

FALK Project – Phase Three Summary

December 16th. 2019



Products from TerraNor



Orthorectifying, mosaick, DTM, DSM



Lidar analysis, DTM/DEM, DSM



Classification, analysis

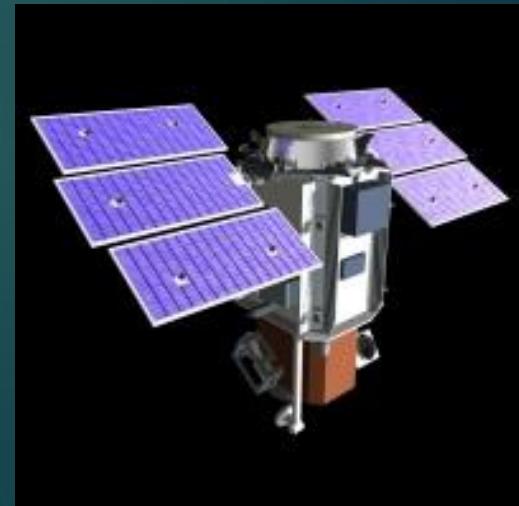


Satellite data



GIS was invented by Canada in 1960
Remote sensing – Corona 1959, military

The rest is history you know



Falk project for Norwegian Environmental Agency - MD

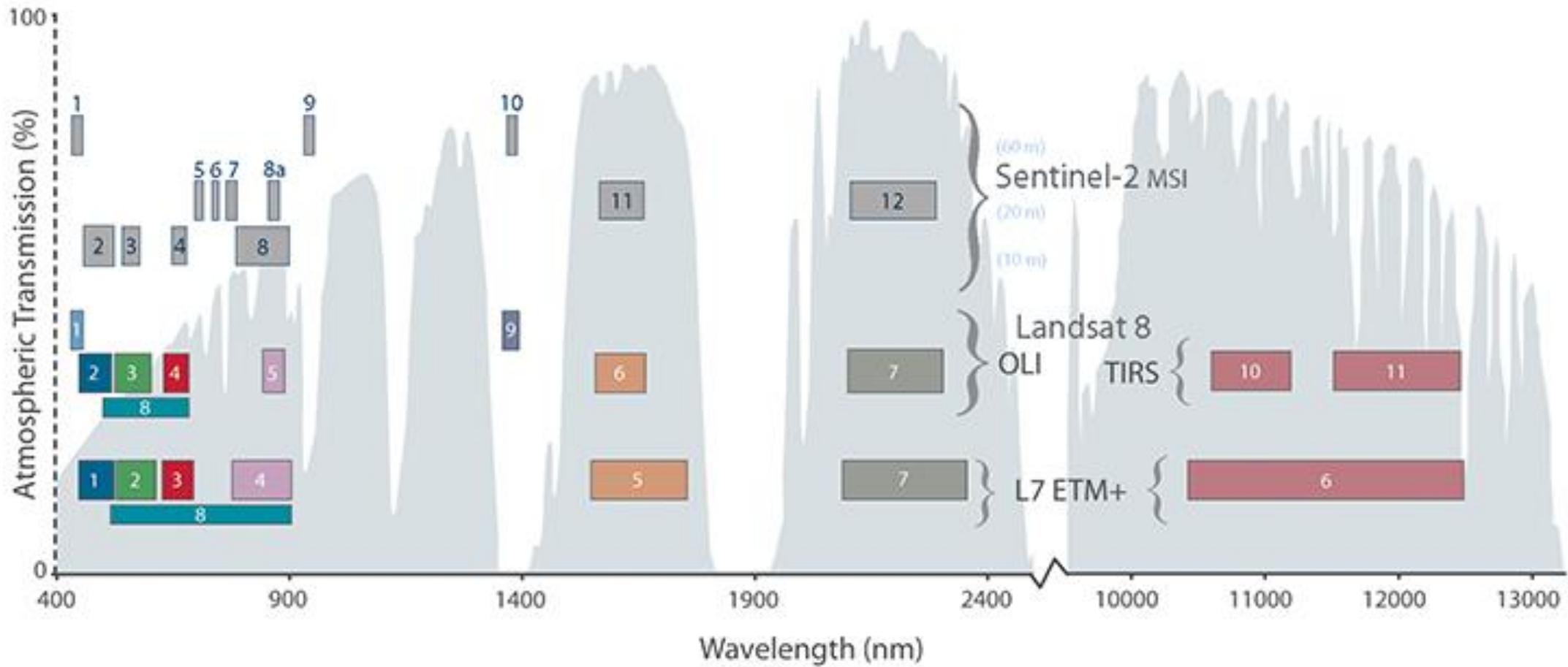


What can you find here?

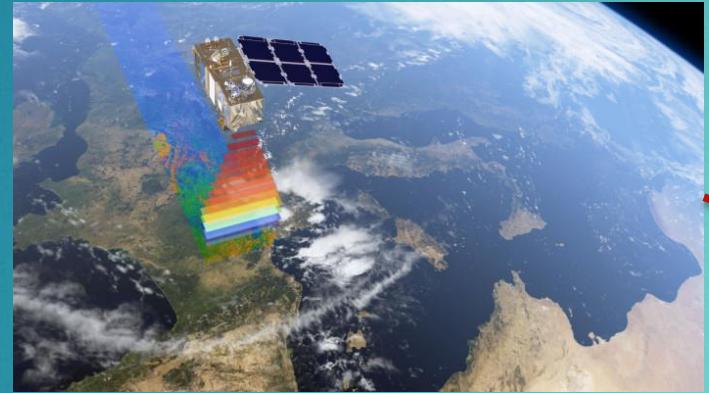
UiB
TerraNor
PCI Geomatics
Trimble eCognition team

Landsat 7/8 and Sentinel 2

Comparison of Landsat 7 and 8 bands with Sentinel-2



From raw data to analysis



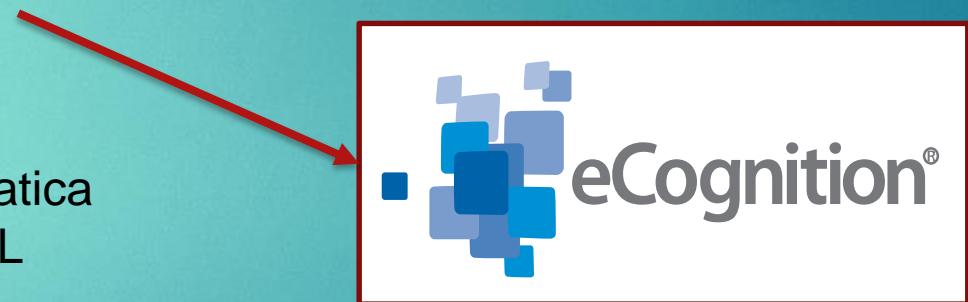
L2A
L1C
??DTM



Multitemporal
Atmospheric correction
Match existing images
Large areas?
Resolution
What bands do I need?
What analysis shall I do

100 images: PCI Geomatica
10 000 images: PCI GXL

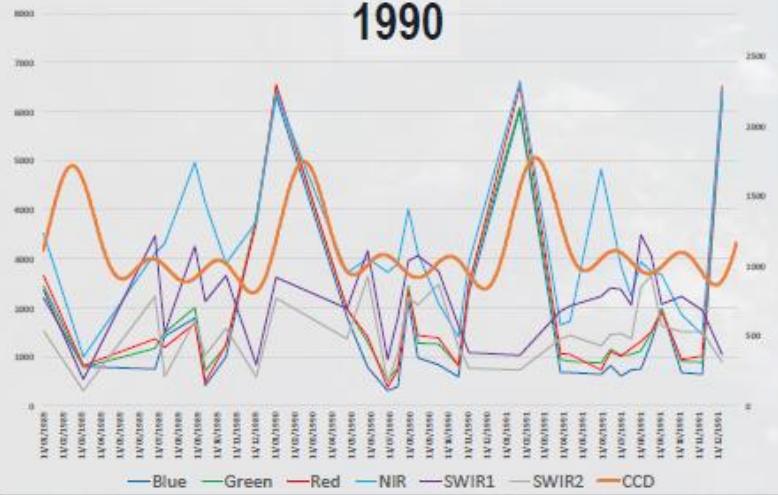
Speed
Functionality
Cost



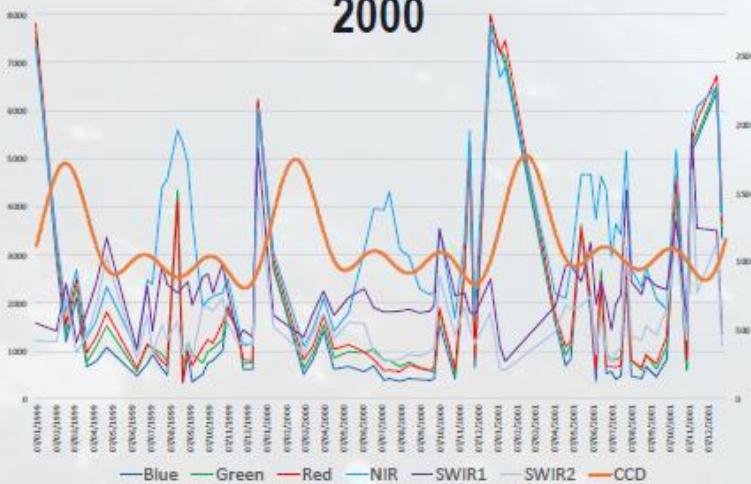
Multitemporal



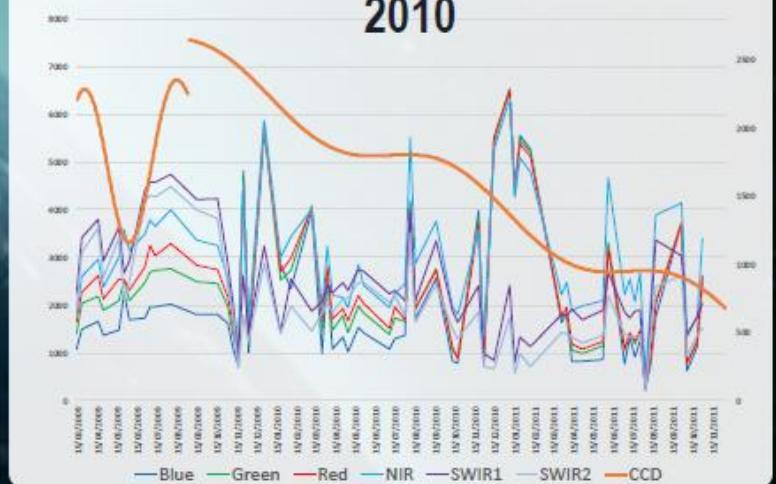
1990



2000



2010



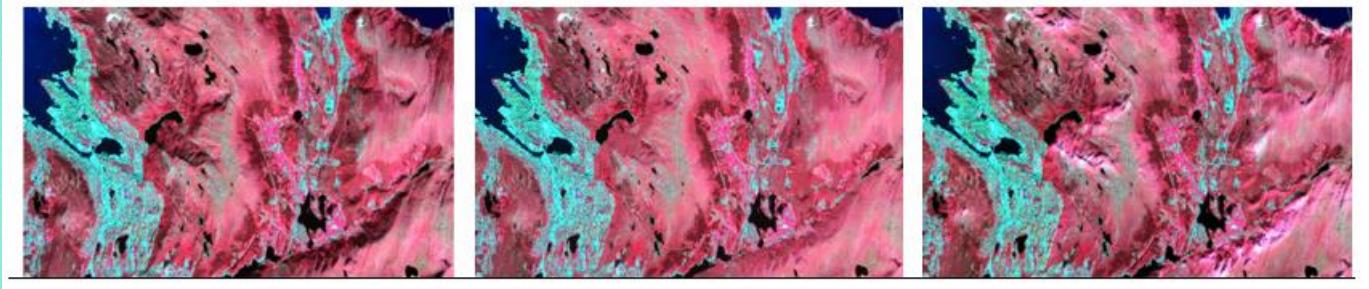
ARD

- ▶ Analysis
- ▶ Ready
- ▶ Data



What is Analysis Ready Data ?

- Geometric alignment (Multi-temporal)
- Radiometric correction and topographic normalization



GXL Orthorectification



GXL produces a variety of high-quality ortho products

- DTM ortho
- DSM true ortho
- True ortho

Many tools are available to ensure highly-accurate ortho products

- Automatic multi-ray GCP collection and TP collection
- Automatic bundle adjustment and point refinement
 - Statistical (RMS)
 - Density and clustering
- Automatic accuracy reports



GXL Orthorectification



TerraNor

Reference

GXL produces a variety of high-quality ortho products

- DTM ortho
- DSM true ortho
- True ortho

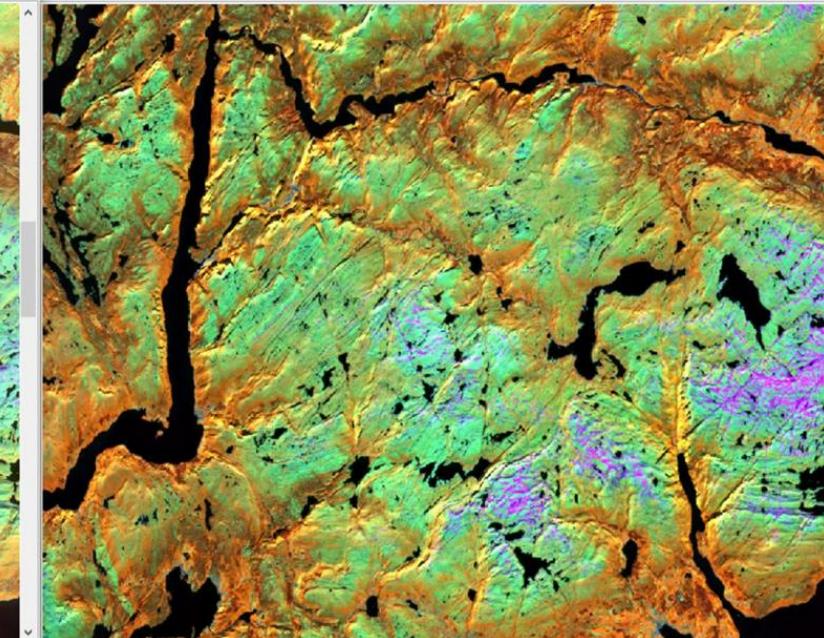
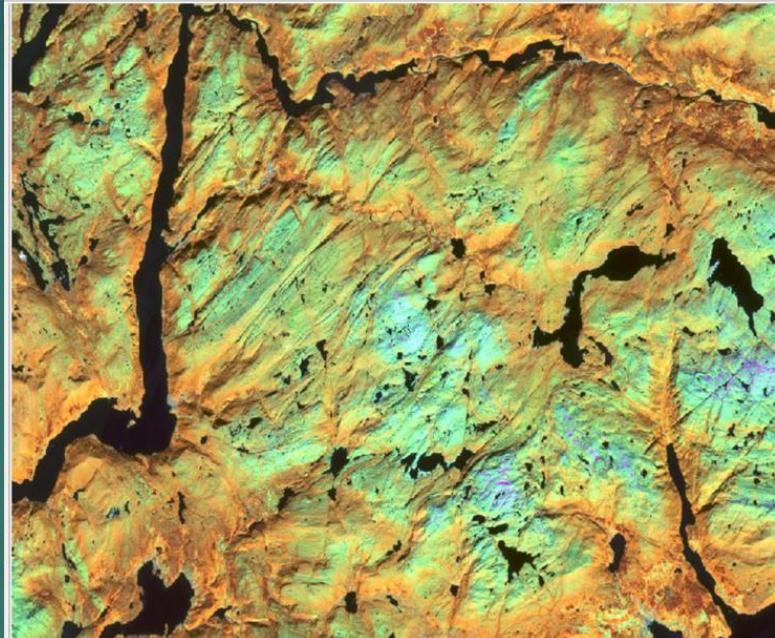
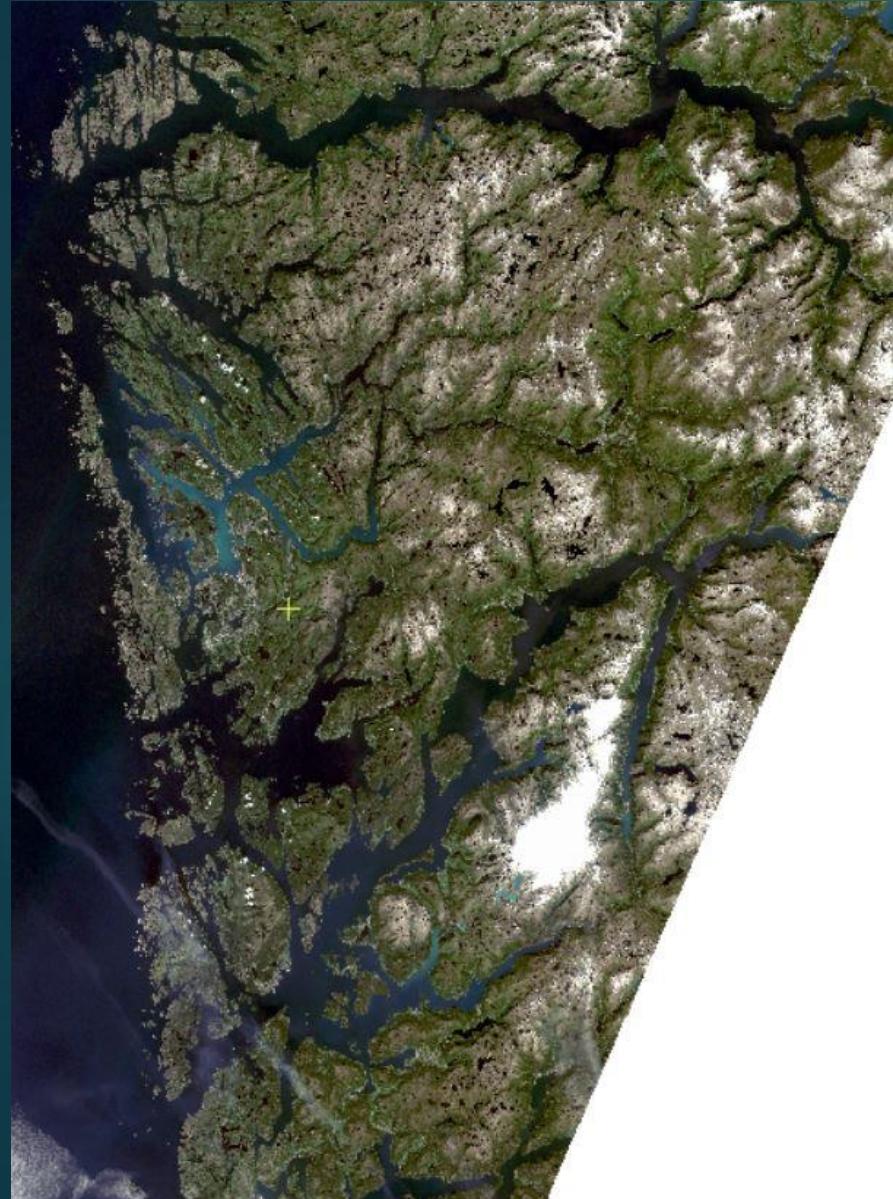
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PCI
GEOMATICS

Hordaland (Viken), Oversikt område



PCI image Topografisk normalisert vs L2A

Prepare for Analysis

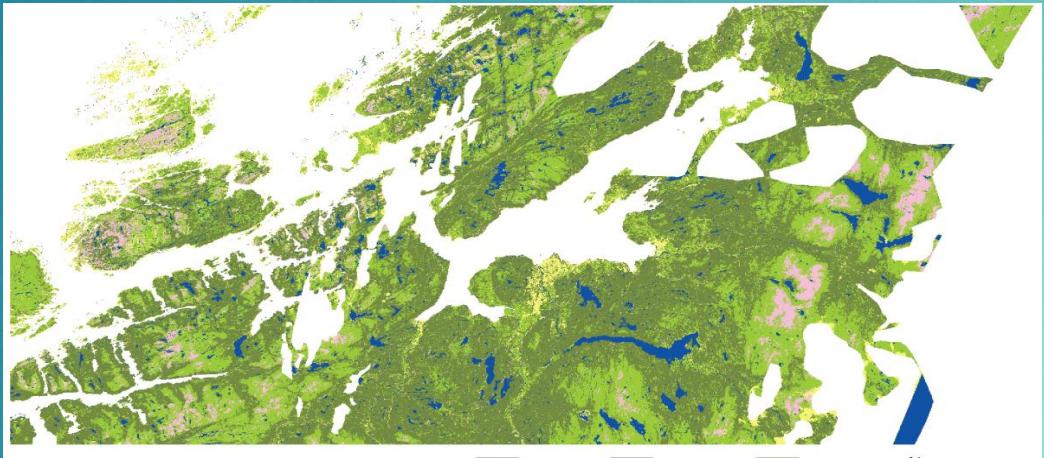
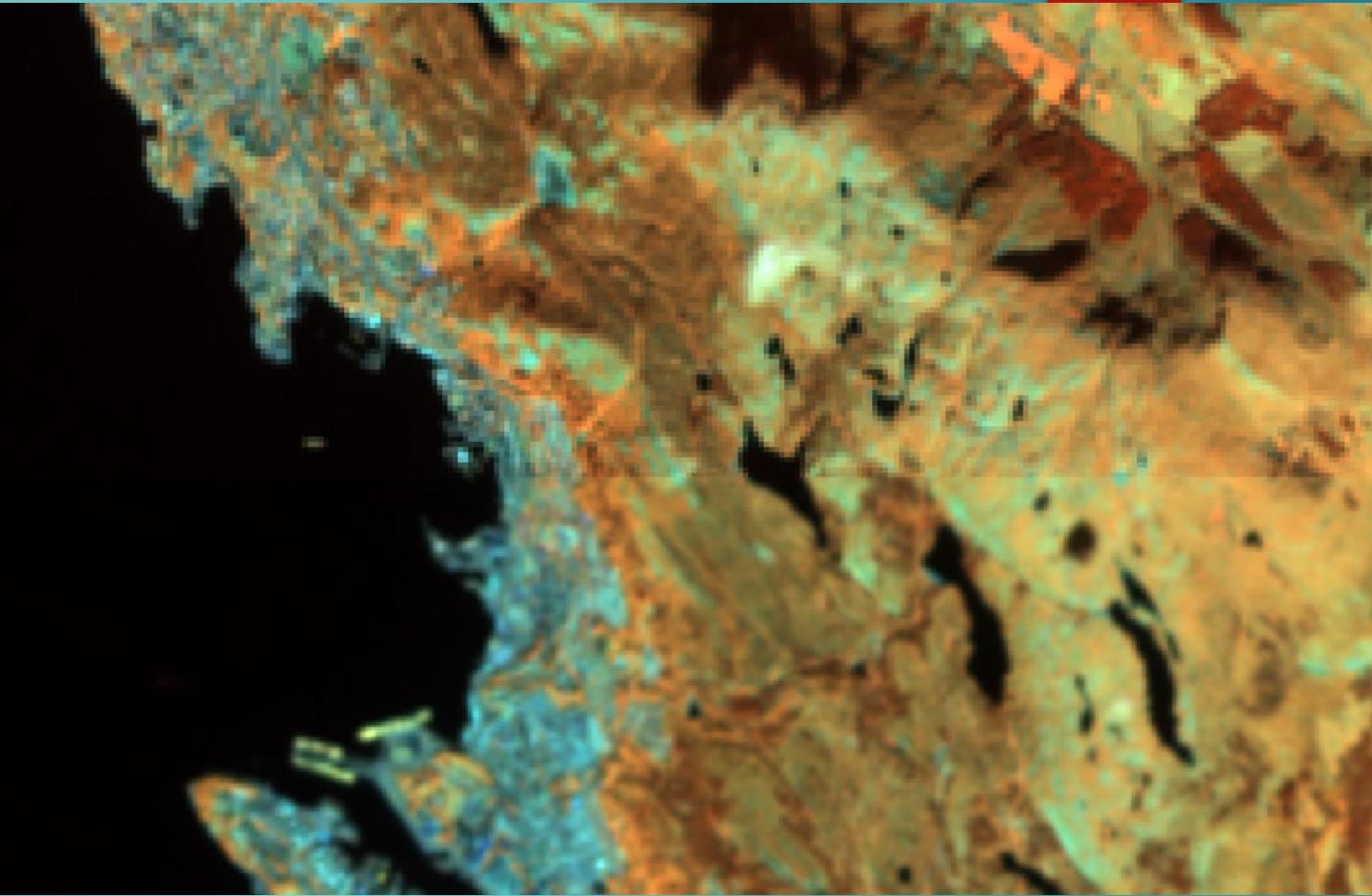


Figure 2: Klassifisert subset av Trøndelag. Skyer, hav og manglende DTM er klippet bort

Cut out clouds, ocean and missing DTM



Pan sharpening (MRA)
10 + 20 + 60 m → 10 m
Nir + Swir-1 + Swir-2



GXL Pan-Sharpening - MRA

Multiresolution Analysis (MRA): Data fusion carried out using wavelet decomposition

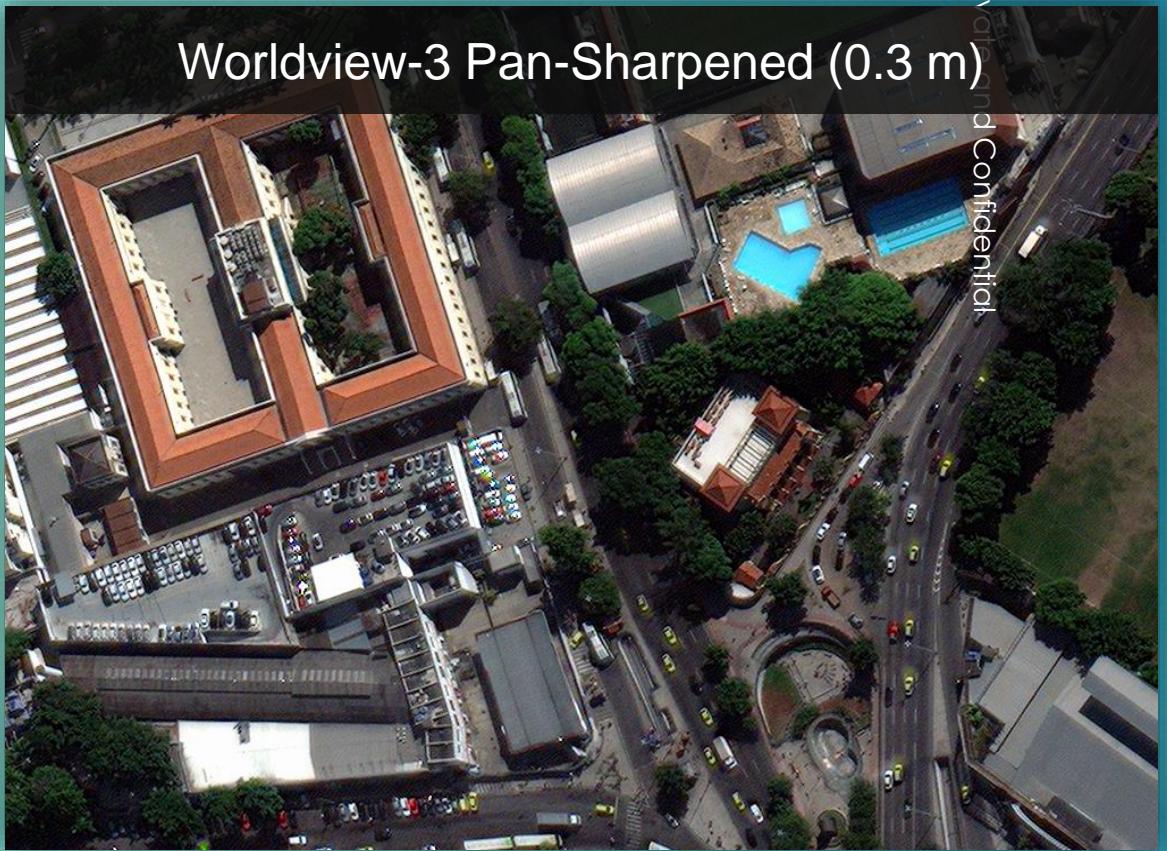
- ▶ Known for preserving multispectral radiometry
- ▶ Fit for analytical applications



GXL Pan-Sharpening - MRA

Multiresolution Analysis (MRA): Data fusion carried out using wavelet decomposition

- ▶ Known for preserving multispectral radiometry
- ▶ Fit for analytical applications



GXL Pan-Sharpening - UNB

UNB: Data fusion carried out using statistical approach

- ▶ Known for overcoming color distortion issues
- ▶ Fit for high-quality mapping applications



Private and Confidential
15

GXL Pan-Sharpening - UNB

UNB: Data fusion carried out using statistical approach

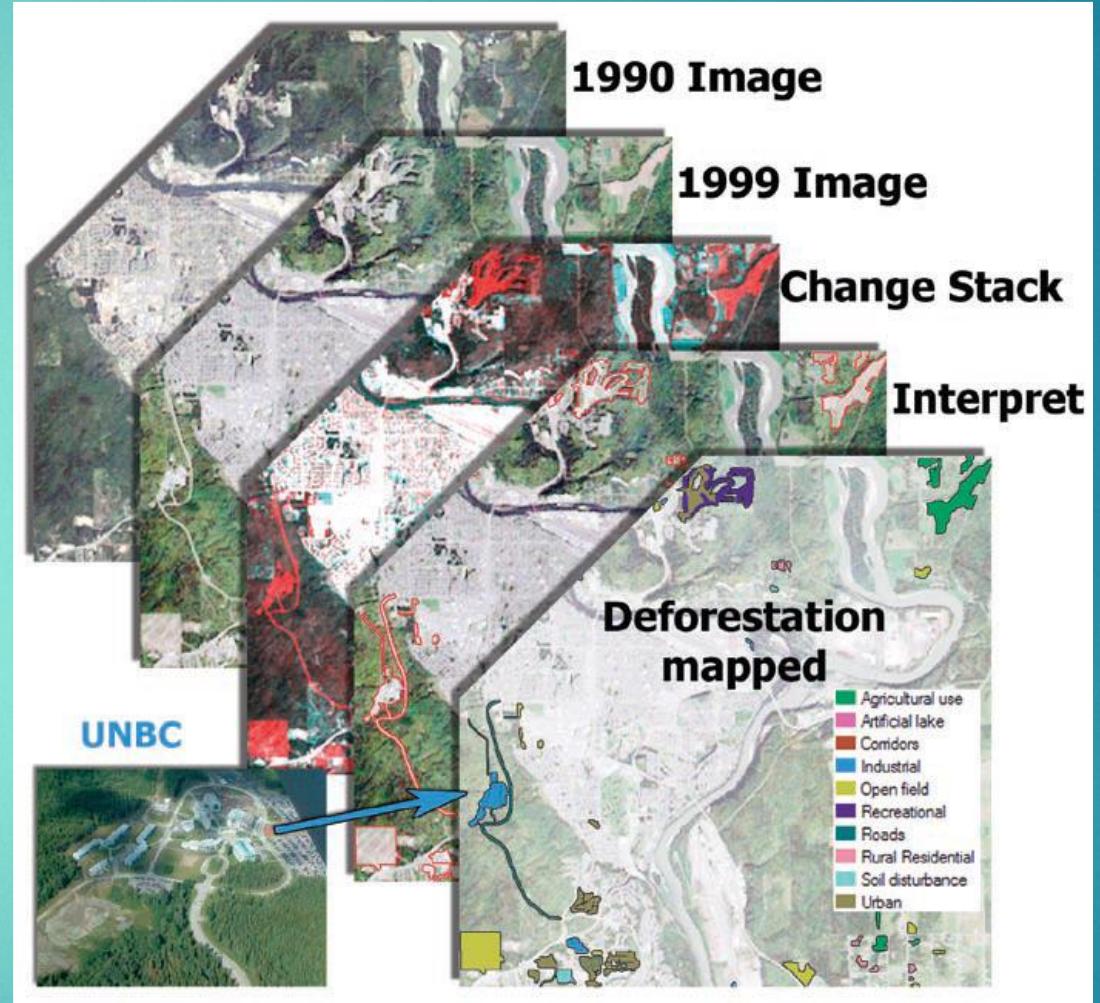
- ▶ Known for overcoming color distortion issues
- ▶ Fit for high-quality mapping applications

Private and Confidential
16

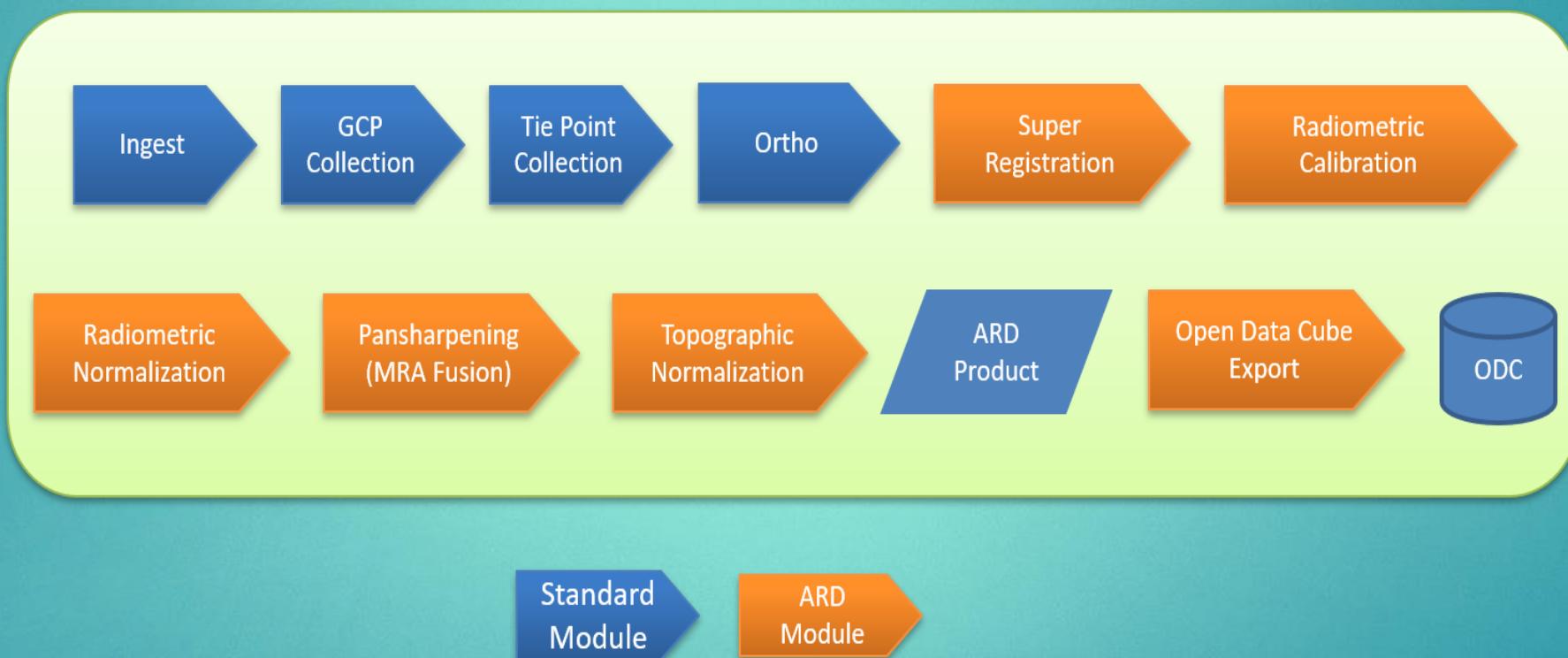


Why Analysis Ready Data ?

- Consistent and reliable multi-temporal analysis
- Additional utilities:
 - Deep learning CNN
 - Quantitative analysis
 - Physical measurements (e.g. LAI)
 - Automating image classifications
 - Environmental applications



Proposed ARD Workflow – FALK Project



Ongoing ARD Projects - Government

ANALYSIS READY DATA TOOLS

PCI GEOMATICS - SOLUTIONS FOR TIME-SERIES ANALYSIS



LARGE-VOLUME
PROCESSING



- Prepare your data for multitemporal analysis
- Preprocessing for machine learning and artificial intelligence

EXPORT TO OPEN
DATA CUBE



CASE STUDIES IN PROGRESS

FLOOD-RISK ASSESSMENT

SAINT JOHN RIVER, NEW BRUNSWICK

46 N, 67.6 W

URBAN-CHANGE MONITORING FOR CARBON ACCOUNTING

TORONTO, ONTARIO

43.7 N, 79.4 W

DEFORESTATION MONITORING FOR CARBON ACCOUNTING

FORT MCMURRAY, ALBERTA

56.9 N, 111.3 W



Canada A white rectangular box containing the word "Canada" in a large serif font, with a small Canadian flag icon to the right.

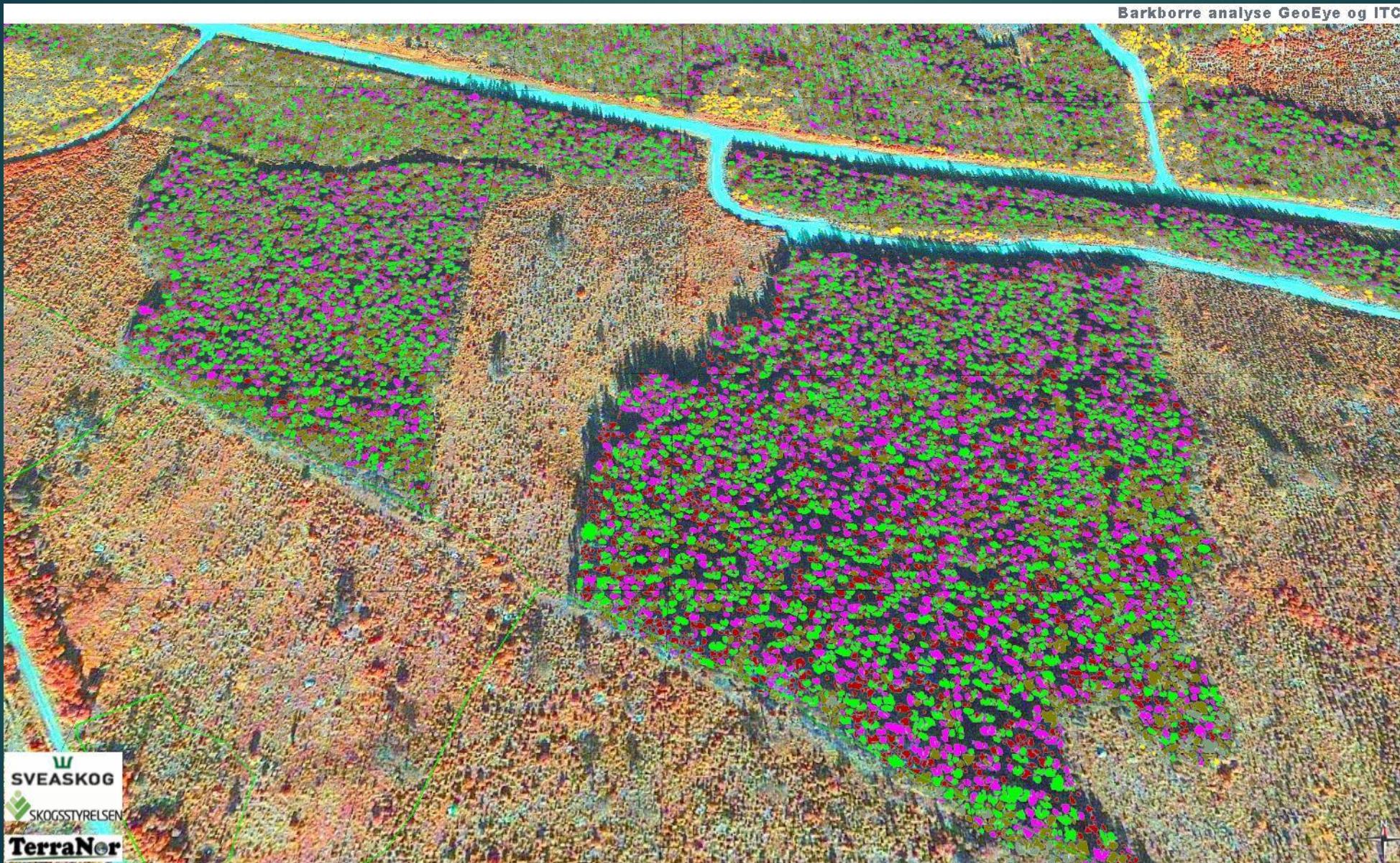
Find out more at www.pcigeomatics.com/geomatica



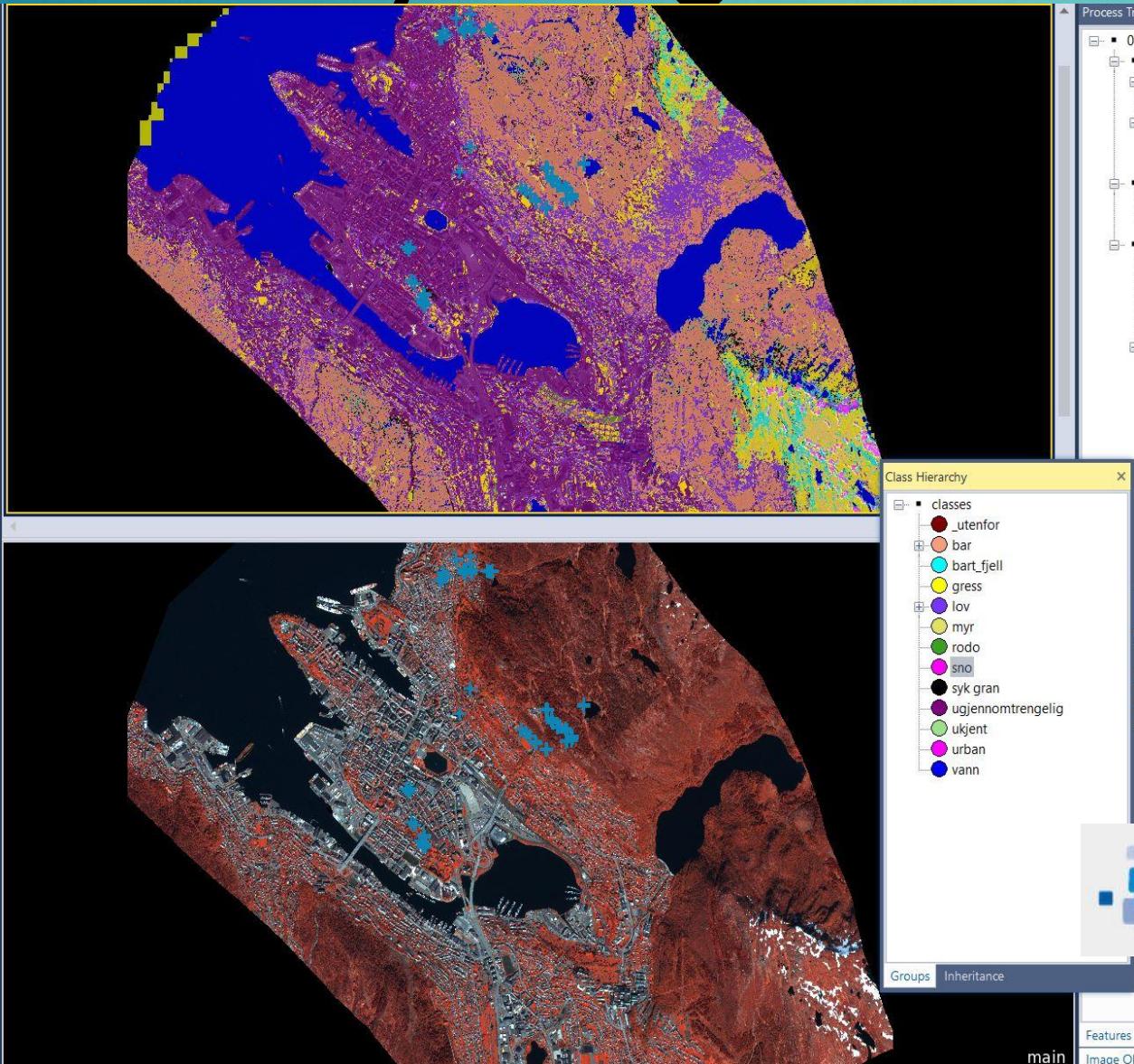
Project for Sveaskog and Skogsstyrelsen



How to use high resolution data for nature mapping



Analysis high resolution, WV 2 40 cm



Threshold: Water / land

Threshold: Vegetation / not vegetation (ndvi)

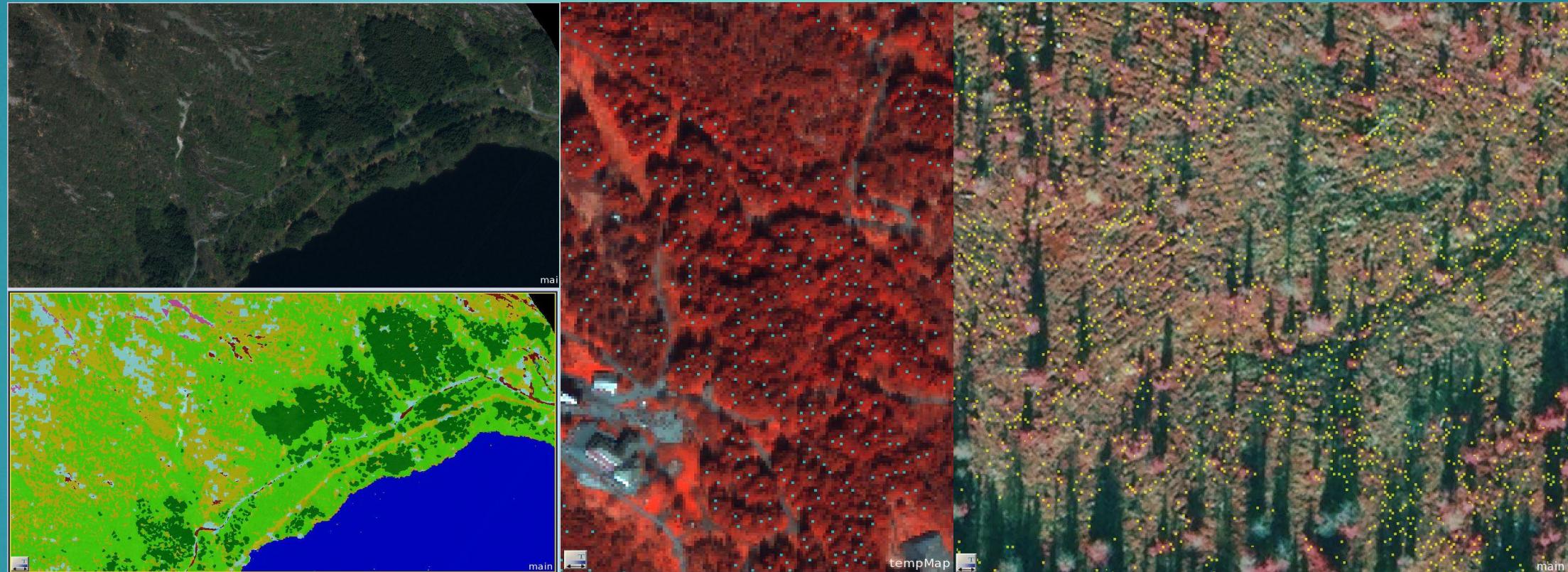
Threshold: Forest / not forest (nDSM)

SVM: Single trees, bushes, plants

SVM: Snow, roads, buildings



Optical/Terrain analysis

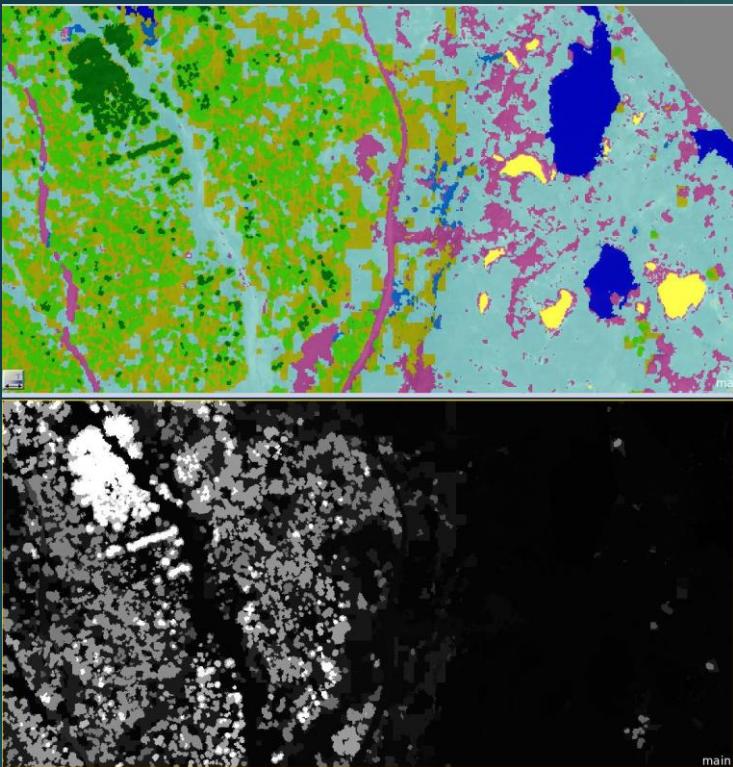


Skog inndelt i områder
Bar, løv, fjell, åpne områder, vann

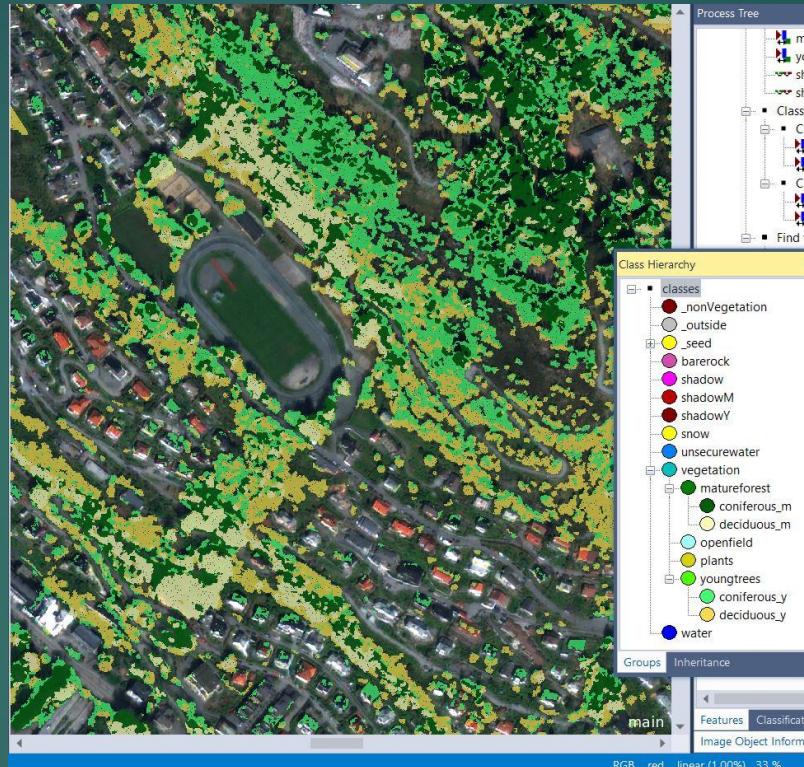
Enkelt-tre store trær

Enkelt-tre planter > 20cm

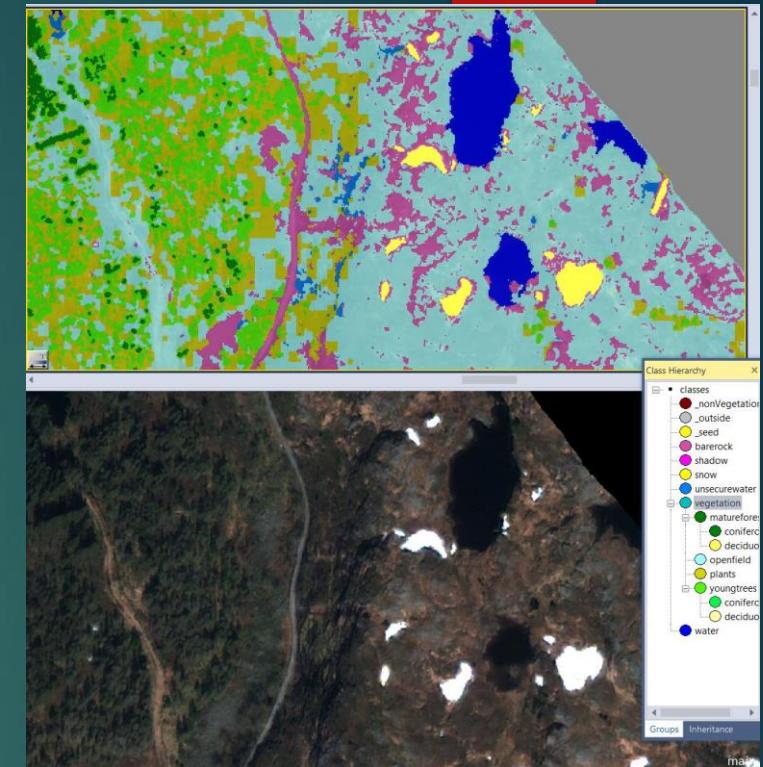
Klasser



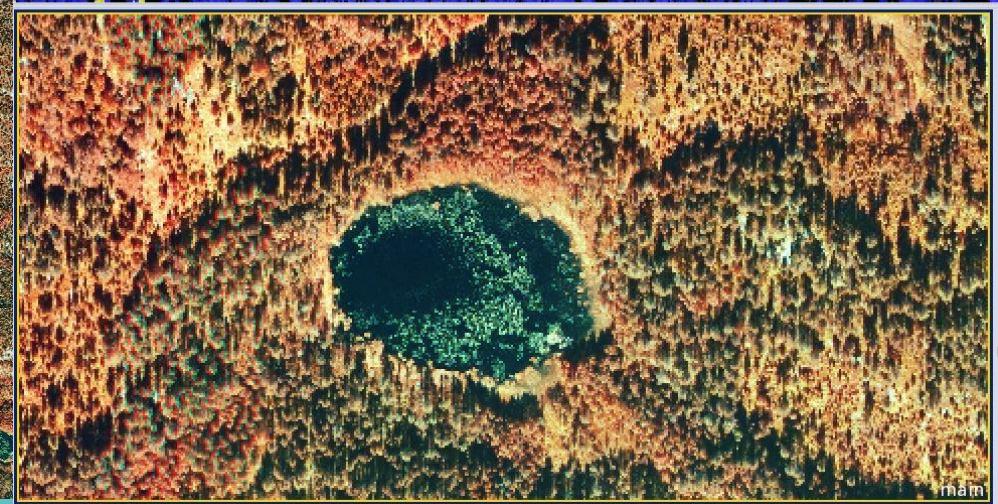
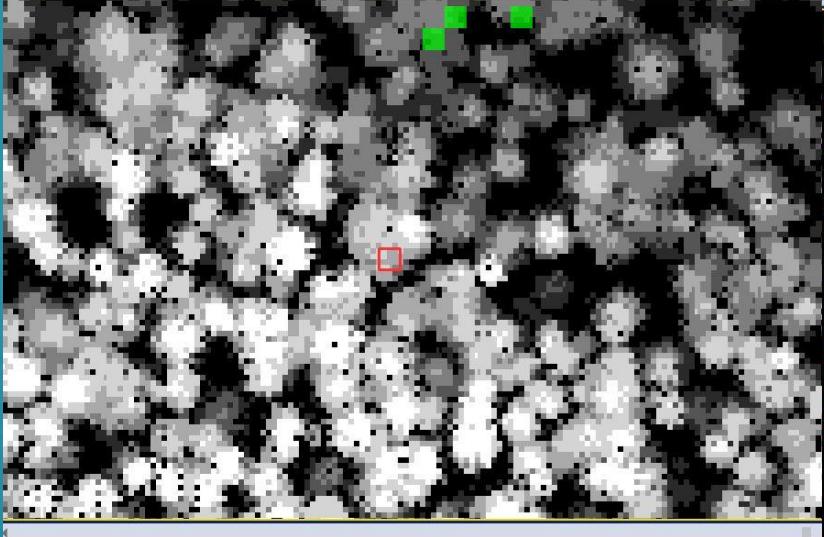
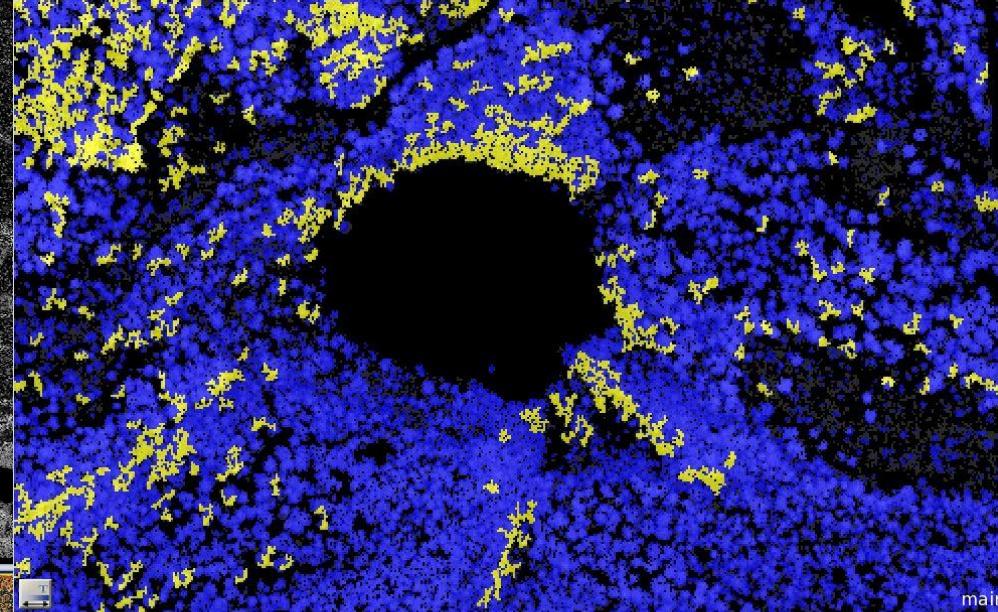
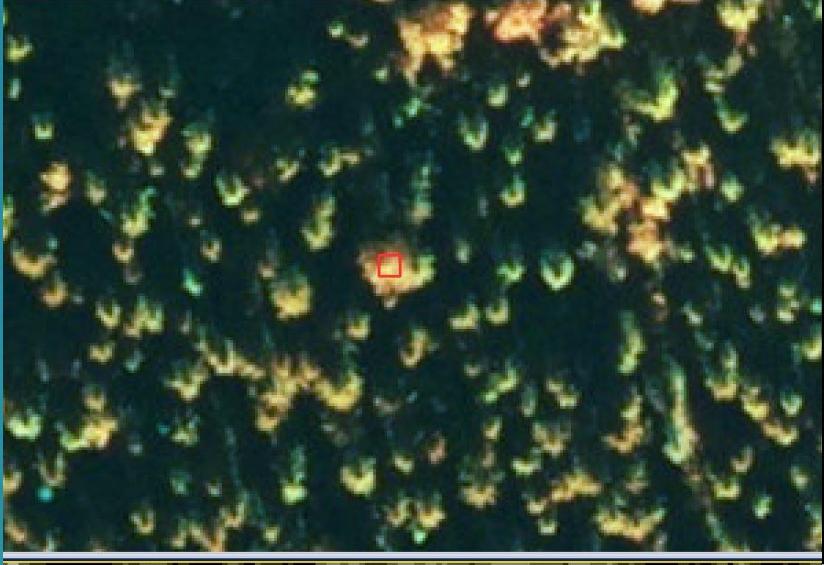
Trehøyder



Ung og gammel skog, bar/løv



Forest analysis



IRGB + nDSM

TerraNor



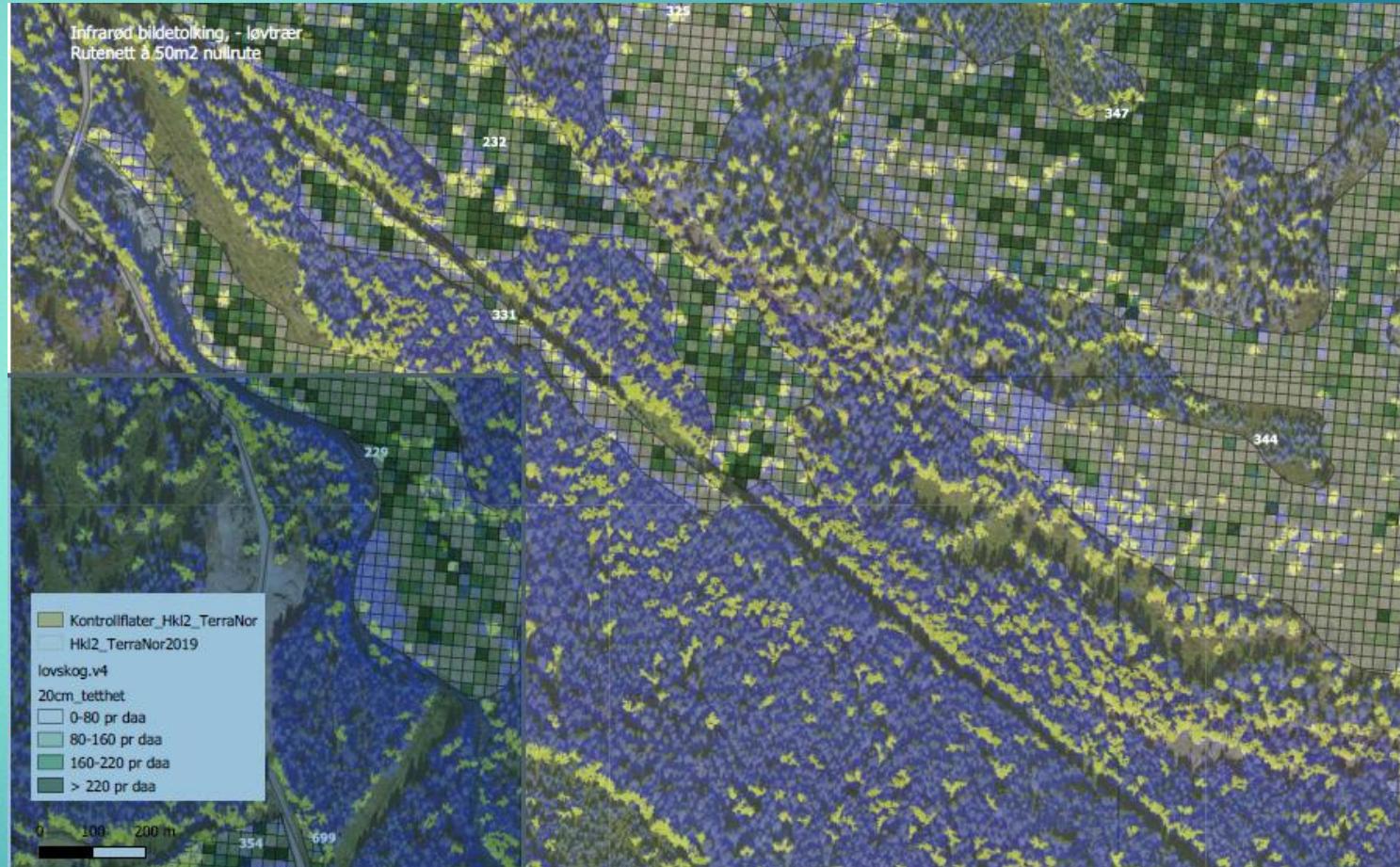
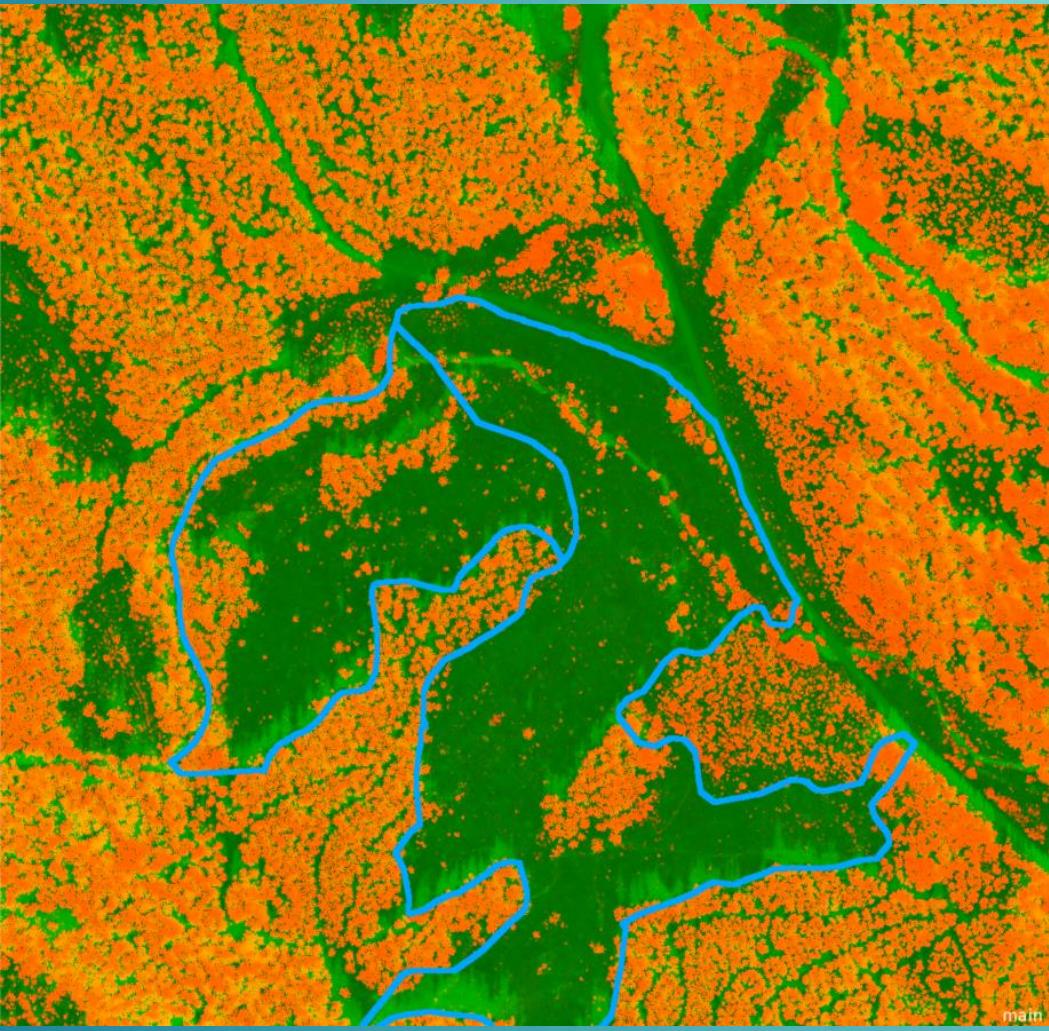
nDSM + IRGB



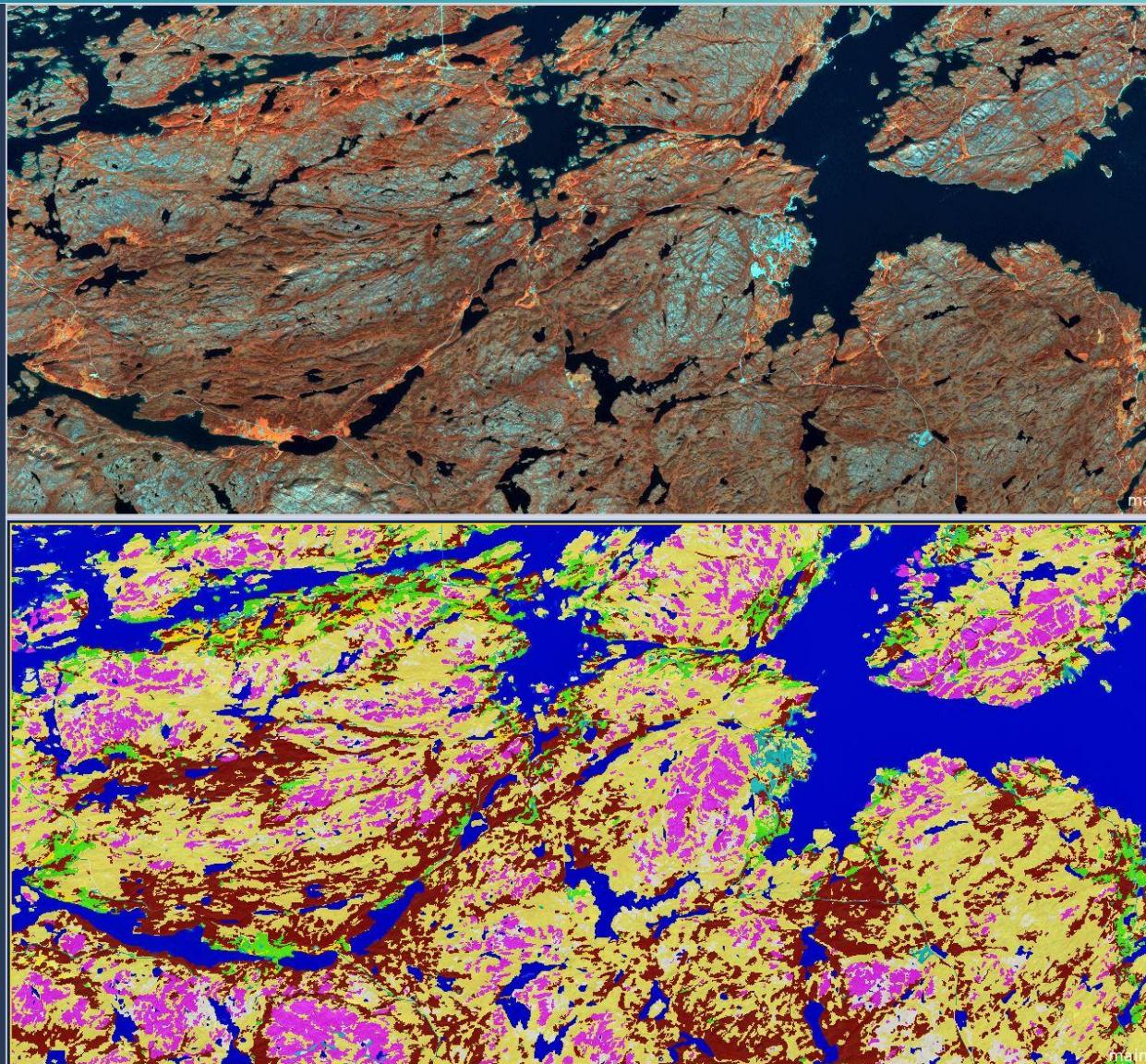
Classified data: Coniferous + Deciduous

PCI
GEOMATICS

Stand delineation correct? Deciduous/coniferous Plant density



Threshold or SVM analysis



Threshold water, watervapour

Threshold: Vegetation/not vegetation (ndvi)

Threshold: Forest / open areas: nDSM

Threshold: Deciduous / coniferous, Nir2

DL/CNN: Better water classification NB!

DL/CNN: Kulturmarkeng – grass

DL/CNN: Bare rock, urban

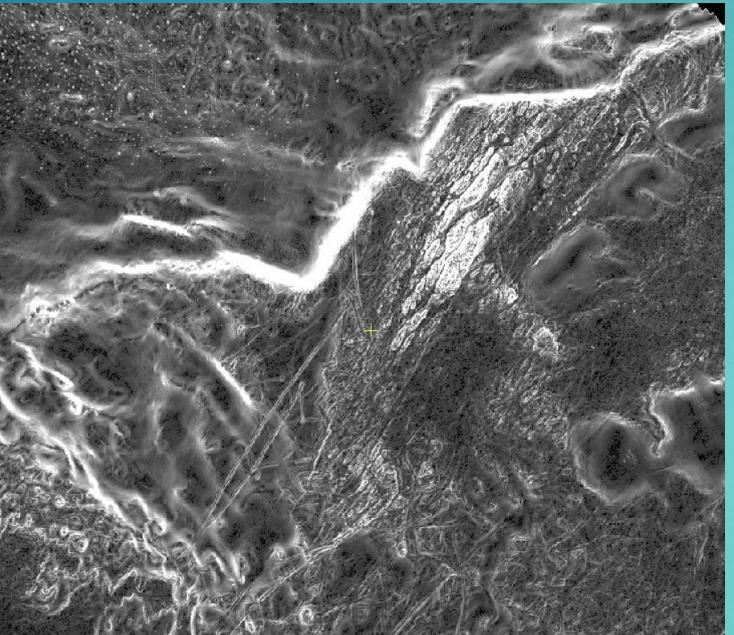
The alternate route:

SVM: water, vegetation, deciduous, coniferous, deciduous.

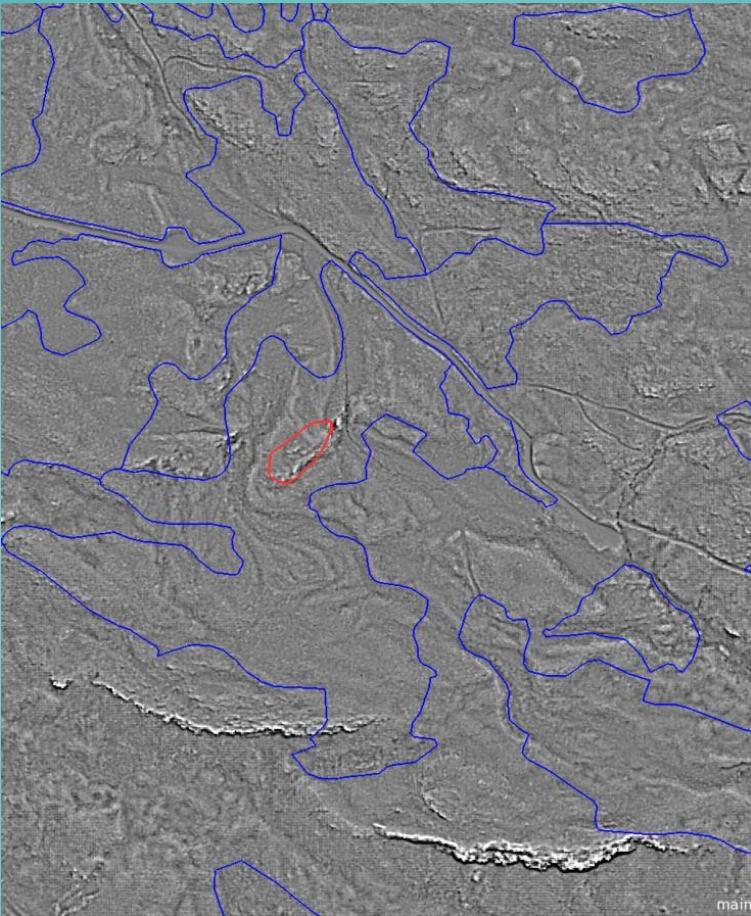
DL/CNN: Snow patches and bogs

DL/CNN: Mountain, rock, urban

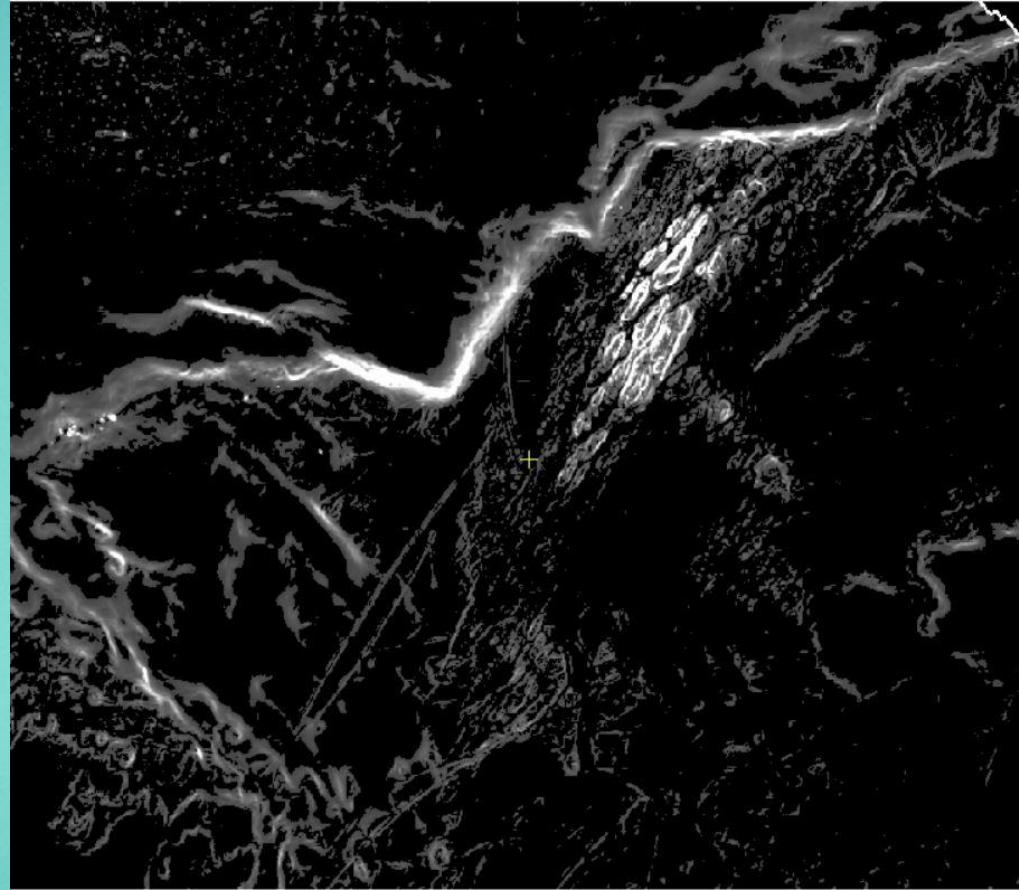
Terrain Analysis



Slope

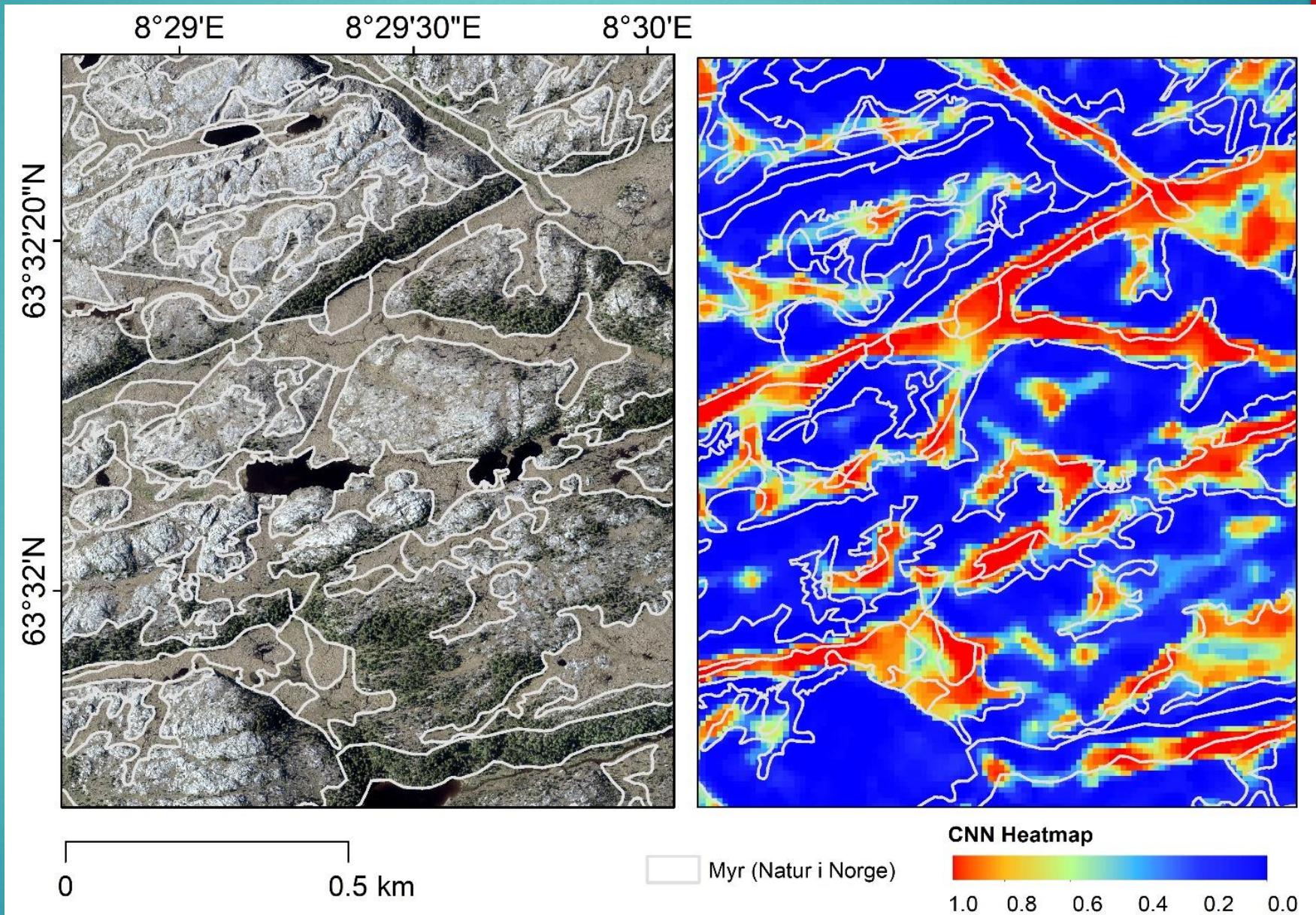


TPI 21

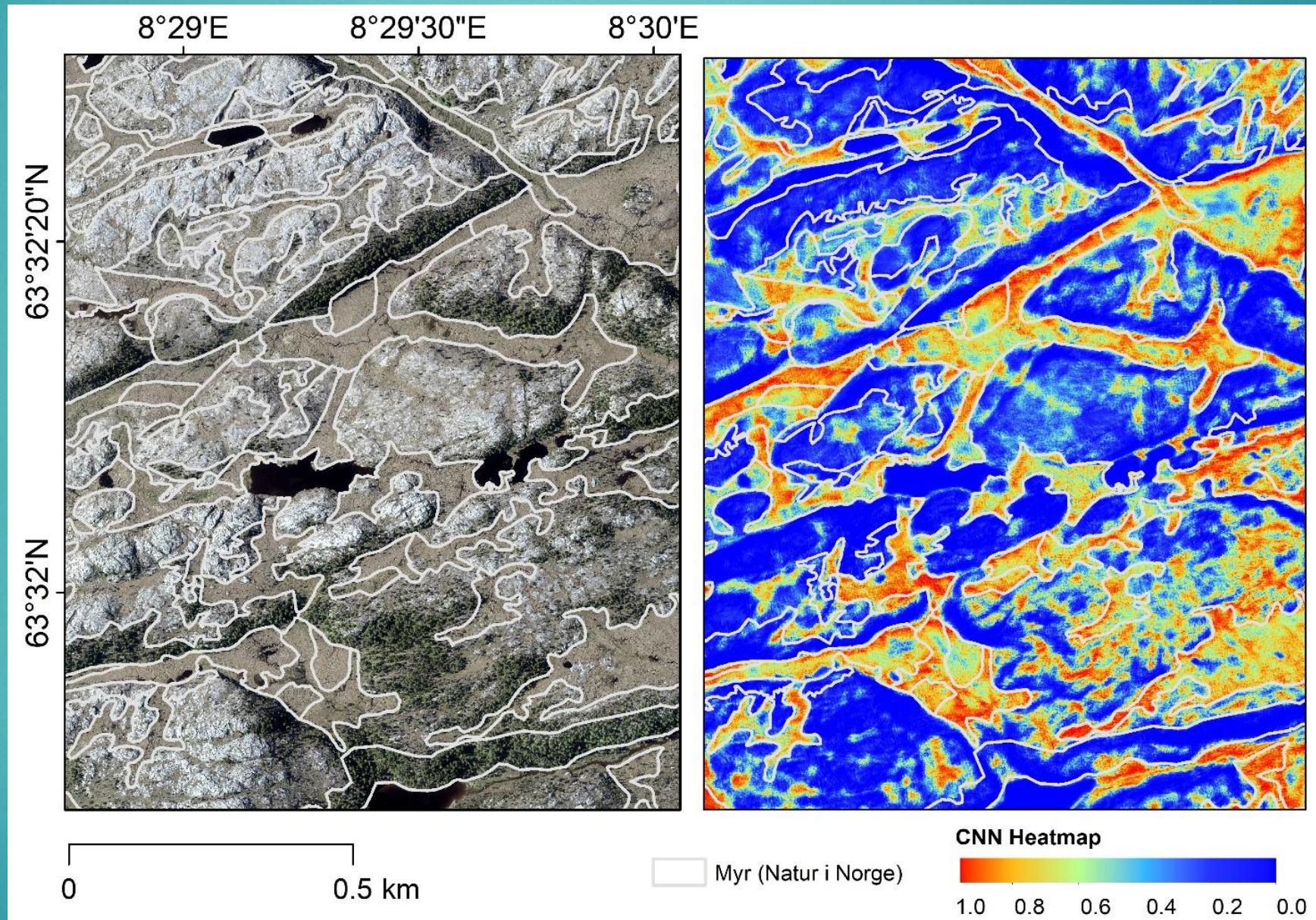


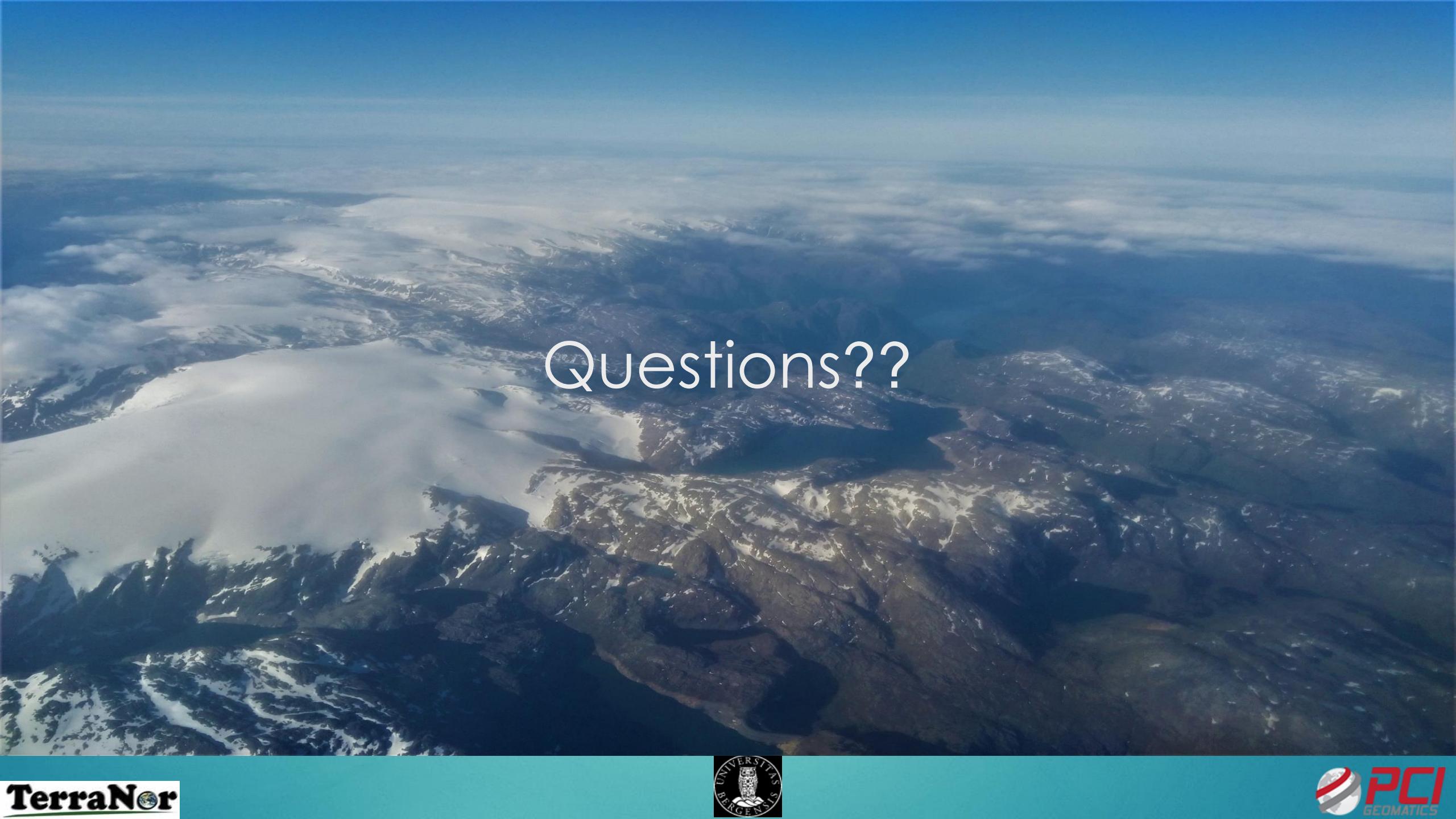
Rugosity

CNN heatmap basert på Sentinel 1 + 2



CNN heatmap basert på 20 cm flyfoto



An aerial photograph of a vast, rugged mountain landscape. A massive, white glacier dominates the left side of the frame, its surface textured with deep blue shadows. To the right, a dark, winding fjord cuts through the mountains. The terrain is a mix of dark rock and patches of snow and ice. The sky above is a clear, pale blue.

Questions??