

## Remote Sensing, Fall 2020: Lab 9 (or is that 8 ?)

### DIGITAL ELEVATION MODELS

In this lab, we will use non-spectral 'ancillary' DEM data. Most of the tasks below could also be completed using GIS software .

#### A. PG - Preparing the DEM from TRIM files

Start Geomatica Focus Banff and open your PG 1996 pix file (you could use your 2013 image file – either way no problem, and display the optimal colour composite.

To confirm the size of the Landsat (TM) pixels, switch the maps tab to files, right-click on the pix filename and select properties -> projection ... this will give you the pixel size.

I've pre-prepared a DEM to match from the BC TRIM

- we are going to transfer the DEM as a new layer (channel) into your image .pix file.

Layer-> add-> grayscale and browse to find **/home/labs/GEOG357/pgdem.tif**

Open/Display the new TIF file and ensure it matches the Landsat in extent

Right-click on the new DEM .tif and -> overview of layer

What is the pixel size: switch to files tab, right-click -> properties and view the last tab

It's part of the BC TRIM provincial DEM created at a different resolution to today's imagery

You can view it this way, but to include it in analysis with your imagery, you need to

**transfer** the DEM layer into your PIX file

**File -> Utility -> Transfer** (NOT translate or you will destroy your output data file)

source : pgdem.tif

destination: your PG 1996 .pix file

select all-> 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

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

Note that it is 16bit signed, whereas the TM image layers are 8-bit unsigned

switch tab back to maps from files

Note: all channels must be in the same pix file for analysis and display

## 1. Viewing your DEM

Add the new channel as grayscale:

**layer -> add -> grayscale -> pick the pg1996 file -> DEM channel -> Finish**

zoom in so you can see individual pixels and compare them with the Landsat (switch the DEM layer on/off) ... transferring the DEM has converted pixel resolution from 25 to 30m to match

.. click the mouse on a few locations and note the elevations in metres, and view all values in layers-> histogram and the cursor panel, what are the minimum and maximum values ?

What do you make of the histogram peaks – knowing the local area geomorphology ?

*They will be more common values - where it is flatter e.g. water or plateau surfaces e.g. the River, Lake, Bowl*

*Q1. What is the elevation of a. Shane Lake b. Tabor Lake ?*

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 layer for other layers

## 2. Shaded Relief ( REL )

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 its not the default like in GIS software

Elevation Angle of Light Source: 45

Select LOG tab and run

Look at the shaded relief as a grey-scale image (BW). What do the DNs represent ?

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

### **Note how well it displays topography:**

The bowl versus Cranbrook Hill, the dissected glacial deposits in the Hart, sinuous eskers north of the Nechako, flat area near the airport (you can see the roads as they are raised on gravel above the wet clay lands of beds of glacial lake Prince George); note the general NE-SW trend of the small hills on Cranbrook Hill (=direction of glacial advance/retreat), and how clear Tabor Lake is compared to the DEM. There is some vertical striping from the TRIM "mass points".

### 3. Some bitmap flooding

a. In the same way that we tried to extract water using a threshold value in the NIR band for water in Lab 2, let's do the same here by finding and 'flooding' the image with a rise in water level to 600metres elevation.

Tools → algorithm librarian and find THR

Input is the elevation channel

Output to viewer-PCT

In the parameters, add 600 for maximum

If you need a minimum, enter the lowest elevation for this DEM

Run and you should see the landscape 'flood' to 600 metres.

Turn off the DEM channel so you can see the flooding over the image landscape (543 composite)

When the glaciers retreated ~12,000 years ago, impounded meltwater formed *Glacial Lake Prince George* which reached up to ~ 760 metres elevation ..exactly the height of UNBC Agora. Rerun THR with a maximum value of 760 – output to viewer-PCT and your pix file. Zoom in on UNBC to see where the lakeshore would have been.

#### **b. ARE task – Area under bitmap**

This calculates the area under the bitmap (area flooded in this image)

Input elevation channel

Mask = the bitmap you just created

Output – you get a numeric output 'actual area' and 'projected area'

*Q2a: what are the two area values and what do they mean (the help is not helpful),  
hint: they would be the same if it was flat – ArcMap gives the same dual results*

#### **c. VLM task**

This calculates the volume under the bitmap – in this case the volume of flood water

The answer may be in scientific notation, but the 'output parameters' tab also gives the answer.

*Q2b. What is the volume of water with the lake at 760m  
(in this image ... the lake extended far further beyond the image area)*

Note: if you wanted to calculate the unflooded area and volume of land above the lake level, you'd simply do the reverse threshold and find all land above 760m

**OK, enough of PG, we are off to the Rockies .....**

---

## 4. Preparing the Resthaven DEM

Let's enjoy a more exciting DEM:

File-> New project

No need to save the PG 'project' unless you want to load this exact setup again

– then save and give it a name

Open your 2015 Resthaven file from last week (rm2015.pix) and the stretched 654 composite

As this is across the Iron Curtain in Alberta, there is no 'TRIM' DEM data, but I've downloaded the federal DEM from 'Toporama' online and clipped it to fit our image area stored in

L:\labs\GEOG357\willmore\rh-dem-utm.pix (I saved as .pix, but it could have been .tif)

Open this file in the project (no need to copy it) and we'll transfer it into our image file

File-> utility-> TRANSFER

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

destination: your rh2015.pix file

select all-> 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

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

Note that this time, it's a 16 bit layer, like the image bands, but 16S (allowing for possible negative values unlike an unsigned channel for band reflections) while the bands are 16U.

switch tab back to maps from files

Note: all channels must be in the same pix file for analysis and display: every new layer you create in the lab becomes a channel in your 2015 .pix file

## Viewing your DEM

Remove the original DEM file from your display (the one stored in L:\labs)

Add the new transferred DEM channel to the display: layer -> add -> grayscale -> pick the 2015 file -> DEM channel -> Finish

.. click the mouse on a few locations, and view all values in **layers-> histogram**

*Q3a: what are the minimum and maximum elevation values ?*

You could flood this landscape too if you wished using the same method as in A. for PG, but it's too beautiful to flood, unlike downtown PG

## 5. Shaded Relief ( REL )

Output Ports: Select Viewer-Grayscale - no need to save this as a channel as it's for viewing

### 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

Elevation Angle of Light Source: 45

Select LOG tab and run

It's a bit scrappy – the federal models from digitised map contours are not as smooth as the BC TRIM directly from air photos, but it will do. You can see the difference in the SW corner section in BC where it is derived from BC TRIM data.

*Q3b: What is a typical shaded relief DN value on a flat slope e.g. lake ?*

## 6. Slope gradient (and ASPECT): SLASP

Input = the DEM channel

Run and display slope in viewer-PCT, and also output to your .pix file

We don't have any need for Aspect, so don't tick any output options for Aspect

query the slope values: what are typical DNs on the slopes inside the lakes, on mountain tops ?  
(You must highlight the slope layer in the TOC list)

AARGH!! they are in 32-bit - overkill !

We could fix that by 'transferring it into an 8 bit channel... create an empty 8-bit raster layer

Files tab, right-click on filename -> New -> raster layer -> 8 bit .. add one and close

In Tools-> EASI Modeller, type %x=%y (and Run) DO NOT TYPE X and Y !!!!

**Where x is your new empty layer and y is your slope channel.**

This write the 32 bit slope values into an 8 bit file, truncating the decimals.

**Note:** if you do this in reverse, you wipe out your slope layer with 0 values from the empty layer  
You should now have a slope layer with DNs in integer values – no silly 5 place decimals

If you have problems with this, no worries as we can use the decimal slope layer – it's just 'false precision' as the model is not good enough to warrant such detail.



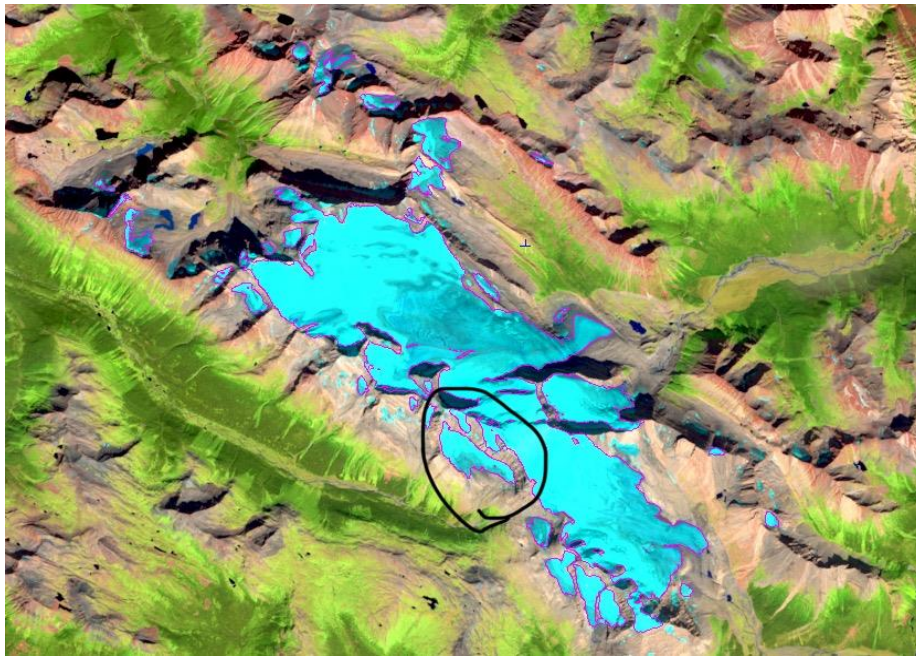
\*We have two Mackenzies, but this one is MacKenzie M. and Mackenzie H has a small k. So I'll refer to them as MacK and Mack, or Mack H and MacK M. It's a bit like the Spice Girls who had two Melanies, so they were known as Mel B and Mel C - as well as Scary and Sporty :)



MacK seems to be near 338000, 5915000 for view 1, and 337000, 5914000 view 2. She can correct me if I'm wrong – I used the slope layer to find flat spots – you can match the glaciers in the image with those in the photos (see image area below).

Your goal then for the final mark is to recreate one of these views in 'Fly' as below:

- or if you have difficulty with these views, select a perspective of your choice that captures the essence of the area



## 8. FLY (like an eagle)

It's like Google Earth, with a better band combination, but lower Landsat res. here  
Run the flight simulator from the Geomatica Banff 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 2015 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..

*Q5: Use the windows (Osmotar) snipping tool to capture your image (same as last week)*



**Questions repeated here: please send by next Wednesday** – either as email message with image attached, or as .doc file including the image

*PG DEM*

*Q1. What is the elevation of a. Shane Lake b. Tabor Lake ?*

*Q2a: what are the two area values under the bitmap and what do they mean (help is not helpful),*

*Q2b. What is the volume of water with the lake at 760m*

*Resthaven DEM*

*Q3a: What are the minimum and maximum elevation values ?*

*Q3b: What is a typical hillshading DN value on a flat slope e.g. lake ?*

*Q4a. What are the minimum and maximum incidence values*

*Q4b. What is the incidence value on a flat slope e.g. lake .. why is this value obvious ?*

*(think trigonometry)*

*Q5. Attach your flight image*

## **9. Classification – Optional or project**

One reason to create these DEM channels is to improve classification in mountain areas like BC. I'm thinking this lab is already long enough .. it would not take long with unsupervised, but likely needs supervised e.g. to create training areas with sunlit and shaded samples for bare rock. This would be a possible project option.

Try an unsupervised classification –

a. using as input only bands 6,5,4

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

- does adding DEM channels help ?