Demo zu EO-basierten Bodenprodukten SoilSuite Europe

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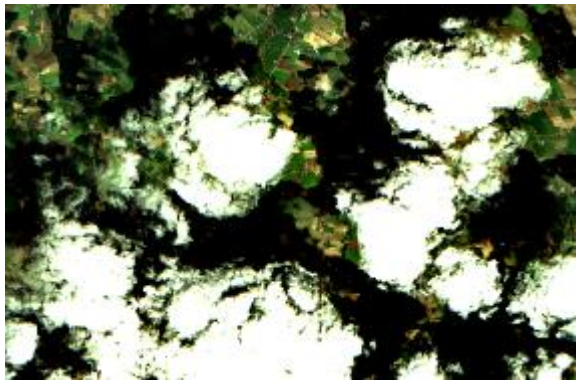
Land im Blick Copernicus-Workshop

25.09.2025

Observing soils from optical satellite platforms

Clouds / Cloudshadow / …

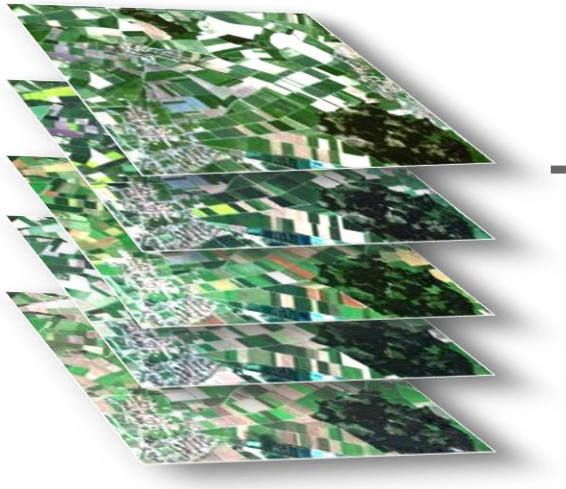


Detecting bare soil

Disturbances:
Green and dry vegetation, stubbles, moisture, roughness

Basic idea – temporal compositing of bare soils

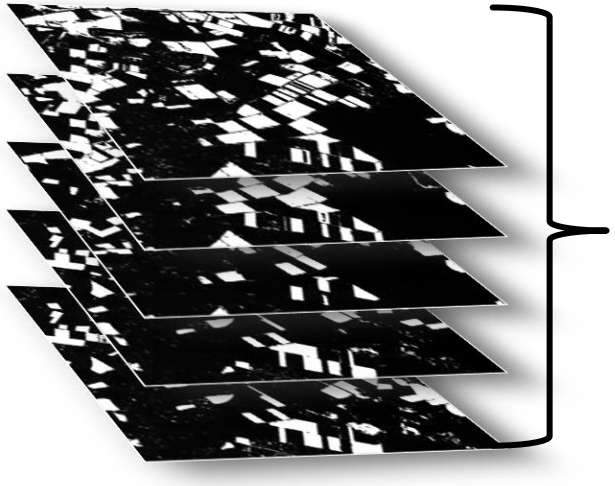
Temporal stack
Reflectance images



Spectral index
threshold

Temporal stack
Bare soil masks

April 20.5%
May 17.5%
July 13.8%
Aug 26.8%
Sept 25.8%



Temporal Composite
Bare soil mask

Expanding data base
Bare Soil Exposure = 47.9 %

References (selection)

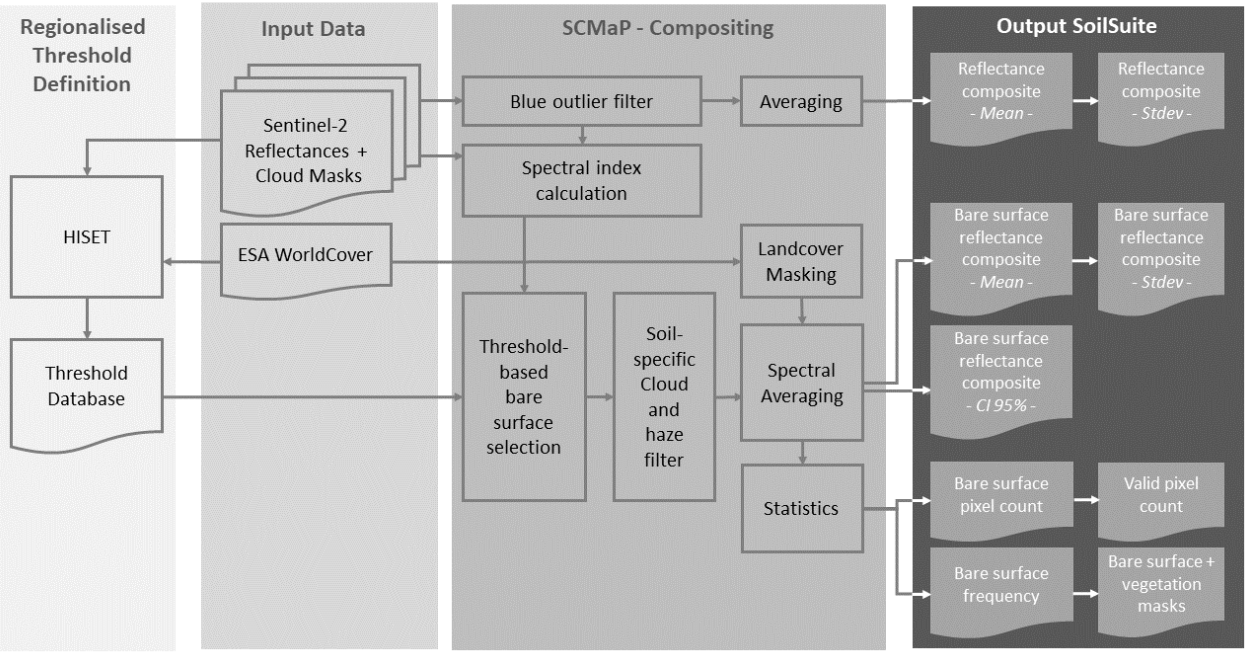
- Diek, S. et al. (2017). Barest Pixel Composite for Agricultural Areas Using Landsat Time Series. Remote Sens. 2017, 9, 1245.
- Rogge, D. et al. (2018). Building an exposed soil composite processor (SCMaP) for mapping spatial and temporal characteristics of soils with Landsat imagery (1984–2014), RSE, 205, 1-17.
- Demattê, J.A.M. et al. (2018). Geospatial Soil Sensing System (GEOS3): A powerful data mining procedure to retrieve soil spectral reflectance from satellite images. RSE, 212, 161–175.
- Vadour, E., et al. (2021). Temporal mosaicking approaches of Sentinel-2 images for extending topsoil organic carbon content mapping in croplands, International Journal of Applied Earth Observation and Geoinformation, 96, 2021, 102277, DOI: 10.1016/j.jag.2020.102277.
- Dvorakova, K. et al. (2021). Sentinel-2 Exposed Soil Composite for Soil Organic Carbon Prediction. RS, 13 (9), 1-21. doi: 10.3390/rs13091791
- Heiden, U. et al. (2022). Soil Reflectance Composites - Improved Thresholding and Performance Evaluation. Remote Sensing, 14 (18), Seiten 1-26. doi: 10.3390/rs14184526.

SCMaP Overview

- Fully automated and operational processor generates product suite for:
  - Digital and spectral modelling and mapping of soil parameter
  - Statistics about soil use intensity
  - Evaluating the quality - spectral uncertainty (confidence interval)
- SCMaP modular – can be configured based on the demands of users / projects
- Temporal statistics of several spectral indices such as NDVI, NBR, NDWI, etc.
- Tested and validated for Europe, parts of Brazil, Westafrica, Canada, China
- Deployed e.g. at terrabyte – DLR‘s HPDA platform and Open Telekom Cloud:

Publication:

- Karlshöfer et al. 2025, Geoderma, 10.1016/j.geoderma.2025.117340.
- Heiden et al., 2025: Tech report, 10.15489/qkud8cudg596
- Heiden, U. et al.,2022: RS, 10.3390/rs14184526
- Rogge et al., 2018: RSE, 10.1016/j.rse.2017.11.004



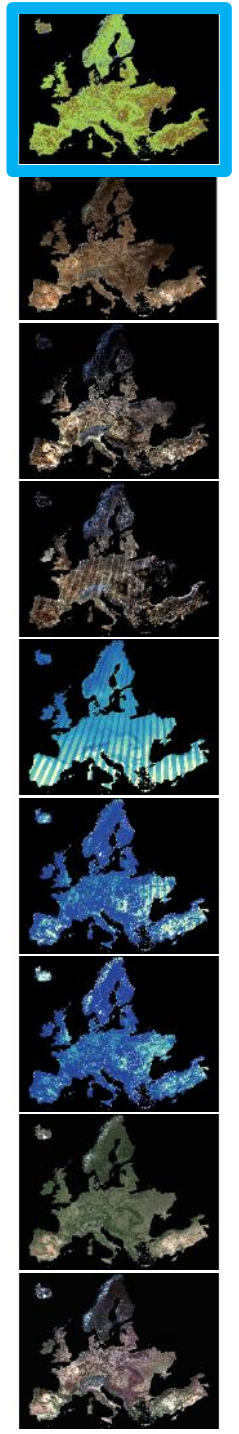
SOILSUITE EUROPE

SoilSuite 2018 – 2022

- Sentinel-2
- 2018 – 2022
- < 80 % cloud cover
- > 20° sun elevation
- 20 m pixel size
- 3 bands

<u>Bare Surface Mask</u>

- Bare surface occurrence
- Permanent vegetation
- Other surfaces



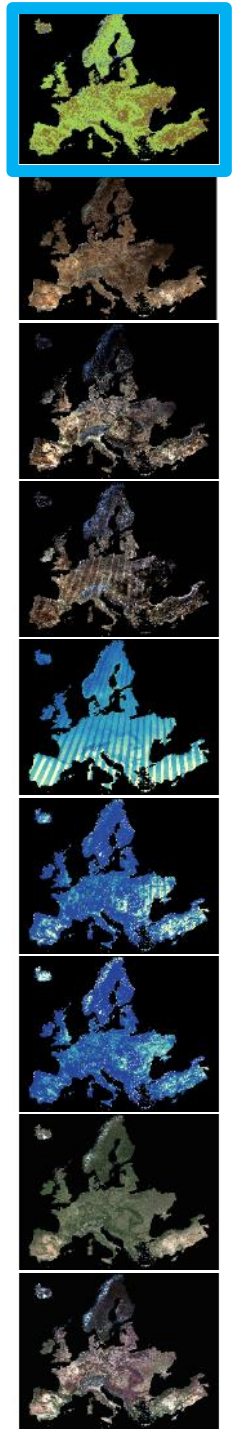
DLR

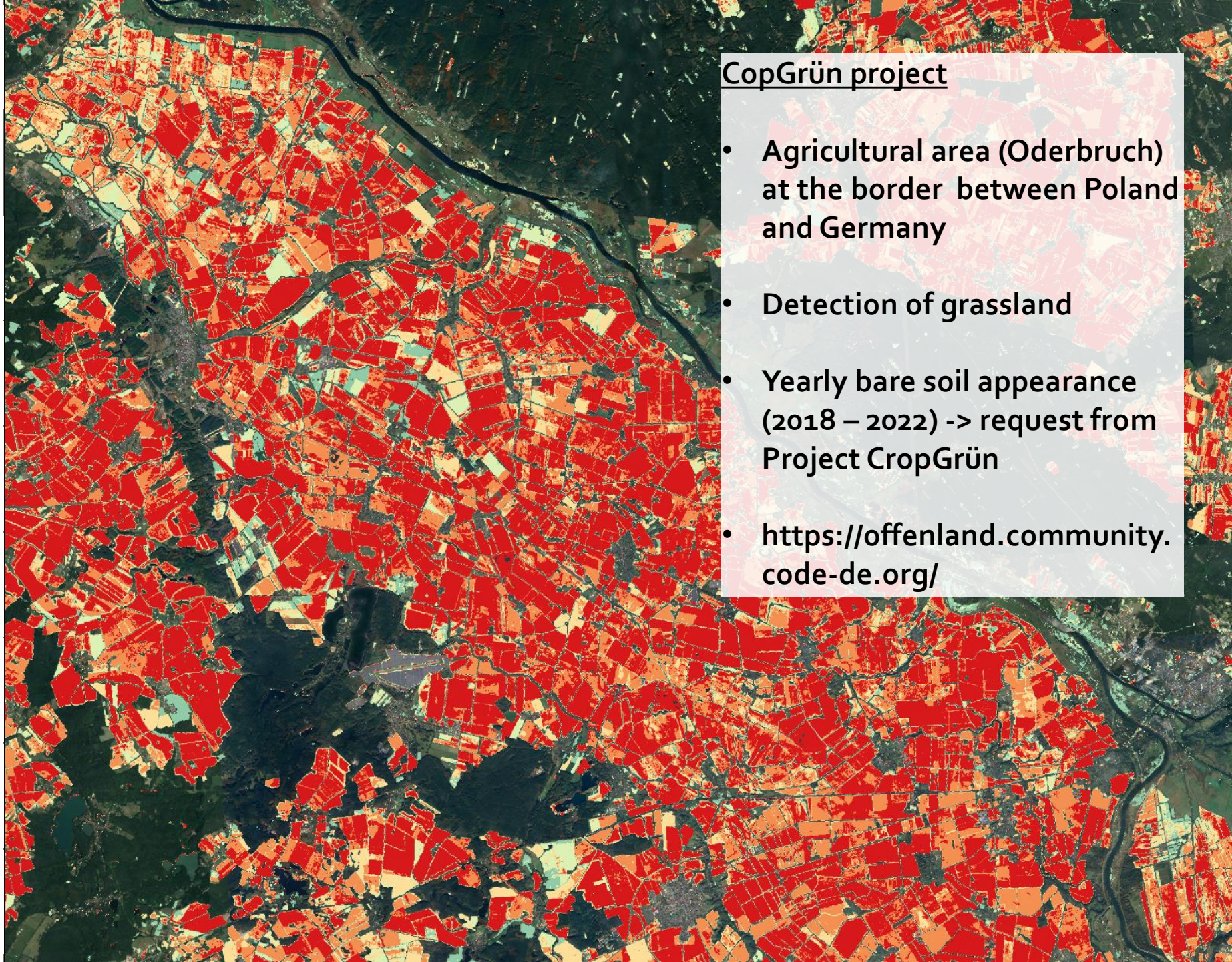
SoilSuite 2018 – 2022

- Sentinel-2
- 2018 – 2022
- < 80 % cloud cover
- > 20° sun elevation
- 20 m pixel size
- 3 bands

Bare Surface Mask used to detect grassland (0/5)

- 0/5
- 1/5
- 2/5
- 3/5
- 4/5
- 5/5





CopGrün project

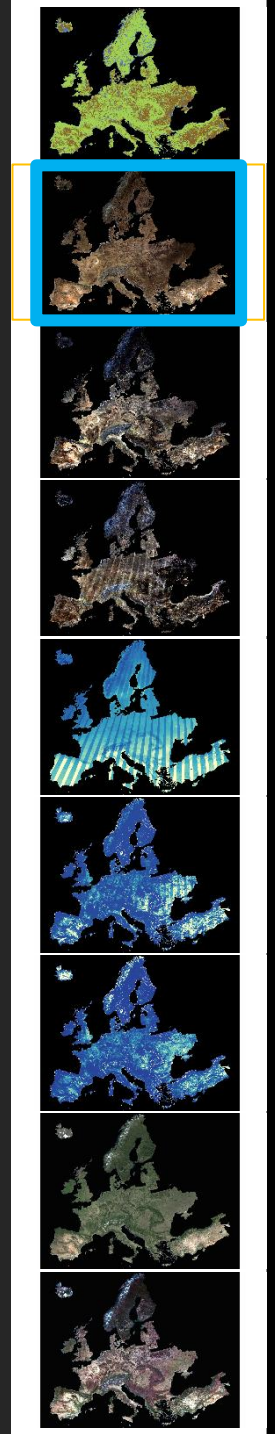
- Agricultural area (Oderbruch) at the border between Poland and Germany
- Detection of grassland
- Yearly bare soil appearance (2018 – 2022) -> request from Project CropGrün
- https://offenland.community.code-de.org/

SoilSuite 2018 – 2022

- Sentinel-2
- 2018 – 2022
- < 80 % cloud cover
- > 20° sun elevation
- 20 m pixel size
- 10 bands

Bare Surface Reflectance Composite

– Mean



Projects

- EU CUP4SOIL
- EU MRV4SOC
- ESA WorldSoils – SOC

Publications

- doi: 10.1016/j.geoderma.2025.117340
- doi: 10.1016/j.jag.2025.104504
- doi: 10.1111/ejss.70071
- doi: 10.1016/j.geoderma.2024.117113
- doi: 10.3390/rs17010089
- doi: 10.1016/j.geoderma.2024.116867
- doi: 10.1109/IGARSS53475.2024.10642714
- doi: 10.1016/j.geoderma.2022.116128
- doi: 10.3390/rs13091791

DLR

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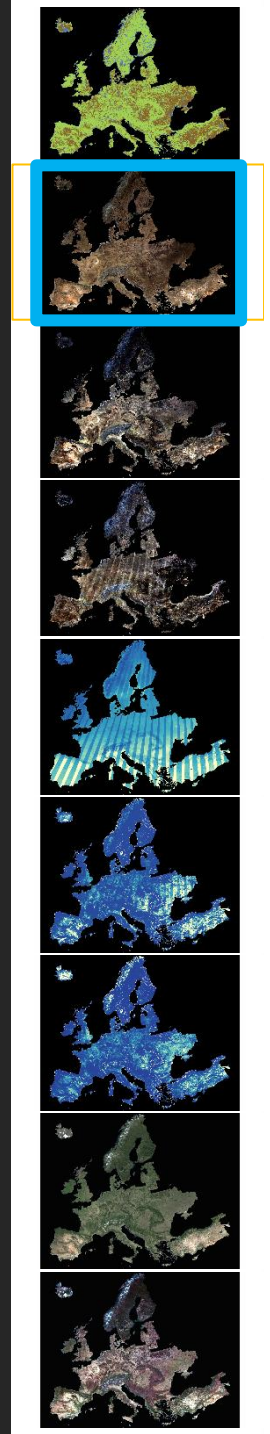
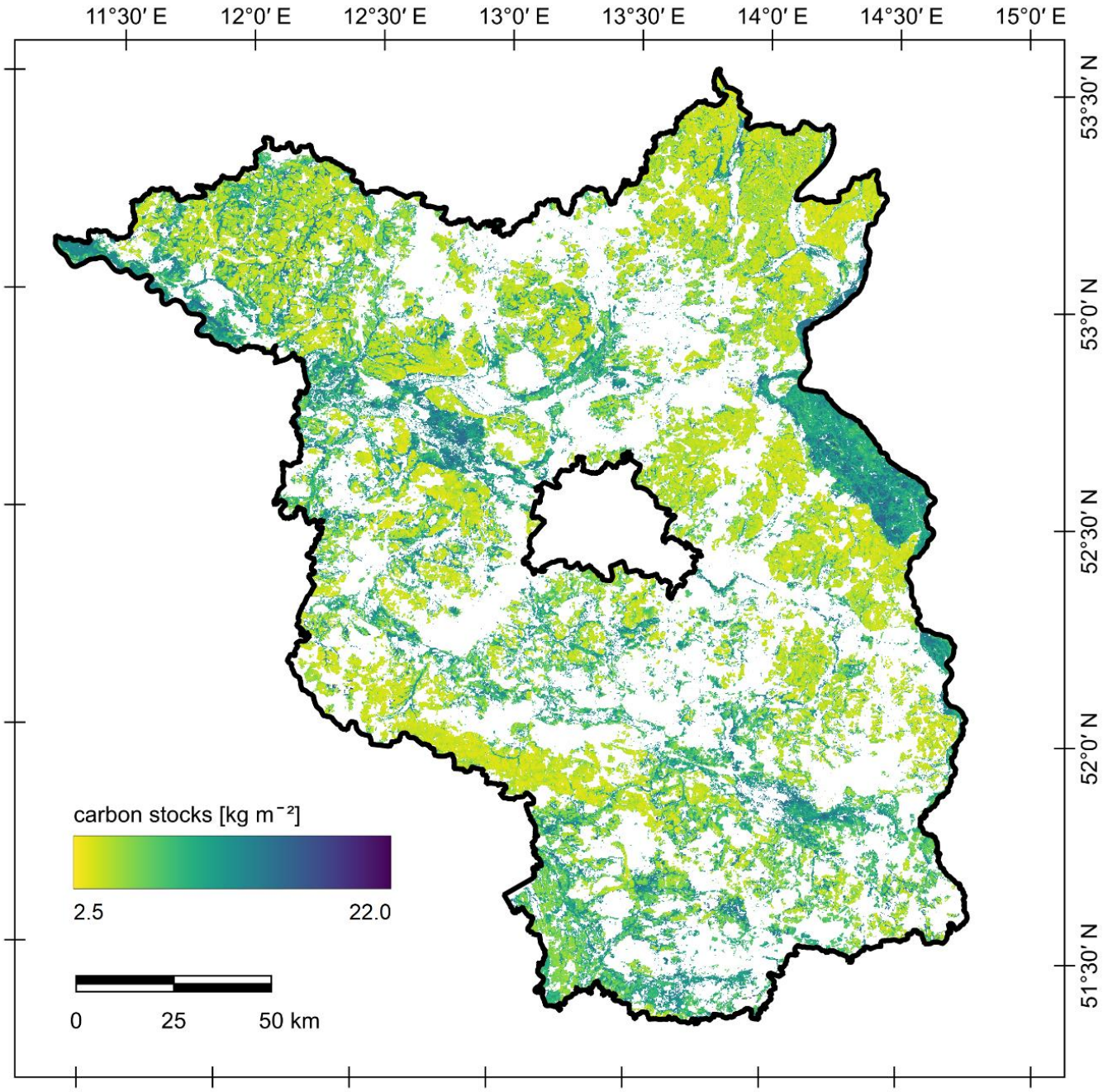




Showcase

Landesamt für Bergbau, Geologie und Rohstoffe Brandenburg

Federal ministry of mining, geology and raw materials Brandenburg (Germany)

First tests to derive Soil carbon stocks

Contact:
Robert Skoruppa,
Alfred Bauriegel

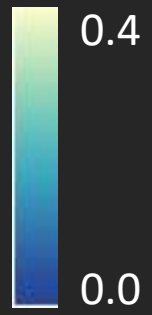
DLR

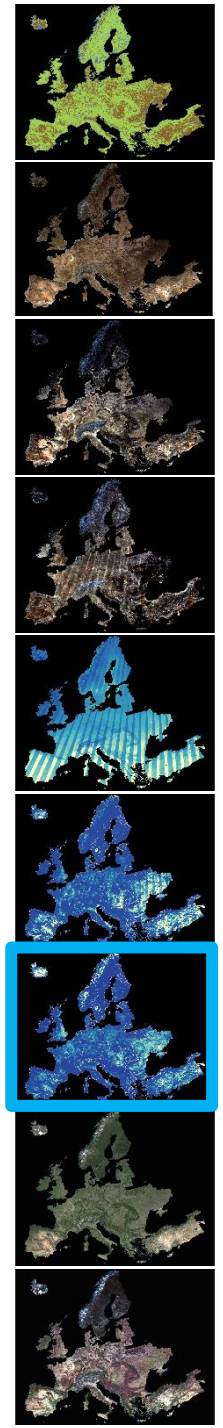
SoilSuite 2018 – 2022

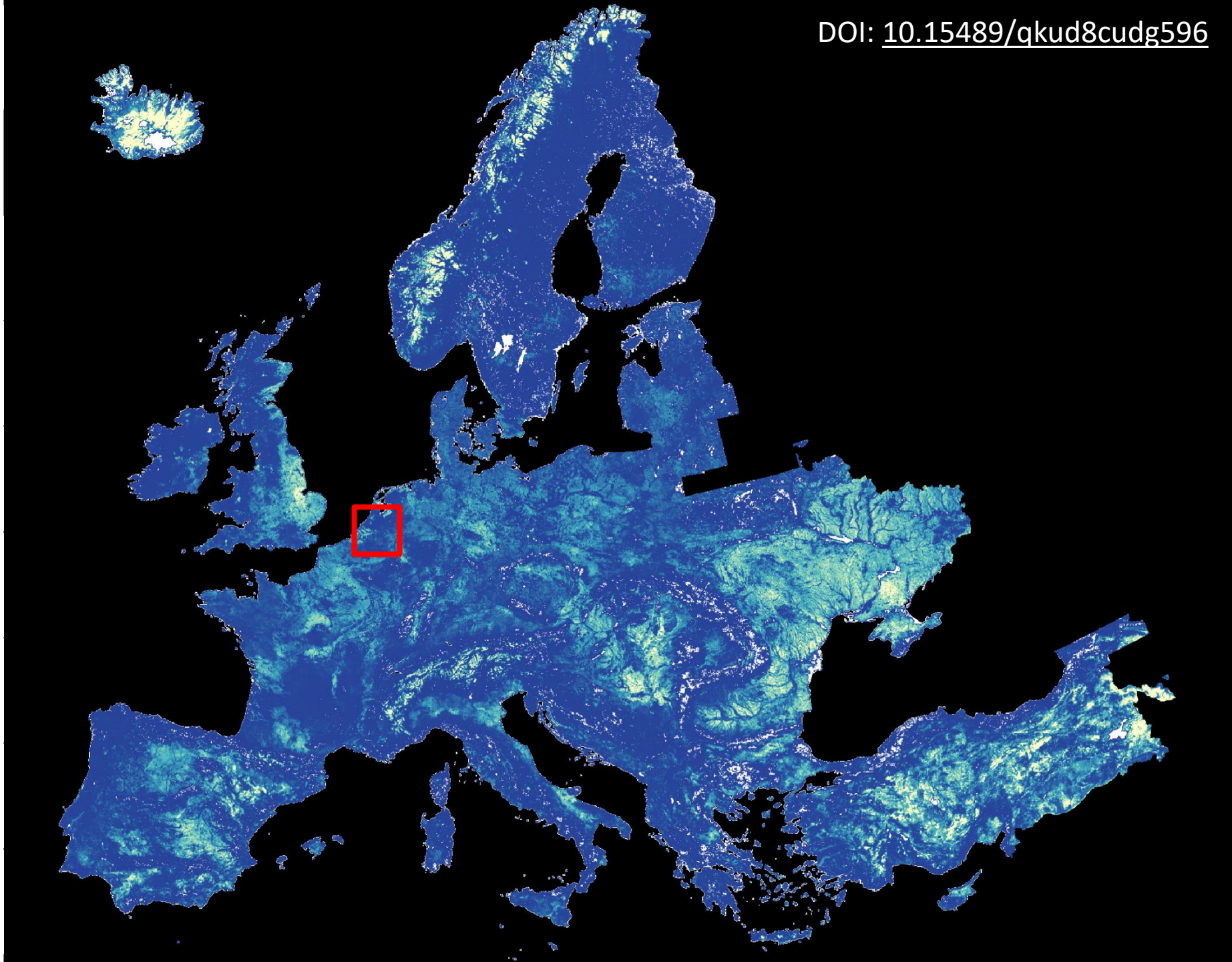
- Sentinel-2
- 2018 – 2022
- < 80 % cloud cover
- > 20° sun elevation
- 20 m pixel size
- 1 band

Bare Surface Statistics

- Bare Surface Frequency [%]







DOI: 10.15489/qkud8cudg596

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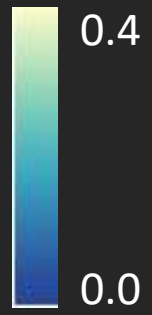
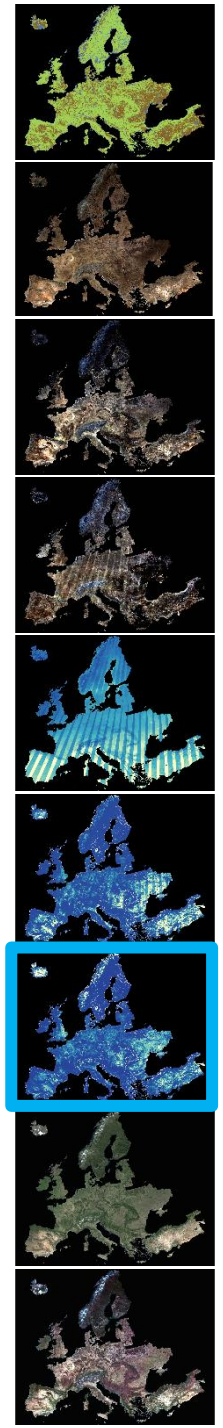




0 = no bare soil in 5 years
0.5 = 50% bare soils in 5 years

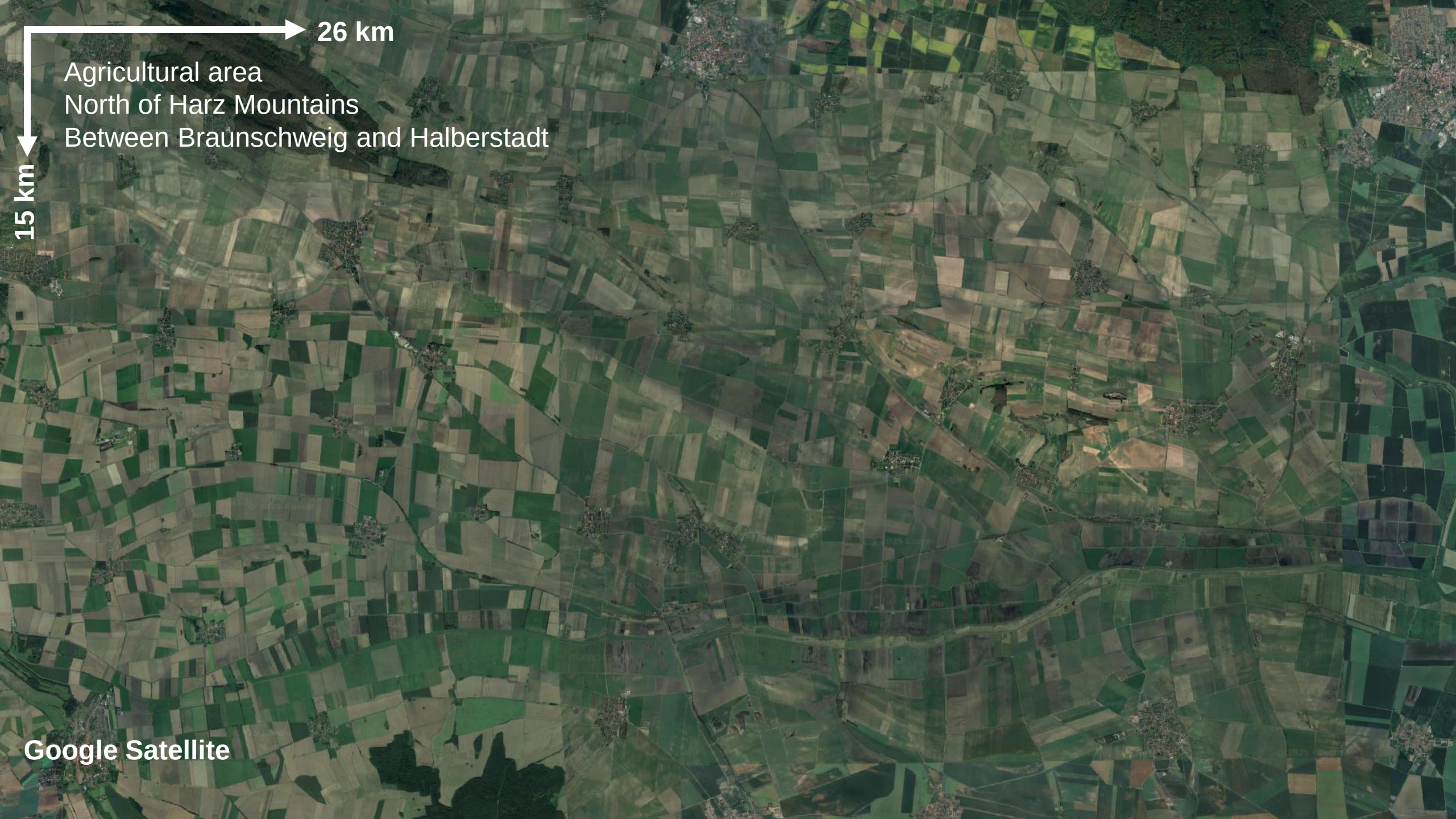
Showcase

SOILCAPITAL

First tests for supporting the monitoring of regenerative agriculture practice

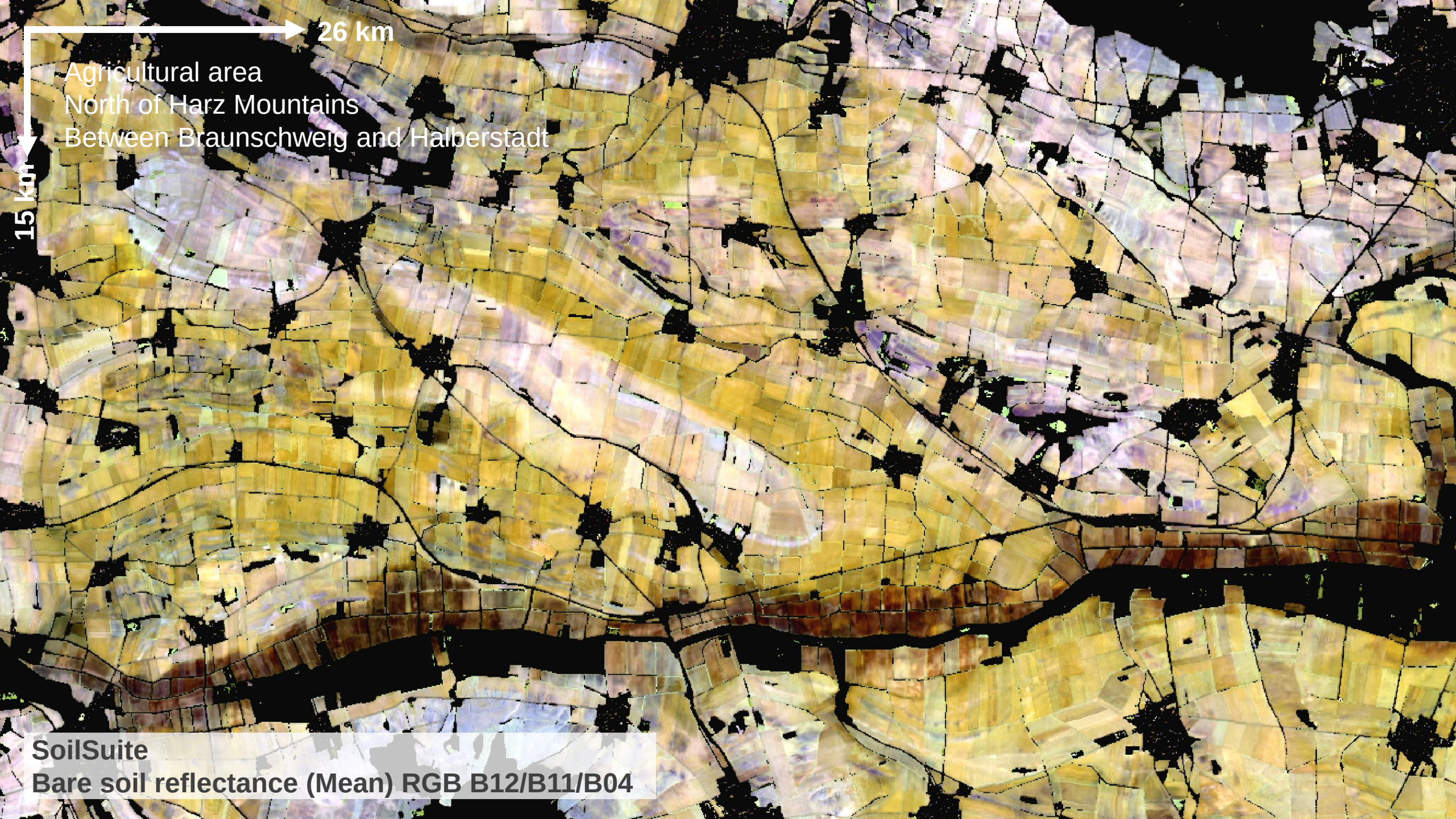
Contact:
Jelle van Wesemael

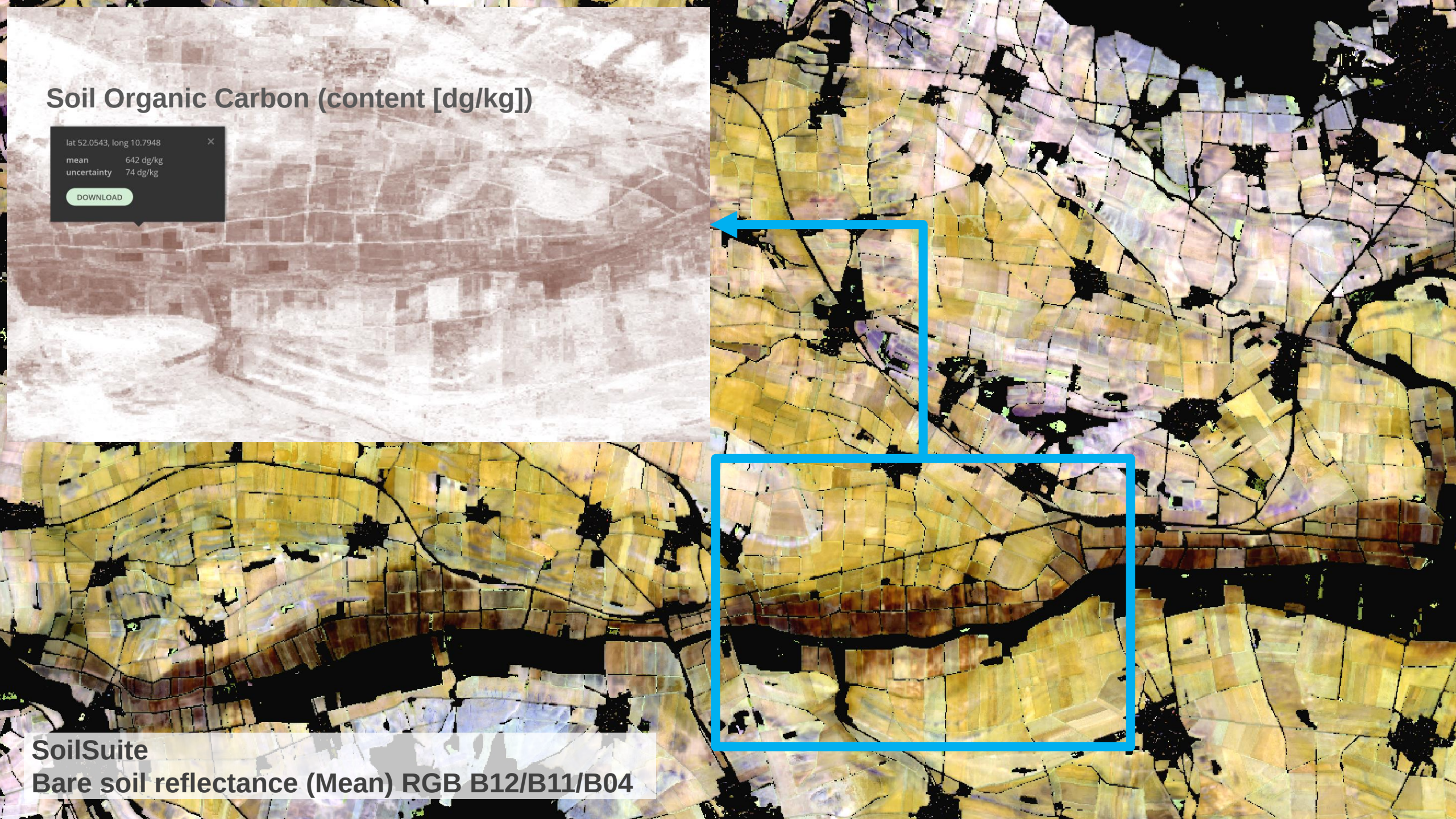
DLR


26 km
15 km
Agricultural area
North of Harz Mountains
Between Braunschweig and Halberstadt
Google Satellite

26 km
15 km
Agricultural area
North of Harz Mountains
Between Braunschweig and Halberstadt
SoilSuite
Reflectance (Mean) RGB B04/B03/B02

SoilSuite
Reflectance (Stdev) RGB B04/B03/B02


26 km
15 km
Agricultural area
North of Harz Mountains
Between Braunschweig and Halberstadt
SoilSuite
Bare soil reflectance (Mean) RGB B12/B11/B04


Soil Organic Carbon (content [dg/kg])
lat 52.0543, long 10.7948
mean 642 dg/kg
uncertainty 74 dg/kg
DOWNLOAD
SoilSuite
Bare soil reflectance (Mean) RGB B12/B11/B04

26 km
15 km
Agricultural area
North of Harz Mountains
Between Braunschweig and Halberstadt
40 %
0 %
SoilSuite
Bare soil frequency

26 km
15 km
Agricultural area
North of Harz Mountains
Between Braunschweig and Halberstadt
Bare surface occurrence
Permanent vegetation
Other surfaces
SoilSuite
Mask

SOIL SUITE DATA ACCESS

Data access

SoilSuite for Europe

SoilSuite – Sentinel-2 – Europe, 5 year composite (2018-2022)

Map | Download | STAC Collection | CSW Record

All Themes | Pedosphere

DOI: 10.15489/qkud8cudg596

DLR | EOC | Land | SCMaP | Soil | Sentinel-2 | Temporal Composites | Soil Coverage | Soil Composite Mapping Processor | Reflectance Composite | Surface Reflectance Composite | Bare Soil Coverage | Bare Soil Frequency

The SoilSuite contains a collection of different image data products that provide information about the spectral and statistical properties of European soils and other bare surfaces such as rocks. It is created using DLR's Soil Composite Mapping Processor (ScMAP), which utilises the Sentinel-2 data archive.

SCMaP is a specialised processing chain for detecting and analysing bare soils/surfaces on a large (continental) scale. Bare surface and soil pixels are selected using a combined NDVI and NBR index (PVIR2) that optimises the exclusion of photosynthetically active and non-active vegetation. The index is calculated and applied for each individual pixel. All SoilSuite products are calculated based on the available Sentinel-2 scenes recorded between January 2018 and December 2022 in Europe. The data package excludes all scenes with a cloud cover of > 80 % and a sun elevation of < 20 degrees. The spectral composite products are calculated from the mean value after extensive removal of clouds, haze and snow effects at both scene and pixel level. The spectral data products are available at a pixel size of 20 m and contain 10 Sentinel-2 bands (B02, B03, B04, B05, B06, B07, B08, B08a, B11, B12).

Contacts:

- Uta Heiden (Producer, Processor) DLR/EOC Imaging Spectroscopy
- Pablo d'Angelo (Producer, Processor) DLR/EOC Photogrammetry and Image Analysis
- Paul Karlshöfer (Producer, Processor) DLR/EOC Imaging Spectroscopy
- EOC Geoservice (Host) DLR/EOC

Data access

SoilSuite for Europe

SoilSuite – Sentinel-2 – Europe, 5 year composite (2018-2022)

Map | Download | STAC Collection | CSW Record

All Themes | Pedosphere

DOI: 10.15489/qkud8cudg596

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ISRIC
World Soil Information

Webplatform for Derived soil properties:
https://cup4soil.isric.org/

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- EOC Geoservice (Host) DLR/EOC

SOIL

SOIL PROPERTIES

SOIL REMOTE SENSING

SOIL PROPERTIES

Soil property maps at continental level for Europe

- Bulk density in cg/cm³
- Coarse fragments in cm³/dm³
- Clay in g/kg
- Nitrogen in cg/kg
- pH in pH*10
- Sand in g/kg
- Silt in g/kg
- Soil inorganic carbon in dg/kg
- Soil organic carbon in dg/kg

https://cup4soil.isric.org/

Data available:
Free and open
WMS, WCS, Download

ISRIC
World Soil Information

DOWNLOAD

INFO

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SOIL

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