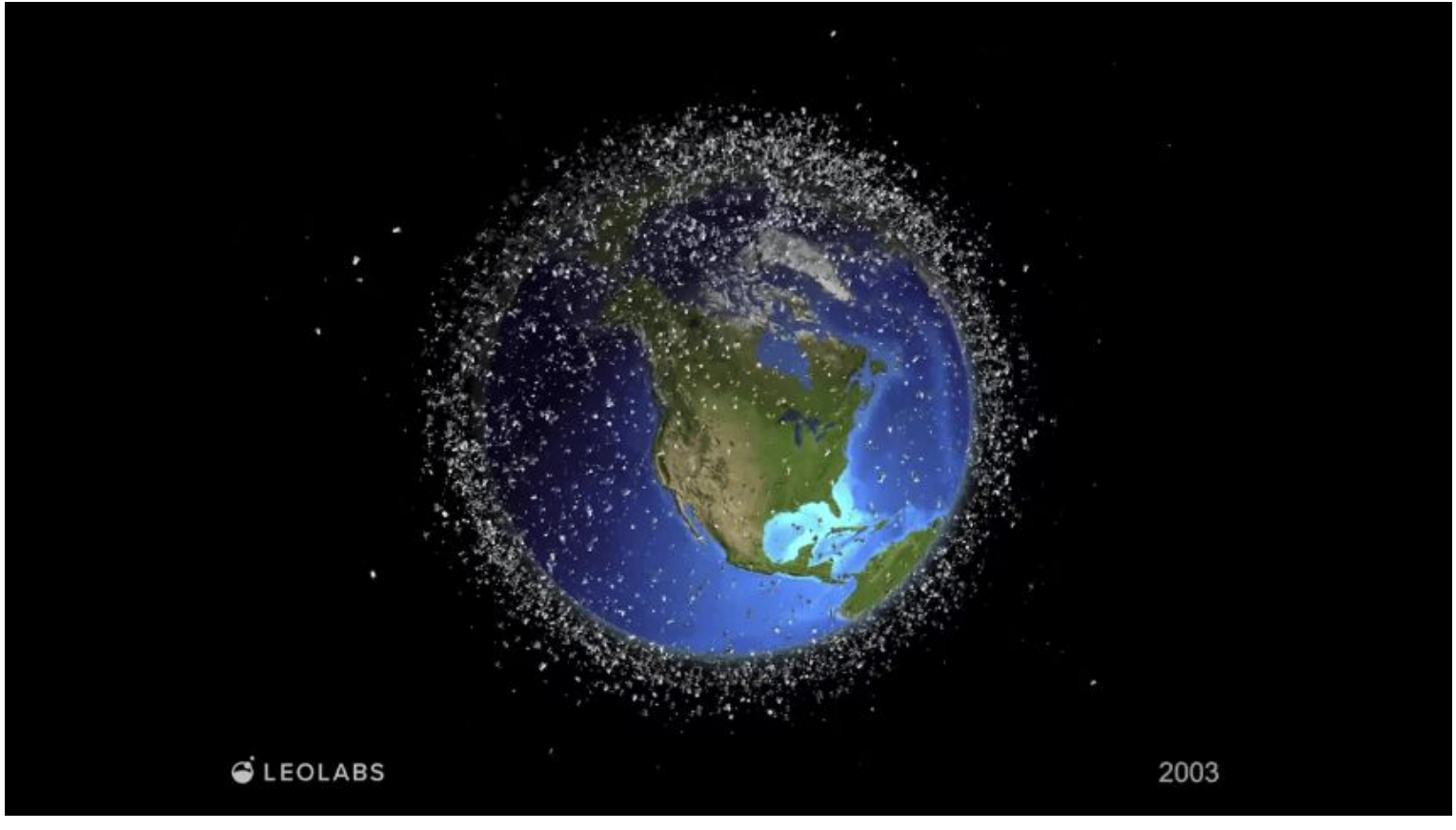
GISS Visit, 2026-01-29

AI Methods for Large-Scale Satellite Image Analysis

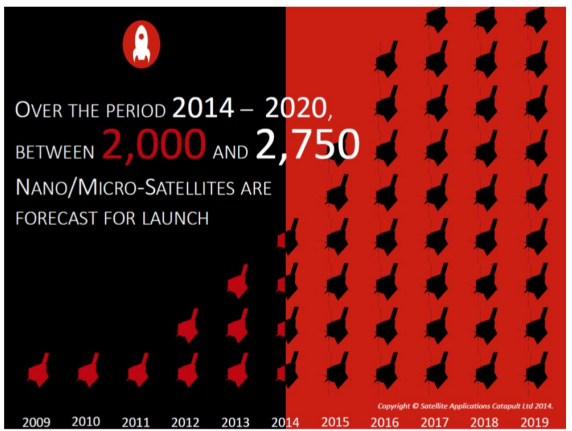
Sebastian Hafner, Space Technology, RISE Research Institutes of Sweden

Earth Observation



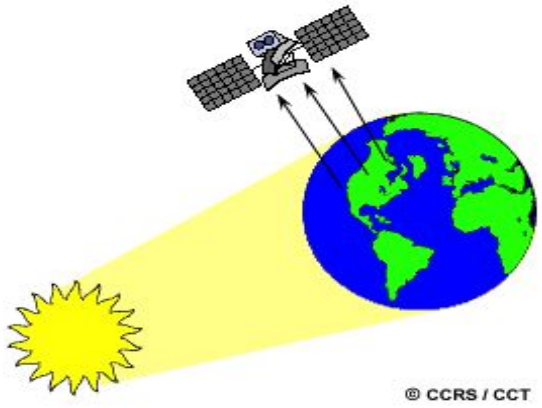
New Era of Earth Observation

International, national space agencies and innovative companies are supporting various Earth observation programs acquiring huge volumes of data every day

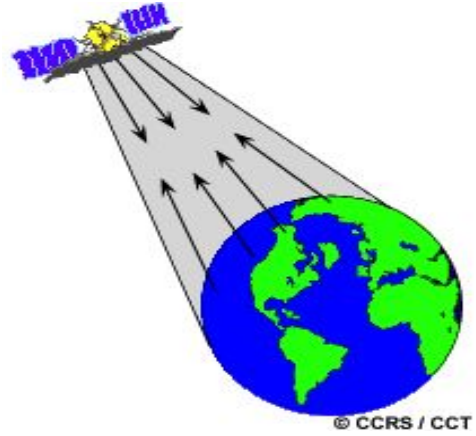


Earth Observation Sensor Types

Passive Sensors



Active Sensors



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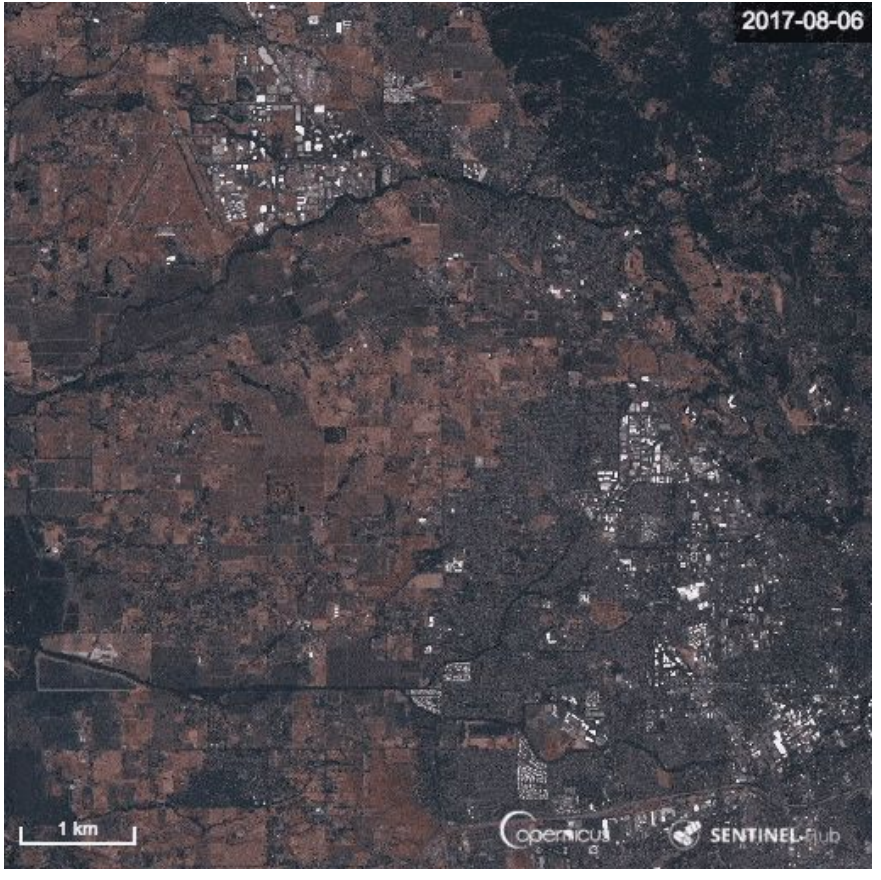
Optical Earth Observation

- Every 5 days
- Multispectral
- 10-60 m

ESA
Sentinel-2



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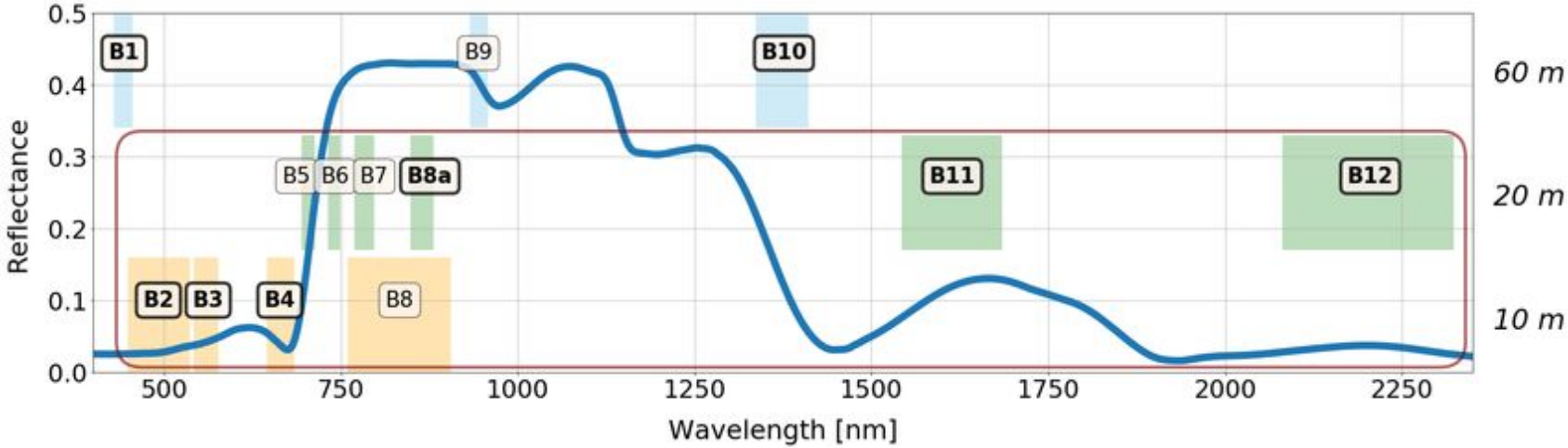
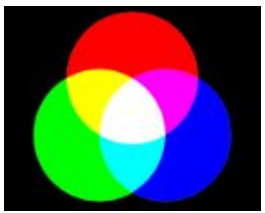
Optical Earth Observation





True color
R: Red (B4)
G: Green (B3)
B: Blue (B2)

False color
R: NIR (B8)
G: Red (B4)
B: Green (B3)

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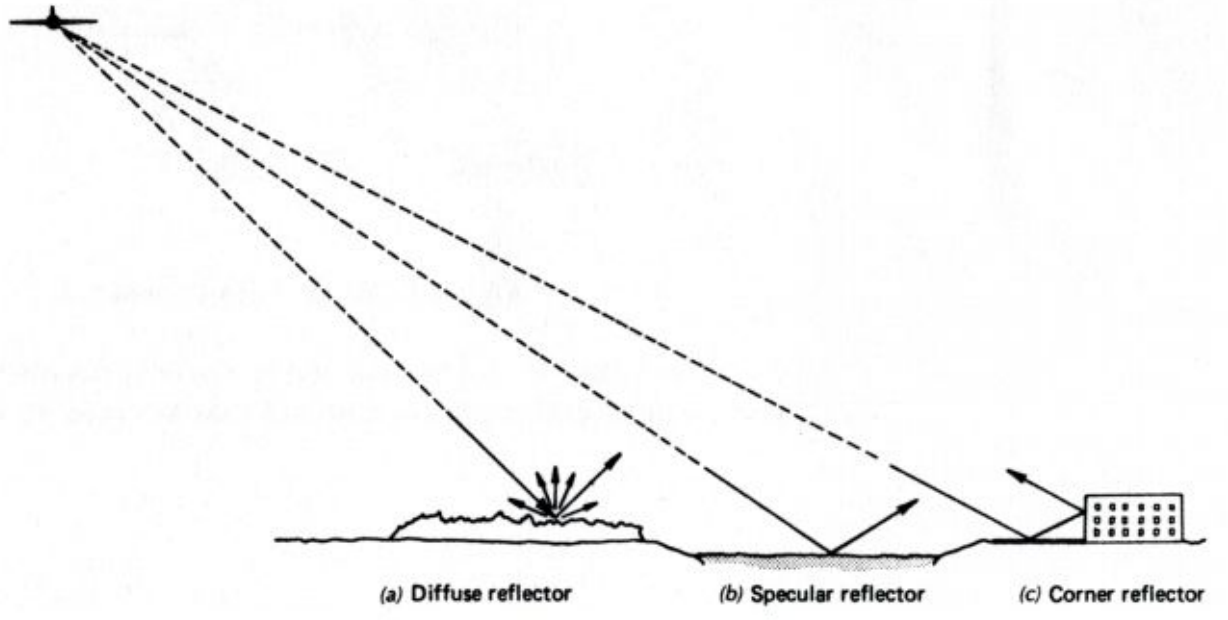
Synthetic Aperture Radar (SAR)



- Active sensor sending out microwaves
- Penetrate through clouds
- Collects information on surface geometry
- Vertical structures appear bright in SAR images

Credit: University of Zurich, RSL

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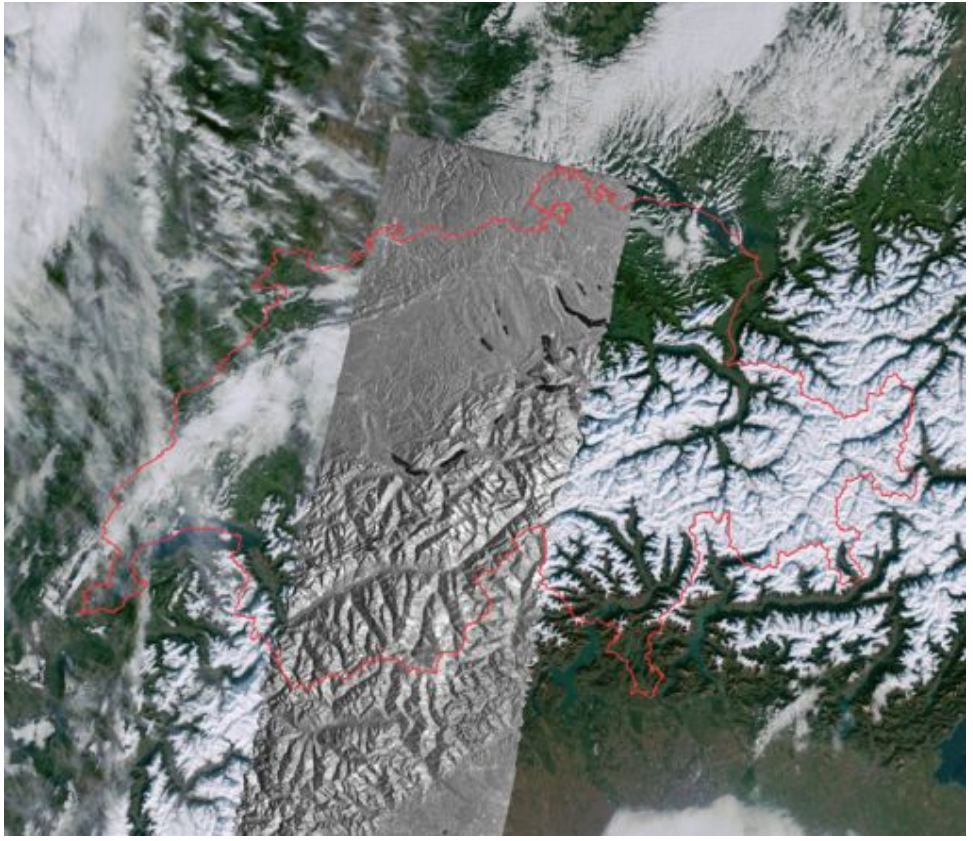
Synthetic Aperture Radar (SAR)

- Every 6 days
- SAR
- 20 m resolution

ESA
Sentinel-1



Credit: University of Zurich, RSL

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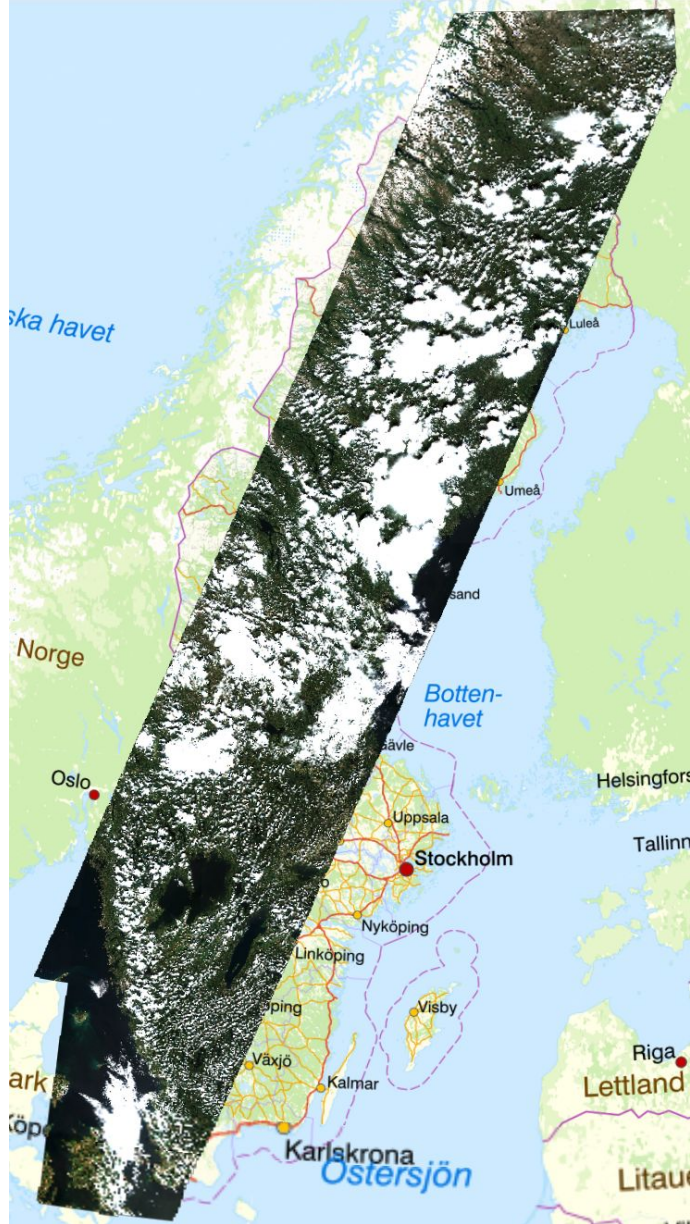
Digital Earth Sweden

What we provide

- Large archive with satellite data
  - Long time series of Sentinel-2 data over Sweden
  - Data is stored at RISE ICE datacentre in Luleå
- Scalable tools for analysis of satellite data
- Available for everyone to use, today!
- With Sweden and its surroundings as primary focus



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Swedish National Space Agency

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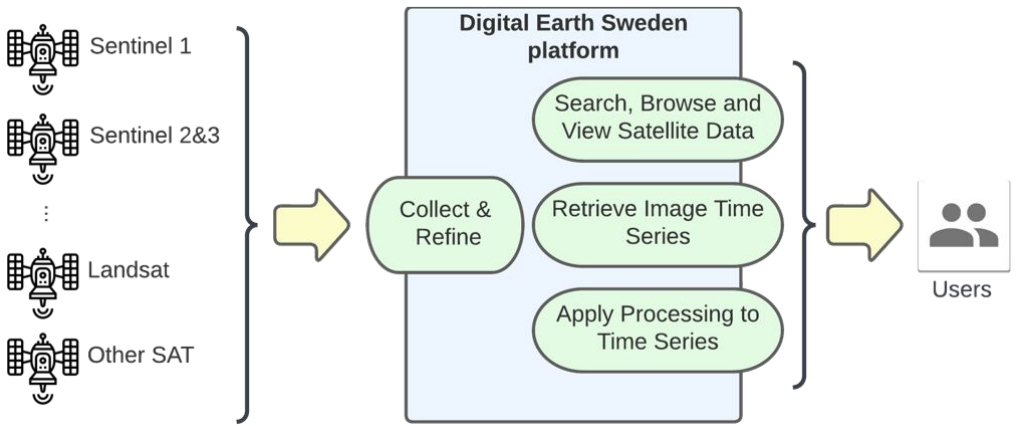
Digital Earth Sweden

Vision

- We want to empower Swedish authorities to seamlessly benefit from EO data analysis
- Support and enable EO-based innovation



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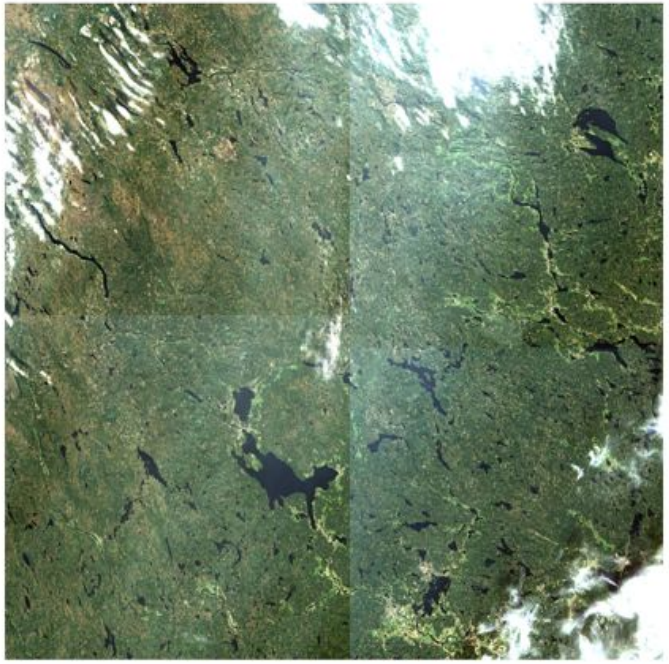
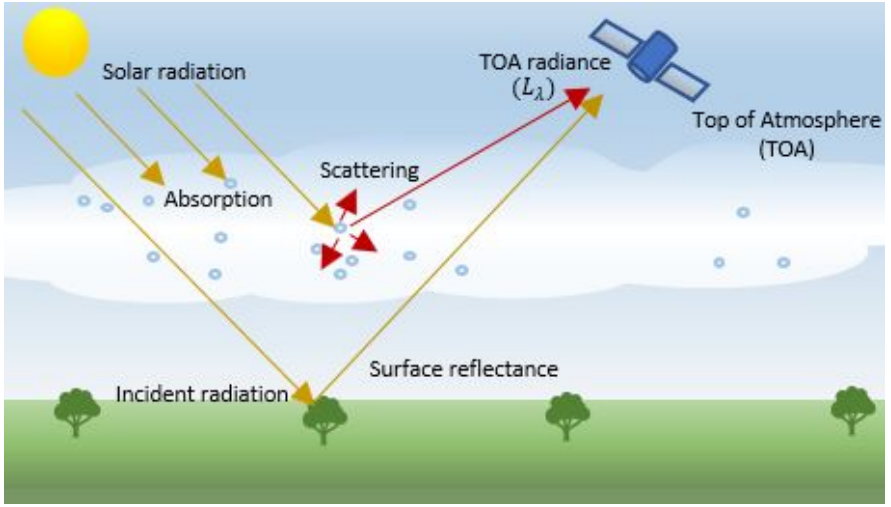
Limitations of Sentinel-2 L2A data provided by ESA





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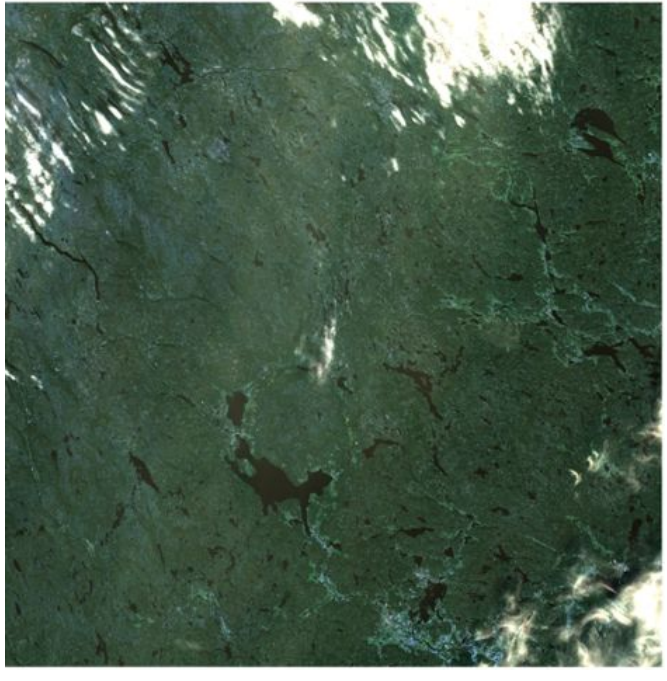
Coming soon to Digital Earth Sweden



L2A product from Copernicus Data Space Ecosystem

L2A product produced with FORCE

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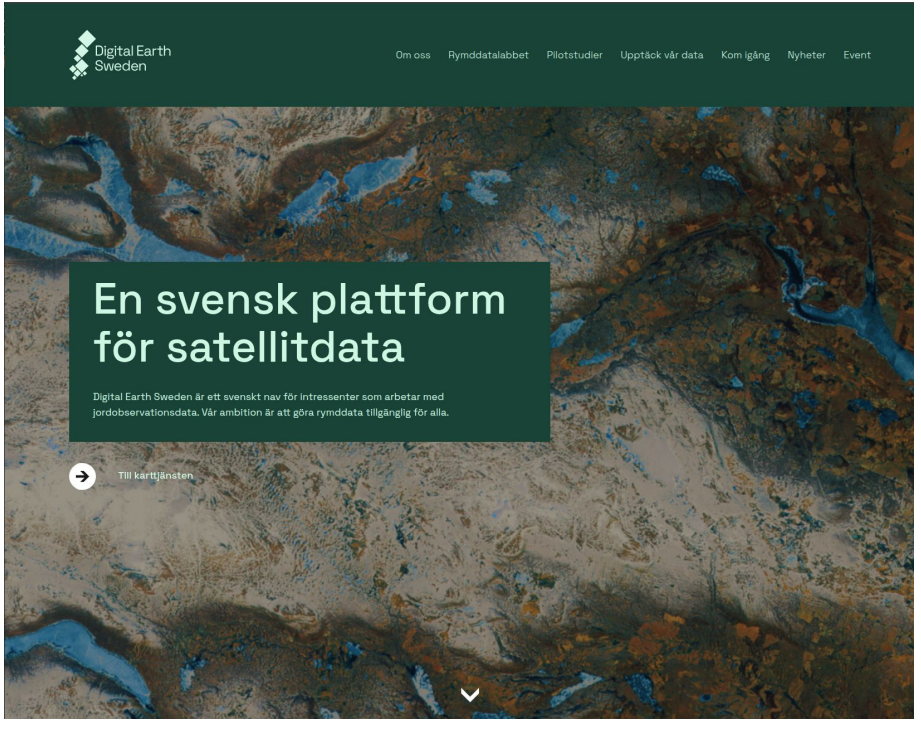

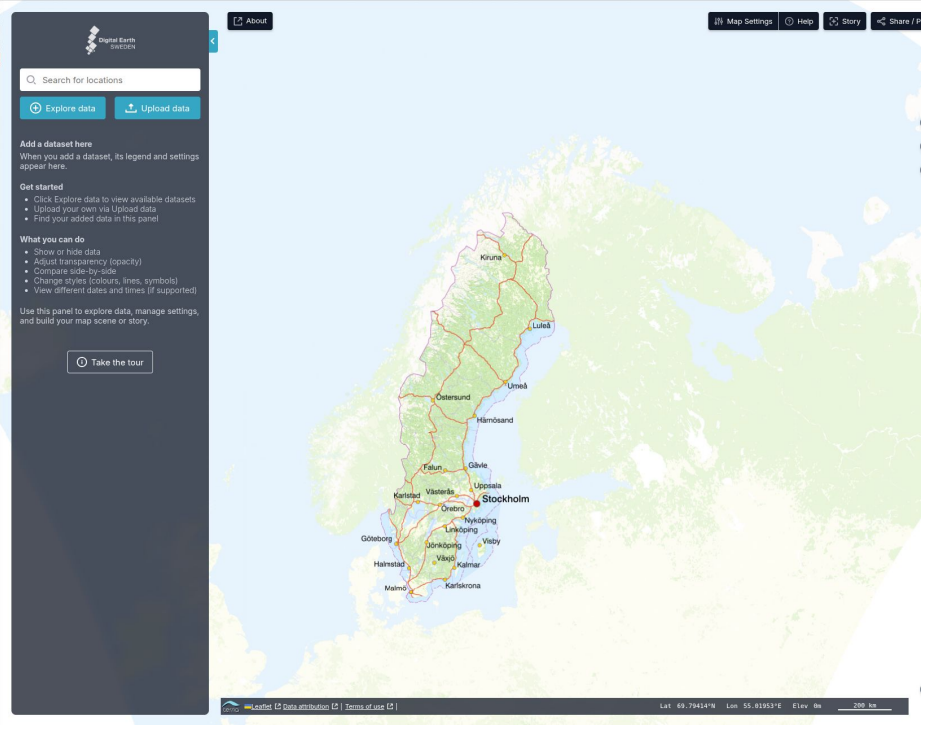

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Co-funded by the European Union

Estimating crop residues based on Earth observation data

- Relevance: Greenhouse gas inventory and nutrient balance for agricultural land
- Current approach: Farmer surveys to sample crop residue practices
- Obstacles:
  - Funding: Lack of permanent funding to produce crop residue statistics
  - Respondent burden: Data collection from farmers imposes administrative burden on agricultural holdings
- Aim: Finding cost-efficient alternative data sources

EU funded project “Earth Observation Data for Urban Land Use and Agri-Environmental Statistics” (Project 101195601 — 2024-SE-GEOS_SATDES)

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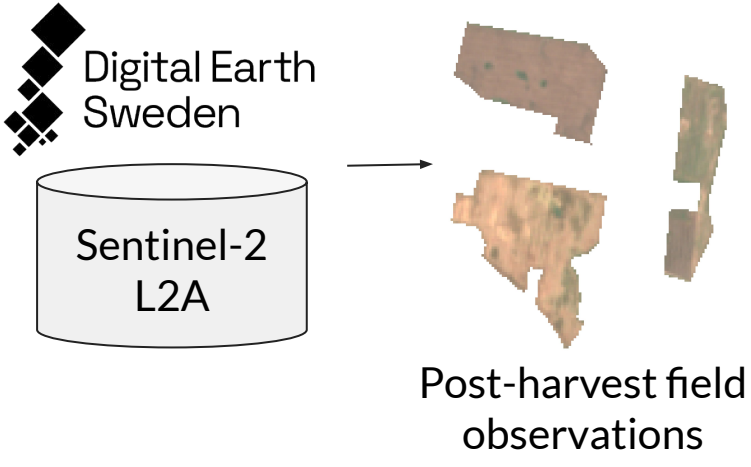
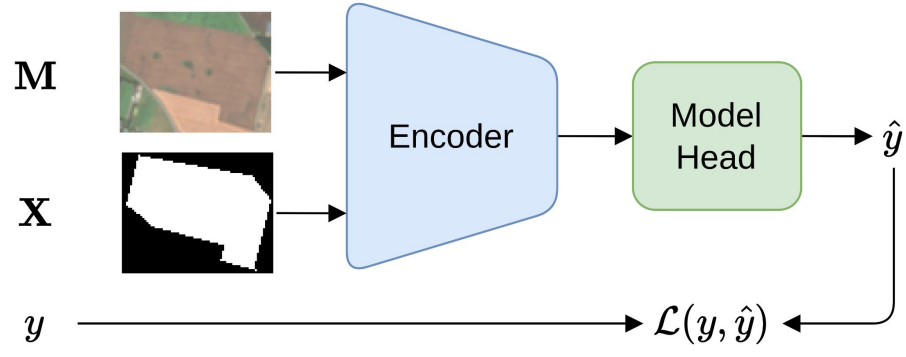
Step 1: Data collection



Step 2: Model training and evaluation



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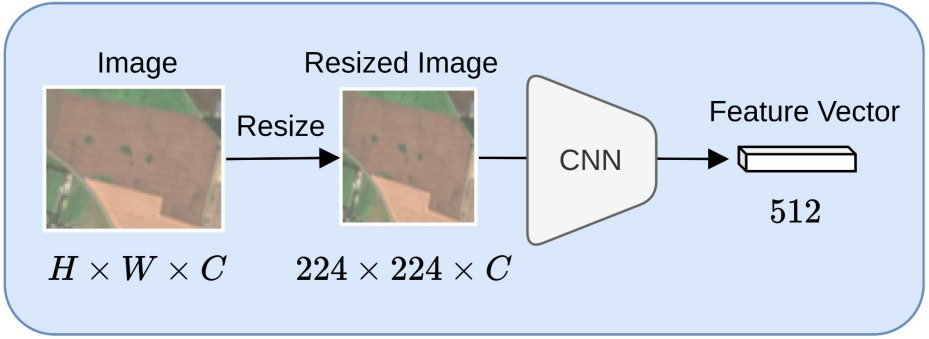
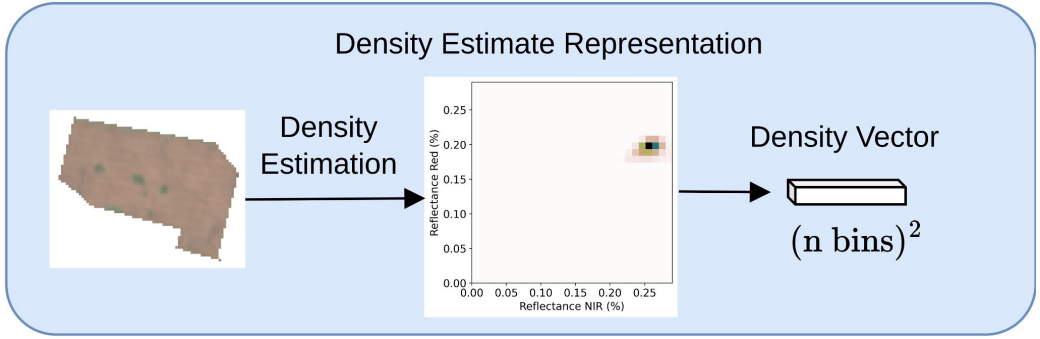
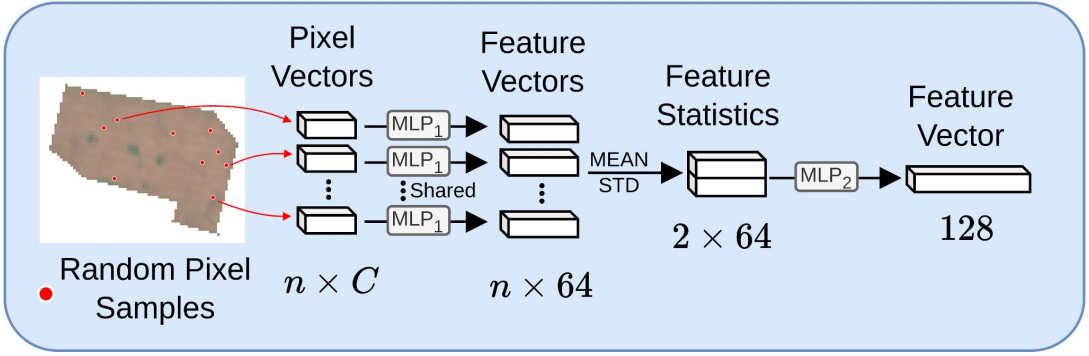
Step 2: Investigating different encoding methods







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Two MSc theses investigating the value of Sentinel-1 SAR data

- Kristine Berezkova: Machine Learning–Based Detection of Crop Residue Using Sentinel-1 SAR Data in Dalarna, Sweden

- Johanna Wicht: Detecting Cereal Crop Residue in Skåne, Sweden Using Sentinel-1/2 Sensor Fusion and Machine Learning

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Thank you for your attention!

Feel also free to contact Burcu Kocoglu
(burcu.kocoglu@ri.se) for information on the projects

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