Remote sensing, Fall 2015: Lab 6
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 - indeed I mosaiced the two map sheet DEMs 93G and 93J using the arcmap mosaic tool.

I have grayed some options out as they are less important and marked them as optional

I have extended the options in this lab - do as many as you feel you want.
Sections 0-12 are the basics; after that, the options apply to the mountain scene

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0. Preparing the DEM from TRIM files

Start Geomatica and open your PG 2011 pix file.
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.

- we are going to transfer the DEM as a new layer (channel) into that file, but first a few steps, as the DEM covers two 1:250,000 map sheets. The DEM mosaic is *dem93gjmosaic.tif*
Open this file from **/home/labs/geog432/data2015** (you DON'T need to copy it)

Right-click on this file and view projection properties ... it has a different pixel size versus Landsat

Now switch back to the ('maps') list on the left and select **tools -> clipping/subsetting**

Input file is the DEM mosaic
Output file will be in your geog432 folder and match the landsat image in extent
Select a TIF format from the dropdown, and name your file something like *pgdem.tif*

Under *clip regions* - *definition method* choose -> select a file - and pick your PG pix file
Once selected, you should see a red clip box in the big window showing the clip extent
Tick the 'available layers' raster button and click RUN
when it's done, click close
Open/Display the new TIF file and ensure it matches the Landsat in extent

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 : your clipped DEM .tif
destination: your PG .pix file
select all-> add->transfer layers

Add the new channel as grayscale: layer -> add ->
zoom in so you can see individual pixels and compare them with the Landsat (switch the DEM layer on/off) ... you will see that transferring the DEM has converted pixel resolution from 25 to 30m to match the image

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1. Viewing your DEM

View the DEM either as **grayscale**, or **pseudocolour**
.. 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 3 histogram peaks – knowing the local area geomorphology ?

My 'map guy' interpretation may be they are the valley floor, glacial lake bed, and Cranbrook Hill are the peaks at 600, 670 and 750 metres respectively ??

All tasks listed below are found in Algorithm Library -> Analysis -> DEM Analysis
Resulting output image layers will be mostly to the viewer- grayscale
In all cases, you are inputting the DEM channel

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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
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? ... why use 315, 45 ?

Where are the approximate maximum DN values ?
What is a typical DN value on a flat slope ?

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 even in this DEM with resolution); note the general NE-SW trend of the small hills on Cranbrook Hill (=direction of glacial advance/retreat).

You may be able to see some residual vertical striping from the TRIM data collection method ...

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3. Some bitmap flooding

'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
b. Add this bitmap as a layer … **layer -> add -> bitmap** (its empty at first)
c. In tools -> easi modelling, flood the terrain up to 600 metres

if %1 < 600 then
%%x=1
endif

(where your new bitmap number is 'x'), then ***run***

d. increase the elevation by 50 metres, run again, and continue to flood the bowl (heh heh !!) ... 650, then 700, then 750 - this is how it was in 10,000BC

e. After the glaciers retreated ~12,000 years ago, impounded meltwater formed *Glacial Lake Prince George* which reputedly reached up to ~750 (maybe even 760 metres) elevation ..

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4. ARE (area under a bitmap)

How much area stayed above the lake at 750m elevation ? ... to answer this:
Create a new (empty) bitmap and use EASI MODELING to identify all land above 750 m
(if %1 > 750 ..... etc)

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)

what is the difference between 'actual' and 'projected' area ? (hint- if the area was flat, they would be the same)

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5. CONTOURS - optional!

Instructions are here, but why would we want to do this ?

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.

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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 ... but I deleted the metadata file (MY BAD!!) ... we'll assume as its captured about 10.30am, (and 6am = 90, noon = 180), so about an azimuth angle of 150, and elevation angle of 40 [the real numbers are available if I download the scene again, but this is close enough for a lab!], and distance 10000 (km)... technically it could be 92 million - distance to the sun

Output to grayscale
Run ANG
What are the resulting DN values .. range and typical values on slopes and flat? How are the DNs different to the hillshading ? .. - ..... incidence values are always between 0-90

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7. Slope: SLP

Run slope (in degrees), and display in either viewer-grayscale and viewer-PCT, and query the values:
what are typical DNs ?
a. on the scarp of Cranbrook Hill
b. sides of Connaught Hill (downtown)
c. The bowl and top of Cranbrook hill
Note also the gulley cut by Shane Creek down from Shane Lake, past campus and to the bowl

Use tools -> EASI modeling to answer this query for practice;
[First, add a new bitmap layer to display the results]:
You plan to build a house, above 700 metres elevation (to avoid fog and floods) AND on slopes > 20 degrees (for a view). What is your model equation to pick only these sites ? [you could also do this in QGIS or ArcMap]

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8. Aspect: ASP

Run ASP with the correct parameters (30 for X and Y, 1 for step size)
Select Viewer-PCT as output
Note that you could specify a value for zero slope (flat)
Run
What range of values have been assigned ?
What value is given to flat (no aspect) pixels if you don't assign one ?
Now assign **-1** to flat slopes, run and see how the image differs visually - otherwise the same DNs but different colour palette - this can often happen because of one extreme value - you should understand why.

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9. VLM (volume report under bitmap)

If local lakes or sea level rose to 750m, what volume of dry land is left behind above this elevation?
- use the mask (bitmap) from section 4 above.

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10. SEENAREA (visibility)

A valiant band of prehistoric UNBC students survived the flooding. From this location (512000E, 5971800N), and a lookout post 5 metres above the ground (z=5), output to PCT-viewer and display the area they can see from their vantage point. (This would likely look best draped on the DEM, but not right now). You can view it over the hillshade by right-clicking on the produced PCT layer-> properties and change opacity to 25% (enable hillshade to be visible if not already).

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11. Pseudo-Stereo Pair Task: STE

These are produced in the opposite manner to an air photo stereo pair:
By combining a DEM and a band (here band TM 4), a simulated image is produced from a slightly different view with different parallax offset.
Input image is band 4

output to a new channel
parameters: stereoscopic factor - 10 (this is a guess!)

Display Band 4 and stereo pseudo-band image (9) in 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:(should be in the lab)

Display Band 4 image plane in Blue, an empty channel in Green, stereo pseudo-band (9) in Red - or display band 4 in blue and green if you don't have an empty channel

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This next section creates 3D perspectives - it used to work much better than ESRI options (before ArcScene)

12. FLY

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, and then 5-4-3 in your copy of the 2011 image

The defaults fly you too low, so change using edit -> options
The area is a bit limited, but if you all flew a bigger area, things slow down.

If you're flying, try this larger scene:
Larger scene (Bowron Lakes) is available for more flying at: **/home/labs/geog432/dome.pix**
Check the channels: 1,2,3 are bands 3,4,5 for 1994; 4,5,6 are 3,4 5 for 1986 and channel 7 is the DEM

FLY control panel:
left button allows you to change parameters - you will need to increase 'elevation' from 1 to 4 to exaggerate terrain
second button starts a FLY
third button displays a vertical view
check out options etc..

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13. You could load the same DEM and scene in ArcScene (Osmotar) – optional

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14. Mountain DEM – McBride

For a more exciting DEM in the coastal mountains, steps 1,2,6,7,8 could be repeated with the McBride image:

0. Repeat the step to clip/import/transfer/ the DEM into the image file: the 1:250,000 map sheet is **dem93h.tif**

1. View the DEM as above

2. REL

6. ANG

7. SLP

8. ASP

New: run an unsupervised classification with inputs: bands 4,5,6 plus DEM, SLP and ANG *
I do have the metadata for McBride - ask for them if I didn't update this pdf

- can you see any improvement over previous attempts ? .. basically in a mountainous area like this, a serious attempt at classification would require incorporating a DEM.

15. 3D Perspectives: PSGIMAG – for reference; this option can be testy ...

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 2011 or 1992
InputElevation: choose dem channel from pgdem.pix
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

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).