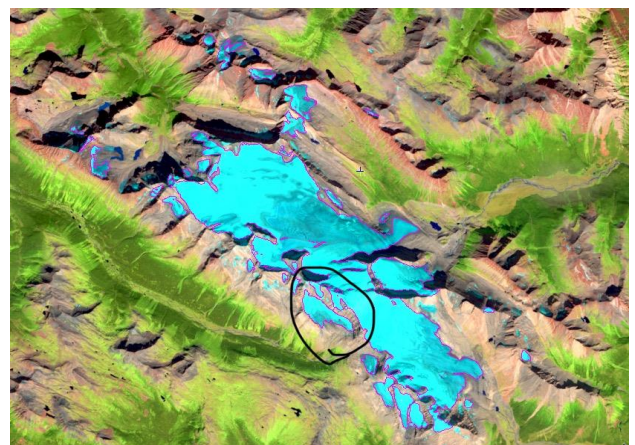
FLY control panel:

left button allows you to change parameters - you will need to increase 'elevation' from 1 to 3 to exaggerate terrain

second button starts a FLY

third button displays a vertical view ... check out options etc..

see if you can replicate this view taken by a student in this class a few years ago - – she seems to be near 337000, 5915000 – see photo and annotated image



Questions repeated here: please send by next Wednesday –as .txt or .doc

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1b. What is the maximum difference 2000-2015 (= ice elevation lost) ?

Q2a. What are the minimum and maximum incidence values

Q2b: What is the incidence value for flat terrain (lakes): why is this obvious in hindsight ? (given how Incidence is created ...)

Q3-4. Attach your Classification Report – just down as far as ‘KAPPA COEFFICIENT’

Q5. The Copernicus GLO-30 DEM represents the best available DEM for most parts of the world, and would be where you’d go to download a DEM for projects, except perhaps for BC and local areas covered by LiDAR.

a. Is this DEM a terrain model (DEM) = the bare ground, or a surface model (DSM) = includes vegetation, buildings etc..

b. There is a related downloadable higher resolution (10m) DEM for some places – which ones ?