Remote sensing, Fall 2024: project – download image data

The project goal could be to classify or threshold a selected area, generate clean and meaningful polygon vectors for selected features, and present these with the satellite image, and/or DEM layers. These might expand upon lab examples, using threshold values from ratios, indices, transforms or supervised / unsupervised classifications to enhance and extract features such as vegetated or urban classes, fires or glaciers. Using 2 or more images to show change can be appealing, not a requirement.

Week 1 (Nov 13); data search and download. Clip …
Week 2 (Nov 20): channel creation / classification, analysis
Week 3 (Nov 27): vectors/analysis/write-up
Week 4 (Dec 3): 3 minute demo in the last lecture period

Week one: Dataset extraction

Datasets can be created, from Landsat TM (1984-2011), OLI (2013-2024) or Sentinel MSI (2015-24) Plan for a subset - approximately filling a screen but not too much more. e.g. ~1800 x 1200 pixels, unless more is required for your goals.

It is essential to select an area and possible application before you download any image data.
The process for data search may be similar to Lab 6 (Environmental Change), except for downloading and extracting the full scene product, which can range from 400mb to 1.5 Gb in size, compared to the images used in Lab 6 (~10mb). L8/9 image datafiles are bigger than L5 – more bands and 16-bit data.

The main goal this week will be to search for and download image data for your area and import into a Catalyst .pix files that holds all the image bands. When you download, the band layers are usually separate TIFF or JP2 files, georeferenced in the local UTM zone.

1. Image search and selection

This process was previously limited to images stored in the EarthExplorer site you used for Lab 6. It has been expended now for ESA Copernicus Sentinel 2 data. A quick summary comparison:
Sentinel 2 includes 4 VNIR bands at 10m resolution and SWIR at 20m resolution. It also has 4 red edge bands (but no thermal). Like Landsat, we don't make much use of bands 1 (coastal) and 9-10 (cirrus).

You will see options such as such as LIC vs L2A or level 1 vs 2 – the level 2 includes atmospheric correction, mostly for US scenes; there are not many (any?) for other areas, and it's not important here. For any of the options below, pick data and year ranges, and loud cover as you did for Lab 6.

Sentinel-2 Bands	Central Wavelength (µm)	Resolution (m)
Band 1 - Coastal aerosol	0.443	60
Band 2 - Blue	0.490	10
Band 3 - Green	0.560	10
Band 4 - Red	0.665	10
Band 5 - Vegetation Red Edge	0.705	20
Band 6 - Vegetation Red Edge	0.740	20
Band 7 - Vegetation Red Edge	0.783	20
Band 8 - NIR	0.842	10
Band 8A - Vegetation Red Edge	0.865	20
Band 9 - Water vapour	0.945	60
Band 10 - SWIR - Cirrus	1.375	60
Band 11 - SWIR	1.610	20
Band 12 - SWIR	2.190	20

Explorer browser: for projects, you'd pick the 'bundle' which holds all bands - it's likely not worth the extra effort to hand pick bands just to exclude 1 and 9. You can use our generic login/password

Copernicus browser: is just for Sentinel 2 data; you'll need to request a login account, or maybe the 'anonymous' login allows you to download data.

Sentinel browser: can download Sentinel or Landsat – but the download option can be hidden. There is a 2nd way to download, with button on the right-hand side panel, but it is limited to 2500 x 2500 pixels (25 x 25km at 10m). If useful, this would avoid having to clip later – as we did in Lab 6.
Note: I am not best friends with this browser at present, though it seems that ESA have outdone NASA!

It needs switching from Basic to Analytical and also ticking the 'raw' option for individual bands, plus UTM and TIFF options. This seems to be intended more for creating illustrative images; it also has a 'harmonised' Landsat/Sentinel search but the results would be 30m pixels losing Sentinel resolution. There is also the option to let it create options such as NDVI etc.. basically for non-RS specialists…

Earth Explorer: http://earthexplorer.usgs.gov
Copernicus: https://browser.dataspace.copernicus.eu
Sentinel: https://apps.sentinel-hub.com/eo-browser/

Here are the instructions for EarthExplorer – there will be similar options in Copernicua/Sentinel
You've done the first part already in Lab 6; you don't need to login to 'search' but will to download

Zoom to your chosen area, and use 'Map' or 'circle' option to select your area
Change max cloud cover to 2 or 5% (or even 0%)
Collection: e.g. Landsat Collection 2 - Level 1 → Landsat 4-5 TM or Landsat 8 / 9 OLI
Remember in Canada to search for summer months only and pick your dates e.g. July 1-Sept 15
Identify your area with the 'use map' option

Search and preview the **browse image** to be sure it's good – e.g. view for clouds. Note that Landsat 9 thumbnail Geotiff images may look black – if so, try the jpg to preview the scene, or download one band as a preview.

Once you have found your image, Unlike the environmental change exercise, you will want the **Landsat Collection 2 Level-1 Product Bundle** .. the first option listed
….. Instead of the second option (GeoTIFF) you selected in Lab 6 – though you could download this first to further check the image quality.
You can expand the bundle to see the list of files you would download
Download only when you are confident this is the image you want – it takes some minutes to download

2. Scene download

Select the optimal scene(s) from Landsat archive or another
This brings up a new window asking for a user name and password
The class group username is: **geog357**
The password is**:** **unbc4thenorth**

Before you download, do these two things:
a. Create a subfolder in your geog357 folder for your project
b. Check your browser settings so the option is ticked for 'always ask where to place downloads'

If this is really the scene you want, then continue as below …. be sure to check for cloud cover
Select 'download' button for 'Level 1 bundle' (the first listed option)
This downloads a tar.gz file ('tape archive'), select your folder and save … it may take 5-10 minutes

The downloaded file will be zipped (as .tar or .tar.gz ?)
From the windows start button, find and open the 7-Zip (file manager) * this step may have changed!
click on the downloaded filename and select 'extract', then follow the options to download all files

This will produce several .tif files – one for each band (7 for Landsat 5) or (12 for Landsat 8) .. bands 1-11, including 2 TIRS, 1 PAN and also BQA (quality assessment) plus 2 text files.

3. Creating a multi-channel .pix file – in Catalyst

Start Catalyst

All you need do is drag the metadata text file in the image folder into the TOC, and select the MS option, or file->open the metadata file (ends in .... mtl.txt) - all the TIFs are present, and rasters listed.

- If you get an error pop-up, see section 5 below (may not work for Landsat 9)

It selects only layers with the same pixel resolution - 6 for TM and 8 for OLI. (No thermal/PAN).
This is not yet permanent, only onscreen so we then need to create the PIX file:

File-> Utility-> Import to PCIDSK

Name it suitably in destination file and navigate to suitable folder
Take the other parameter defaults and IMPORT .. this takes a few minutes
When done, open your new pix file and remove the previous mtl.txt from the maps display
The file layers are nicely identified by their EM spectrum location.
You can also load the PAN file if there is one … layer-> add -> grayscale and pick band 8 TIF
Similarly for the thermal band(s).

BUT it seems they have NOT formatted all image scenes in this way, with the metadata file, especially Landsat 9. There does not seem to be a similar process for Sentinel 2 data. see instructions below

Make sure you have retained or recorded your **image date(s)**
I've repeated clipping/subset instructions below, though you already did this in Lab 6.

4. Here is the other way to turn multiple band TIF files into a single .pix file

you might have to use this if the .mtl text file is absent or does not link properly; this seems to be the case for Landsat 9 images – and I don't see this file for Sentinel 2 data

Open the first .tif (band 1) in Focus and convert this to a .pix file by:
a. File-> Utility → choose **translate**
For Sentinel data, load a 10m image band first, so the others all take on this same resolution
The source file is your .tif, the destination file is a new .pix file (you pick the name)
Click on: Select all - . add transfer -> close
You now have a .pix file that the other bands can be transferred into:

*Now select File -> utility and choose **transfer***
For **source** file, pick the next band .tif file (Band 2)
For **destination**, pick the .pix file created in the previous step
select the new band, add and transfer

Repeat this process for the other .tif files - it will add them all into the SAME pix file
When done, view/enhance your favourite band combination as RGB composite e.g. SWIR-NIR-Red
You are now ready to view your scene and clip/subset as required

5. Subset/clip your area of interest - don't try to capture too large an area

Set up your screen display to cover the area you want – a 'landscape' rectangle is usually best to optimise the use of the screen; square or portrait shaped areas are less preferable, but may be needed to match your AOI.

Subset your area of interest:
Tools-> subsetting / clipping

Choose a new file name that will describe your selected area
Tick the bands you need (likely all) – though not the BQA and perhaps Cirrus band
Select **use current view** as option under Define Clip Region / Definition method dropdown

Note: if you are working with more than one image scene, you would do steps 1-3 independently for each scene, and when it comes to step 5, subset one first and then clip the rest to match the first - use ‘select a file definition method’ option if it’s possible the current view has changed (use the first clip to define subsequent clips).
But why am I repeating this – you already did this in Lab 6 ..

GEOG357 Project outline 2024 (here for reference)

1.Project design

a. Geographic area ? (province / country / region ?

b. Application area e.g. forestry, habitat (landcover), glaciers, urban development

c. Image requirements – expected years, could include change but not required

d. Anticipated processing e.g. classification, ratios, transforms, indices

e. Expected outcomes e.g. extracted features or classes

2. Steps

Week 1: Preview and Download imagery, convert to pix file and clip to fit – I recommend a screen size study area to avoid excessive pan and zoom e.g. max. 1800 x1200 pixels (approx.)

Week 2: Image processing: classification, ratios/indices, transform etc., (change detection) feature extraction, vector creation etc..

Week 3: Final images and results – e.g. vectors overlain on optimal image, calculation and presentation of results; possible 3D images using DEM; possible inclusion of Google maps/earth image for context/reference. Write up text.

Project Output Summary

Introduction: A brief summary of your project – goals, area and result

Study Area and Data Source

- Study area description
- The data you need for the project (including image dates)
- Comments on image quality (clouds, time of year etc.)

Data methods and analysis

- brief description of methods (could use point form)
- the primary resulting channels from analysis e.g. ratio or classification

Results

- Discussion of results
- Final image display e.g. vectors on image
- Final conclusions of successes or limitation

Images do not need to be super high res. 150 dpi is suggested as enough (.jpg)
You can provide zoom in images if it helps to show detail

submit project as pdf via Moodle