GEOG432/632 Fall 2015 Lab 2
Digital numbers and Histograms

This lab will continue from last week and examining the DNs that make up satellite image bands, in this case for Landsat Thematic Mapper, and then Landsat 8 OLI data

Visible: 1,2,3 (Blue, Green, Red) Near IR: 4 Mid-IR: 5,7 Thermal IR: 6

Thematic Mapper (TM)	Landsat 4-5	Wavelength (micrometers)	Resolution (meters)
	Band 1	0.45-0.52	30
	Band 2	0.52-0.60	30
	Band 3	0.63-0.69	30
	Band 4	0.76-0.90	30
	Band 5	1.55-1.75	30
	Band 6	10.40-12.50	120* (30)
	Band 7	2.08-2.35	30

1. Color Image Display and Set-up

Remember the difference between RGB – the display guns and the image bands (1-7)
Image Bands: Refer to the individual Landsat TM bands ranging from 1 -7.
Display guns (RGB): up to three planes can be displayed simultaneously in red-green-blue (RGB). Displaying the same channel three times in RGB produces a gray tone image.

All files for this lab (and future labs) are in the folder***: /home/labs/geog432/data2015***
The native format for PCI images is **.pix** (though you can load other formats)

Use the PCI local launch icon to start geomatica2015 (in Linux)

Loading Satellite Imagery in Focus

- **file -> Open** and select **pg2005.pix**
- This shows a portion of a scene captured in late 12 august 2005
- Resize to get best display .. you should be able to see the whole dataset without panning

The initial display usually has poor contrast; default bands 1-2-3 are in R-G-B ('reversed': blue band is shown in red, red in blue) -> 'flip' bands 1 and 3 by right-clicking filename and then **RGB mapper** right-click enhance enhance - root- usually works best

Maps and Files tabs
On the left in the 'TOC' you see two tabs: maps and files. The default is files, which enables display options, while files shows database information. Switch the tab to files and right-click on the filename.
General – file size History and metadata – none given
Projection – ACEA (Albers Conic Equal Area)
Switch tab back to Files

2. Examining histograms

View the histogram by selecting:
Right-click filename -> histograms OR select (in menu bar at top) **Layers -> Histograms**

This displays the histograms for the bands in the file displayed
Get more detail and information for each one by clicking on its histogram (yes, try it!)
Would higher or lower standard deviation give you more variation in an image band ?

Note (as in lectures): the 3 histograms are similar in shape (all are visible bands);
All have a low range of values compared to the 0-255 possible range
The minimum DN decreases as wavelength increases as bands are less affected by haze

Layer-> Add RGB and add the 5-4-3 composite (enhance)

View the histograms for this composite (note that you have to select/highlight this layer) Note the differences in shape, and how the IR histograms are bimodal (why?)
Switch band 3 with 2 in the composite display – it won't change much as 2 and 3 are similar

To complete looking at all bands, switch the RGB mapper to show bands 765
Note that 5 and 7 are both mid-IR but do have some differences
Also note that band 6 has a lower DN range (what is the min and max DN value ?)

3. Add a second image (2003)

File –>Open and select pg2003.pix - a scene from 22 July 2003
Note that generally DNs might be higher on average than the 2005 scene as its 3 weeks earlier in the year, and thus with higher sun angle = greater reflection (if no other changes)

Change the band combination to 543 (enhance); check the histograms - are the DNs > 2005 ?

Use the files tab to find its projection – what is it ?
This image was provided by the BC government so it is also the standard BC data projection
Switch tab back to files

You should be able to click the display tick on and off to view changes between 2003-05: there are several forested areas cleared including the one on the east side of Tyner Boulevard (I heard it was owned by a UNBC professor who made some money from this).

As well as a visual change, check the DNs and compare - do this by clicking on a point, and then simply highlight the other scene data in the TOC ... watch the DN display at bottom change - which band is changing more ?

Do this for other locations e.g. another cleared area, and an area with little change - is one band changing more than the others ? We will use this info later in the change detection lab.

4. Image interpretation

The best overall combo is one band each from the visible, near-IR and mid-IR e.g. 543 or 742
543 is generally the most commonly used
In the 5,4,3 colour composite for 2005 - note the following general colours for surface types:

- Dark-green: coniferous.
- Light-green: deciduous.
- Pink: arable / agricultural.
- Dark-purple: industrial.
- Light-purple: residential.
- Black: deep or sediment-free water.
- Blue: shallow or sediment-laden water.

Click with your mouse on a sample location of each of these to see why the colours appear as they do
Remember that Near IR indicates vegetation vigour / health, high DN = healthy vegetation
Mid-IR indicates moisture – or rather lack of it; high DN indicates low moisture

First select the chip piles at Canfor (brightest place on the image) … they are bright (white) as they reflect high in all 3 bands

Note we are seeing the original band DNs – the enhancement might disguise their true values

Now check the surface types especially – why do fields appear as they are, water and forest
– why is deciduous forest brighter than coniferous ?

Shadows: Check out the esker ridges north of the Nechako – ask Roger if you don't know where –
mouse-query the DNs in the shadows versus the illuminated south facing slopes

UNBC: Finally Check some values around the UNBC campus on the 2005 image, just west of the lab buildings – we may do a wee tour to visit some of these pixels

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5. Landsat 8 OLI - McBride, August 2014

We shift to McBride and Landsat 8 (platform) OLI (sensor) data

As this is a new area, start a new window project ;
file -> new project (no need to keep the old one... we only displayed a file and its channels
Open the file**: mcbride2014.pix**

What is the projection coordinate system here ? - it's now used for all Landsat data downloads

Change the tab from maps to files, and click on rasters - this will list the expanded number of bands; In place of the PAN band (8), I have inserted a 'dummy' channel so that bands 9-11 retain their band numbers as channel numbers.

Flip from 123 to 321 (RGB) and enhance - note the DN display at bottom - now in 16-bit
View the histograms – they will look different to PG in a non-urban landscape and with the 16 bit DNs. What is the general range - ignoring the outlier values in long tails

Change the band combination to 654 (=TM543) enhance and view these histograms - remember to click on each one to expand and see the proper details. Now query the DNs in

a. water

b. lower non-snow covered glaciers and

c. higher snow covered ice
(they show as brighter blue) … can you see why they appear in these colours)

Also check: a. bare rock b. coniferous and c. deciduous

Pansharpening

One of the extra bands is the higher resolution (15m) Panchromatic band.

File -> Open and select **mcbride2014pan.tif**

click this band on and off so you can see the relative higher resolution
You can see this better if you zoom into the town of McBride (by the meanders) and turn the PAN band on/off; try this also viewing a glacier edge

Using the Tools-> Algorithm Librarian find PANSHARP and/or PANSHARP2
We'll run it, outputting just to the RGB display (default)
The Multispectral image should be bands 6-5-4 and the Pan band the TIF file

Read the help to see which parameters to pick - you can do this more than once, once for visual effect, and once to retain the spectral values for classification in next week's lab. You can end up with multiple images as it is for display only (none will be saved). Check the DNs in the newly created layer compared to the original, along with the sharper edges for homogenous areas - glaciers, forest, avalanche slopes, water bodies and Mcbride town features.

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6. Viewing satellite imagery in ArcMap

Note that arcmap can display a PCI .pix file, though if you plan to do major analysis, its more stable to convert it to .img or .tif

In Osmotar, start arcmap and a blank new map

You may need to map a network drive to access ninkasi and the data folder
L:\labs\geog432\data2015

Add data – and select the mcbride2014.pix file (you may need to ‘connect’ to this folder).

It will ask about building pyramids – whatever, say No to display quicker
It will display as it does in PCI with 123 in RGB

Right-click select properties and the symbology tab Switch the bands to 543

You should also need to enhance one of the stretch types
This takes some experimenting - there may be an initial gray rectangle, resulting from the DNs being 16 bit change stretch type to standard deviations
You may need to change 'current display extent' to 'each raster set' - I can never remember!

Query DN values using the 'I' (info) button to get the 3 DNs

Some users do all their image processing in arcmap – especially if they don't do enough to warrant buying more software. Generally PCI Geomatica will have more options - enhancements are much easier

That's it for now. Next week, we'll use these DNs to classify an image into land cover types.