

Summer school 22 - "Multi-sensor Earth observation in practice"

I attended one-week International Summer School supervised by Dr Zahra Dabiri in Salzburg. Following topics were the main focus of for each day:

28th June: Big Earth Observation Data

29th June: Geomorphological Mapping

30th June: Glaciers Mapping

1st July: Field Trip to Werfenweg

4th July: Geomorphological Mapping using UAV

5th July: GI Salzburg Conference Presentation

Day 1

To start with a brief overview introduction was given by Dr Zahra Dabiri about the activities in Summer School and the expected outcomes. To follow with Dr Stefan Lang provided concepts for Earth Observation based biotope type mapping and Environmental Monitoring. Main points of the discussion were as follows

United Nations Conventions (CCD, CBD) United Nations Convention to Combat Desertification, Commercial Biodiversity

Land Use and Land Use Change in Forestry (LULUCF) is the next new thing.

Illegal logging, forest strategy, Carbon trade.

Common Agricultural Policy (CAP) to control the crop dynamics and what the farmers do.

DRR Disaster Risk Reduction

CBD 1992 was a political decision to halt biodiversity loss. There is nothing related to how to measure loss of biodiversity.

In the framework of CBD, it is not sensible to think about national boundaries. Therefore, Biodiversity regions were introduced.

If habitat are preserved, species are preserved.

WFD. A directive in Europe for water quality management. Salzach river became lifeless and ugly because of Upstream.

Politics is still a problem in reporting. Rivers should not be considered as natural borders rather they should be looked upon as catchments. So that reporting is in the correct manner. E.g. For Salzach River Austrian government giving different reports as compared to German government for the other side.

Regional approach is inevitable to solve biodiversity problem instead of national.

A clever person who was adaptive to modern technology downloaded best quality Sentinel - 1 in Austria better than normal quality of the downloaded imagery.

IKNOS Long desired by scientific community in 2000 high resolution satellite imagery.

GMES was renamed to Copernicus Land Monitoring Service.

Copernicus is set to be an empty stage as there is a question that satellite imagery should be made a generic tool or should it be specific to use cases.

Quadruple Helix means we need to connect Government, Academia (Research), Industry (Business) and civil society.

Digital Twin Earth a global ambition (AI, Scientific Knowledge) and Sustainable Development Goals is the Brain.

Digital Twin means a digital copy-built environment that models reality and enables shapes of future.

Computer vision people previously did not took care of geographical coordinates or where things are. Space and Geoinformation was bridged through Copernicus .

Every 5 years government has to report on LULUCF for Quality status (like wetlands). Or one has to pay enormous amount of fine. Now standards to check for them are being built through satellite observations.

Riparian Forest area near Salzach River, NATURA 2000 network is being implemented. Therefore, it is a converted zone, and no bridge could be built in that area.

Alpines means mountainous.

CLMS whole department is Alumini of ZGIS.

CLMS Portfolio

- Systematic Biophysical Monitoring
- Land Cover and Land User mapping
- Thematic hotspot mapping (e.g. Riparian Forest)
- Reference data – (MOSAIC satellite data)
- Ground Motion service (RADAR)

Data availability was the problem for RADAR data Sentinel 1 solved the problem for EO Biotope mapping. There are gradients between agricultural, mountainous area.

Later half of the day was focused on the topic Satellite image time series in the Big Earth Observation data context. During the practice session for Sen2Cube tool, following were the main points of discussion:

Hands on Sen2Cube web-based Tool

When gigabytes of data is involved one needs to move into cloud or high performance infrastructure one of this data cube. Where you can define the coordinates to get the time series data processed.

Satellites data processing and presenting it user is in our domain.

Radar is not weather independent.

Sentinel 2 revisit frequency for most of the planet Earth is 5 days.

The more you go towards the north, more is the number of Acquisitions.

Sentinel has greater temporal resolution. Towards the North due to overlapping orbits. In Greenland, 4 acquisition per day. In Austria 3.5 Acquisitions per day.

Sentinel is prioritizing Europe while Landsat United States. Therefore, one can have more number of Acquisitions for that area. For sentinel satellite sensor can be turned on and off through ground based stations.

Sampling distance

Cell size [Ground sampling distance] or Instantaneous field of view there is a confusion for sentinel since it is being done in ESA and there is no open-source documentation available for it.

Usually there is a trade-off between spatial and temporal resolution.

SITS Application was shown for Brazil where there is illegal to convert from Forest to crops but not to convert from pastures to crops which has the same effect. Therefore, area could be converted into pasture from Forest and then later on it could converted into crops.

Soil Sealing in Austria was being observed through Vegetation spectral curve.

Data Cube backend processes:

Processing:

Chuncking

File Formats

Sentinel Satellite have one pixel shift allowed according to their documentation. This causes black errors in pixel based time series analysis like done in Sen2Cube.

Query operations available on Sen2Cube

1. Reduce over time using a count operation in Sen2Cube data cube.

Means look for a pixel and look for value in all images.

Means to look for an image

2. Reduce over space using count operation in Sen2Cube data cube.

Aggregate over space means or all the Aoi aggregate over whole area one value and count.

Shadows are removed from Water by including a query through Digital Elevation Model such that the slope is less than 2.

The north facing slope has different characteristics than south facing slope for Mountains. It is not necessary that it is result of an error.

Base maps always have a date and its fine if it does not completely overlap the satellite imagery due to different resolution.

Sentinel 2A and 2B have slight difference in reflectance values but that is more of neglectable.

Day 2

Dr Zahra Dabiri talked about Radar Interferometry its application. The main points of the talk are as follows:

Landslide monitoring for practical purposes in industry, OBIA is being used in addition to Logistic Regression for Land Susceptible Mapping.

The digitized polygons for land slide area by humans were being used for reference data.

ASF Data Search Web application for downloading Sentinel 1 data.

In SAR data, perpendicular baseline is very important. Greater perpendicular baseline is desirable as it corresponds to better quality. Perpendicular baseline and ambiguity are inversely related to each other.

Similarly, coherence as well. A coherence value of 0.6 or above indicates good quality.

DEM (15m by 15m resolution) from the Sentinel 1 Imagery was created by each of the students in the practical workshop using the open source SNAP software.

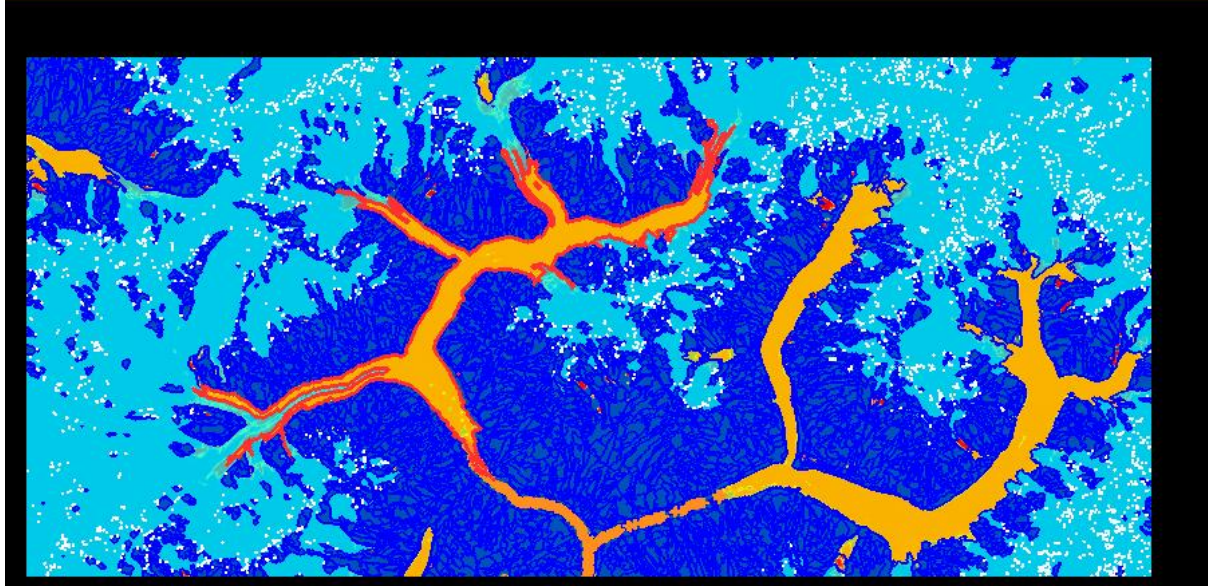
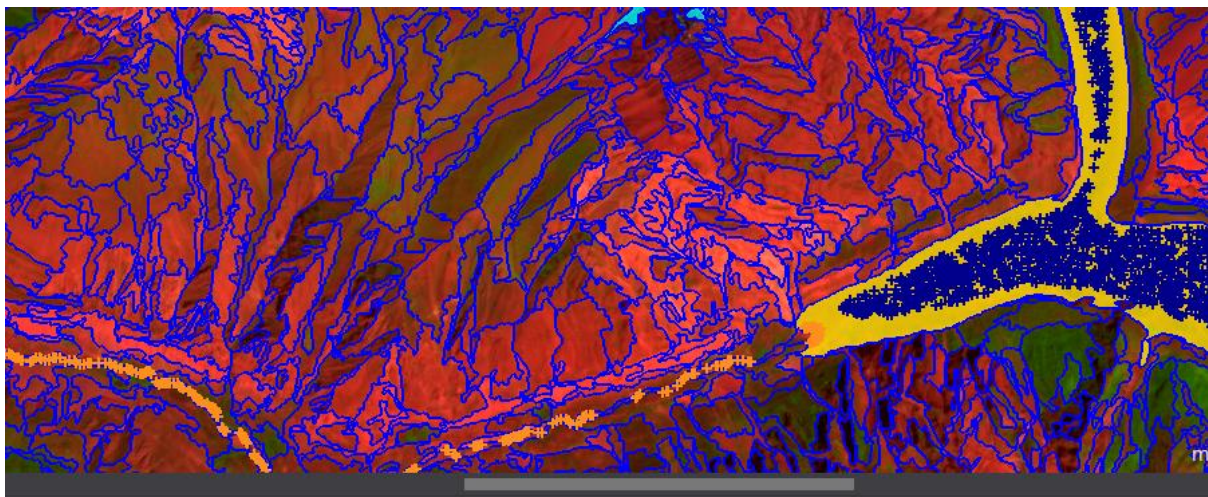
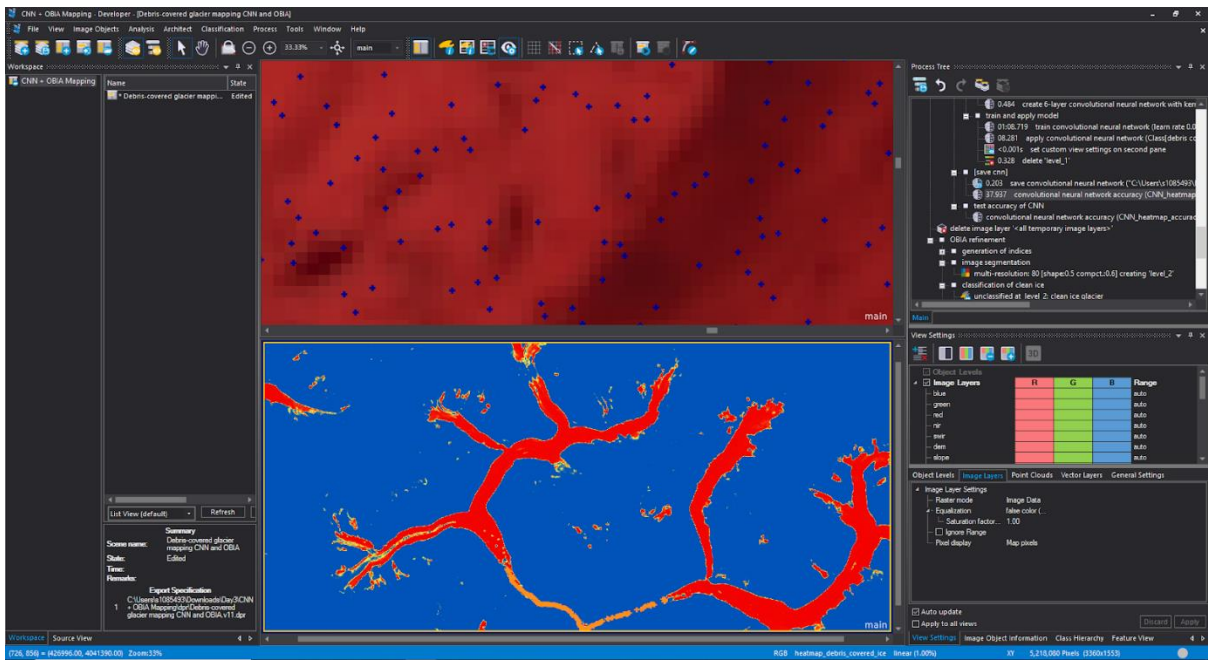
Day 3

Professor Benjamin Robson from University of Bergen gave us a workshop for Glacier Mapping using CNN and OBIA. A ruleset in Ecognition was developed using Sentinel 2 Imagery. A tutorial was provided for hands on practice session was followed by all students.

Later, collected data through Unmanned Aerial Vehicle.

The plan for UAV imagery collection was made using dronelink web service.

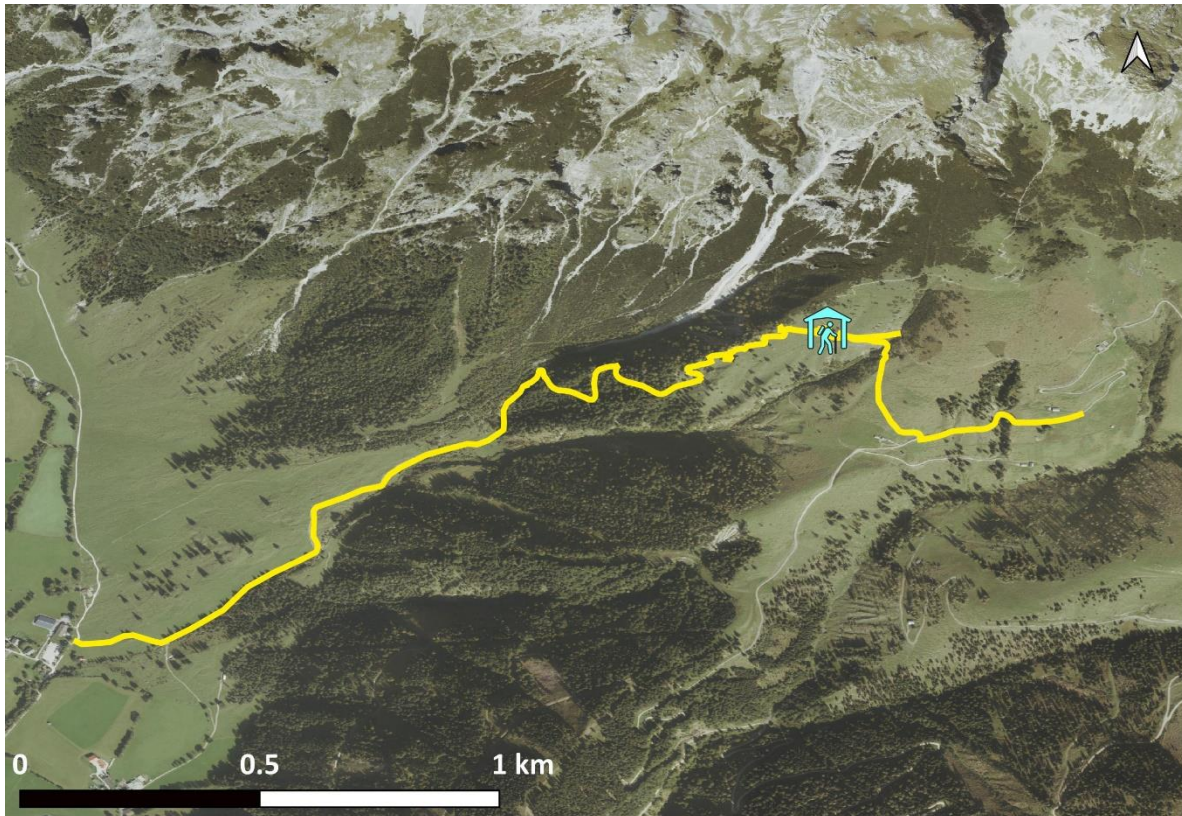
In mapping debris-covered glaciers using Convolutional Neural Networks and Object-Based Image Analysis, Inventory data (Glaciers points created by glacier monitoring experts) was used for training data.



Final result. Differentiation between Glacial Clean Ice and Debris Covered Ice.

Day 4

Route for the field trip to Werfereneß Salzburg can be seen in a map below. The map given to the students by Dr Zahra Dabiri. The main purpose of the trip was visiting and studying Land slide areas characteristics and UAV data acquisition.



Day 5

Professor Benjamin Robson gave a short overview on how to process UAV data in Agisoft software. The main output of the exercise was orthomosaic imagery.

A short session on project management through Github was demonstrated by Dr Martin Sudsmann. Later that day students formed groups and selected one of the four topics that were learned during the Summer School. Every started the preparation of presentation in the later half. Students in Summer School were supposed to present their topics in GI Salzburg Conference.

GI Salzburg Conference was held on 5th July 2022. I presented the topic "Glacial Mapping Using Convolutional Neural Network and Object Based Image Analysis".