Remote sensing, Fall 2018: Lab 6
DIGITAL ELEVATION MODELS

In this lab, we will use non-spectral 'ancillary' DEM data.
It took me a few tries to resample the provincial TRIM 25m resolution to 30m to match the Landsat image, and you can see the troubles I had by viewing the resulting hillshades. Open these two: *bowronbadshade.tif* and *reallybadshade.tif* in: */home/labs/geog432/data2018*
the first is a result of changing 25m to 30m pixels without compensating for TRIM being in NAD83 and Landsat in WGS84
the second is direct conversion from 'geographic' - latitude/longitude - both are useless.
This cost enough time, that I don't want you to have to do it, so I prepared the DEM for you: *bowdem30.tif*

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1. Preparing the Landsat and DEM file

Start Geomatica and open your copy of the 2009 Bowron Lakes image.
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.

Add the DEM to the display: layer-> add-> grayscale ... and pick bowdem30.tif in /home/labs/geog432/data2018

Note there is a wee sliver of the image located south of the DEM file. If I liked torture, we would mosaic the TRIM tile below it to fill the gap, but as its small, instead you will **clip the image to match the DEM extent**.

- Highlight the Landsat image in the files list
- tools - clipping/subsetting
- Input: the Landsat image should already be selected
- Available layers: pick just the bands (1-7) plus the NDVI and Tassel components, you can also include a classification you might have if you wish
- Output: give it a different name ' you could simply add b to the previous name ...2009b
- Define clip region: pick the option: Select a file
- the file will be bowdem30.tif (in the labs folder)
- The output raster image square should now show a red rectangle, omitting the strip along the south edge - if not, you forgot something
- Click on 'clip' and then close (if it worked)

File-New Project
open the newly clipped image and the DEM .. they should/must be the same extent. Check to make sure-> Overview of layer

Now the image and DEM extents are the same, we transfer the DEM into the next available channel into the .pix file

Now you are ready to **transfer** the DEM layer into your PIX file
File -> Utility -> Transfer (NOT translate or you will destroy your output data file)
source : the DEM .tif
destination: your clipped 2009 .pix file
select all-> add->transfer layers and then 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
Q1: what is the size of this image in pixels and rows (also given in properties)
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 clipped 2009 .pix file

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2. Viewing your DEM

Add the new channel to the display as grayscale: layer -> add -> grayscale -> pick the 2009 file -> DEM channel -> Finish
also add as pseudocolor: (same format as above)

.. click the mouse on a few locations, and view all values in **layers-> histogram**
Q2: what are the minimum and maximum values (for the whole layer) ?

All tasks listed below are found in Algorithm Library -> Analysis -> DEM analysis
It may be easier to pick them from this list than to keep using the 'find' option among all tasks
In all cases, you will input the DEM channel (and if you save, then it's to your 2009 .pix file

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3. Shaded Relief (REL)

Output Ports: Select Viewer-Grayscale - no need to save as a channel, though you can

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
The result should be a work of art compared to the two ugly hillshades at the start of the lab.
Look at the shaded relief as a grey-scale image. What do the DNs represent? ...why use 315, 45 ?

Q3a: In which types of locations are the approximate maximum and minimum DN values ?
Q3b: What is a typical DN value on a flat slope e.g. lake ?
N*ote how well it displays topography, which can't be seen in the DEM channel alone*

4. Some bitmap flooding

What is the elevation of the Bowron Lakes (they are not all the same) ?
- easiest to see by displaying the hillshade but querying the DEM - highlight the DEM on the left

What would happen if the water level rose to 1000m e.g. someone built a dam:
We can 'flood' the landscape based on elevation using the **EASI modelling tool**
a. add a bitmap -> change maps tab to files tab, right-click on filename, **new -> bitmap** and note the bitmap number when you expand the bitmaps list ... change files tab back to maps
b. Add this new bitmap to display … **layer -> add -> bitmap** (its empty at first)
c. In **tools -> easi modelling**, we will flood the terrain up to 1000 metres, type this:

[x = the DEM channel number, y = the empty bitmap; DON'T TYPE X or Y !]

if %x < 1000 then
%%y=1
endif

This says if the elevation (Channel) is less than 1000m, then make that pixel a '1' (= yes)
If you mess up just type %%y = 0 to clear the bitmap - make sure here that you type %% and not % which would erase a channel
then retype the 3 lines above (or save it first as a .eas script)

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5. ARE (area under a bitmap)

Q4a: How much area was flooded in this dataset? ... to answer this, use ARE:

input the parameters to calculate the area under the bitmap you created above; remember to change pixel size to 30 if needed; convert from square metres to square kms (divide by 1 million)

Q4b: what is the difference between 'actual' and 'projected' area ? (hint- if the area was completely flat, they would be the same) – ArcMap does this exactly the same way

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6. Incidence: ANG le of Incidence

Light source: we should have the sun's azimuth and elevation angle from the scene metadata ...
In the Linux folders display, open the .mtl text file for the 31 July 2009 image in the data2018 folder and look for lines that give the values for sun azimuth and elevation. 'Distance is technically 150 million km (the sun) but 100000 is good enough
Output to grayscale
Run ANG
View the resulting DN values .. incidence values are always between 0-90
Q5: a. what is the incidence value for flat terrain (lakes);
b. How/why did you already know this ?
c. We've got some N/A values – isolated white pixels. Why ? and where are they located ?

7. Slope gradient and ASPECT: SLASP

Run and display slope in either viewer-grayscale or viewer-PCT, and output to your .pix file
Include the parameters for Aspect, but output only to screen - pseudocolour
It doesn't give a choice of degrees or % - which one does it use ?
query the slope values: what are typical DNs on the slopes inside the lakes – N/A again (this is annoying), on mountain tops, on glaciers ?
(You must highlight the slope layer in the TOC list)
AARGH!! they are in 32-bit = overkill and not justifiable re the precision of the DEM

8. Classification

Try an unsupervised classification
a. using as input bands 3,4,5,
b. bands 3,4,5 plus DEM, slope and Incidence ...
does adding DEM channels help e.g. separating water from shadow ?

ideally you could at least separate the main cover types: water, snow/ice, bare rock, deciduous. Coniferous, cutblocks, wetlands, but possibly this needs a supervised approach e.g. so you can create training areas for bare rock that include sunlit and shaded areas

9. Pseudo-Stereo Pair Task: STE

These are produced in the opposite manner to an anaglyph from an air photo stereo pair:
By combining a DEM and a band (TM band 4), a simulated image is produced from a slightly different view with different parallax offset, and then an anaglyph can be display from the original band and the pseudo-band

Input image is band 4
(and DEM channel for Input DEM)
Output to your pix file
parameters: stereoscopic factor = 1 or 2 or 3 (my guess !)

Display Band 4 and stereo pseudo-band image each in grayscale (layer->add-> grayscale);
Flick between the two and see the 'shift' from parallax effect - If they were air photos which one would be on the left?

We can see in '3D' by overlaying them in red and blue and using the fancy glasses: (in the lab)

Display Band 4 image plane in Blue and Green, or an empty channel in Green, the new stereo pseudo-band in Red
Don the glasses and screaenjoy the True 3D image

10. FLY (like an eagle)

Run the flight simulator from the PCIworks panel .. (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 5-4-3 in your copy of the 2009 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

If you're flying, try this larger scene: but if everyone is trying, the FLY could become CRAWL..
Larger full scene (Bowron Lakes) is available for more flying at: **/home/labs/geog432/dome.pix**
Check the channels: 1,2,3 are bands 5,4,3 for 1994; 4,5,6 are 5,4 3 for 1986 and channel 7 is the DEM; so pick 7 for DEM and 1,2,3 for colour bands

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..

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11. 3D Perspectives: PSGIMAG – generates a still perspective for reference; this option can be testy ... don't try unless you have time

The algorithm librarian tool PSGIMAG will drape a satellite image over a digital elevation model, to create a 3D perspective- may be useful for presentation.
FILES TAB
Input: choose bands 5, 4, 3
InputElevation: choose dem channel
Output: choose Viewer-RGB

INPUT PARAMS 1
Elevation: 5
Background Colour: 0,0,0 (black)
Edge Colour: 0,0,0 (black)
View Point (Pixels): 1000, 1000
Height Above Sea Level: 7500
Field of View: 45
View Direction: 315
View Inclination: 45
Everything Else: Leave as is

Try a new view
Change View Point: 0, 300
Change View Direction: 120 (again, you can change these if you want)
Then change two parameters to view from the NW looking SE, in PSGIMAG:

- Change **vpoint = -100,-100,7500** (100 pixels to the N and W of the NW corner).
- Change **vangle = 135,45** (azimuth 135= SE) and Select **run**.

NOTE: In a raster system, rows are numbered starting from the top, columns are numbered starting from the left; hence 0,0 (or 1,1) is the top left, 1000, 1000 is the bottom right (if its a 1000 x 1000 file).

NOTES:

- Azimuth is measured clockwise from north starting from 0.
- The vantage point is located 100 pixels outside the corner so that when you view the scene you see the whole scene. If you were located directly above the corner, you would not be able to see what is underneath you, just as you cannot when in a plane.
- Vangle gives the azimuth (horizontal direction of view) and vertical dip of view (at what angle are you looking down).

SEENAREA (visibility) - same as Viewshed in ArcMap

Just for show, no need to do here: Input location with DEM as input layer; it will produce every pixel visible from that point - usually more effective draped on a perspective

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CONTOURS - optional / just here for reference

Instructions are here, but why would we want to do this - it's for cartography not remote sensing ...

Run this operation first with contours every 50 metres, then change to 20 (and run), .. note on the finer values that bits of disconnected lines appear especially in flatter areas (the bowl) - indicating errors from interpolation.
Note the vector options in PCI - with the files tab activated in contents, right-click on the layer name, and in attribute manager, list segments; then under properties, see display options. There are not as many options as in a vector GIS.
