Remote Sensing, Fall 2016
Lab 7: Feature Extraction

Landsat 8 imagery

Band	Description	Wavelength (micrometers)	Resolution (meters)
1*	Violet-Deep Blue	0.43 – 0.45	30
2*	Blue	0.45 – 0.51	30
3*	Green	0.53 – 0.59	30
4*	Red	0.64 – 0.67	30
5	Near Infrared	0.85 – 0.88	30
6	Shortwave Infrared	1.57 – 1.65	30
7	Shortwave Infrared	2.11 – 2.29	30
8*	Panchromatic	0.50 – 0.68	15
9	Cirrus clouds	1.36 – 1.38	30
10**	Thermal infrared	10.62 – 11.19	30
11**	Thermal infrared	11.50 – 12.51	30

* Within the visible spectrum
**100-meter resolution data interpolated to 30 meters

Lets look at a description of the Landsat 8 Bands

Take a look a the following link from Landat explaining the frequencies and uses of the OLI sensor
   http://landsat.gsfc.nasa.gov/?page_id=5377

Start pci geomatica in the usual way
Open the McBride Landsat 8 OLI image - your copy of mcbride2014.pix - bands 654 and also
load the higher resolution Panchromatic band: mcbride2014pan.tif

The image (15 Sept 2014) has McBride in the NE corner (above the larger oxbow / cutoff lakes)
Christie Glacier is in the SW corner

Band 8 is the PAN band, but this version has been forced into the PIX with 30m resolution, so
use the separate TIF to see15m res. Band 9 seems fairly useless – mostly noise

Lab goals

Satellite images like air photos can be used for manual interpretation, but because they are
digital, we can use image processing techniques to semi-automatically extract vector features.
The specific goal in this week's lab is to create vectors for two classes which you can cleanly
identify and reduce to a manageable number of polygons.

There are five main steps:
- Generate a clean layer containing the desired features –a bitmap or raster channel
- Threshold this layer based on a designated DN
- 'Sieve' to create a manageable number (sieve works only on raster channels)
- Generate vectors (raster to vector) – BIT2POLY or RAS2POLY
- Smooth vectors - SMMCMASTER

Features to extract:
- Glaciers
- Water (rivers and lakes)
- Deciduous vegetation
- others ?

Disclaimer: I didn't get time to check all tasks with this new version of Geomatica.
Fortunately I know you young turks - the New Kids on the Block will boldly go ....

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1. Separating features – Ratio and THReshold

Unlike the PG scene, a simple low DN in the Near-IR band here in the mountains around McBride does not separate water from shadow. This might require a classification incorporating slope as an input channel. Instead we'll use two ratios to separate first glaciers and then perhaps deciduous vegetation.

Red/Mid-IR (4/6) for Glaciers and later NIR/Red (5/4) for vegetation

Tools – Raster Calculator

Remember that here and throughout the lab, you need to select the file you are working on – its an annoying part of the software that it does not take 'current file' as default …

To create the 4/6 ratio:
Double-click on the bands (Band 4), single-click on the divisor (/), double-click Band 6
Output type: 32 bit real channel (decimal values)
Click save box and browse to your mcbride PIX file - keep all new layers in one file -ALWAYS!
Run (the little running man)
Name / describe the layer as 4/6 ratio
The resulting image should have all snow/ice as high values and the remainder much lower.

Reminder note: when you query layer DNs, the value displayed is for the layer highlighted, not necessarily the layer displayed - the same as in arcmap !
Click around and view snow/ice versus not snow/ice DNs and consider a threshold value - there may be some confusion with shadowed ice and also meltwater lakes

Also try this to establish a good ratio threshold:
In your Maps setup, ensure you have a 654 composite display
Keep the ratio layer highlighted, but not displayed and query the snow/ice you can see on the composite … you will be able to read the ratio values; look especially where the ice is dark

Can you identify a final threshold value (~2.0?); view also the separate PAN band - but highlight the 4/6 ratio so that ratio values are displayed (confused ? ask me ...)

Spend a fair bit of time, establishing the best ratio threshold value

2. Applying a THRESHOLD: - creates a bitmap holding the snow and ice
Algorithm Librarian – select THR
Input your ratio channel
Output to viewer
Parameters – add your minimum value (for snow/ice)
Run and view the resulting bitmap, clicking on/off over the 654 composite to check quality

If its good, save it - run THR again and write to your copy of the mcbride pix file or you could right click, save as - a layer in your PIX file (it will save a bitmap) …

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3. To reduce the clutter, Run SIEVE (only works on a raster channel)

SIEVE runs only on a channel, and we have a bitmap created by THR– so we need to convert it
Create a new empty 8 bit layer: right-click on filename under files tab; new->raster layer->add
It only needs to be 8-bit (not 32 bit) as it only stores 1's (snow/ice) and 0's

In Tools-EASI modelling, type: %x = %%y
- assuming the new empty channel is x, and the bitmap is y – check first

Now this new channel contains the glaciers, add it to the display, it may need a different stretch to be visible (why? … because the DNs are only 0 or 1)

Remove unwanted small areas with the **SIEVE** function - Try a value of 11 with four neighbors to remove areas less than one hectare (too small?), then up to 55 for 5 hectares (more usual).

Set the output as viewer -> PCT (to view what happened).

For your final version, run it again, but write to your PIX file ... you could also right-click and Save As and write to your file / properly label the layer

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4. Transform raster or bitmap to vector polygons: RAS2POLY / BIT2POLY

This algorithm library function (Spatial Analysis->Conversion Tools -> RAS2POLY
We could have used the bitmap from THR except it doesn't allow us to use SIEVE, so this next step will use RAS2POLY inputting the previously sieved channel

Choose your layer from #2 as input file-channel and pick **whole polygons** as the output type, and check the 'smooth vector' option (default is on); tick the viewer AND your filename as the output then go to 'log' tab and run.   DISPLAY your new vectors

Run it again, but this time with the smooth option unchecked and display on viewer only – compare the two (smoothing is good!). Zoom in on Christie Glacier to view the resulting vectors

The resulting vectors will contain fields for area and perimeter which you can see using the attribute manager layer -> attribute manager or right-click on vector layer-> attribute manager

Clicking the upper left cell of the attribute matrix gives summary statistics for all the extracted polygons. What is the largest...possibly the Christie Glacier ?

Right-click in the table of contents on the first vector, and save to file -> pick the arcview shapefile format and save to your geog432 folder;. Name it so that you know what it is...
[we can load into QGIS to view later)

2b. Lets do it again – but using EXPOLRAS

This algorithm library function (Extract and refine polygons from raster EXPOLRAS), does many of tasks that the combination of THR, SIEVE and RAS2POLY does. Give it a try on your ratio channel and compare the results.

Attribute Values from EXPOLRAS

Take a look at the attributes that are generated by this function. Many make sense, but Scott is interested in the compactness and orientation values. Read the help on EXPOLRAS.

How could the compactness and orientation values help in using masks in classification to :

Draw out differences in cutblocks and avalanche shoots
Help with classifying in the shadow vegetated areas. As we have seen this is often problematic.

Have Scott discuss it – special topics for lecture.

5. Smoothing the vectors = reducing the Jaggies: SMMCMASTER

The raster image involves pixellation, which creates jaggy edges. The vectorisation process includes some smoothing, but it can be smoothed further:

Find these algorithms in Tools -> Algorithm Librarian (Utilities -Vector Utilities). There are 3:
SMBOYLE, SMCHAIKEN and **SMMCMASTER**;
Briefly read the help on all 3 to see why SMMCMASTER is recommended here.

Run SMMCMASTER (input = the vector you have created in step 3).. Output to viewer and file
Compare the result with the unsmoothed vectors … should look much better

Click on the top record – Christie ? ; this could be saved to a separate shapefile if you wanted
Right-click in the table of contents on the smoothed vector, and save to file -> pick the arcview shapefile format and save to your geog432 folder;

Open the vector created in QGIS and view the attribute table.
Note that the smoothing could also be done in QGIS (as can the threshold and conversion to vector.
In QGIS, you can remove unwanted polygons that are below an area threshold by querying the attributes and pick a minimum area to remove unwanted polygons (turn on editing to delete)

6. Displaying further map vectors in Geomatica / QGIS

PCI Geomatica (Focus)

Layer -> add -> vector

navigate in 'browse' to */labs/geog432/data2014/vectors/glaciers1986.shp*
remember to do the final click on the vector segment – the 1986 (TRIM) glaciers should display
and you can zoom and compare how far they have retreated in the 28 years 1986-2014.

You can change the colours using Right-click (on layer) and -> colour

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7. Now repeat steps 1-5 to extract deciduous vegetation

Ratio, Threshold, Sieve, Vectorise, Smooth

use the NIR/Red ratio (32 bit channel) already created;

Note: this does not work as cleanly as for the glaciers, at least at first ..
Continue if you are having fun / have time etc... the learning process was done in steps 1-6

Deciduous vegetation

Create a NIR/Red ratio (32 bit) if you've lost the previous lab version

It appears that deciduous vegetation >2.0 in this ratio (?)

Run THR with your selected value

Its tricky as deciduous includes several types:
valley pasture/fields, alpine meadows, avalanche slopes, upvalley cutblocks

As noted in class (and with the discussion regarding EXPOLRAS attributes), you may be able
to separate these using elevation, slope or aspect/incidence

What is the elevation range of the Robson Valley - especially maximum elevation (xxxx)?

What is the range of slope gradients on an avalanche slope ?

What is the minimum elevation of the alpine meadows ?

In EASI modelling, use this format with either the ratio channel or the threshold bitmap:

If the ratio is channel 15, DEM is channel 16, the bitmap is bitmap 6 and an empty channel is z

For valley agricultural fields:

```
If %15>2.0 AND %16 < xxxx then
%%z = 100
endif
```

line 1 could also be: If %%6=1 AND %16 < xxxx then

you could write similar scripts to identify avalanche slopes - using the slope channel and for meadows using minimum elevation and minimum slope (to eliminate avalanche slopes).

One could also perform a detailed unsupervised or supervised classification inputting the bands plus DEM variables, plus a ratio or transform channel to map the classes and then vectorise.