Kartverket

Sentinel-2 project and production of mosaic in NMA

TerraNor remote sensing user meeting February 2020
Torgeir Ferdinand Klingenberg, Norwegian Mapping Authority

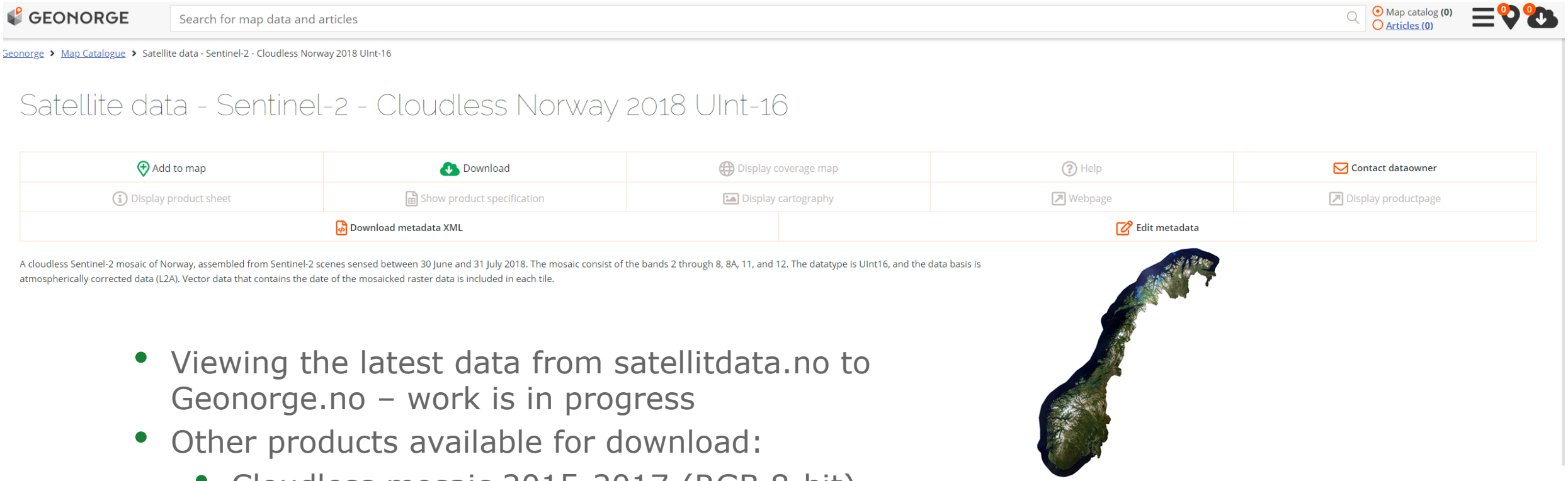
Description of project

- WP-1 Project management, skills development and reporting to Norwegian Space Agency
- WP-2 Integrate data from the national ground segment in Geonorge.no
- WP-3 Testing use cases and functionality in satellittdata.no
- WP-4 Quality control of Sentinel-2 data and DEMs
- WP-5 Cloudless mosaic over Norway
- WP-6 Further develop the "Norway in Images" viewing service for Sentinel-2

WP1: Project management, skills development and reporting to Norwegian Space Agency

- Promote Copernicus data:
  - National Geodata Strategy: Action 13 - Utilizing Earth Observation Satellite Data
  - Geomatics Days 2019: Own “Satellite data” session
- National/global interaction:
  - Norway digital members – satellite meeting
  - EuroSDR Workshop: 4th Workshop on Copernicus / Sentinels

WP-2 Integrate data from the national ground segment in Geonorge.no



- Viewing the latest data from satellitdata.no to Geonorge.no – work is in progress
- Other products available for download:
  - Cloudless mosaic 2015-2017 (RGB 8-bit)
  - Cloudless mosaic 2018 (RGB 8-bit)
- WMS service:
  - 2018 UInt-16, with download grid

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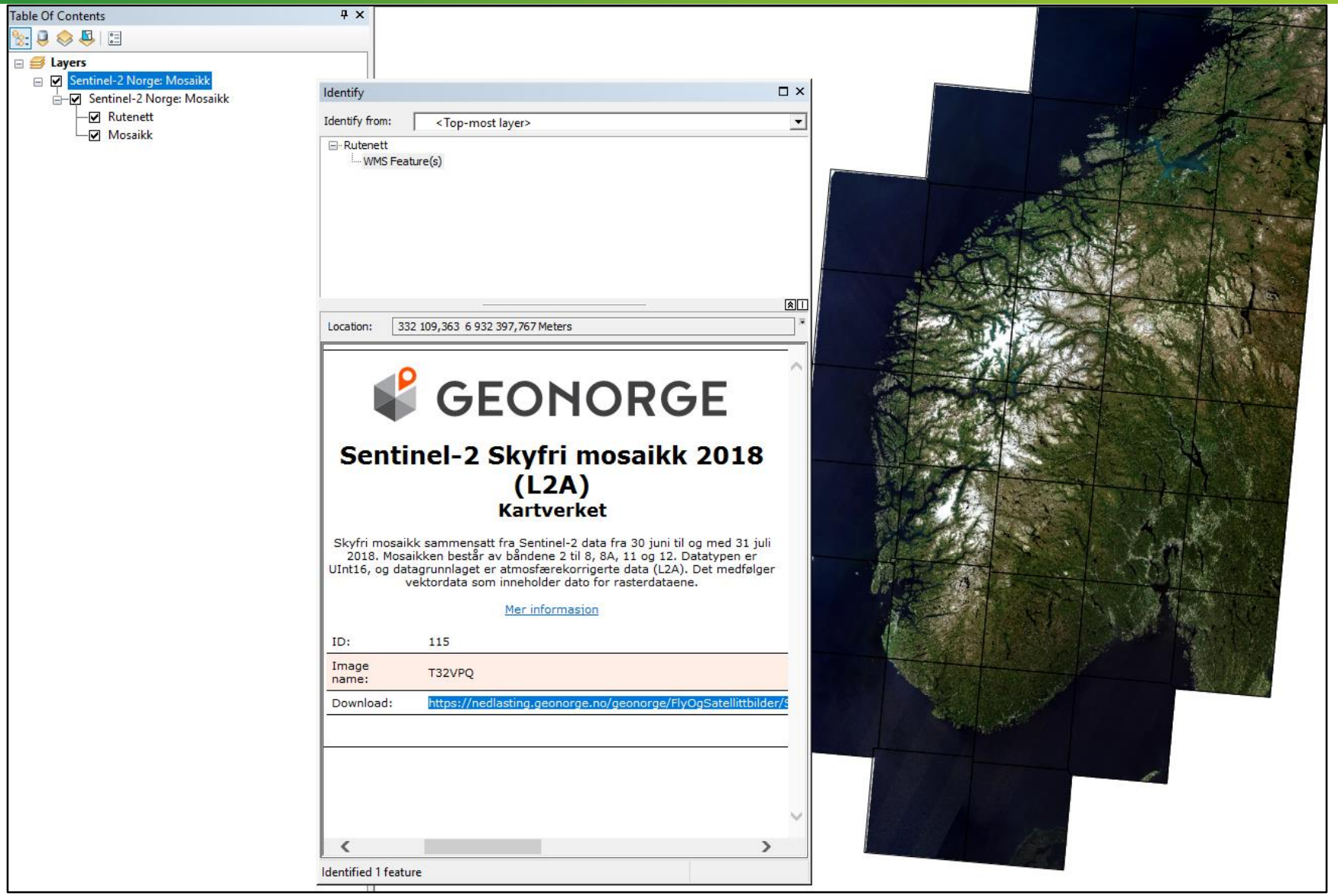

WMS service:
https://wms.geonorge.no/skwms1/wms.sentinel2mosaikk?service=wms&version=1.3.0&request=getcapabilities

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WP-3 Testing use cases and functionality in satellittdata.no

Main focus in this period is

- Focus on change detection and automatic cloudless mosaic
- Testing use cases and user interface in satellitedata.no
- Assists NOSA user survey

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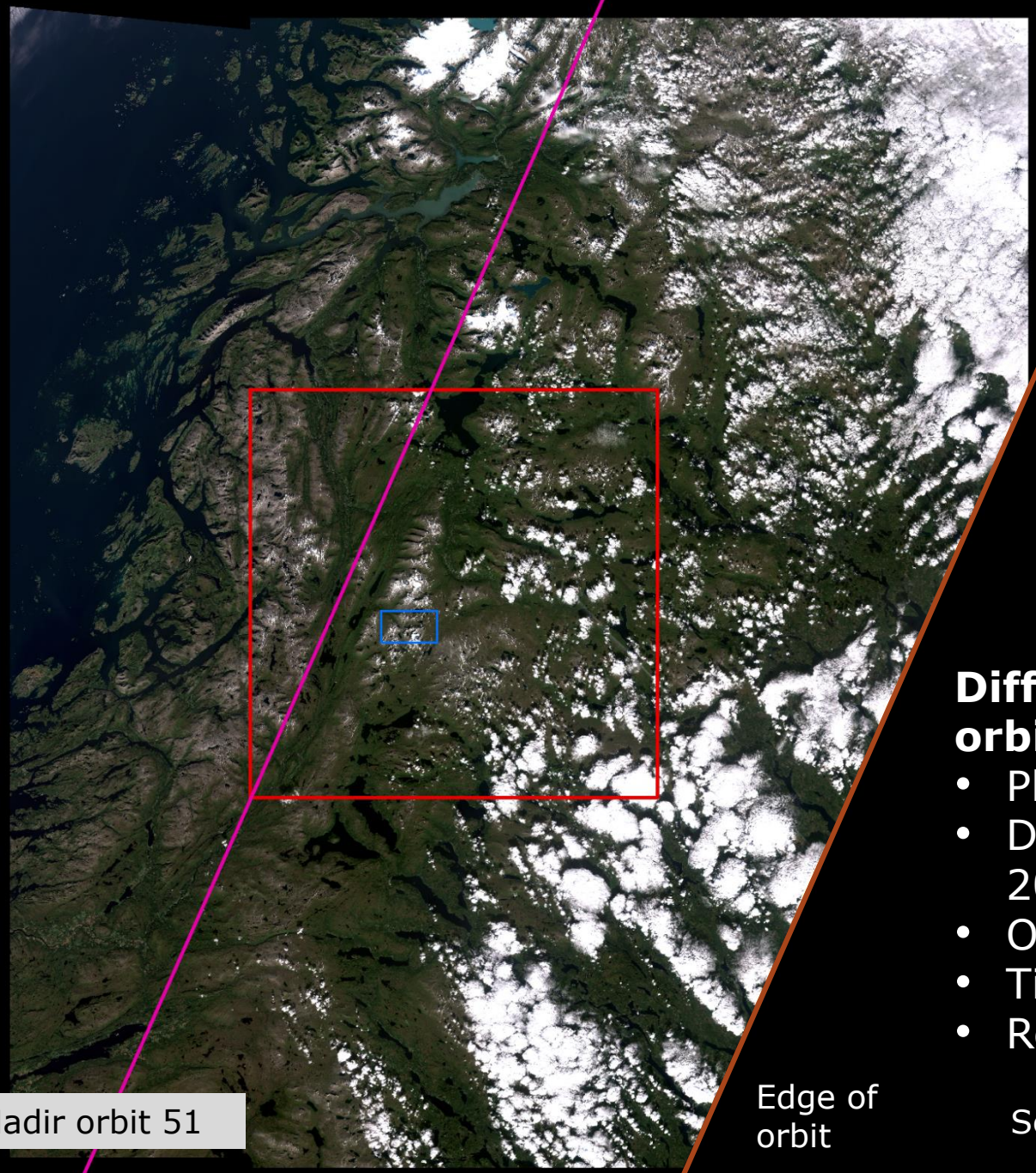
WP-4 Quality control of Sentinel-2 data and DEMs

Background info for this WP:

- Improve the geometric quality of Sentinel-2
  - Today: PlanetDEM90 is used for orthorectification of S2
    - Pilot project: National ground segment ~ DTM10 is used for ortorectifictation of S2
    - Look for the DTERRENGDATA suffix

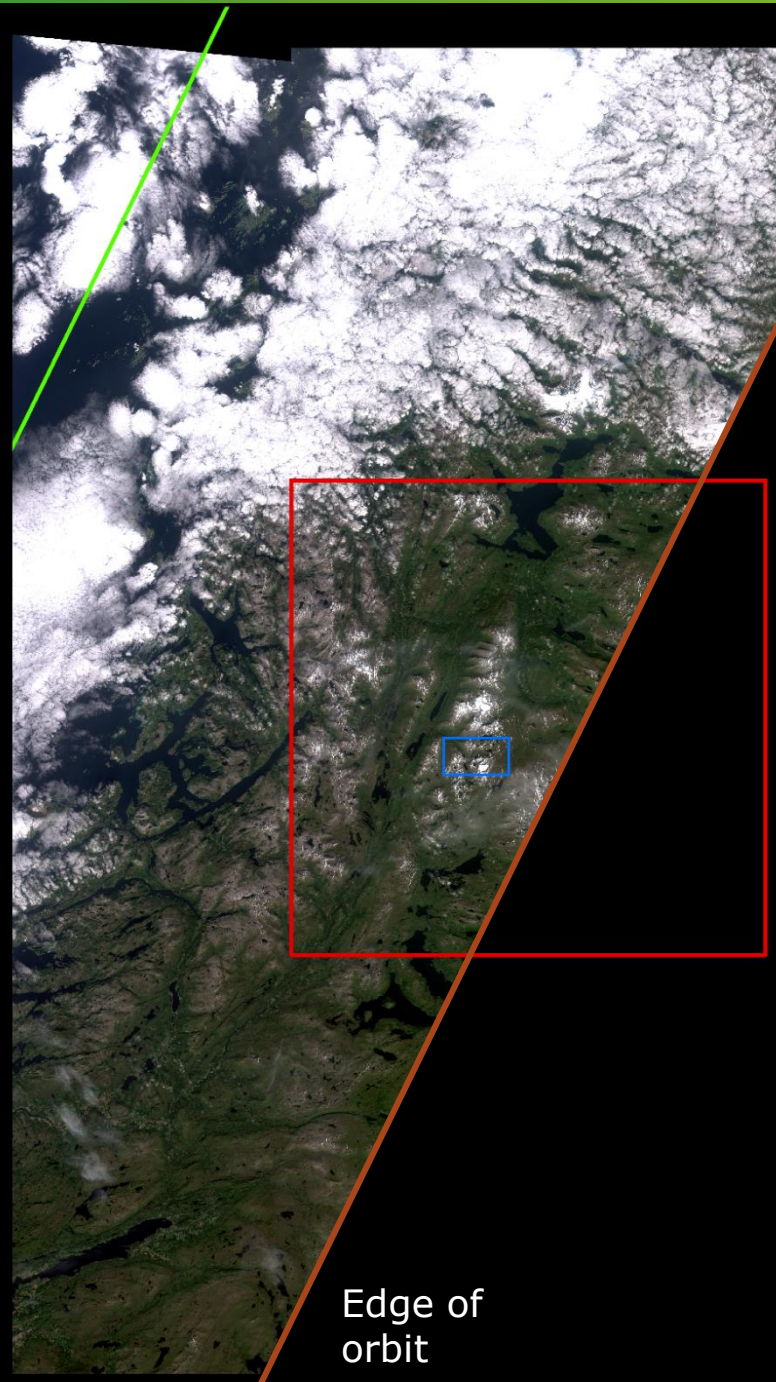


Different dates and orbits:

- PlanetDEM and DTM10
- Date: 2017-08-27 and 2017-09-03
- Orbit: R094 and R051
- Tile: T33WVN
- Region: Børgefjell

Sentinel-2 L1C 2017-08-27

Nadir orbit 94



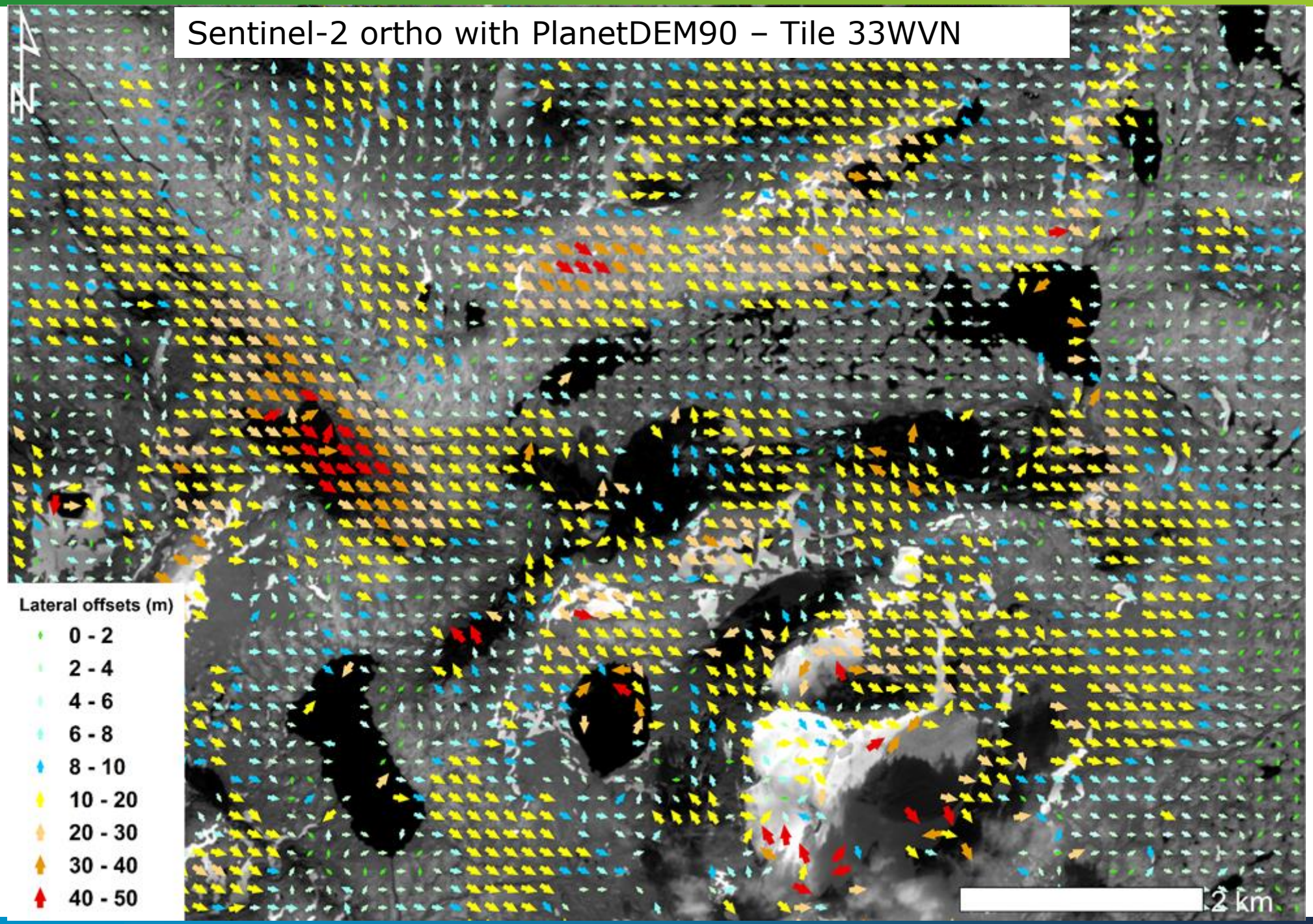
Edge of orbit

Different dates and orbits:

- PlanetDEM and DTM10
- Date: 2017-08-27 and 2017-09-03
- Orbit: R094 and R051
- Tile: T33WVN
- Region: Børgefjell

Sentinel-2 L1C 2017-08-27

Sentinel-2 ortho with PlanetDEM90 – Tile 33WVN



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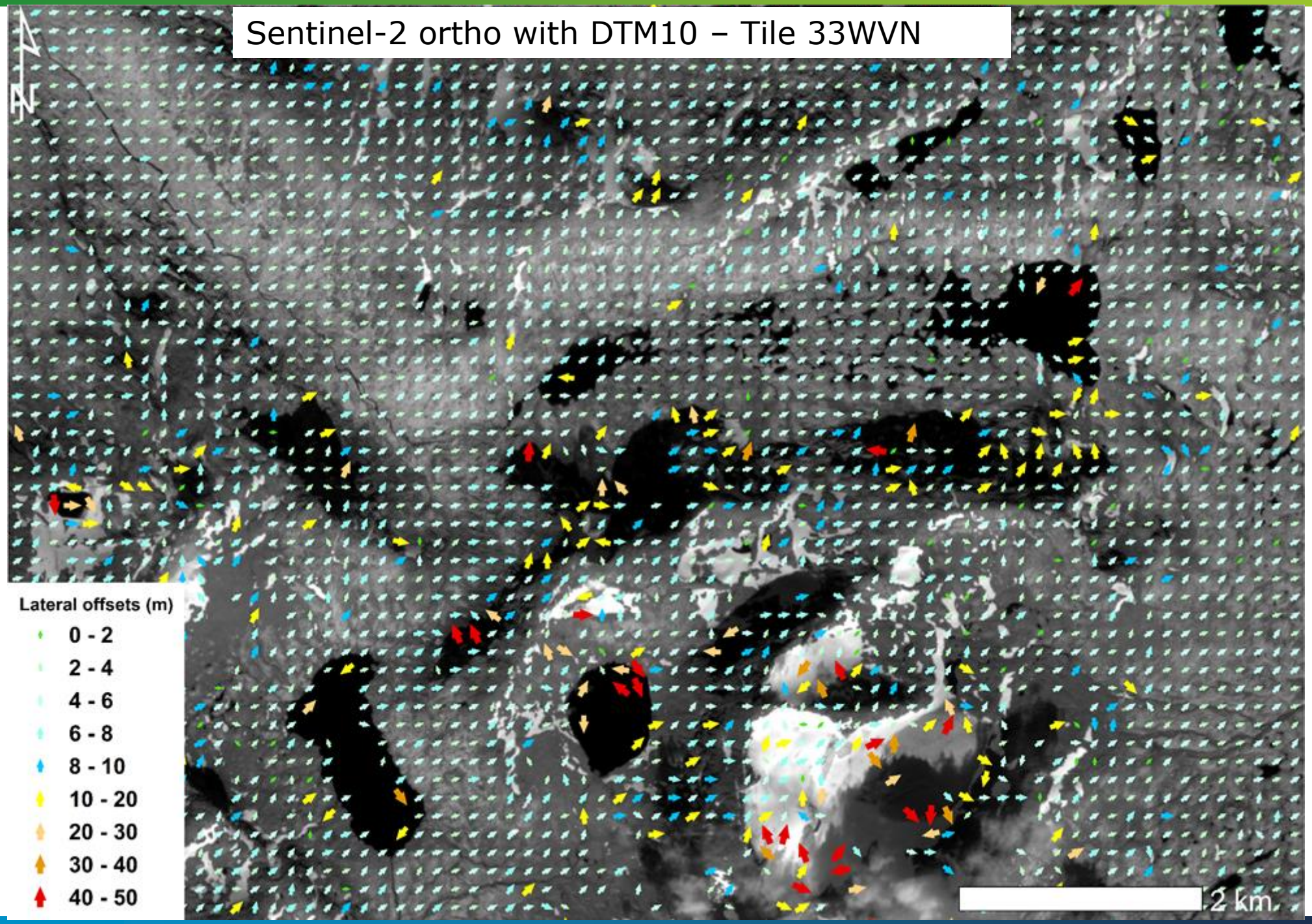
Sentinel-2 ortho with DTM10 – Tile 33WVN



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WP-4 Quality control of Sentinel-2 data and DEMs

Background info for this WP:

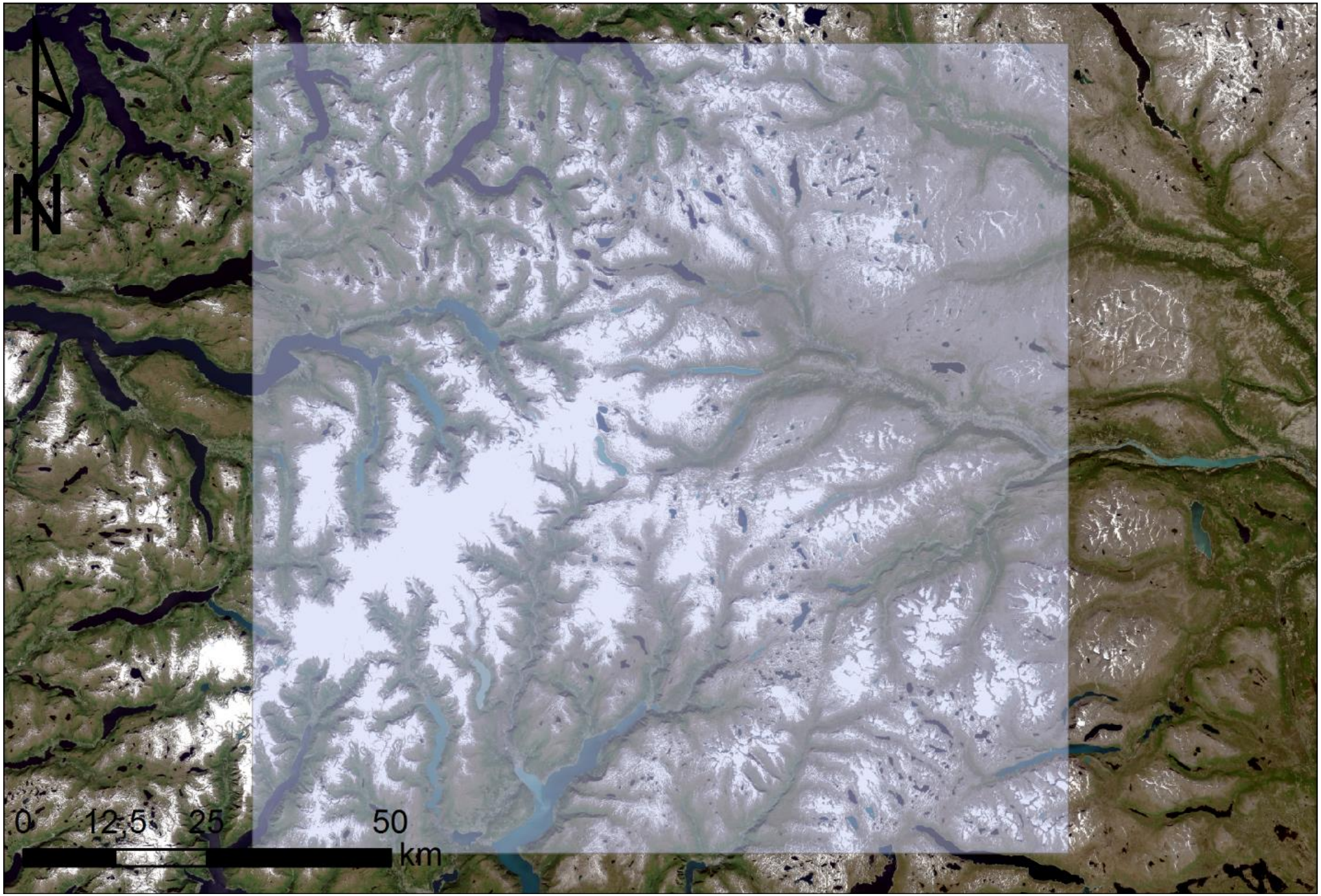
- Improve the geometric quality of Sentinel-2
  - Today: PlanetDEM90 is used for orthorectification of S2
  - Late 2020 new Copernicus DEM

Produced Nordic DEM in collaboration with the Nordic countries

- ESA has requested data to test implementation in the new Copernicus DEM

Test of the height model TanDEM-X **90m** completed

- Not good enough for Nordic areas
- Copernicus DEM testing will be performed when available



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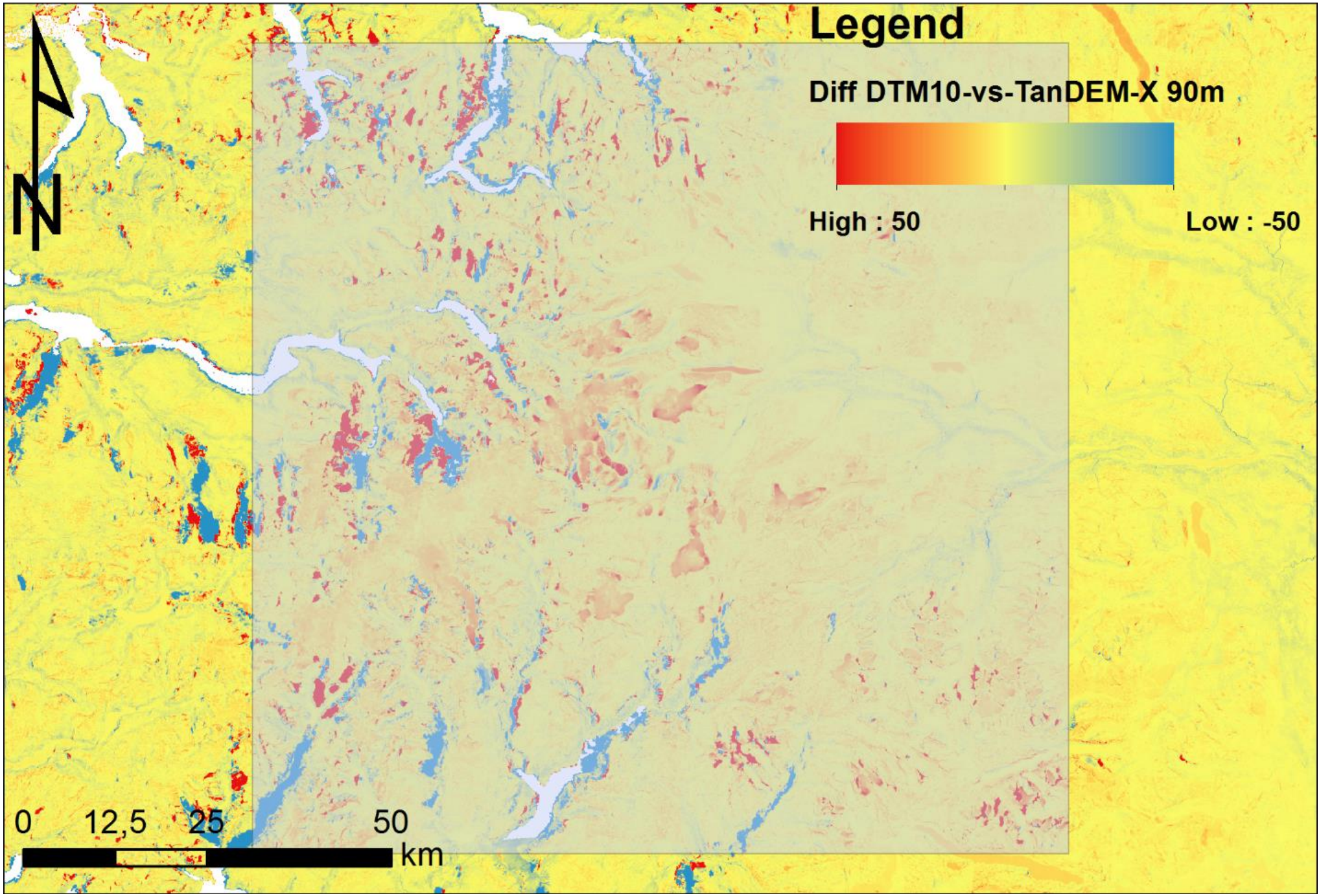

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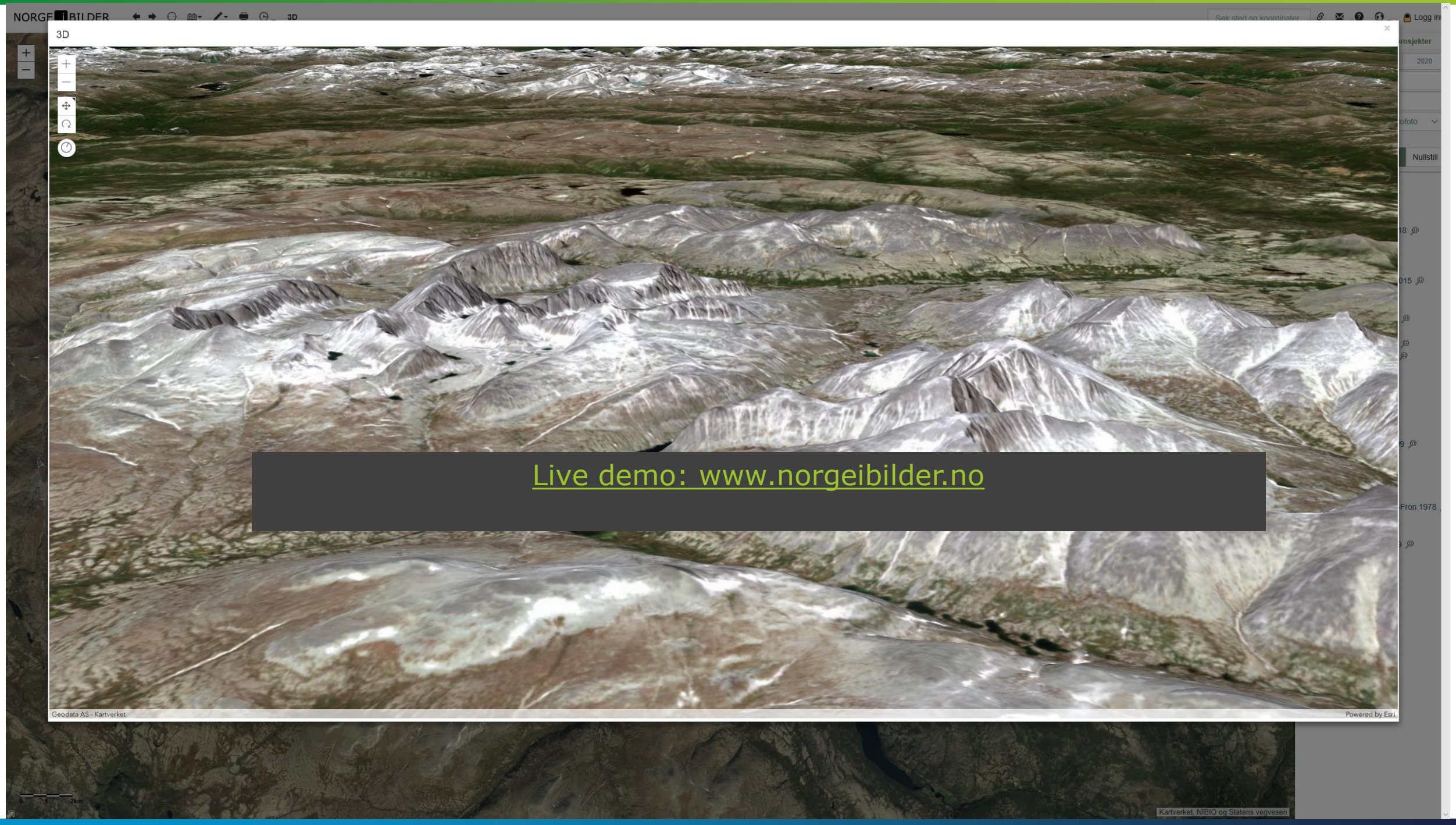
WP-6 Further develop the "Norway in Images" viewing service for Sentinel-2

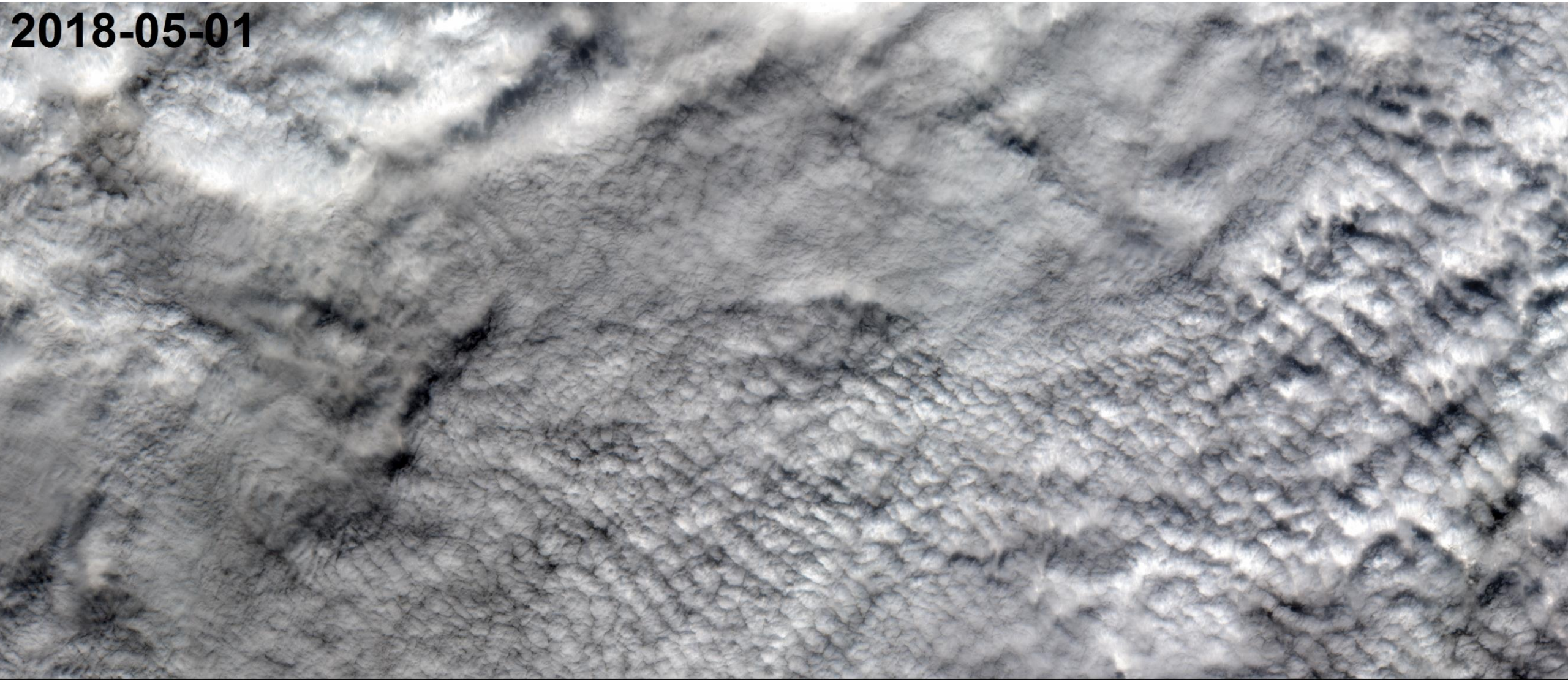
- It is now possible to see different individual layers in 3D in Norway in Pictures
- Sample areas are available at different times. Possibility of change analysis


3D
Live demo: www.norgeibilder.no
Geodata AS - Kartverket
Powered by Esri
Kartverket, NIBIO og Statens vegvesen

WP-5 Cloudless mosaic over Norway

Cloudless mosaic 2019 (RGB and several bands) is in production

- Manually produced, but a semi-automatic method is tested
- Involves several different software:
  - PCI Geomatica
    - Mosaic Tool
    - Focus
    - Python libs
  - ArcMap
  - Anaconda Python
    - Sentinelsat
    - GDAL
    - Packages for U-Net CNN ~ CUDA
  - Erdas Imagine
    - Spatialbuilder

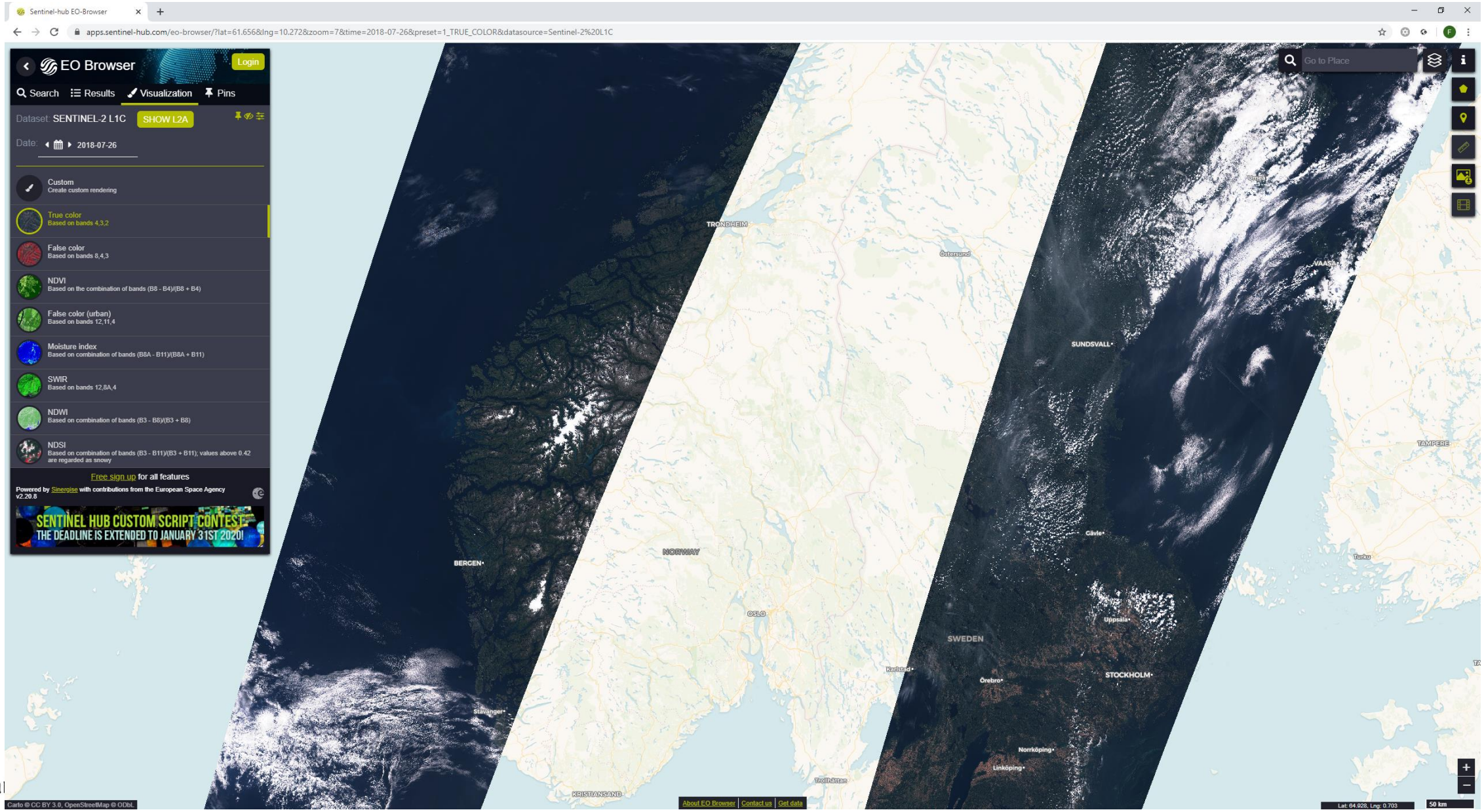

2018-05-01

Sentinel-2A

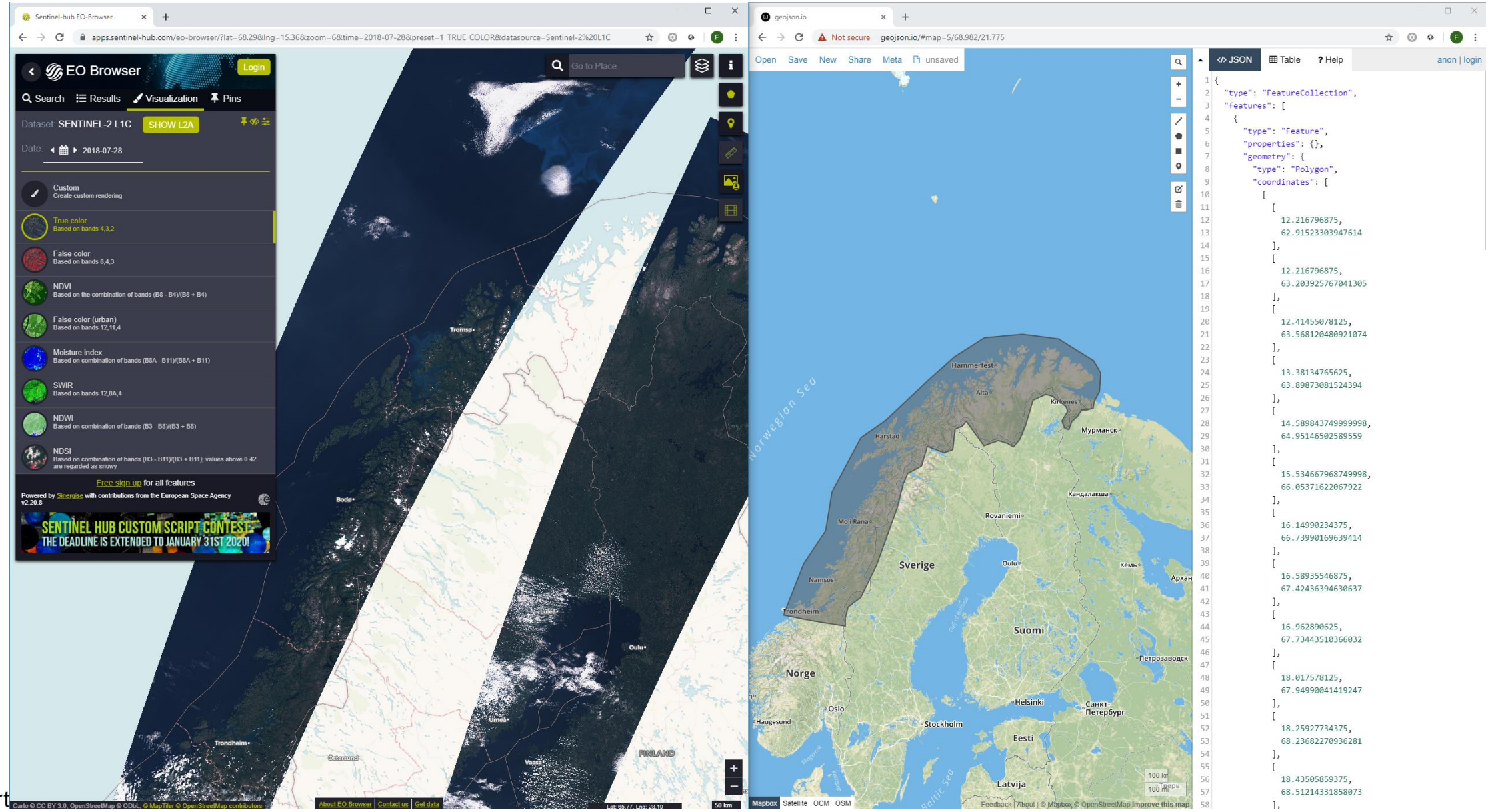
Sentinel-2B

Kartverket

1) Find the data



2) Download the data

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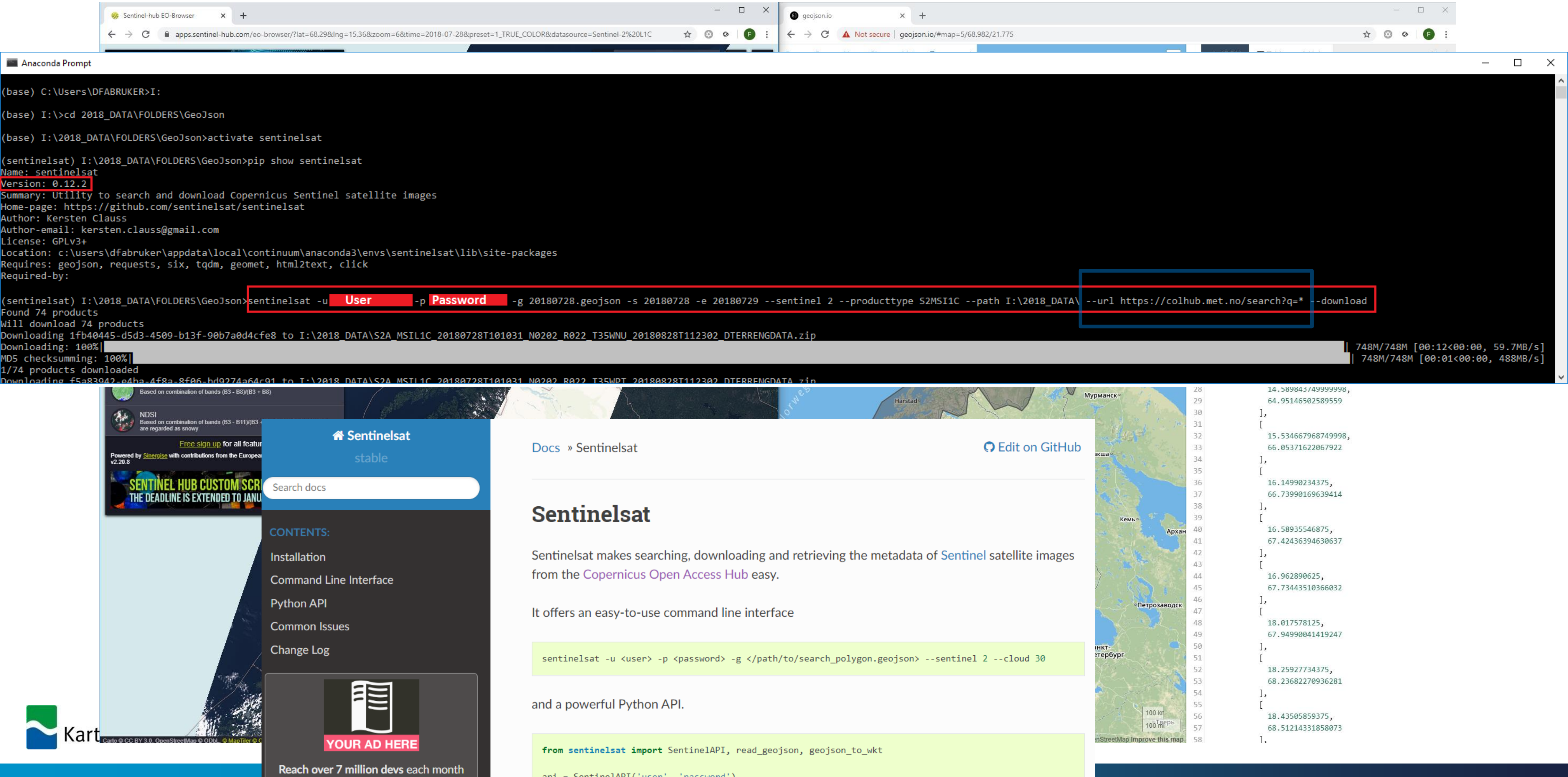
2) Download the data



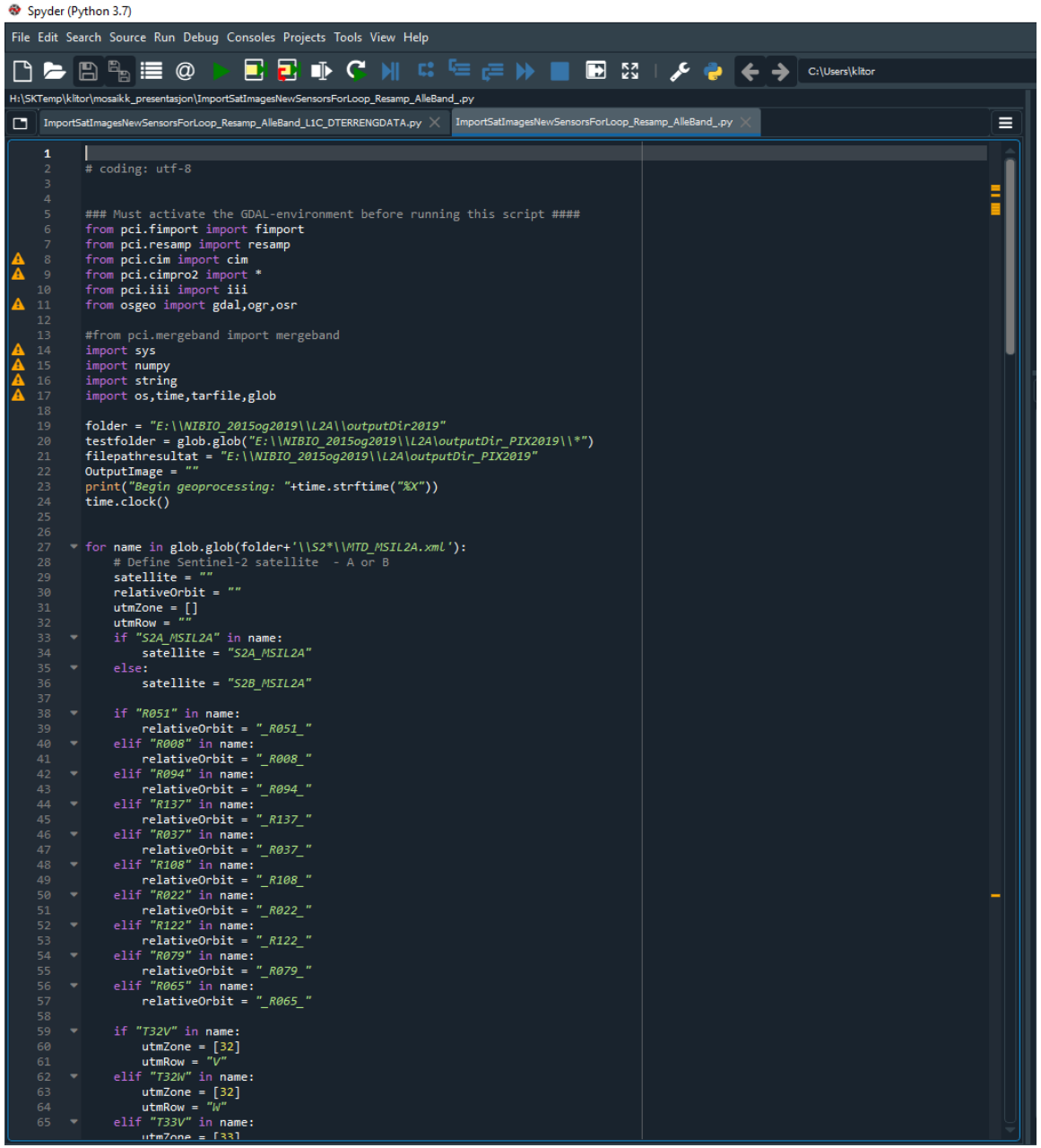
3) Prepare the data

Python libs:

- pci.fimport
  - From auxiliary files to .pix files
- pci.resamp
  - Resample 20 m bands to 10 m
  - Nearest neighbour
- pci.cimpro2
  - Prepare for merged file
- pci.iii
  - Merge bands

Output:

10 bands at 10 m resolution



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4) Automatic cloud detection

- NGVEO - New Generation Value chain for Earth Observation
- Link: https://github.com/ESA-PhiLab/NGVEO
- License: MIT

- Main steps:
  - Prepare data
  - Train data
  - Predict data ~ clouds
  - Threshold
  - Vectorize

- **Authors:**
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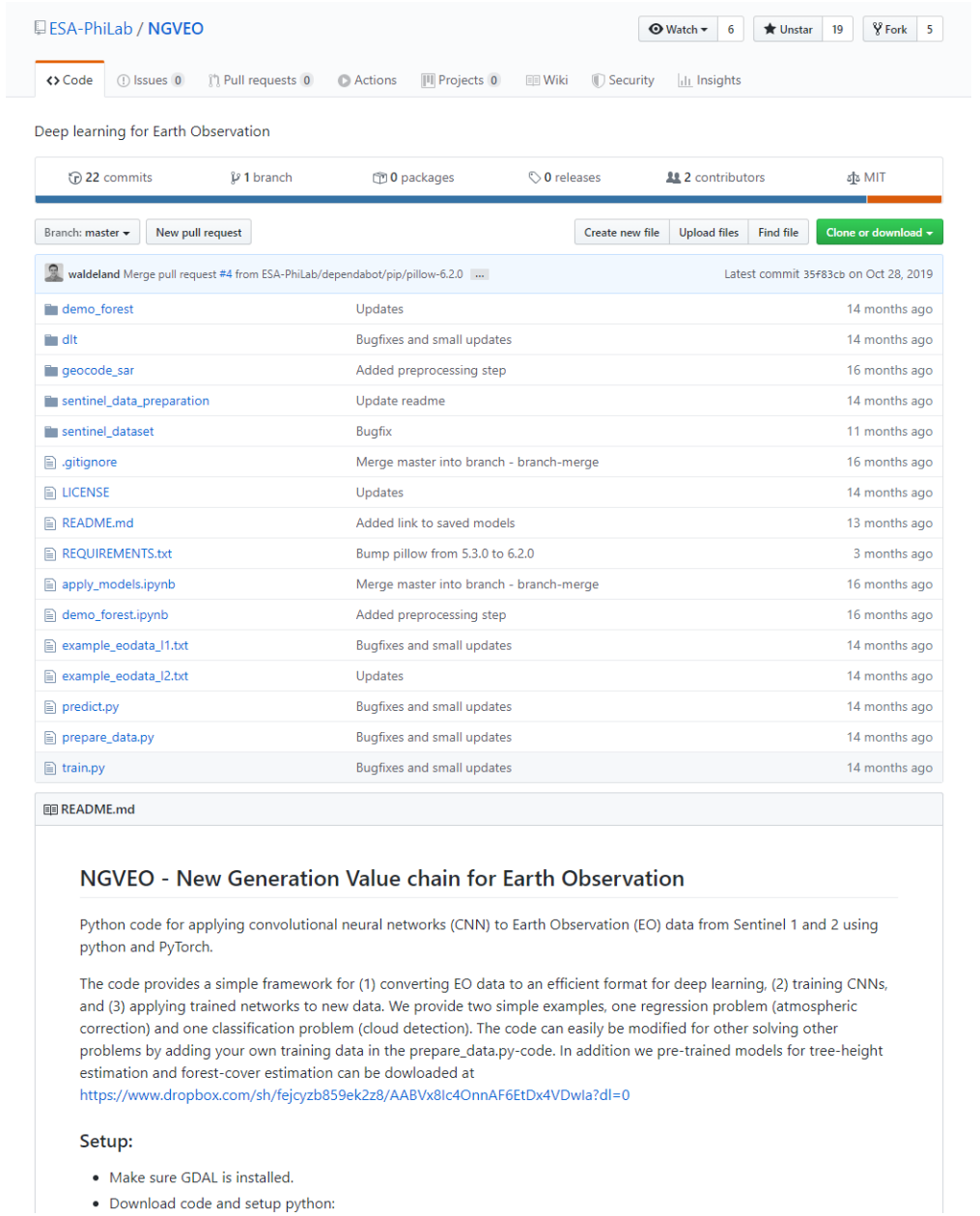
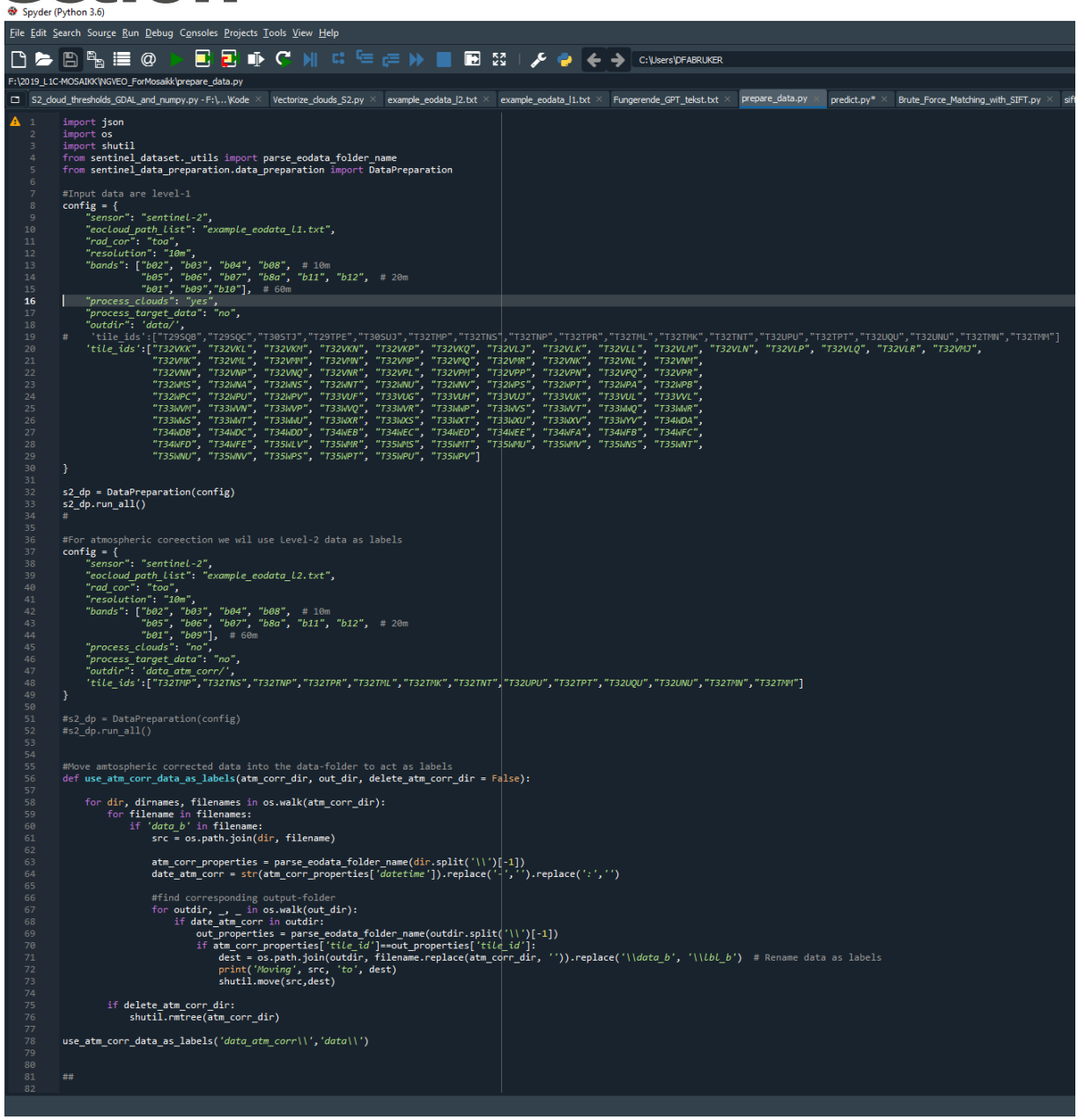
* Norwegian Computing Center (https://www.nr.no/)

** Phi Lab, European Space Agency (http://blogs.esa.int/philab/)



4-1) Automatic cloud detection

- **Prepare data:**
  - Converts to numpy memmap files



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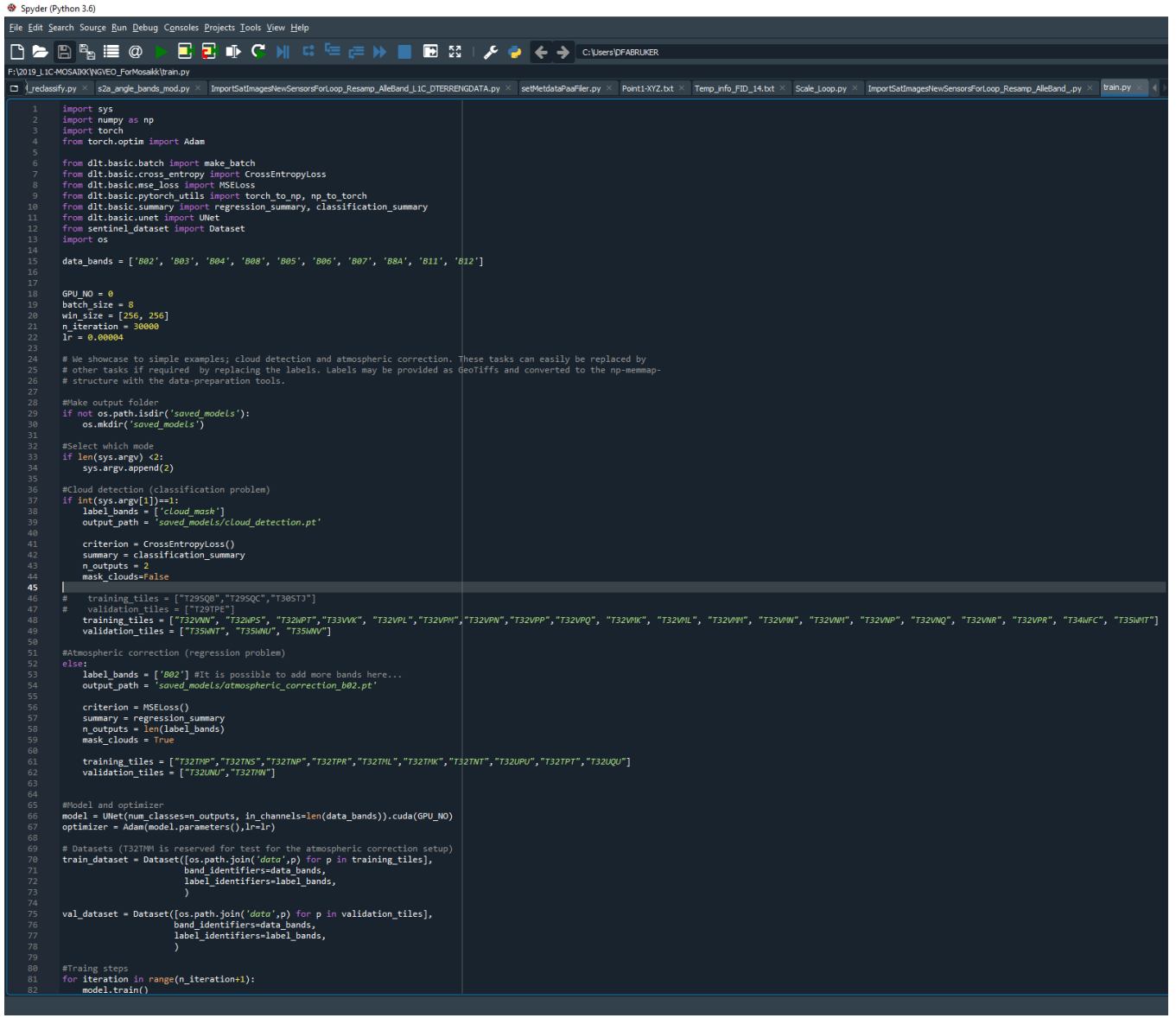
4-2) Automatic cloud detection

- **Train data:**
  - Train data using GPU/CUDA
  - Left to work for two days



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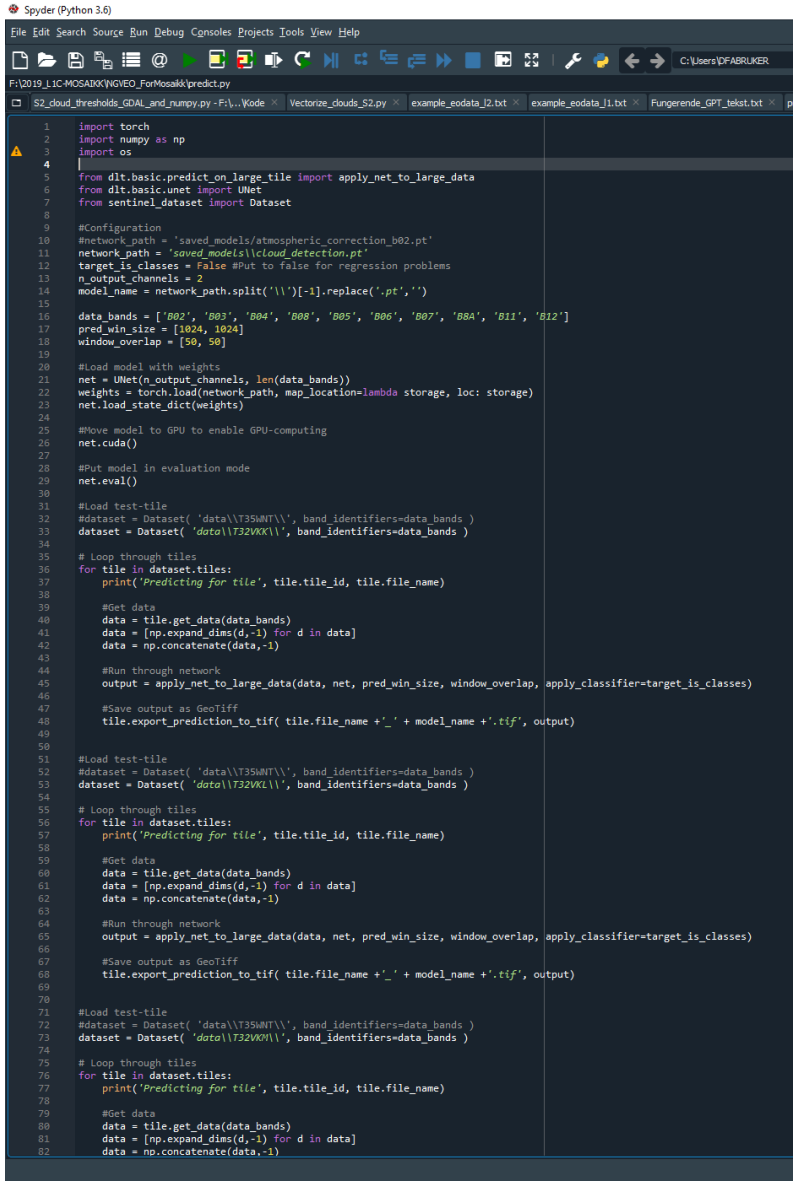
4-3) Automatic cloud detection

- **Predict data:**
  - Tile-by-tile
  - Output: GeoTIFF



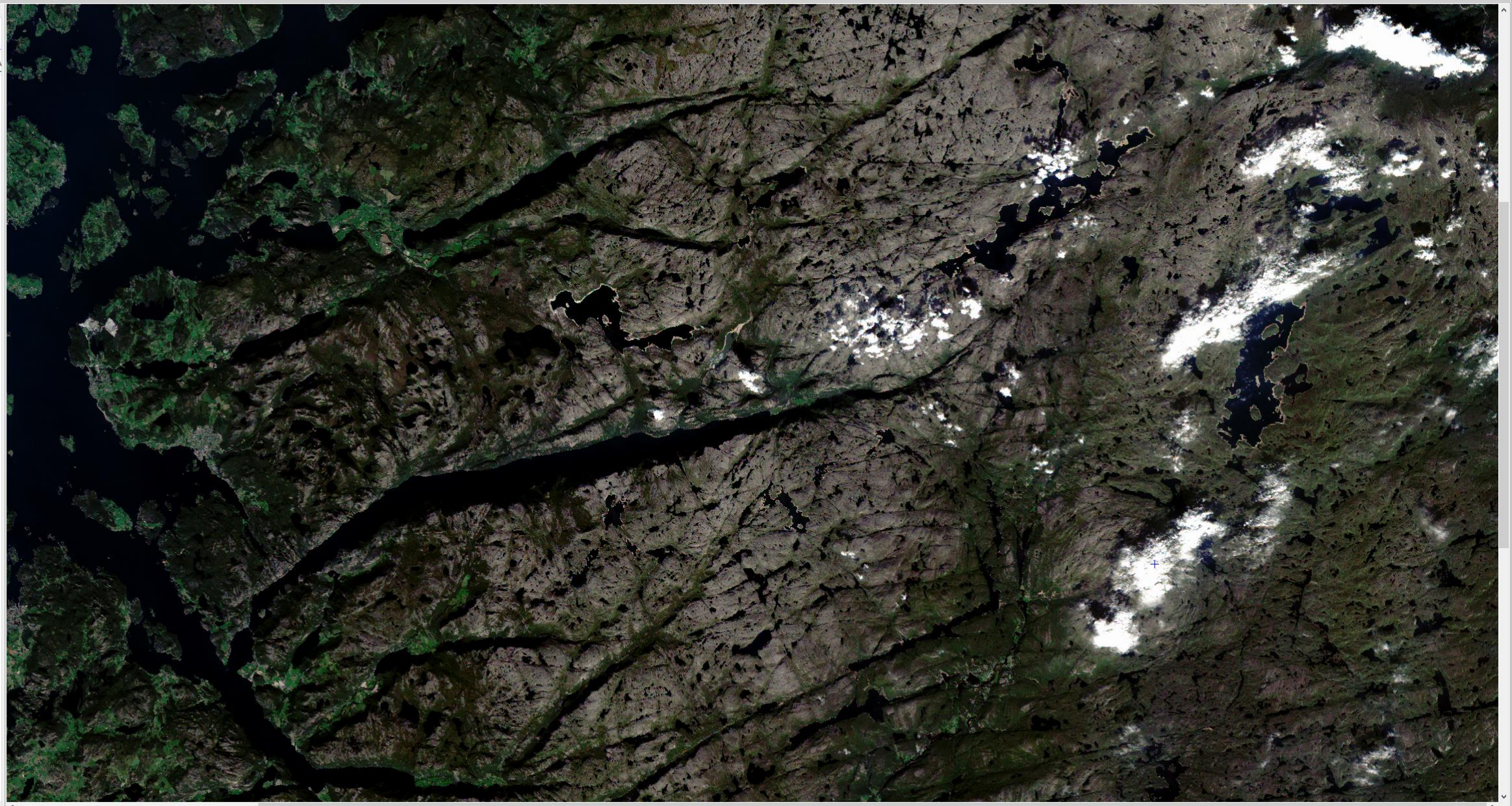
Kartverket

Focus - Unnamed Project - Unnamed Map

File Edit View Layer Analysis Tools Help

Maps Files

Unnamed Map
New Area
S2A_MSIL1C_20190827T
S2A_MSIL1C_R094_T32V
S2A_MSIL1C_20190827T



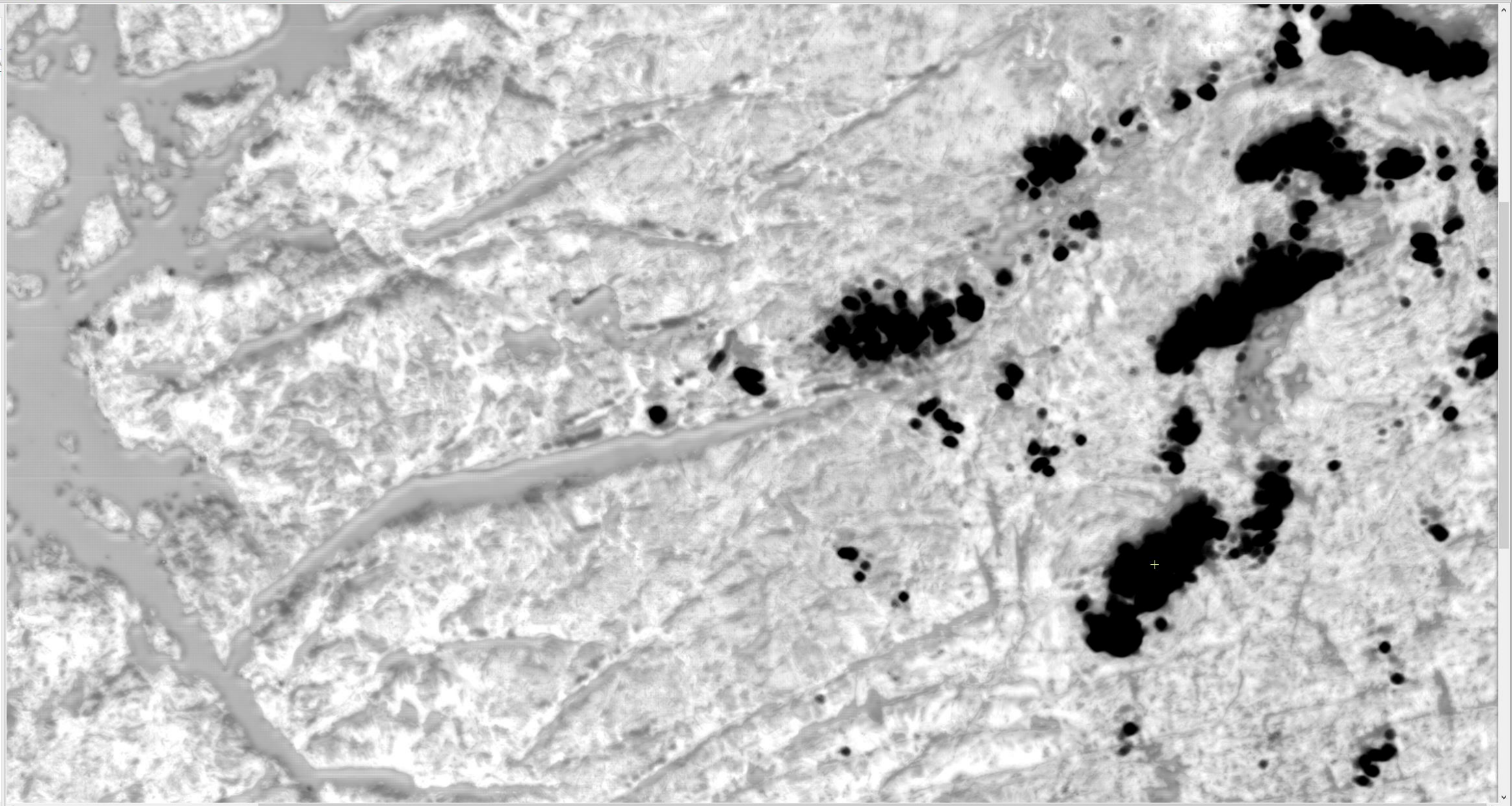
Scale: 294,000 x0.25 388608.750E 6539147.500N G:1

Focus - Unnamed Project - Unnamed Map

File Edit View Layer Analysis Tools Help

Maps Files

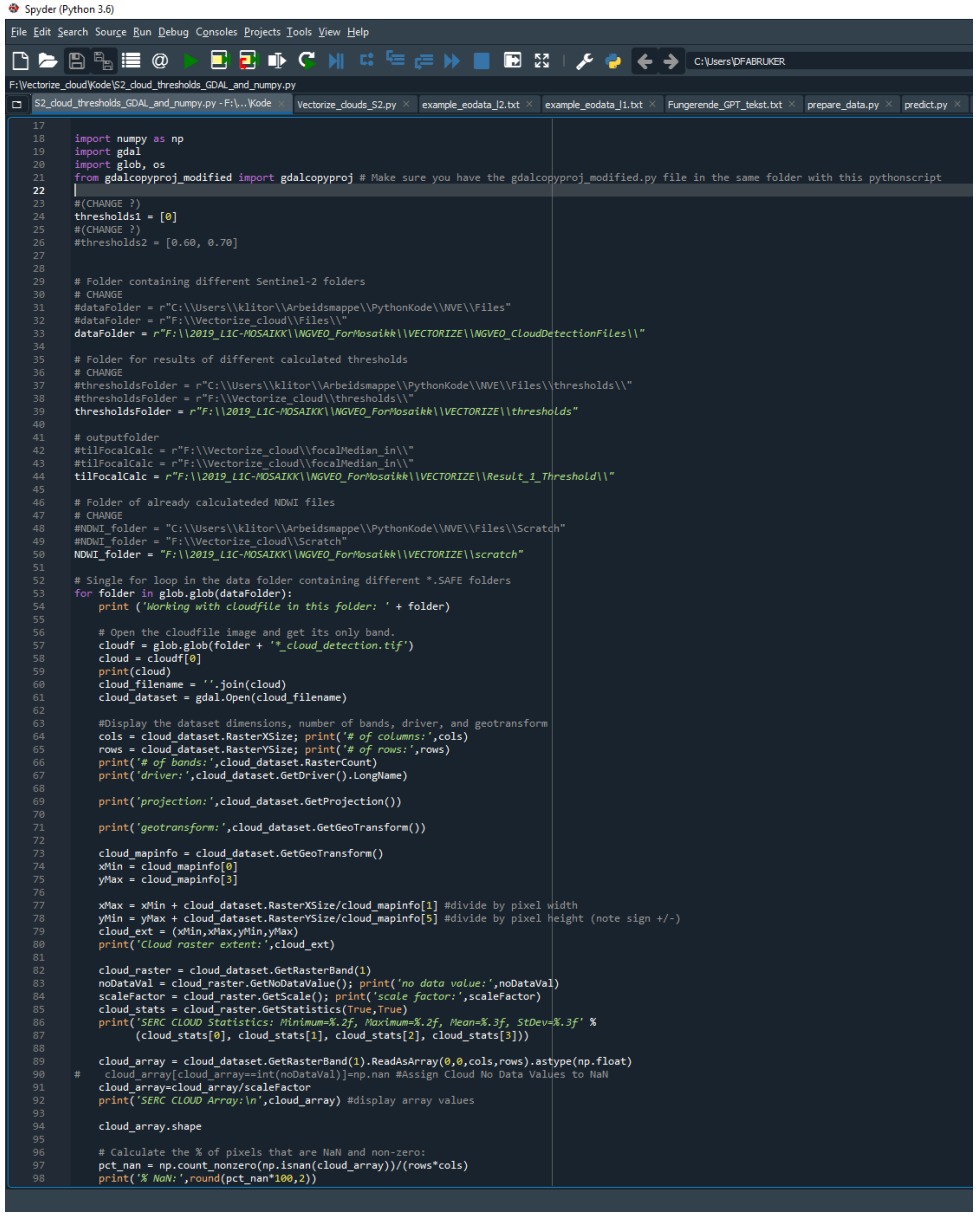
Unnamed Map
New Area
S2A_MSIL1C_20190827T
S2A_MSIL1C_R094_T32V
S2A_MSIL1C_20190827T



Scale: 294,000 x0.25 388608.750E 6539147.500N G:1

4-4) Automatic cloud detection

- **Threshold predicted data:**
  - Creates a new GeoTiff file with values for predicted clouds



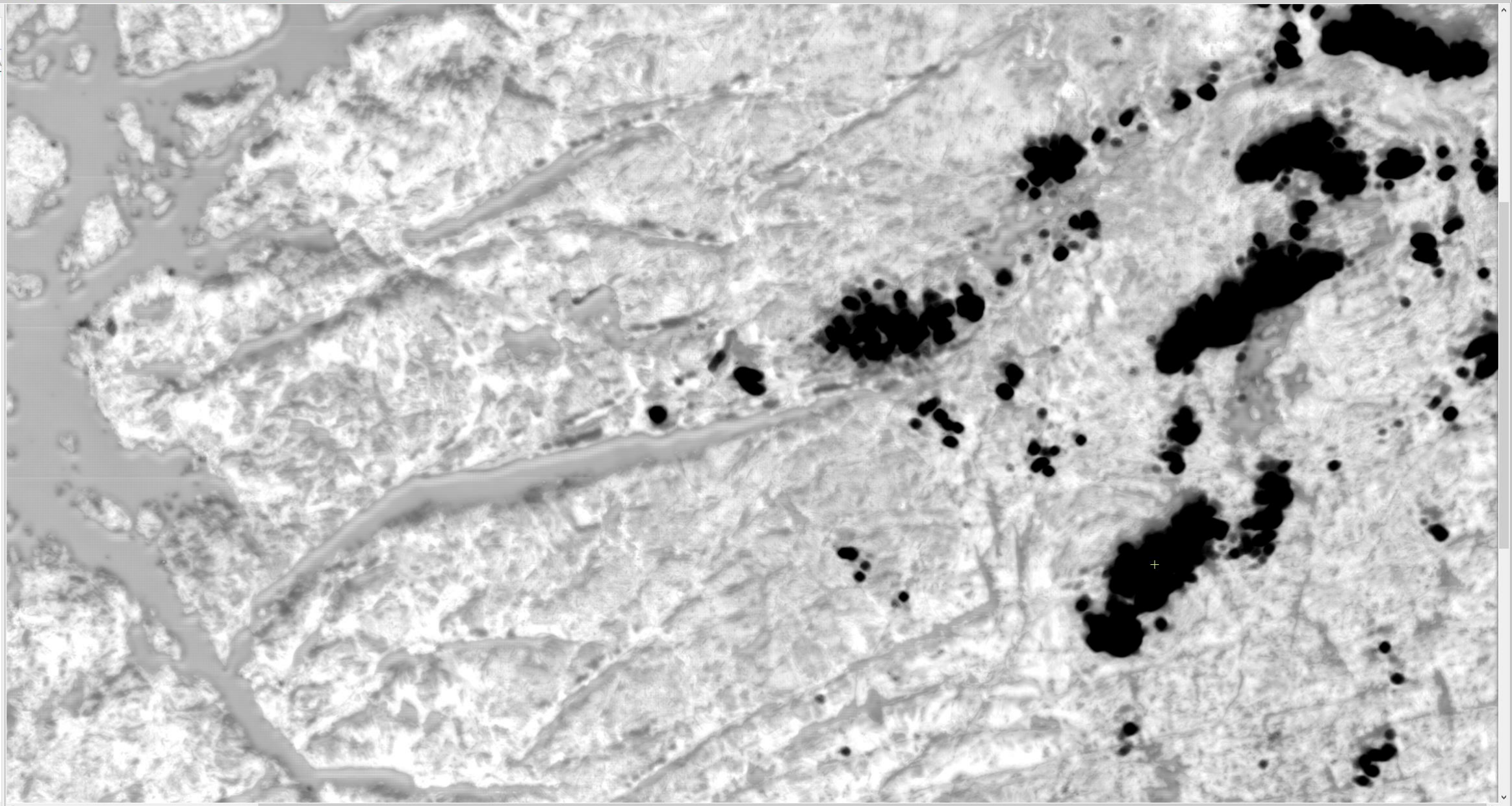
Kartverket

Focus - Unnamed Project - Unnamed Map

File Edit View Layer Analysis Tools Help

Maps Files

Unnamed Map
New Area
S2A_MSIL1C_20190827T
S2A_MSIL1C_R094_T32V
S2A_MSIL1C_20190827T



Scale: 294,000 x0.25 388608.750E 6539147.500N G:1

Focus - Unnamed Project - Unnamed Map

File Edit View Layer Analysis Tools Help

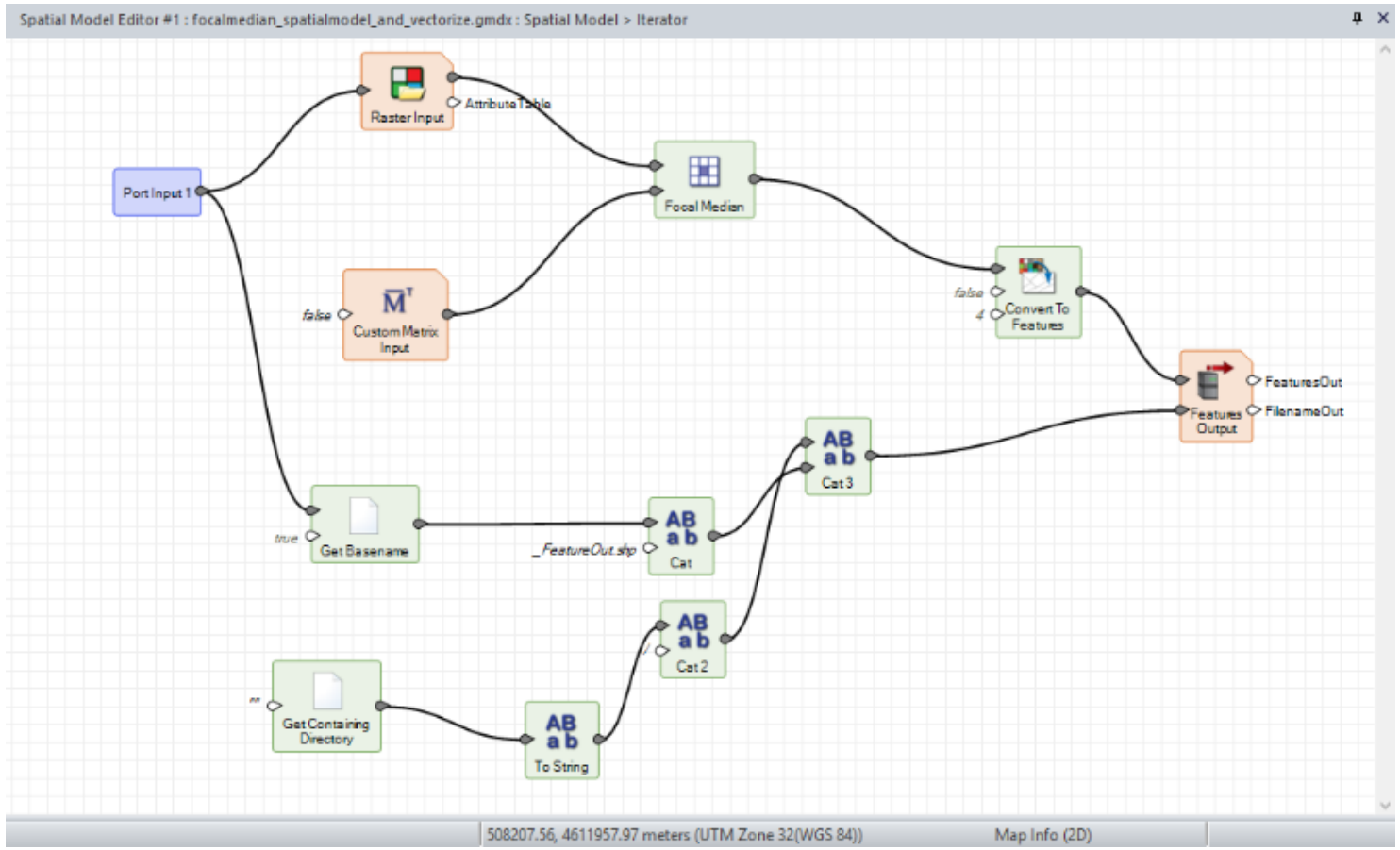
Maps Files

Unnamed Map
New Area
S2A_MSIL1C_20190827T
S2A_MSIL1C_R094_T32V
S2A_MSIL1C_20190827T

Scale: 294,000 x0.25 388608.750E 6539147.500N G:1

4-5) Automatic cloud detection

- **Vectorize predicted data:**
  - Creates a new shapefile of predicted clouds



Kartverket

Focus - Unnamed Project - Unnamed Map

File Edit View Layer Analysis Tools Help

Maps Files

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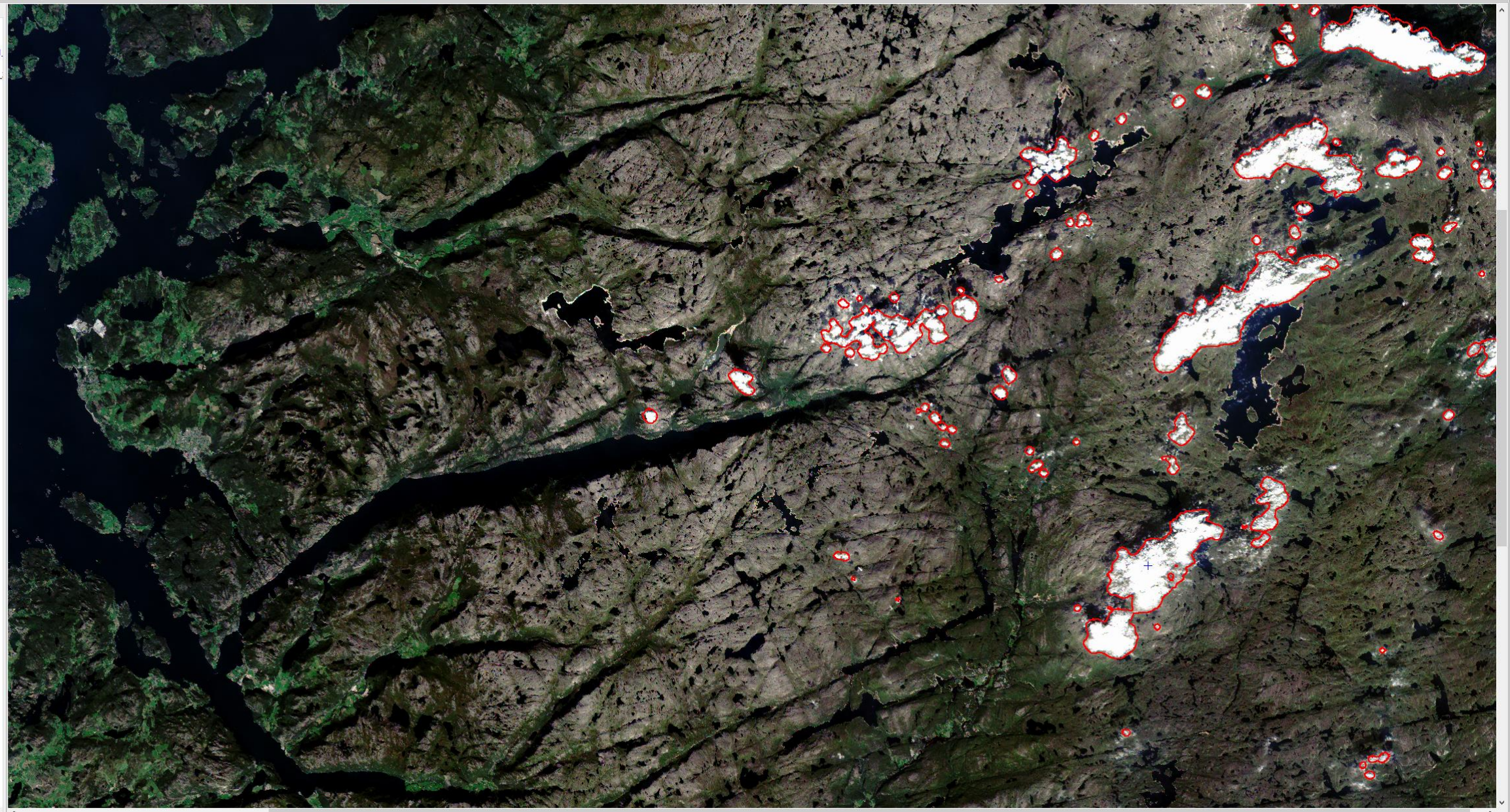
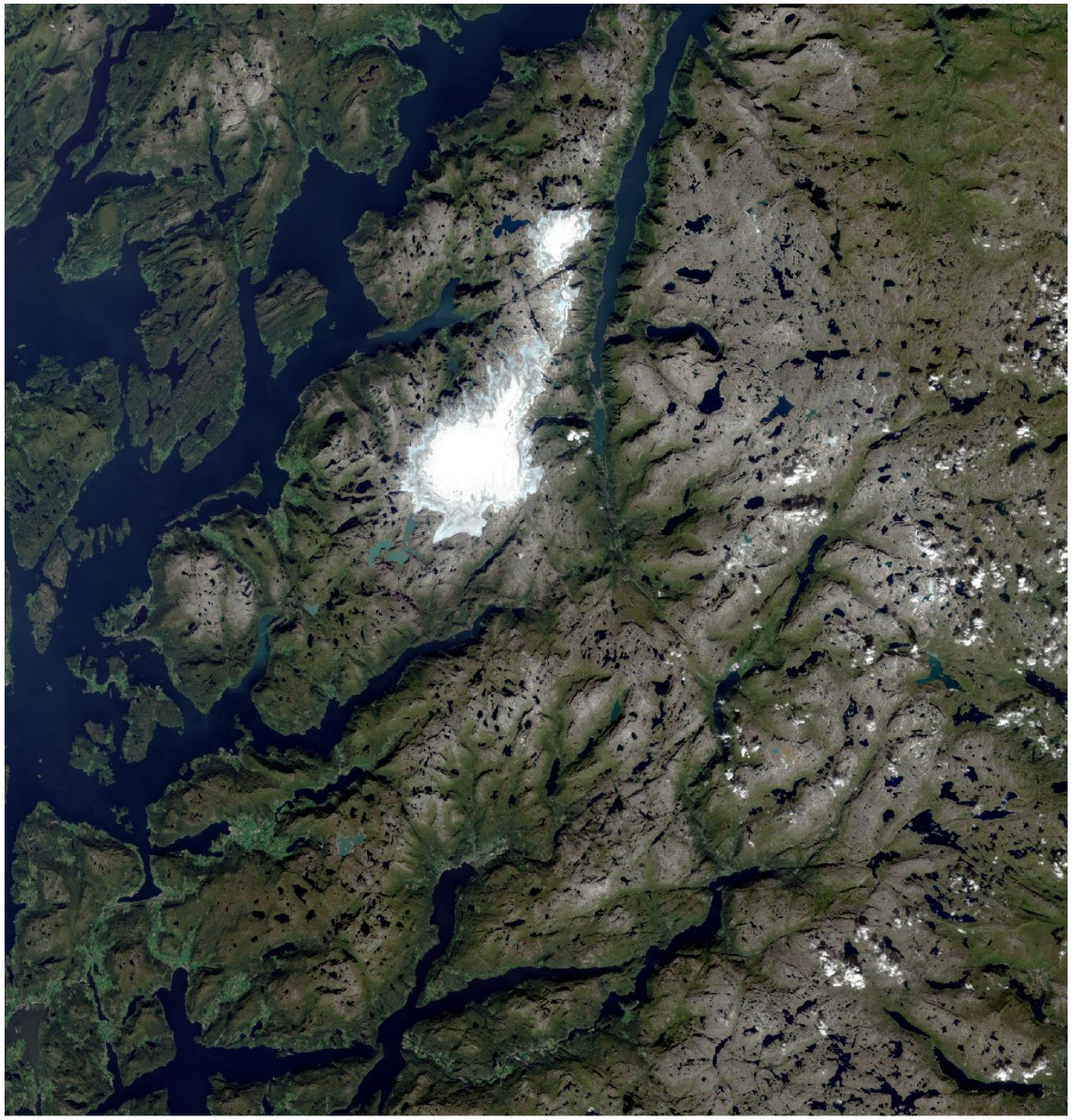


Scale: 294,000 x0.25 388423.543E 6539290.086N 0 selected

5) Vectorizing clouds

- Draw cloud and cloud shadow by hand
  - Use automatic cloud detection as guideline
- Vectorize tile-by-tile, with respect of neighbouring tile
  - Easier colorblend ~ no large time difference



Copernicus Sentinel-2 data(27-08-2019)

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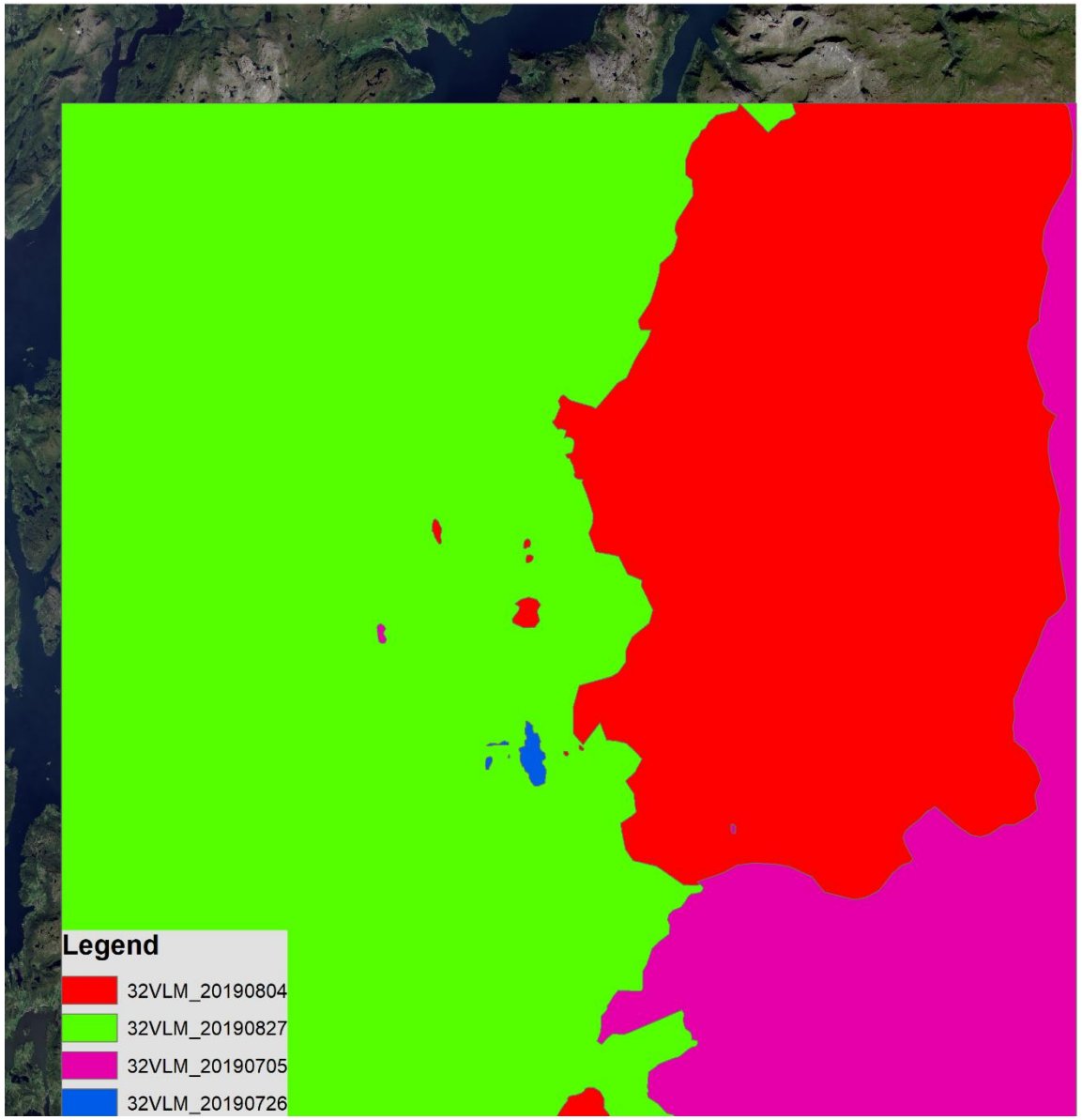
5) Vectorizing clouds



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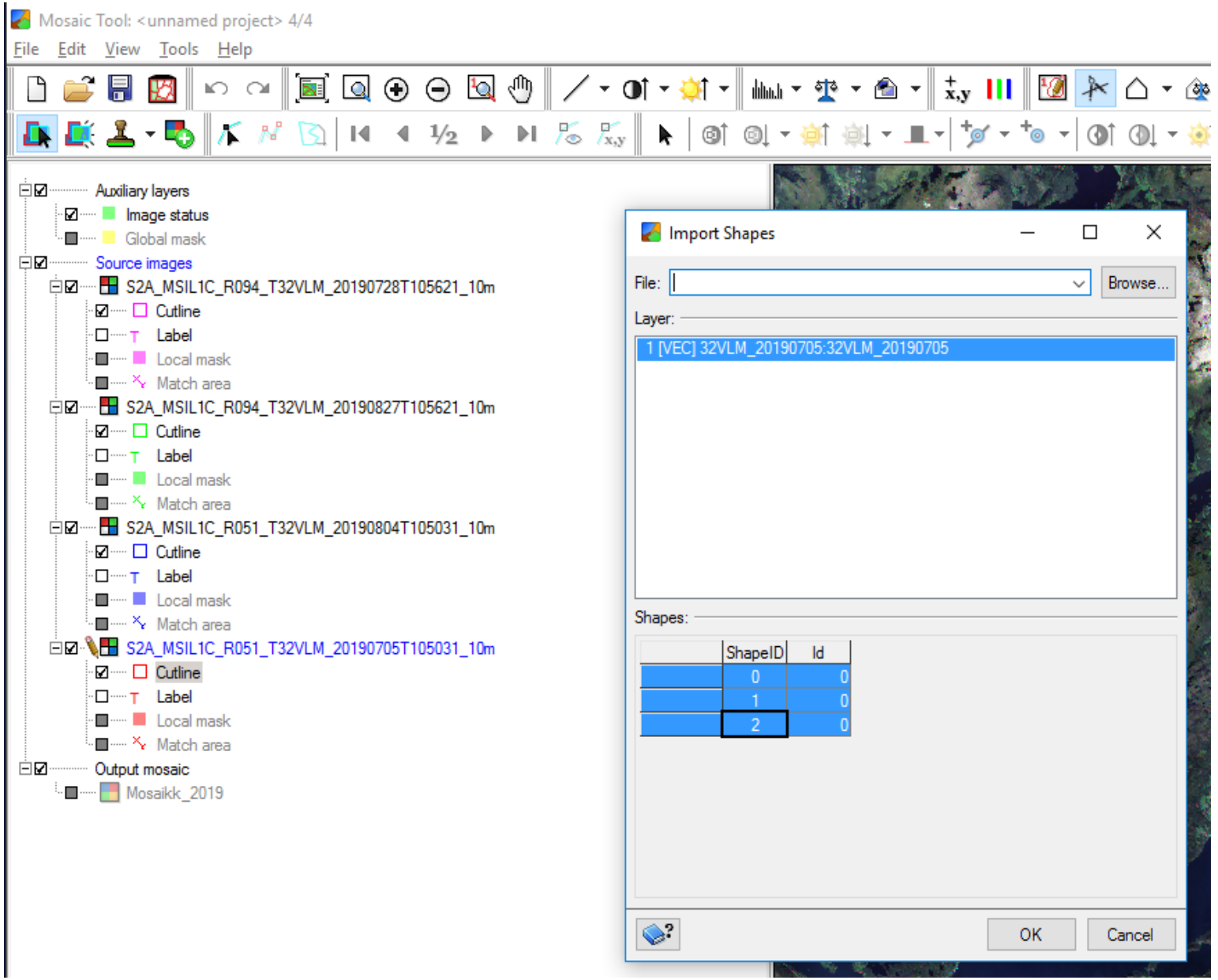
6) Mosaicing

PCI Geomatica: Mosaic Tool

- Import cloud-free vectors for each file



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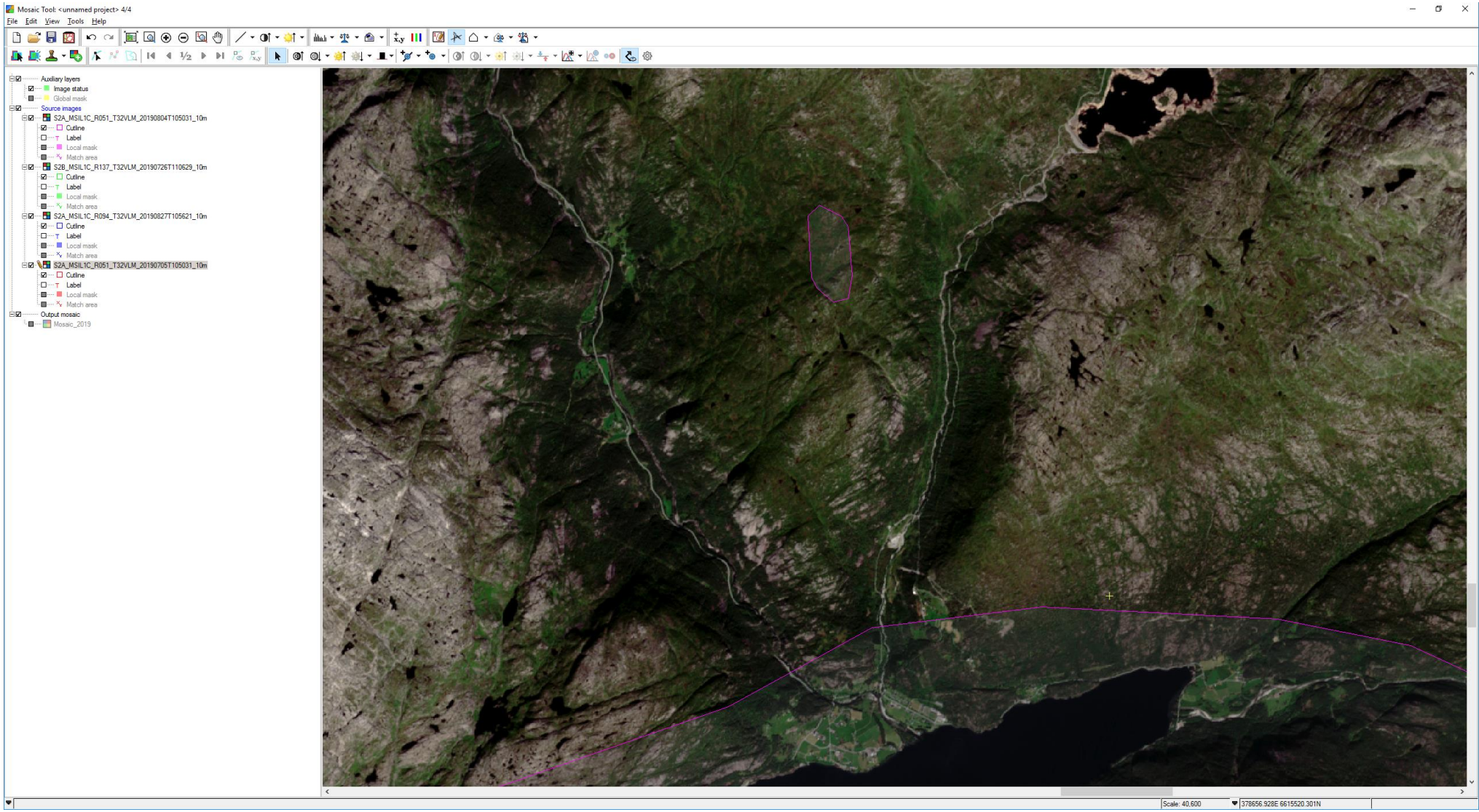
6) Mosaicing

PCI Geomatica: Mosaic Tool

- Dogding



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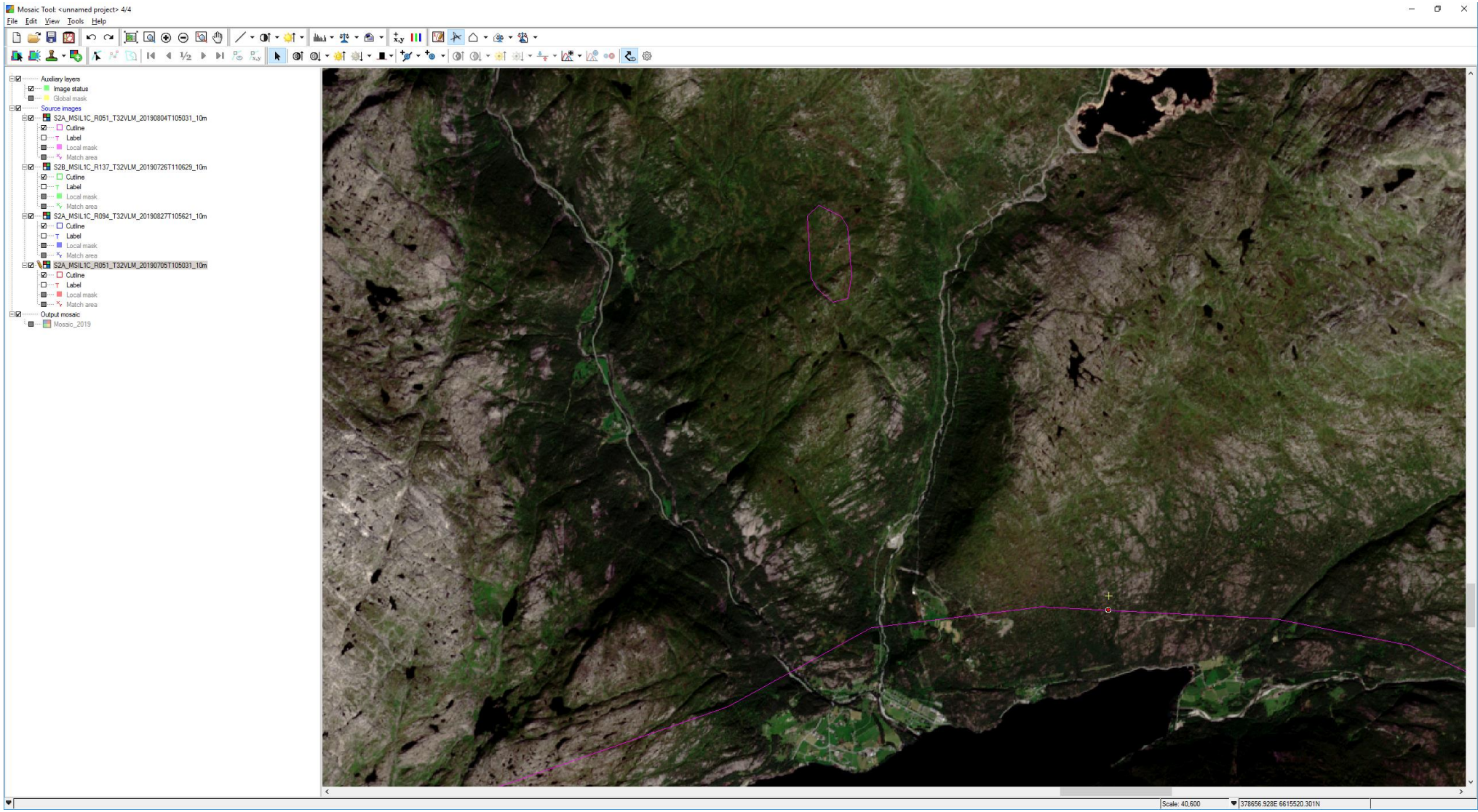
6) Mosaicing

PCI Geomatica: Mosaic Tool

- Dogding



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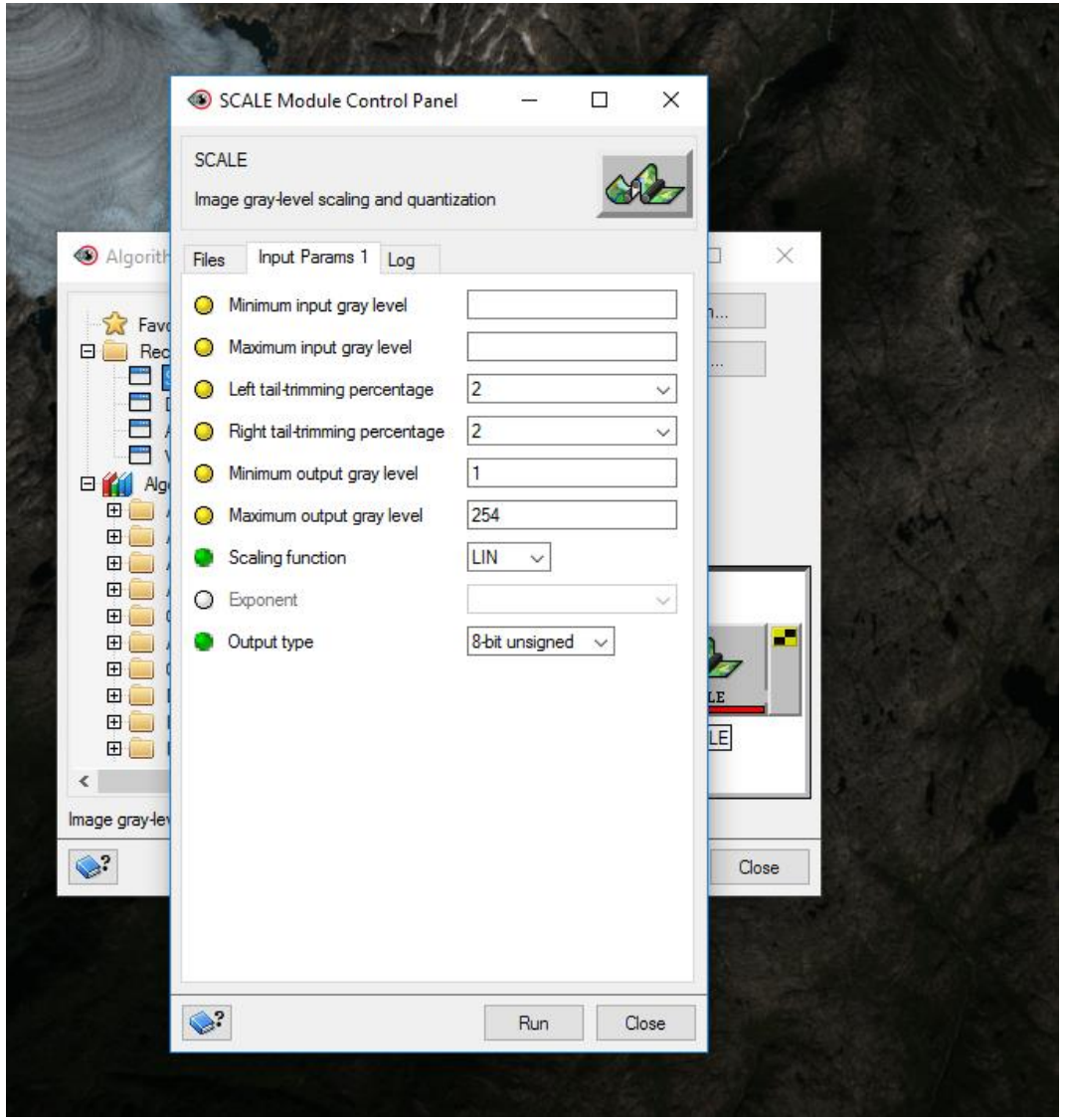
7) Scale

PCI Geomatica: Focus

- Due to 8-bit limitation in “Norway in Images” we scale the mosaic from Uint 16 to Uint 8
- Min value 1 and max value 254
  - Then we don’t risk transparency pixels (0,0,0 and 255,255,255)



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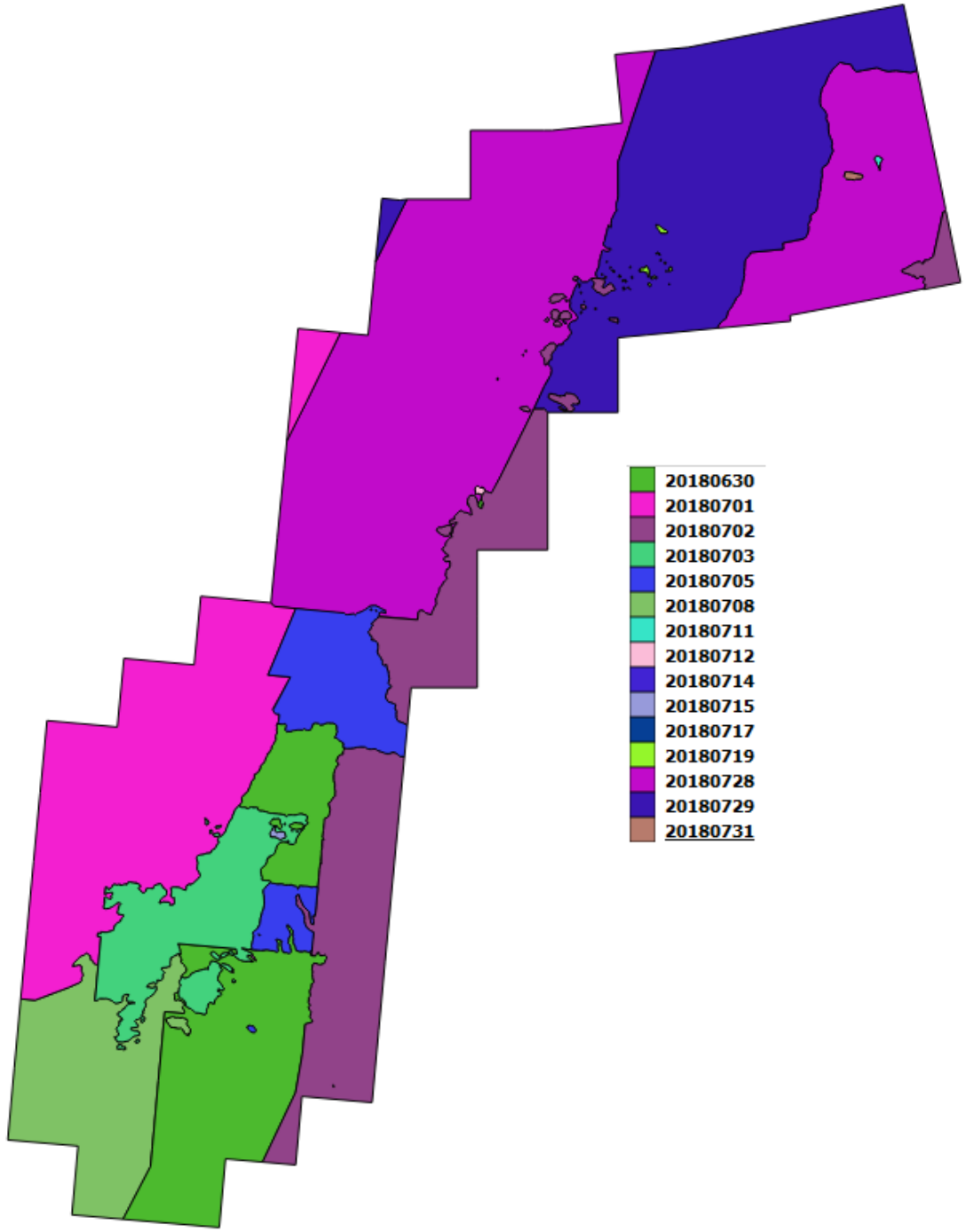

Kartverket

2018 version

- Download at Geonorge.no
  - RGB 8-bit
  - 10 bands 16-bit

2018 version

Thank you for your attention

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www.kartverket.no