

GEOG 357 Fall 2025: Lab 8

DIGITAL ELEVATION MODELS

In this lab, we will examine 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\labs2025\resthaven-dems.pix

1. Viewing your DEMs

In Catalyst:

Open your copy of rh2023.pix ... edit the RGB Mapper to display 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 2016 from Panchromatic imagery
- 4: GLO-30 2019 from TanDEM (Radar)

They are similar so the ‘composite’ displayed is mostly grayscale. The 3 channel DNs and the histograms will confirm this. View the DNs at bottom to see only minor differences – the glaciers may have downwasted a bit, notably in recent years. Note that the earliest DEM does not include canopy height while the others do, so there may be apparent elevation gain in the valleys. Most variation is within the precision of the DEMs, with small variations mostly due to variable slope interpolation.

Display each DEM separately:

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

In RGB Mapper, then flip the RGB to channel 2 (SRTM), then 3 then 4 – little difference to see

Stay with the latest (and best) DEM #4

1a. Using the GLO-30 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 lakes on the composite).

Run THR to find all land above 3200m; the highest point will be in the centre of the largest high area polygon. You can find the highest point by querying that centre area location and also examine the elevation layer histogram for maximum value.

1b. What is the highest point in this area in elevation (metres) and x,y (UTM)

We could use the Raster Calculator to subtract two DEMs and display to viewer, but the DEMs need careful re-registration to avoid interpolation errors, missing data and shadows – this might be more suitable in the advanced RS course

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

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

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

Resulting output image layers will 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 it is 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 is from the 1980s TRIM digital data.

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

No need to save them, just display in viewer / grayscale

You should find DEM 4 is the best – the most recent and derived from higher resolution data, though 1-2 decimal places (cms) are hardly justifiable. But no artefacts or terracing.

With the shaded relief as a grey-scale image (BW), what do the DNs represent (0-255) ?

The numbers are simply on a comparative scale relative to lighting from the NW.

NW facing slopes have higher DNs and SE slopes lower DNs.

Flat surfaces e.g. lakes will have intermediate DN values. You can read lake elevations by viewing the hillshade but highlighting the elevation layer (same as in Q1a).

3. Transfer the Resthaven GLO-30 DEM into your 2023 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 (GLO-30 DEM) -> 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. GLO-30DEM

You no longer need the original file with 4 DEM layers - ALL work now MUST be done in the rh2023.pix file. It's best to remove all other files from the project:

Switch to 'files' tab; right-click on resthaven-dems.pix and 'remove from project'

4. Incidence: ANG le of Incidence

Remember from lecture notes, we can avoid 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 again

Pixel X Size and Y size are 30; Elevation step size = 1

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 2023 text file (.txt) in the folder on L:\GEOG357\labs2025, double-click on it: you don't need any software for a text file and look for these two parameters:

They are just below the first full screen:

Sun Azimuth = ~ 160 and Sun elevation = ~ 40.5 (rounded from decimals)

Light source distance is technically ~150 million km (the sun) - 150000000 is good enough

Output to grayscale AND your image pix file

Run ANG

What are the DN values ?.. How are the DNs different to the hillshade ?

The image is like an inversion with the sun in the SE but now they are meaningful

Note some 'dead zones' in the shadowed areas with 'N/A' given as the result = no light

These can be removed / modified using EASI modelling, but not this day !

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 Angle of Incidence is created geometrically ...)*

5. Classification

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

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

OLI bands 4,5,6, Elevation, and Incidence

a. Unsupervised

Try an unsupervised classification – you will need to add 4 unsigned 16-bit new layers

Use Isodata with 16 classes and defaults

a. use as input bands 6,5,4 (and as RGB display); run the classification

b. repeat with bands 6,5,4, plus DEM (Elevation) and Incidence ... output to the same channel

- did adding DEM channels help ? No, due to the strong shadows and probable need to ‘scalar’ the DEM layers to similar scale / ranges as the image bands.

b. Supervised

Run a supervised classification with the same 5 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. Make sure NOT to close the windows for raster seeding and training site editor

Let’s keep it simple with these 6 training classes:

water - seed both clear lakes and silty meltwater glacier lakes

glaciers - seed both accumulation (snow) and ablation (ice) areas plus shadowed glaciers

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

coniferous - dark green areas mostly in the valleys and lower slopes

deciduous - include some avalanche slopes, alpine areas above the forests and valley meadows

fires - the two regenerating fire areas - likely still mostly deciduous

A full classification e.g. for a project might also subdivide into:

alpine - looks yellow-green, above the tree line

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

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

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

Remember you will need to increase the two tolerance settings in the raster seeding window, which appears when you start the classification training. Save after each training class.
Review and save your signature separability report, to check your seeding / results
You should get good separation with these basic classes if you trained well
In the training site editor window, select tools -> signature separability / save the report

Q3a. Submit the signature separation report in your answers; comment on any low values and why those classes may be tough to separate – no need to get a perfect table / report

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

Q3b. Please attach the classification report – just down as far as the line with Kappa value

Normally we might also have wanted to include a slope layer, but that tool was ‘acting up’.

*Q4. Which classes might have benefitted / classified better with slope included and why ?
i.e. how are these classes associated with slope gradient ?*

The Copernicus GLO-30 DEM represents the best available DEM for most parts of the world, and where you might go to download a DEM for projects, except perhaps for BC and local areas covered by LiDAR. Use your browser / google powers to answer Q5.

5a. Is this GLO-30 DEM a terrain model (DTM) or a surface model (DSM)

5b. There is a downloadable higher resolution (10m) DEM for some places – which ones ?

Submit answers as usual via Moodle as .PDF or .TXT

Optional section if you have time

6. SEENARE – determine areas seen from a point (like Viewshed in GIS software)
This is another tool in the Analysis-DEM analysis section

Input: DEM layer; output: Viewer-PCT

Input params: X,Y, Z for the highest point in the image – (your answer to 1b)

.. you could add 2 metres to Z to include your viewing height

Run

[visible areas from the point should show as a bitmap, best seen over the hillshade)

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

It’s like Google Earth, with a better band combination, but basic Landsat pixel resolution
GE may look better as it is global and not limited to this image area.

Run the flight simulator from the Catalyst menu bar options .. (‘eye in the sky’)

When it starts, pick:

file-> Load DEM + RGB - ignore any warning messages related to image size
in the next window, .. select the DEM channel (navigate to it, select and close)
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 and options

edit-> position/speed/direction-> change elevation to 5000

edit-> perspective-> -change tilt to 50

FLY control panel:

left button allows you to change parameters – position (in x,y), elevation, speed

second button starts a FLY

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

Options -> Render Mode allows you to switch between Normal and **Anaglyph** – like the examples in class, but the image is variable – red/blue glasses available

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

