Remote Sensing, Fall 2020: Lab 4
Ratios, Indices, and Transforms

No more PG, we are off to the ***Bowron Lakes***

Once you connected online to osmotar, use the file manager to copy/paste the image file ***bowron17aug1992.pix*** from **/home/labs/geog357** to your geog357 folder ...

In Focus Banff , open your copy of the **1992 image**, create 543 band combo and enhance

If it's 1992, it must be Landsat 5 Thematic Mapper ! why – no others were operating

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0. Housekeeping

Maps v Files tabs: Maps for working (like ArcMap), Files for Database (like Catalog)
Check the layers you have in your .pix file – switch maps tab to files
Expand the rasters (click on +) .. check the bands / channels
Note thermal band 6 has been excluded, so channel 6 contains TM band 7 (Mid-IR)
You should know the difference between bands and channels by now
Switch tab back to 'maps' when done – don't leave it on 'files' while working

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1. Ratios

First - create a TM **4/3** ratio (NIR / Red) … this can be done in three ways:
a. using Tools -> Raster Calculator in Focus – we'll use this for the GIS-comfy folks
b. finding ARI (Image arithmetic) or c. RTR (ratio) in Focus 'Algorithm Library'

Use the **Tools -> Raster Calculator** dropdown in Focus

Check the file showing: is your Bowron 1992 file

[…..we will create model equations by **double-clicking** on bands, single click on operators- note that selection of a band will return %n … for example %4 for band 4]

To create the ratio NIR/Red:
Double-click on Band 4, single-click on / and double click on band 3
The expression should read: %4 / %3
The default is for 8-bit output = integer values only, no decimals; and output 'Display'

RUN (hit the 'run' button = the wee man running)
... this creates a ratio onscreen .. it hasn't yet been created as a new layer in the database
Apply a linear enhancement if needed
Now you have an image related to vegetation biomass or greenness, but it only has a few different DN values - what is the approximate range? Ratios will normally be 0-10 or less
Check by viewing the histogram: Layer-> histogram, .. click on the histogram to expand

Now switch the output parameter from '8 bit unsigned channel' to '**32 bit real channel**'

Rerun your model (%4 / %3) -- this time the output should show a full display range as the output values are all different - this creates decimal DNs … move the cursor and check the values

RUN once again – change output to your 1992 .pix file (browse to it)
This will add a new channel (layer) to your file – it should be channel 7
to properly label, switch from maps to files tab, expand rasters +, double-click on channel 7and change it to something like ratio 4/3 32bit and switch back to maps tab

Right-click on the ratio layer displayed and select histograms (or use layer-> histograms)
Expand the histogram, and note the minimum and maximum values

In general the ratio should highlight vegetation (the difference between bands 4 and 3) and subdue topographic shading – i.e. what is similar between bands 4 and 3. Check by comparing with Band 4 -> load Band 4 to display:

layer -> add -> Grayscale -> next -> band4 -> finish .. (as always) enhance as needed

'Flick between the band 4 and ratio displays by turning the top layer on and off.
They are broadly similar but the ratio highlights vegetated versus non-vegetated areas

You can also see how the ratio channel was created by changing the RGB mapper combination from 5-4-3 to 4-7-3 (and enhance) to display the ratio DN in the middle gun (G) with Near-IR and Red (in R and B) either side at the bottom. Check a few locations to see the band 4 and 3 DN and the resulting ratio value.

Q1: Why are ratio values lower for Lanezi Lake (in the south - see Google maps) – use your understanding of reflection (DNs) in the near-IR and Red bands for water, similar to the rivers in Prince George image area, and how this has impacted the ratio values.

2. Normalised Difference Vegetation Index - NDVI

The NDVI is the most commonly used modified ratio (index) as an indication of vegetation biomass ….. the formula is as below:
Use the raster calculator (RC) to create a NDVI channel: (TM4-TM3) / (TM4 + TM3)
Note: you need the brackets, so you get the desired result, and must use the RC keypad (not your keyboard) to enter both the bands and characters
Output to a 32 bit channel and view - display

... what is the general range of values for deciduous (broadleaf) vegetation? - flip between NDVI and 543 composite displays – you can also display the 543 composite, but highlight the NDVI in the contents, so that NDVI values show at the bottom, while viewing the composite …

Now here's a complication we don't need –
If you turn off all other layers, you will notice some 'dead' pixels in the water and shadows, with 'N/A' as their DN. Click off the 543 composite display so you can see this easier … highlight the 543 layer (still off), and click on some dead pixels.
You can view the 543 DNs and notice that for every dead pixel, the DNs in G (Band 4) and B (Band 3) are the same value.
So the Geomatica raster calculator is apparently unable to deal with a '0' result in the NDVI equation as a numerator. Whatever it is divided by, the answer is N/A not 0
[Matt tried to explain this to me – for me the answer would be 0, but not in CompSci !]

We can fix this by running RC again using this formula:

(%4-%3 +0.1) / (%4+%3) .. this will minutely add to 0 values.

Go on, do it – and create a 'corrected NDVI' layer which we will use in future labs. Remember to select 32-bit layer and Save it this time to your .pix file (always!) - relabel it suitably. Display the new channel 8 and check you have 'filled in the holes'.

Q2. What are the minimum and maximum ratio values for the NDVI (use histograms) - note that the results are for onscreen display, so 'zoom to layer' for a full image.

Q3. What are approximate NDVI values for: a. water b. coniferous forest

c. deciduous e.g. avalanche slopes

3. Tasseled cap : TASSEL

The tasseled cap is a transformation that is often used in ecosystem and habitat studies. This operation will produce 3 new data channels equated to brightness, greenness and wetness (BGW) – it enables us to 'reduce 6 input bands' to 3 essential ingredients

From **Tools -> Algorithm Librarian** -> Find -> Tassel

Tassel has changed dramatically in the last year, for both better and worse …
The input needs to be channels 1-2-3-4-5-6, and on the first (files) tab, you need to expand each raster one at a time to click on the appropriate channel/band
I may need to show you this to see what I mean !

Output: tick viewer-Grayscale
- and in the bottom box, save to your 1992 pix file –use the browse button to find it

Input Parameters
Sensor: Landsat 5 TM *
Output type: 16 bit signed (it won't run otherwise)
Other parameters, leave as is
Click the Log tab and Run

* this is the 'better part' .. previously it was only for Landsat MSS, TM and ETM+, now there is a choice of over 50 sensors, which will yield question $5 (see below)

Check the resulting 3 image channels, display each in grayscale

Examine the spread of data using **layer-> histogram**, and the correlation between them (**Tools-> Scatterplot**) - they should be mostly uncorrelated
(Br v Gr; Br v Wet; Gr v Wet … using their respective channel numbers – 9,10,11)
Using the layer->scatterplot function, calculate these two coefficient values:

Q4a. What is the correlation (r) between the Brightness and Wetness channels ?

Q4b. *What is the r value between Greenness and NDVI ?*

Q5. Choose one of the sensors apart from Landsat, SPOT or Sentinel (which have been mentionned in class) listed in the Tassel sensor option menu – you can also find them listed below and in the help panel for Tassel (click on the book ?) bottom left corner.
For your selected sensor, use your google skills to find this information:
a. date of launch b. pixel size resolution (metres) c. Number of bands

Please send your answers to wheate@unbc.ca by Wednesday 14 Oct.
Either just send the answers, or also copy/paste the questions if you wish.

Sensors supported in Banff Focus Tassel algorithm:

Deimos-1
DMC
Resourcesat-2 LISS-4
ALI
WorldView-3
ALOS Avnir-2
CBERS-4 MUX
CBERS-4 WFI
Deimos-2
FASat Charlie
Formasat-2
Gaofen 1
Gaofen 2
GeoEye-1
Gokturk1
Ikonos-2
IRS-1A
IRS-2B
KazEOSat-2
KOMPSAT-2
KOMPSAT-3
KOMPSAT-3A
OrbView-2
PeruSAT-1
Pleiades
QuickBird
RapidEye
SuperView-1
TripleSat
WorldView-2
WorldView-4
ZY-3
ZY3-2
Aster
CBERS-4 P10
IRS-1C
IRS-1D
IRS-P6
Resourcesat-2 AWiFS
Resourcesat-2 LISS-3
SAC-C