

Cloud-free Sentinel-2 Mosaic Generation over Norway: Utilizing MAJA and WASP

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Outline

- Introduction
- How we are utilizing MAJA and WASP
- Documentation
- Our data
- Current Challenges & Next Steps
- Use cases and applications
- Operational Implementation



Introduction

- Why are we creating cloud-free mosaics?
 - Ready to use products for beginner and expert
 - Seasonal and annual change
- Why are we utilizing MAJA and WASP
 - Drawing cloud and cloud-shadow by hand is time-consuming.
 - We can create much more similar products each year
 - The Sentinel-2 Global Mosaic (S2GM)
 - MAJA turned open-source in 2020
 - And WASP in 2019



How we are utilizing MAJA and WASP

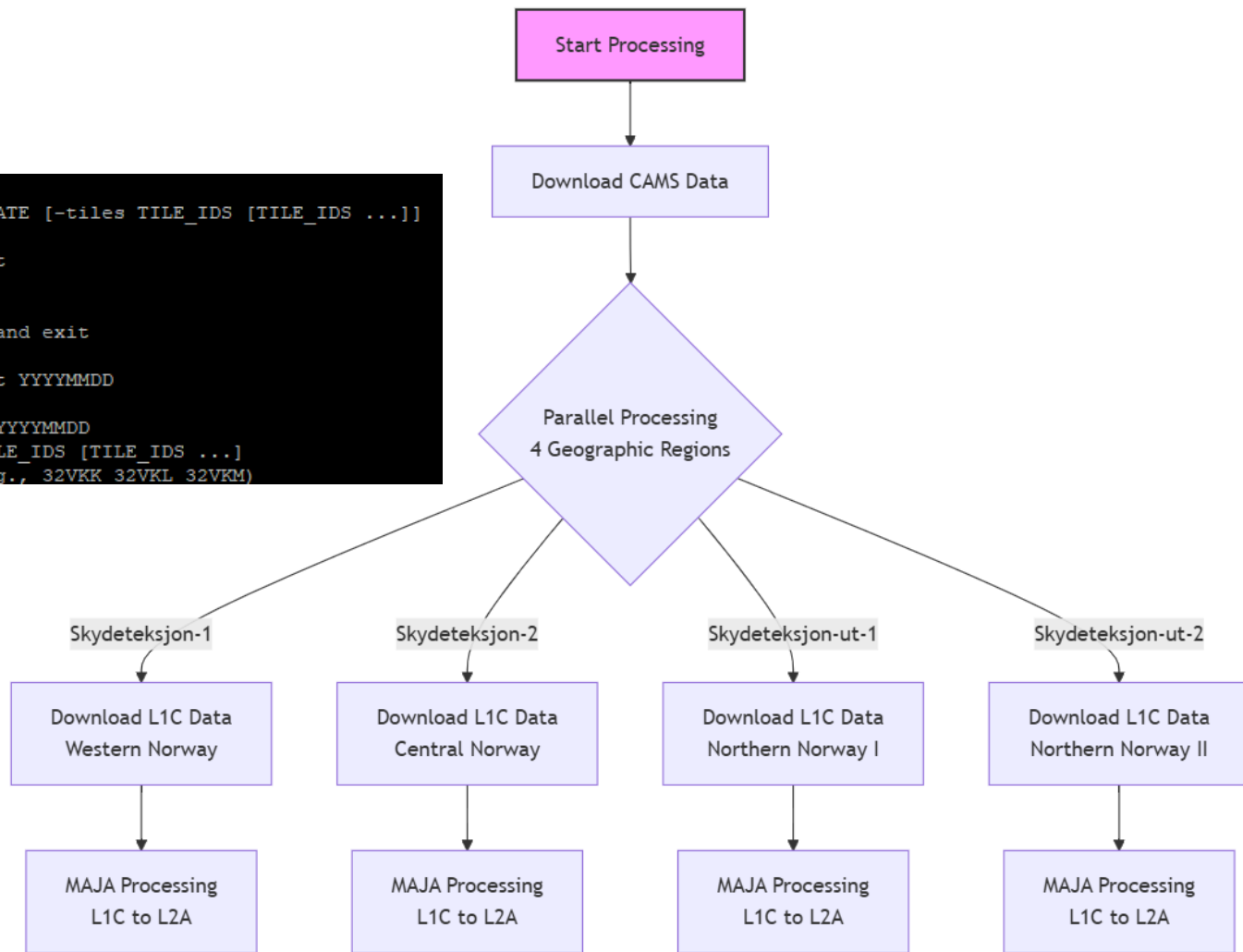
- Season target:
 - Quick L3A production – June-July and July-August
 - «Master mosaic» June-August (extended season if needed)
- One processing-server and one test-server
- Two file-servers
- MAJA L2A production:
 - CAMS
 - Modified DEM
 - Two tiles are processed on each file server at the time
- WASP L3A production:
 - One tile is processed on each file server at the time



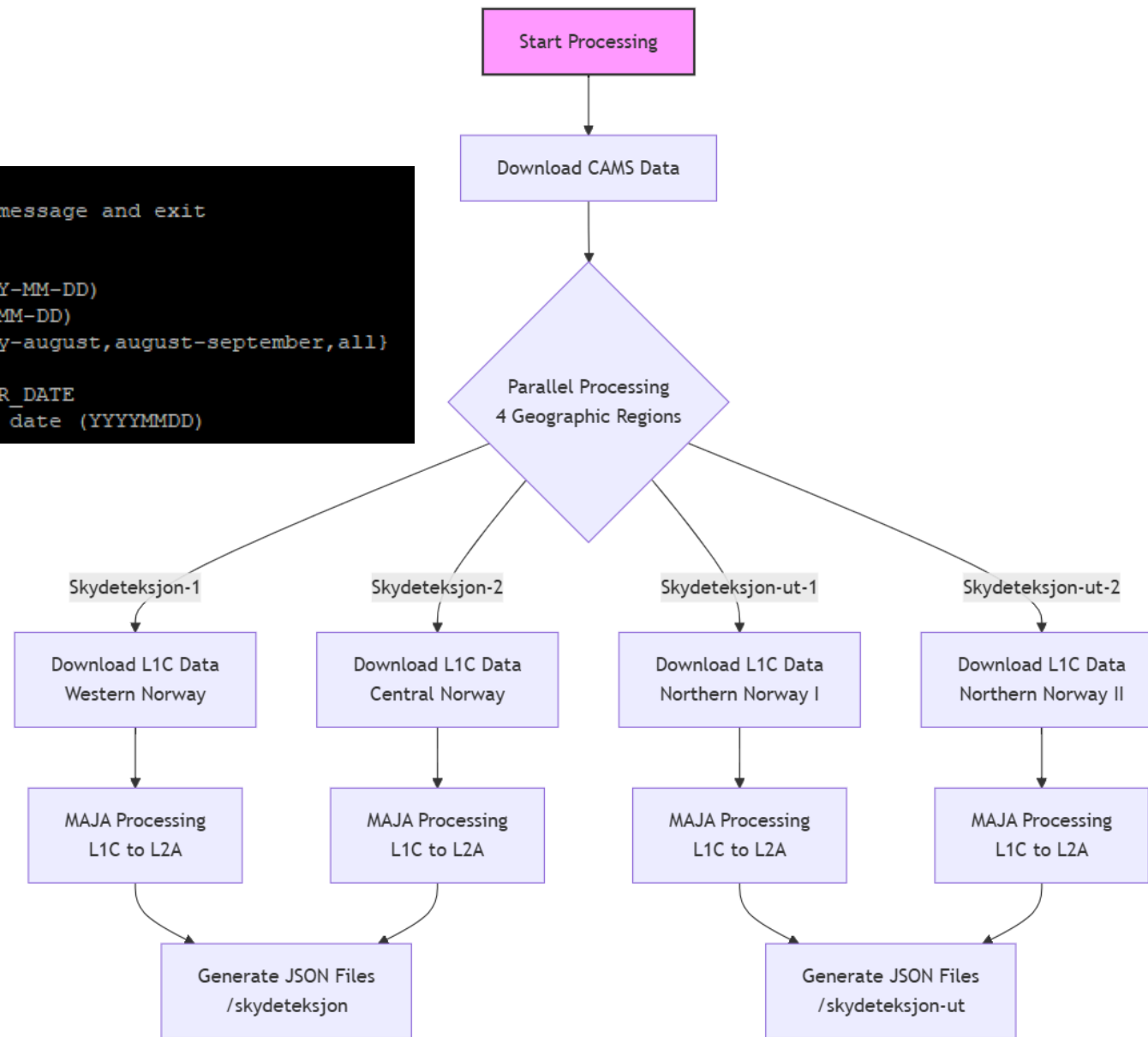

```
(eodag) python L2A.py --help
usage: L2A.py [-h] -start START_DATE -end END_DATE [-tiles TILE_IDS [TILE_IDS ...]]

CAMS, L1C downloading and MAJA processing script

options:
-h, --help            show this help message and exit
-start START_DATE, --start_date START_DATE
                      Start date in the format YYYYMMDD
-end END_DATE, --end_date END_DATE
                      End date in the format YYYYMMDD
-tiles TILE_IDS [TILE_IDS ...], --tile_ids TILE_IDS [TILE_IDS ...]
                      Tile IDs to process (e.g., 32VKK 32VKL 32VKM)
```



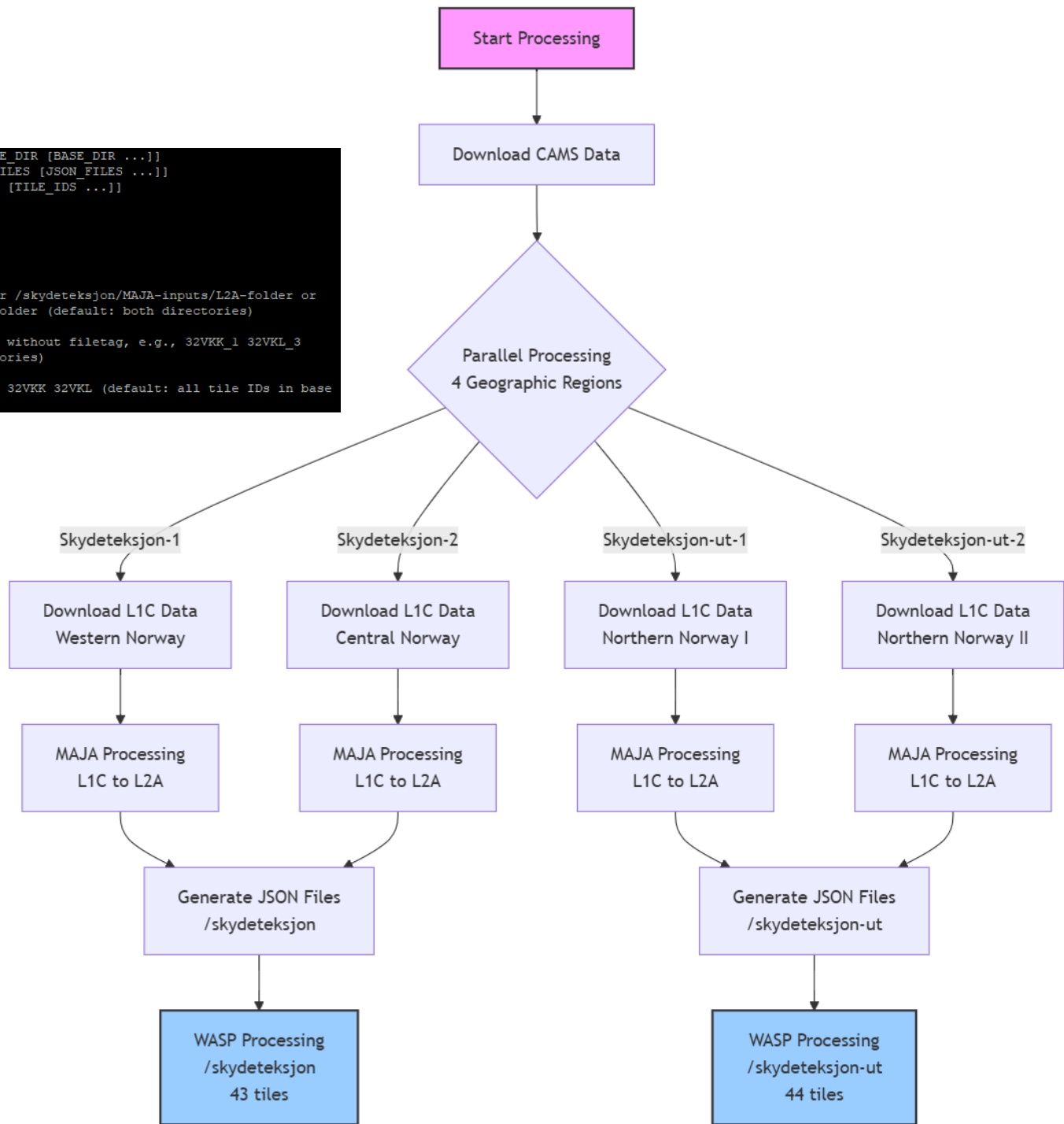
```
options:
-h, --help          show this help message and exit
--base-dir BASE_DIR Base directory
--start-date START_DATE
                    Start date (YYYY-MM-DD)
--end-date END_DATE End date (YYYY-MM-DD)
--date-range {april-may,june-july,july-august,august-september,all}
                    Date range
--selected-center-date SELECTED_CENTER_DATE
                    Selected center date (YYYYMMDD)
```



```
usage: WASP-kjoering-av-json-files.py [-h] [--base-dir BASE_DIR [BASE_DIR ...]]
                                     [--json-files JSON_FILES [JSON_FILES ...]]
                                     [--tile-ids TILE_IDS [TILE_IDS ...]]

Run WASP on JSON files

options:
  -h, --help            show this help message and exit
  --base-dir BASE_DIR [BASE_DIR ...]
                        Base directories to process, either /skydeteksjon/MAJA-inputs/L2A-folder or
                        /skydeteksjon-ut/MAJA-inputs/L2A-folder (default: both directories)
  --json-files JSON_FILES [JSON_FILES ...]
                        List of JSON file names to process without filetag, e.g., 32VKK_1 32VKL_3
                        (default: all files in base directories)
  --tile-ids TILE_IDS [TILE_IDS ...]
                        List of tile IDs to process, e.g., 32VKK 32VKL (default: all tile IDs in base
                        directories)
```





Guide for operasjonalisering av MAJA og WASP

MAJA

Klargjøring

L2A.py - CAMS, L1C nedlastning og MAJA kjøring

CRON

Gotify

WASP

WASP-lag-json-files.py - Autogenerering av JSON filer for WASP prosessering

[WASP-kjoering-av-json-files.py - Kjøring av WASP fordelt på to prosesser samtidig](#)

Full opplisting av alle funksjoner kan enn finne med:

```
sg mosaic -c 'python WASP-lag-json-files.py --help'
```

WASP-kjoering-av-json-files.py - Kjøring av WASP fordelt på to prosesser samtidig

Det er i all hovedsak fire ulike argumenter vi kan bruke for å kjøre WASP med de ulike JSON filene vi lagde tidligere:

1. Kjør skriptet uten noen argumenter.

```
sg mosaic -c 'python WASP-kjoering-av-json-files.py'
```

Standard er å kjøre alle JSON filene i de to basekatalogene: /skydeteksjon/MAJA-inputs/L2A-folder og /skydeteksjon-ut/MAJA-inputs/L2A-folder .

2. Kjør skriptet på bare en av basekatalogene.

```
sg mosaic -c 'python WASP-kjoering-av-json-files.py --base-dir /skydeteksjon-ut/MAJA-inputs/L2A-folder'
```

Om argumentet ikke brukes vil begge basekatalogene kjøres.

3. Kjør skriptet med en liste av spesifikke JSON-filer.

```
sg mosaic -c 'python WASP-kjoering-av-json-files.py --json-files 32VKK_1 32VKL_3'
```

Om argumentet ikke brukes vil alle JSON filene kjøres i enten begge eller en egenvalgt basekatalog. Denne funksjonen er grei å bruke når vi ønsker å korrigere manuelt, f.eks. fjerne enkelt L2A produkter i JSON filen.

4. Kjør skriptet med en liste av fliser.

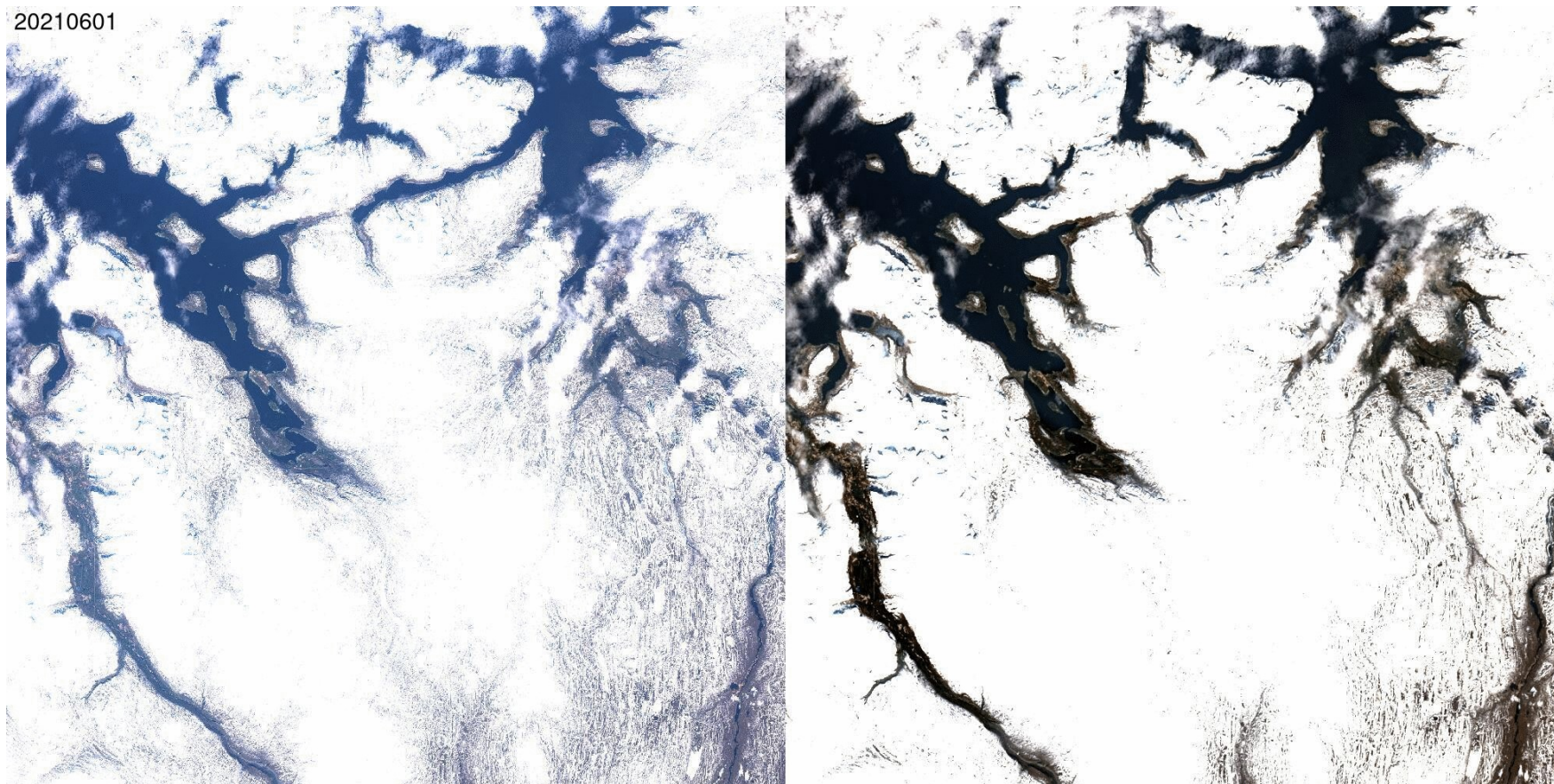
```
sg mosaic -c 'python WASP-kjoering-av-json-files.py --tile-ids 32VKK 32VKL'
```

Om argumentet ikke brukes vil alle JSON filene kjøres i enten begge eller en egenvalgt basekatalog. Denne funksjonen er grei å bruke når vi ønsker å lage WASP produkter til NIBIO/SSB for deres spesialleveranse, f.eks. der det ikke er så mange produkter, men spesifikke fliser som skal produseres.

Full opplisting av alle funksjoner kan enn finne med:

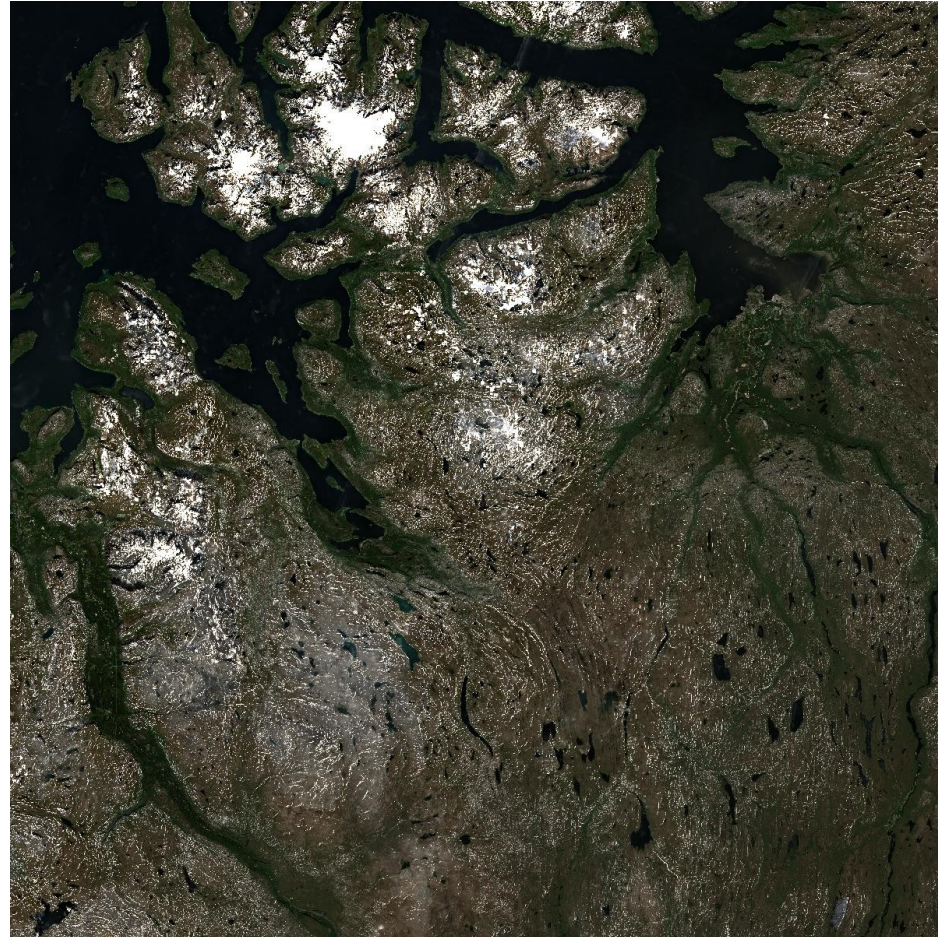
```
sg mosaic -c 'python WASP-kjoering-av-json-files.py --help'
```


Our data: L1C->L2A (MAJA)



Contains modified Copernicus Sentinel-2 data (2021)

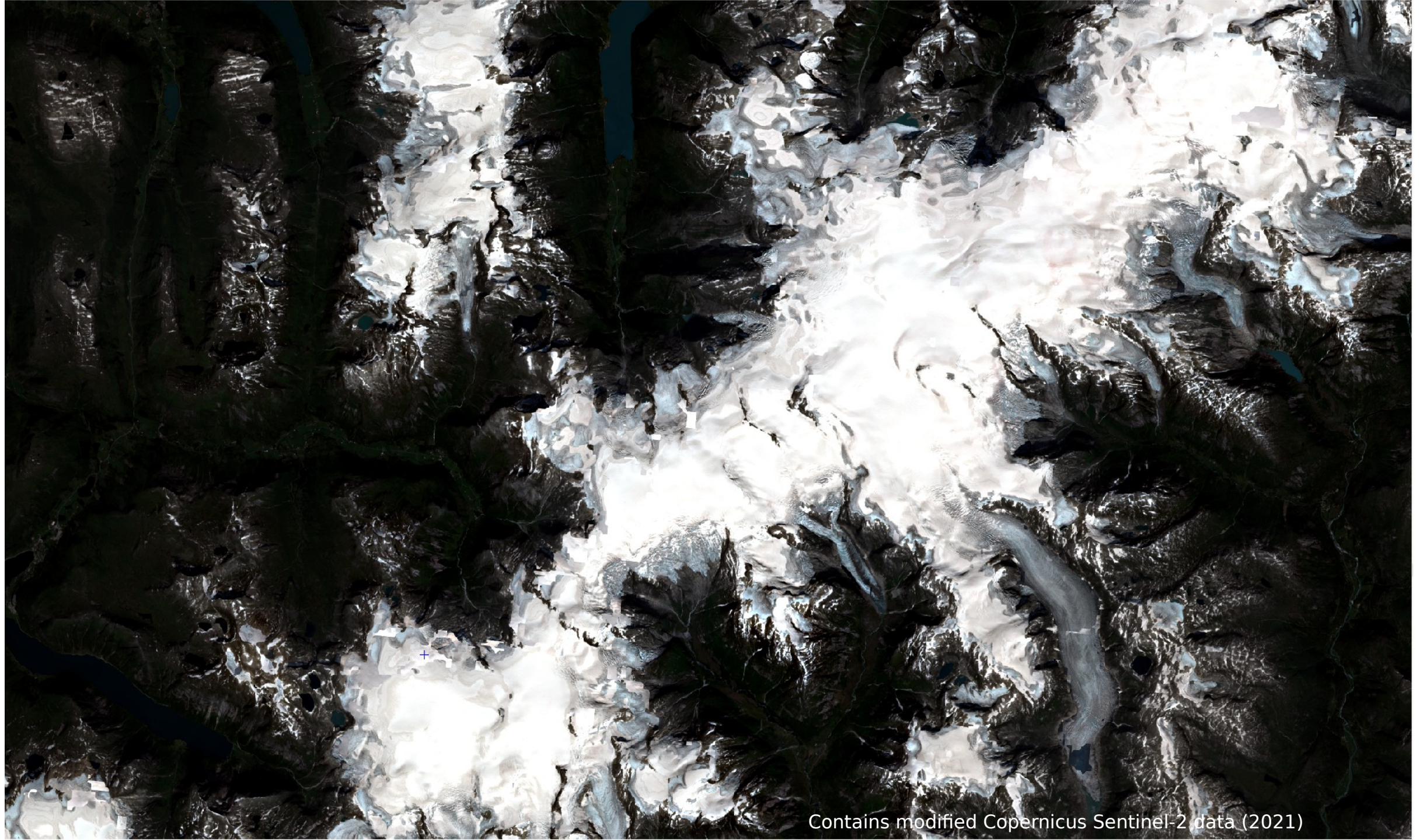
Our data: L3A (WASP)



Contains modified Copernicus Sentinel-2 data (2021)

Current Challenges & Next Steps

1. Clouds over glaciers
 2. Patches of snow not detected
 3. Clouds not detected in MAJA
- To further investigate:
 - Could implementation of the module Let-it-Snow help, or use existing snow map from Copernicus Land?
 - Any settings we should tune to improve MAJA's cloud-detection over Norway?



Contains modified Copernicus Sentinel-2 data (2021)



Contains modified Copernicus Sentinel-2 data (2021)

Use cases and applications

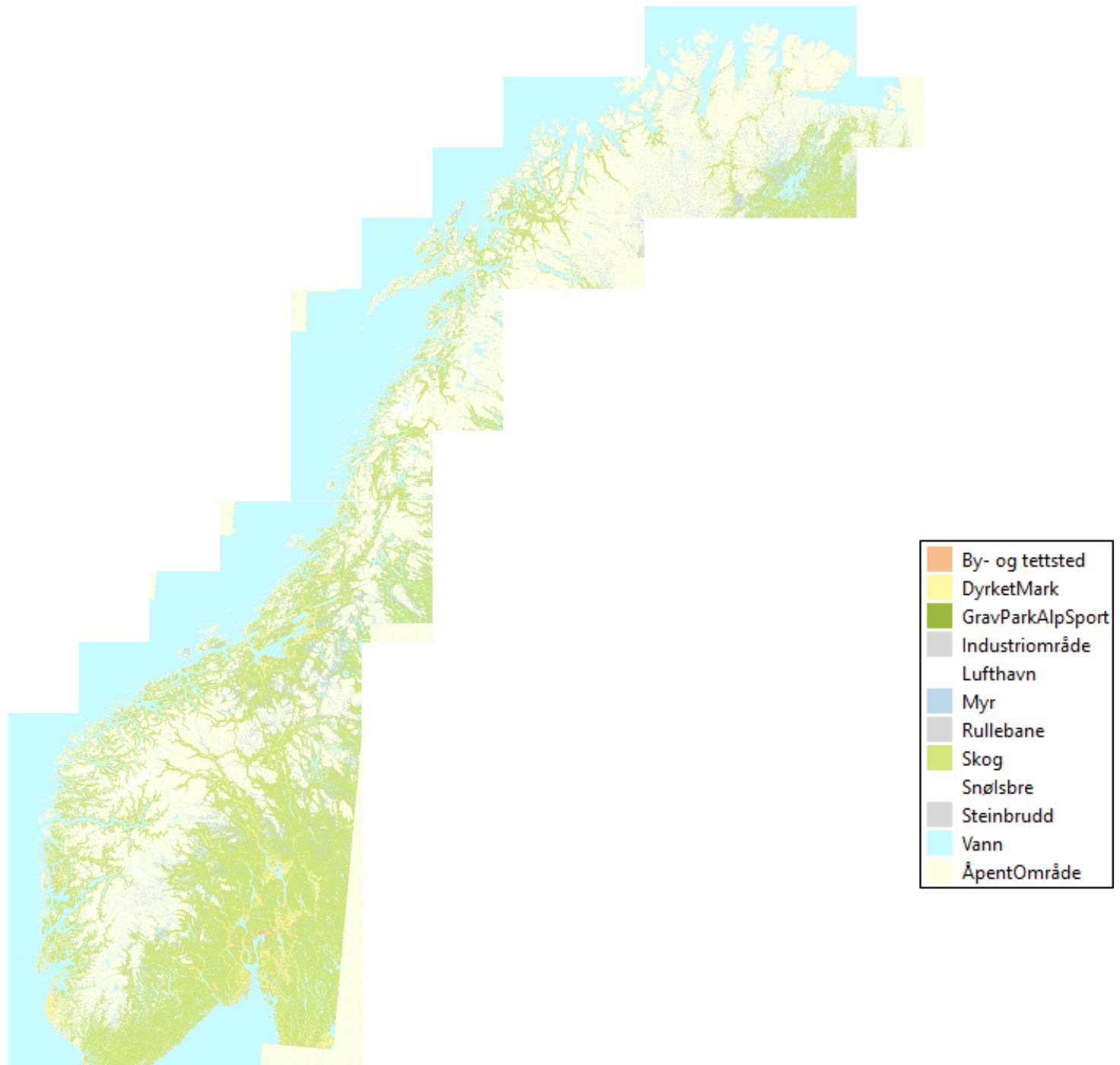
1. 1:50 000 Topographical land data -> OTBTF
2. OBIA tree classes -> Iota²
3. Road detection (mosaics and Copernicus VHR data) -> OTBTF
4. Super-Resolution model trained in the frame of the EVOLAND Horizon Europe.

OTBTF



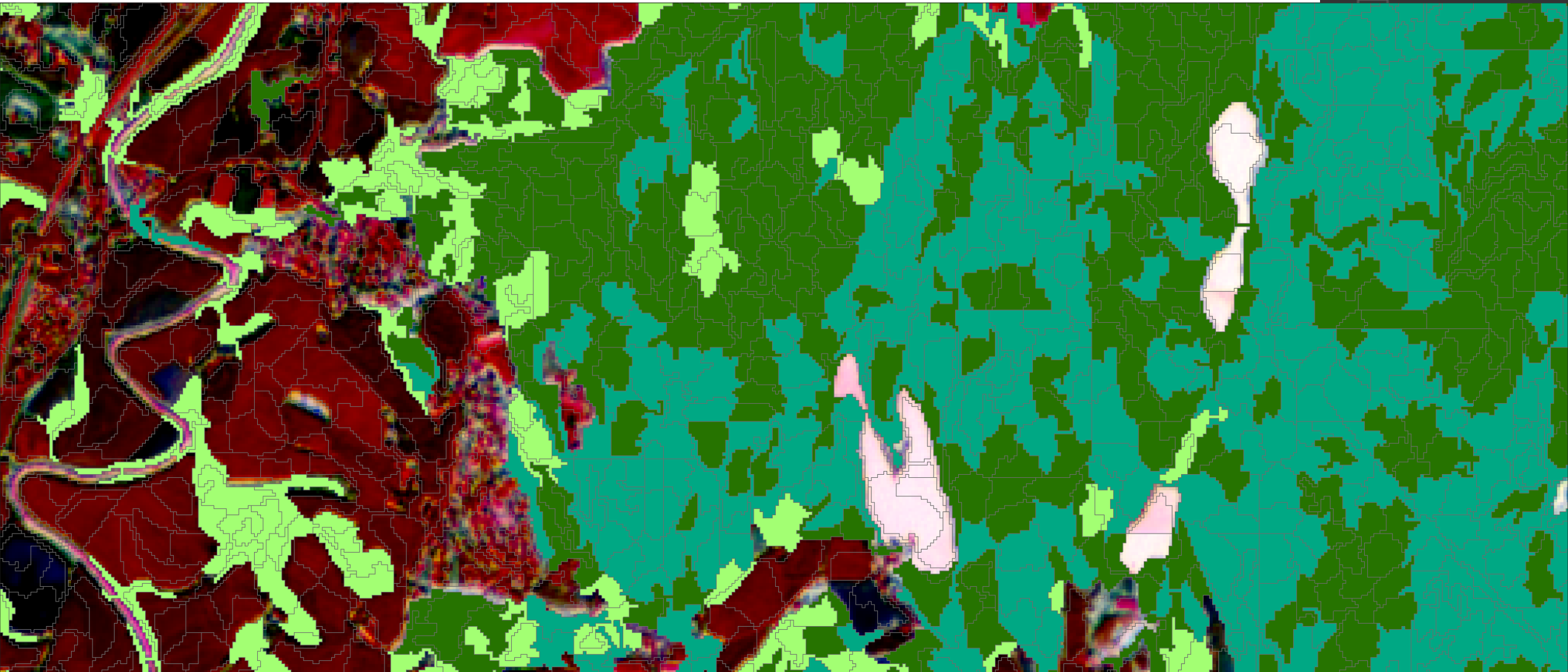
- Isbre
- By- og tettsted
- Dyrket Mark
- Industriområde
- Rullebane
- Lufthavn
- Myr
- Skog
- Steinbrudd
- Vann
- Gravplass, Park, Allé
- Åpent område

Contains modified Copernicus Sentinel-2 data (2020)



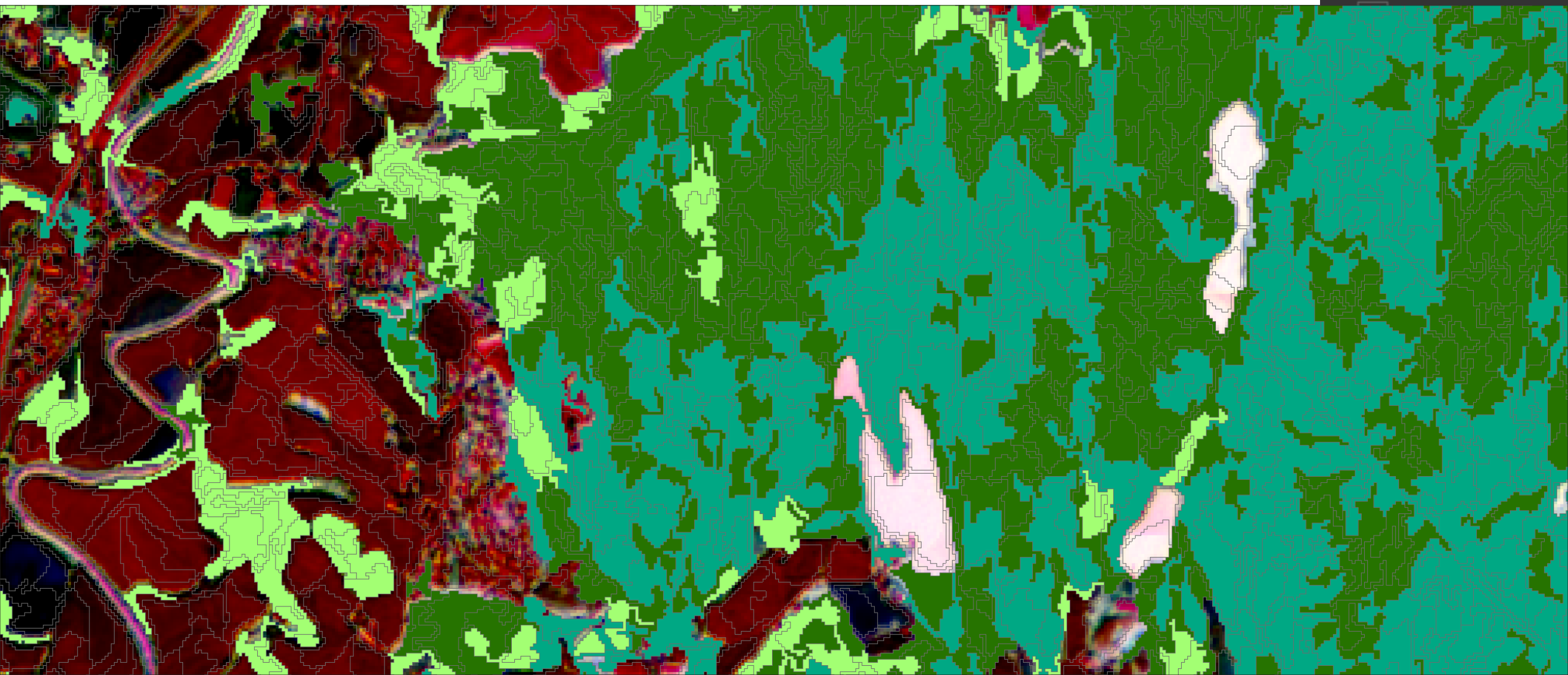
Iota² OBIA: Full stack with 65 MAJA-L2A

- Gran
- Furu
- Lauv



Iota² OBIA: Four season mosaics with WASP-L3A

Gran
Furu
Lauv





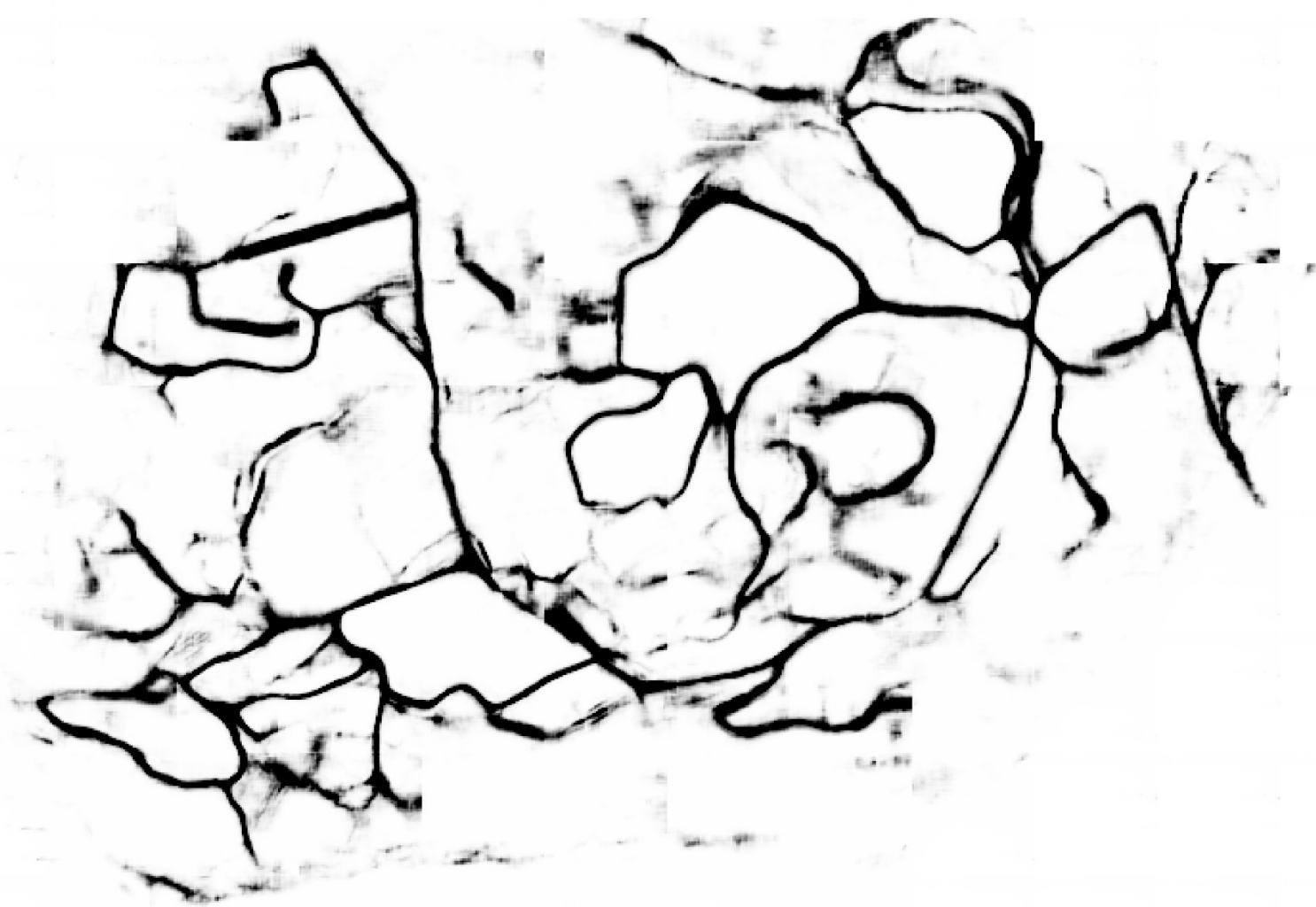
WorldView-3 © Maxar Technologies, Inc. (2021), provided under COPERNICUS by the European Commission, ESA and European Space Imaging

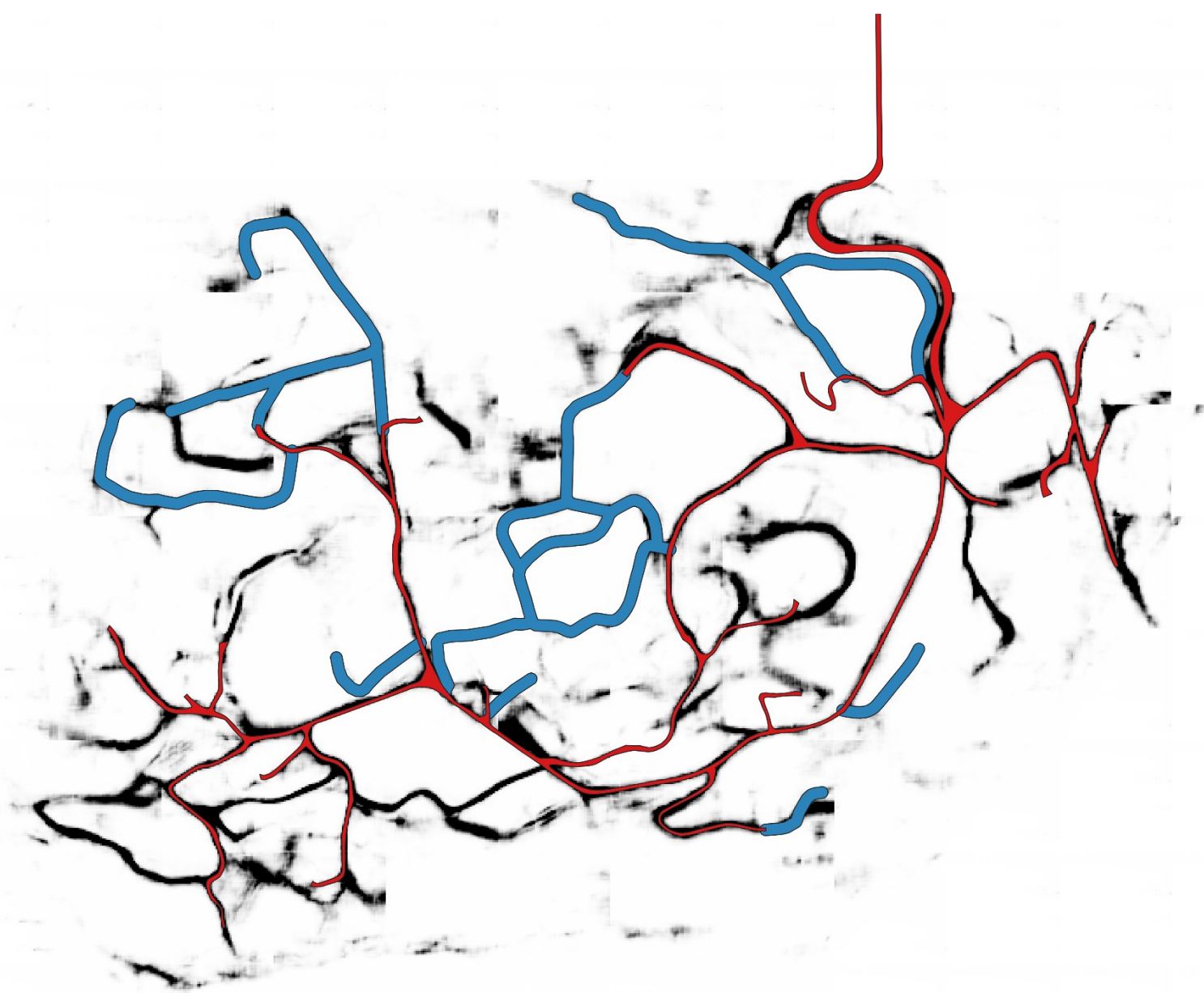




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WorldView-3 © Maxar Technologies, Inc. (2021), provided under COPERNICUS by the European Commission, ESA and European Space Imaging





20190228 - 10 m - original

Contains modified Copernicus Sentinel-2 data (2019)



20190228 - 5 m - Super-resolution

Contains modified Copernicus Sentinel-2 data (2019)



Questions?

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Kartverket