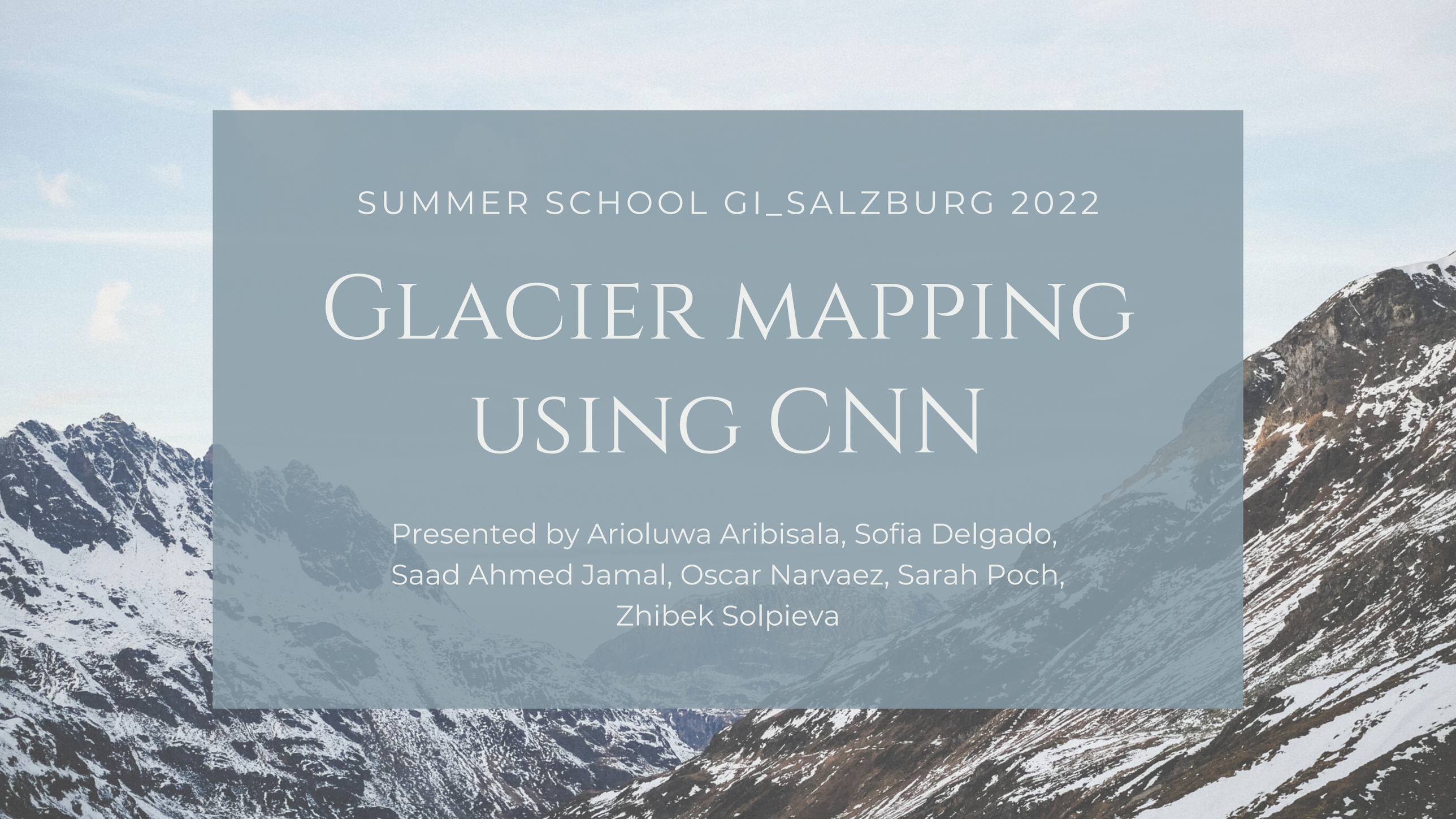
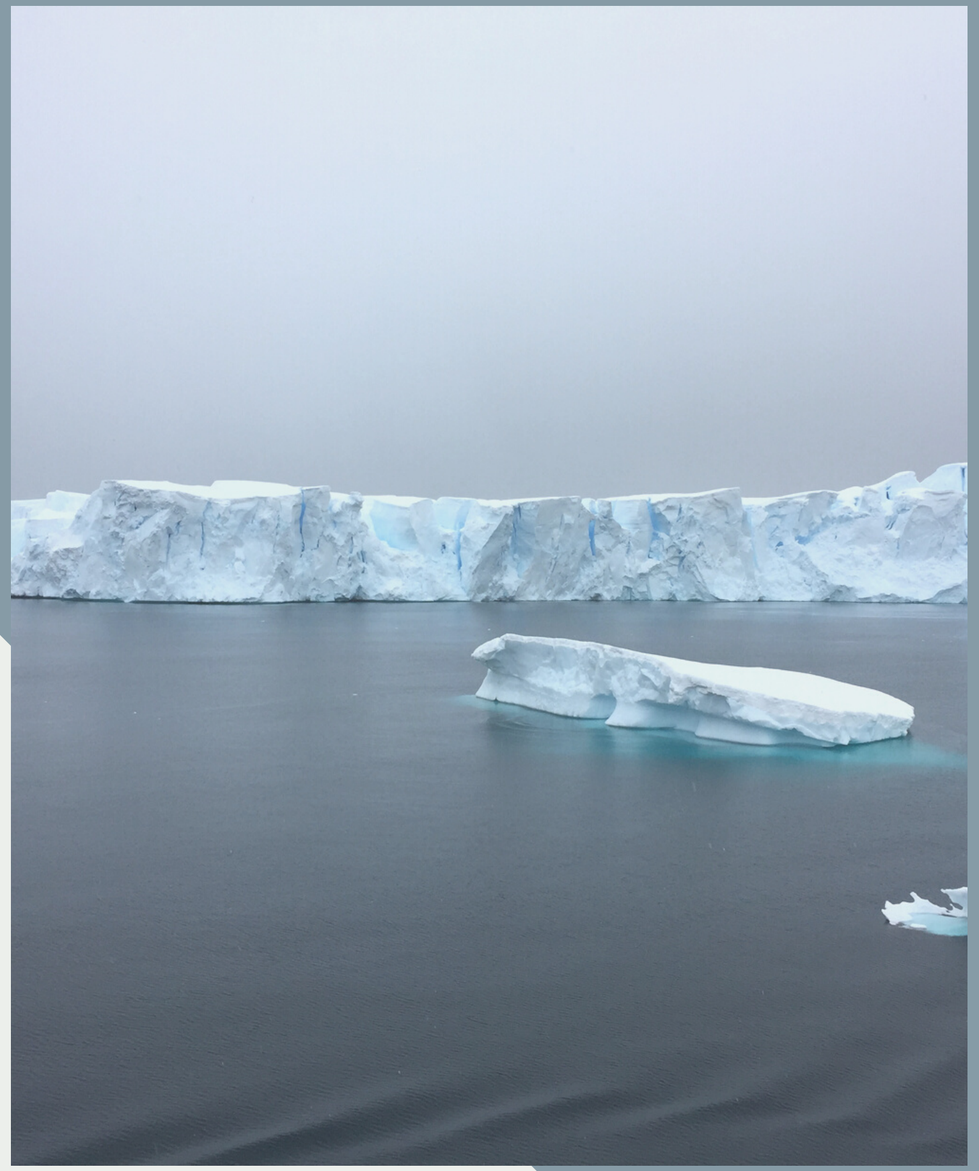


SUMMER SCHOOL GI_SALZBURG 2022

Glacier mapping using CNN

Presented by Arioluwa Aribisala, Sofia Delgado,
Saad Ahmed Jamal, Oscar Narvaez, Sarah Poch,
Zhibek Solpieva



Content

- Introduction
- Study Area and Data
- Basic concepts
- Flowchart
- Final results

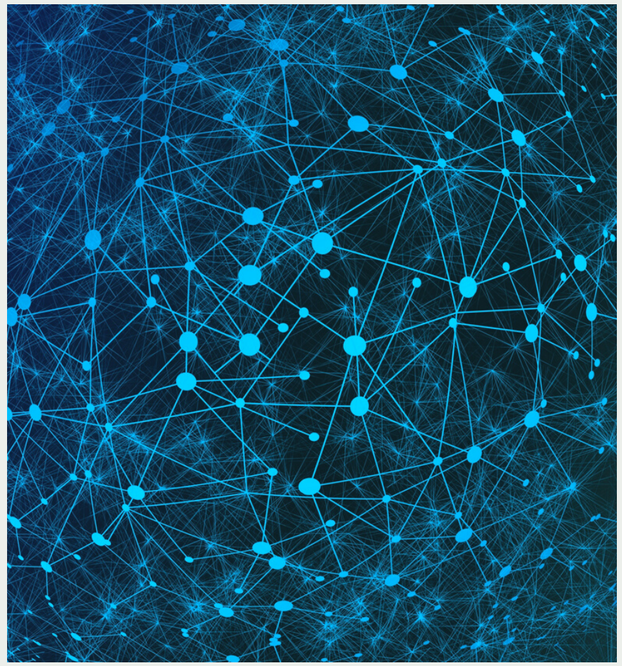
Introduction

glaciar mapping
why is it important?

Solheimajokull, Iceland in 2007 and 2015.

Photos by James Balog and the Extreme Ice Survey (Bryner, 2017)

Basic concepts



DEEP LEARNING
AND
CONVOLUTIONAL
NEUTRAL
NETWORKS

OBJECT-BASED
IMAGE ANALYSIS

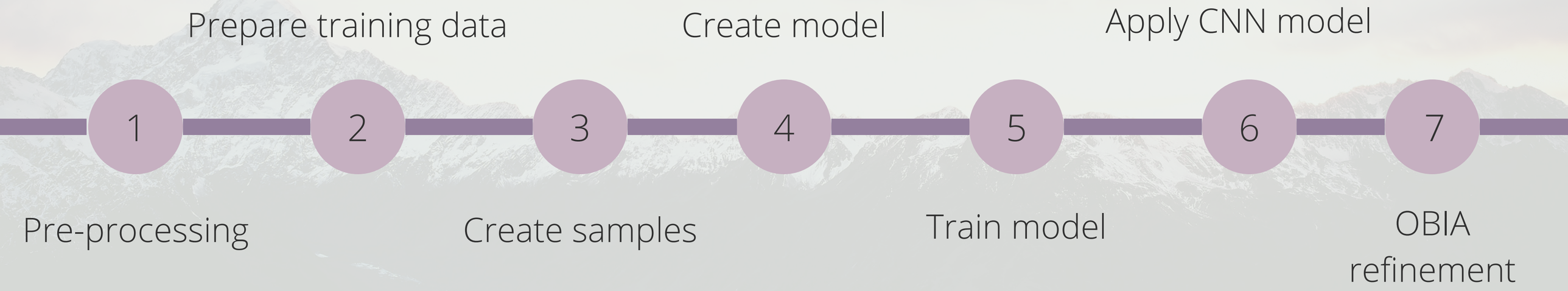
Study area and data

THE GLACIERS IS LOCATED IN HUNZA VALLEY IN PAKISTAN

- Sentinel 2 optical satellite imagery from 04.08.2018.
- Coherence data based on two Sentinel 1 images (05.08.2018 and 17.08.2018).
- Topographic data from the ALOS Global DEM.

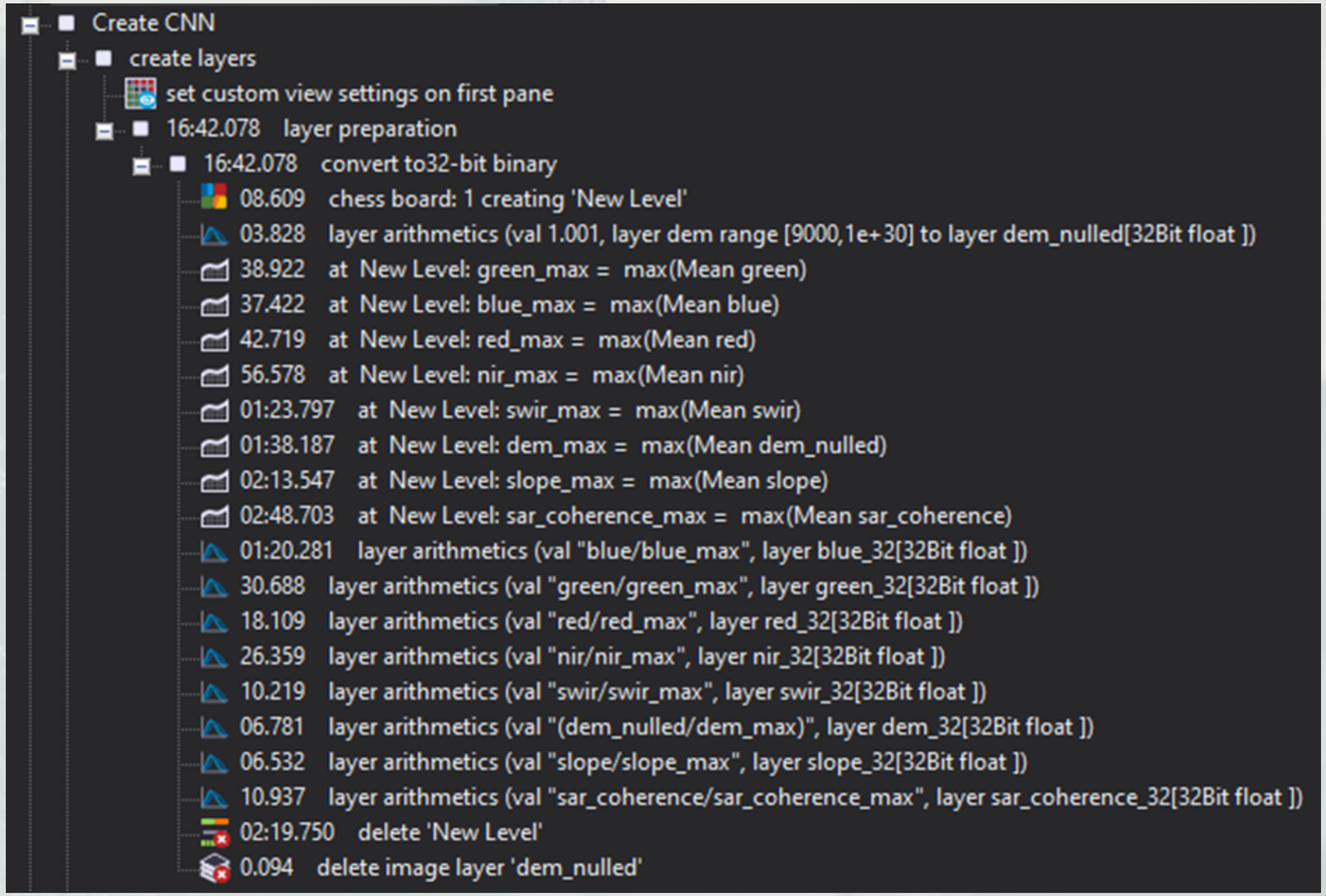
- Software eCognition

Flow chart


Prepare training data
Create model
Apply CNN model
1
2
3
4
5
6
7
Pre-processing
Create samples
Train model
OBIA refinement

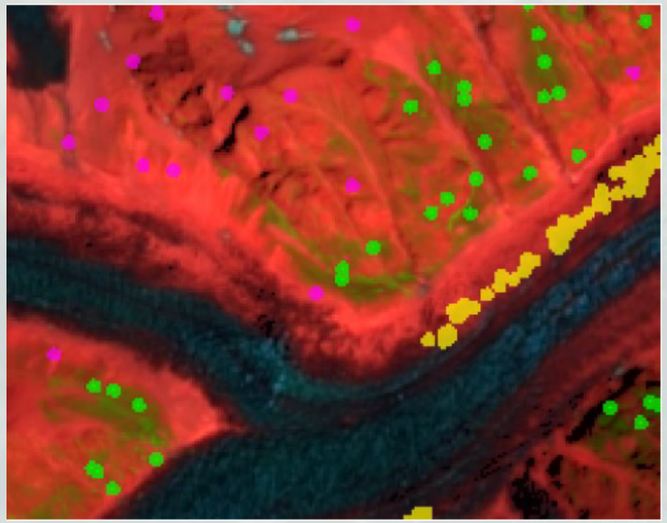
1 Pre-processing

- For each pixel, it makes one segment
- These steps are creating normalized values for each raster band one by one
- The CNN algorithm takes input in 32 bit floating point type
- Layer arithmetics calculated



2 Prepare training data

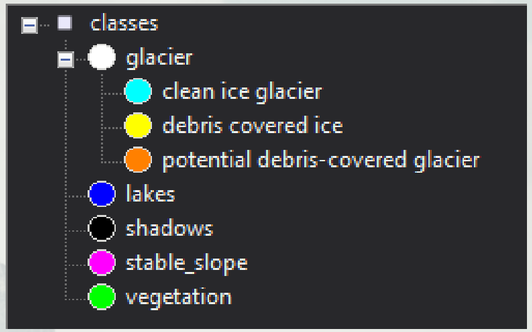
- Creating a buffer around each thematic class



```
load in training data
  53.094  prepare training data
    <0.001s  buffer_size = 25
    <0.001s  vector buffering/shrinking 'clean_ice' -> 'clean_ice_buffered' (delta=buffer_size, round)
    <0.001s  vector buffering/shrinking 'debris_covered_glaciers' -> 'debris_covered_glaciers_buffered' (delta=buffer_size, round)
    <0.001s  vector buffering/shrinking 'stable_slopes' -> 'stable_slopes_buffered' (delta=buffer_size, round)
    <0.001s  vector buffering/shrinking 'lakes' -> 'lakes_buffered' (delta=buffer_size, round)
    <0.001s  vector buffering/shrinking 'vegetation' -> 'vegetation_buffered' (delta=buffer_size, round)
    04.985  chess board: 1000000 creating 'level_1'
    0.922  unclassified with Num. of overlap: debris_covered_glaciers > 0  at  level_1: debris covered ice
    0.937  unclassified with Num. of overlap: clean_ice_buffered > 0  at  level_1: clean ice glacier
    0.922  unclassified with Num. of overlap: lakes > 0  at  level_1: lakes
    0.922  unclassified with Num. of overlap: stable_slopes > 0  at  level_1: stable_slope
    0.953  unclassified with Num. of overlap: vegetation_buffered > 0  at  level_1: vegetation
    20.641  unclassified at  level_1: chess board: 1
    21.765  unclassified with Mean nir < 900  at  level_1: shadows
    01.047  clean ice glacier, debris covered ice, lakes, shadows, stable_slope, vegetation at  level_1: chess board: 1
```

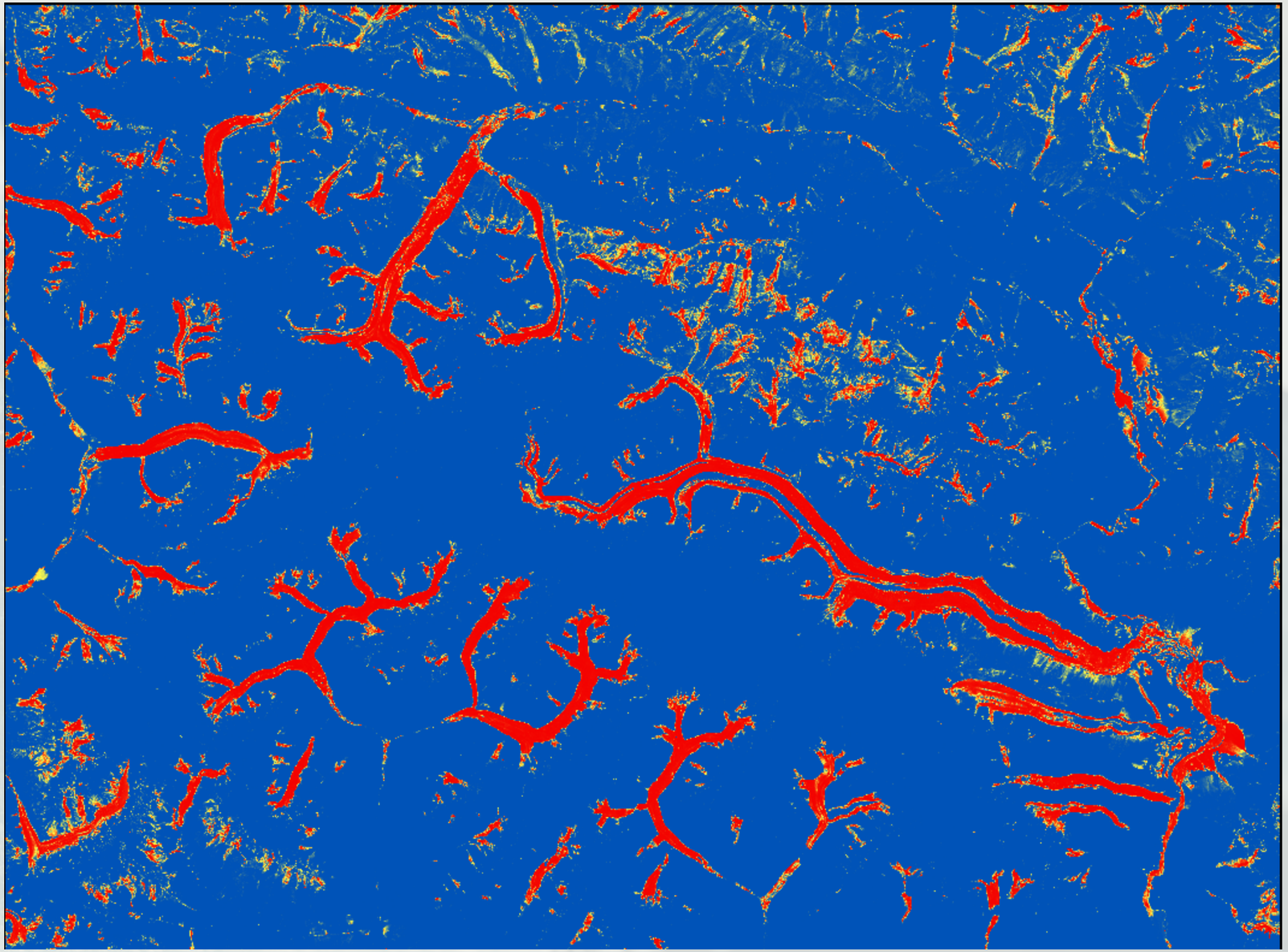
CNN

3 4 5 6

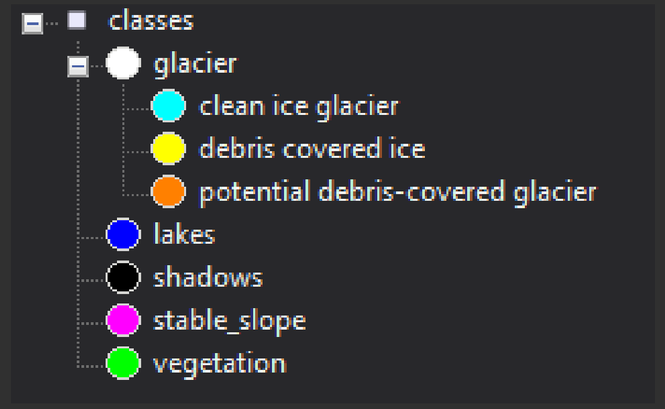


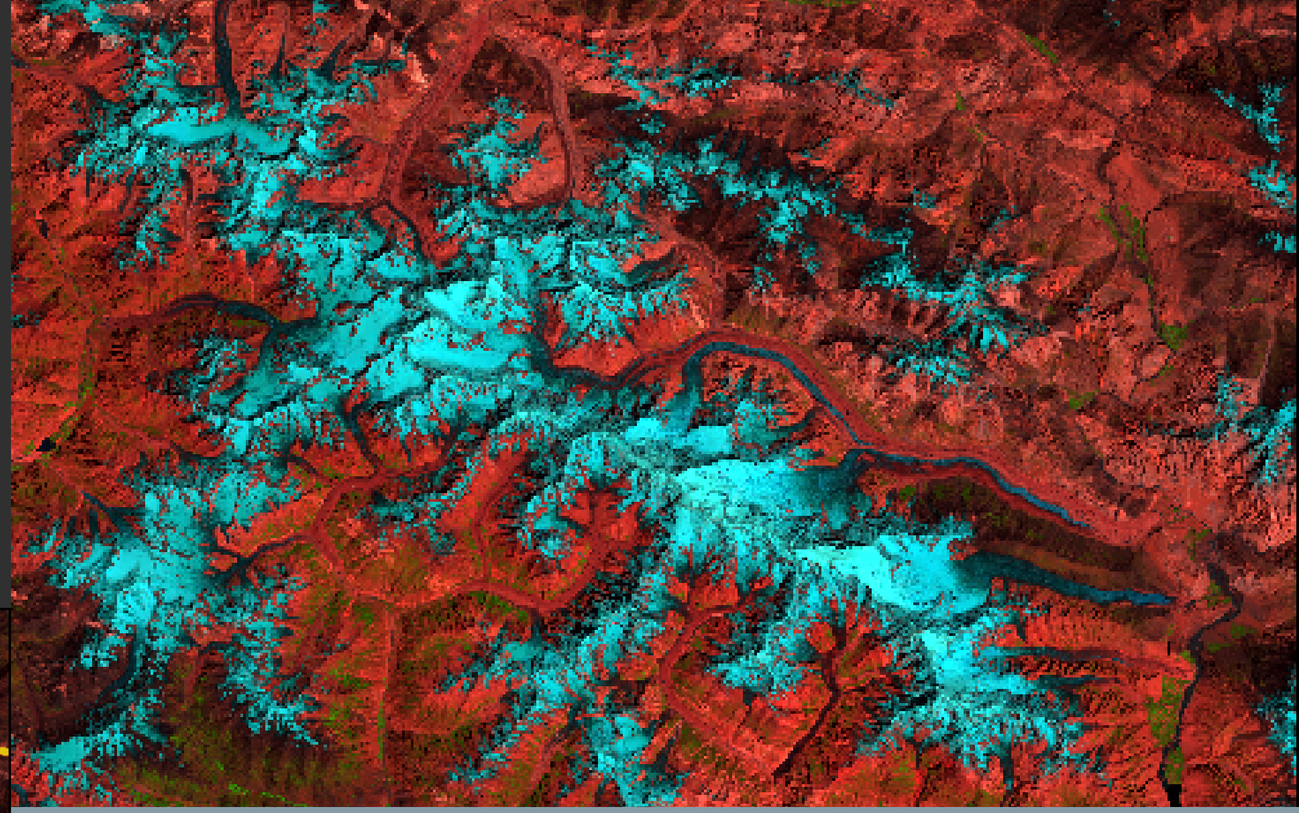

```
create samples
  create
    sample_size = 16
    sample_folder = "{:Workspc.OutputRoot}\samples\"
    debris covered ice at  level_1: generate 8000 raw sample patches sample_sizexsample_sizex6 using layers ("sample_folder")
    clean ice glacier at  level_1: generate 2000 raw sample patches sample_sizexsample_sizex6 using layers ("sample_folder")
    lakes at  level_1: generate 2000 raw sample patches sample_sizexsample_sizex6 using layers (sample_folder)
    stable_slope at  level_1: generate 18000 raw sample patches sample_sizexsample_sizex6 using layers (sample_folder)
    vegetation at  level_1: generate 2000 raw sample patches sample_sizexsample_sizex6 using layers (sample_folder)
    shadows at  level_1: generate 2000 raw sample patches sample_sizexsample_sizex6 using layers (sample_folder)
  shuffle
    shuffle labeled sample patches ("sample_folder")
    split labeled sample space from '"{:Workspc.OutputRoot}\samples"' to '"{:Workspc.OutputRoot}\samples\samples1"', '"{:Workspc.OutputRoot}\samples\samples2"'
03:10.984   create, train, apply
  0.531   create model
    0.531   create 6-layer convolutional neural network with kernels [3,3,3,3,3], features[50,30,20,20,16] and pooling [false,false,false,false,true]
  03:10.453   train and apply model
    01:09.765   train convolutional neural network (learn rate 0.0006) with 5000x16 samples ("{:Workspc.OutputRoot}\samples\samples1")
    01:55.719   apply convolutional neural network (Class[debris covered ice]->Layer[heatmap_debris_covered_ice])
    <0.001s   set custom view settings on second pane
    04.969   delete 'level_1'
```

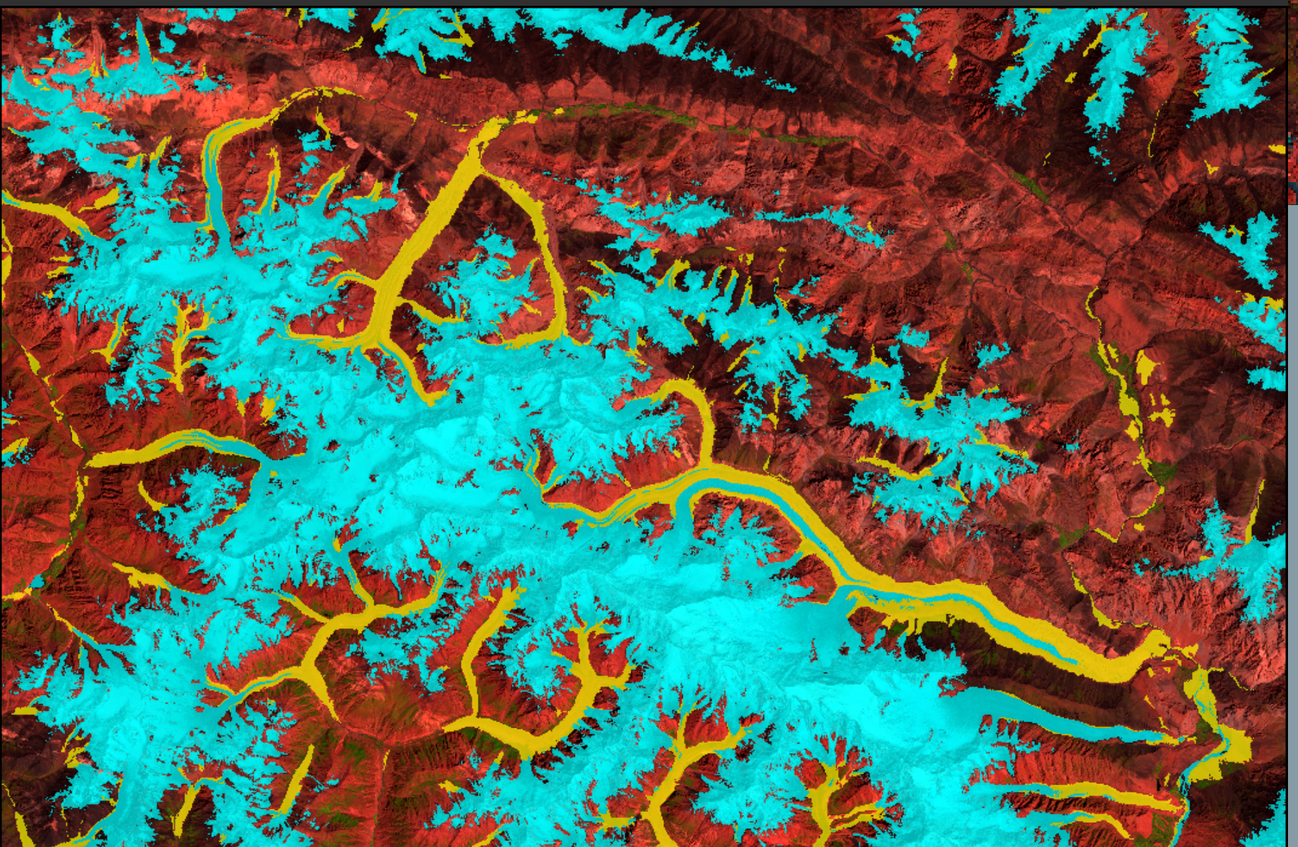
HeatMap



OBIA refinement







FINAL RESULTS

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Thank you for your attention !

REFERENCES:

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