A COMPARISON OF FRACTIONAL VEGETATION COVER IN CAMARENA, SPAIN FROM DESIS AND ENMAP OBSERVATIONS.

WHISPERS Athens, Greece 02. Nov 2023

2nd DESIS User Workshop

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DLR

Why is Fractional Vegetation Cover important ?

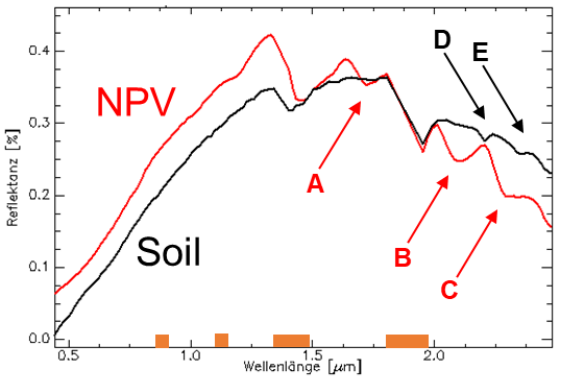
- Reliable identification of open/bare soil
- Soil carbon – largest carbon pool of the terrestrial Earth
- EO suitable for soil organic carbon content estimation

- Allows conclusions on:
  - Areas vulnerable to erosion
  - Soil specific parameters (SOC)
  - Input for modelling

- Fractions of subpixel abundance for
  - Photosynthetically active Vegetation (PV)
  - Non-Photosynthetically active Vegetation (NPV)
  - and Bare Soil (BS)

- Hyperspectral sensors taking advantages of spectral features (SWIR)

Spectral similarities between BS & NPV



: atm. water absorptions

Absorption features of
A: Xylan & Cellulose
B: Lignin & Cellulose
C: Cellulose

D: Clay
E: Carbonates

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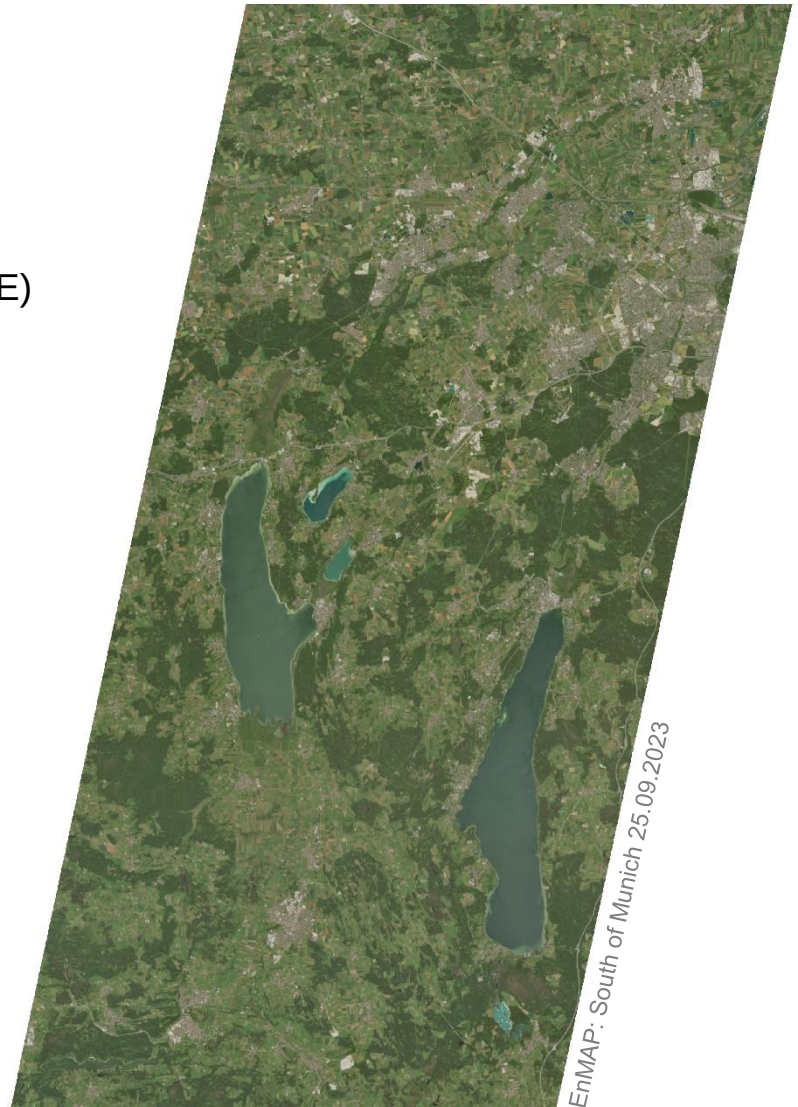
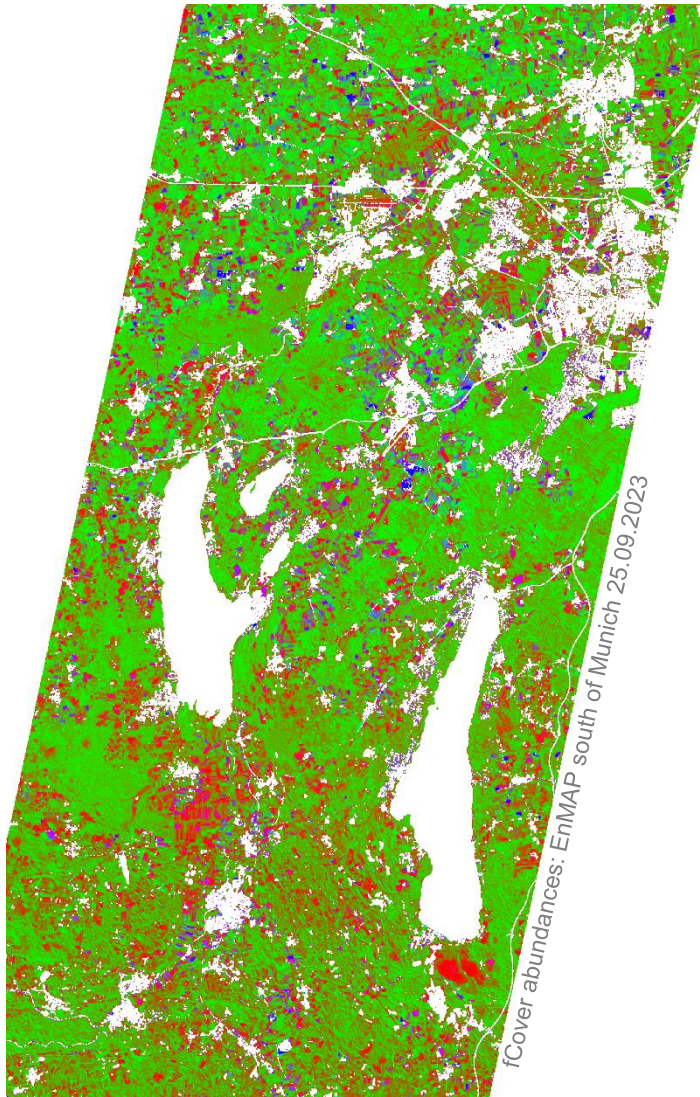
Overview

- fCover Processor:
  - M.Bachmann, D.Marshall
- Based on:
  - Spatial Spectral Endmember Extraction (SSEE)
  - Linear spectral unmixing (µMESMA)
- Content:
  - Small adjustment of existing fCover methodology
  - Example for DESIS & EnMAP - Camarena
  - fCover Validation - Munich





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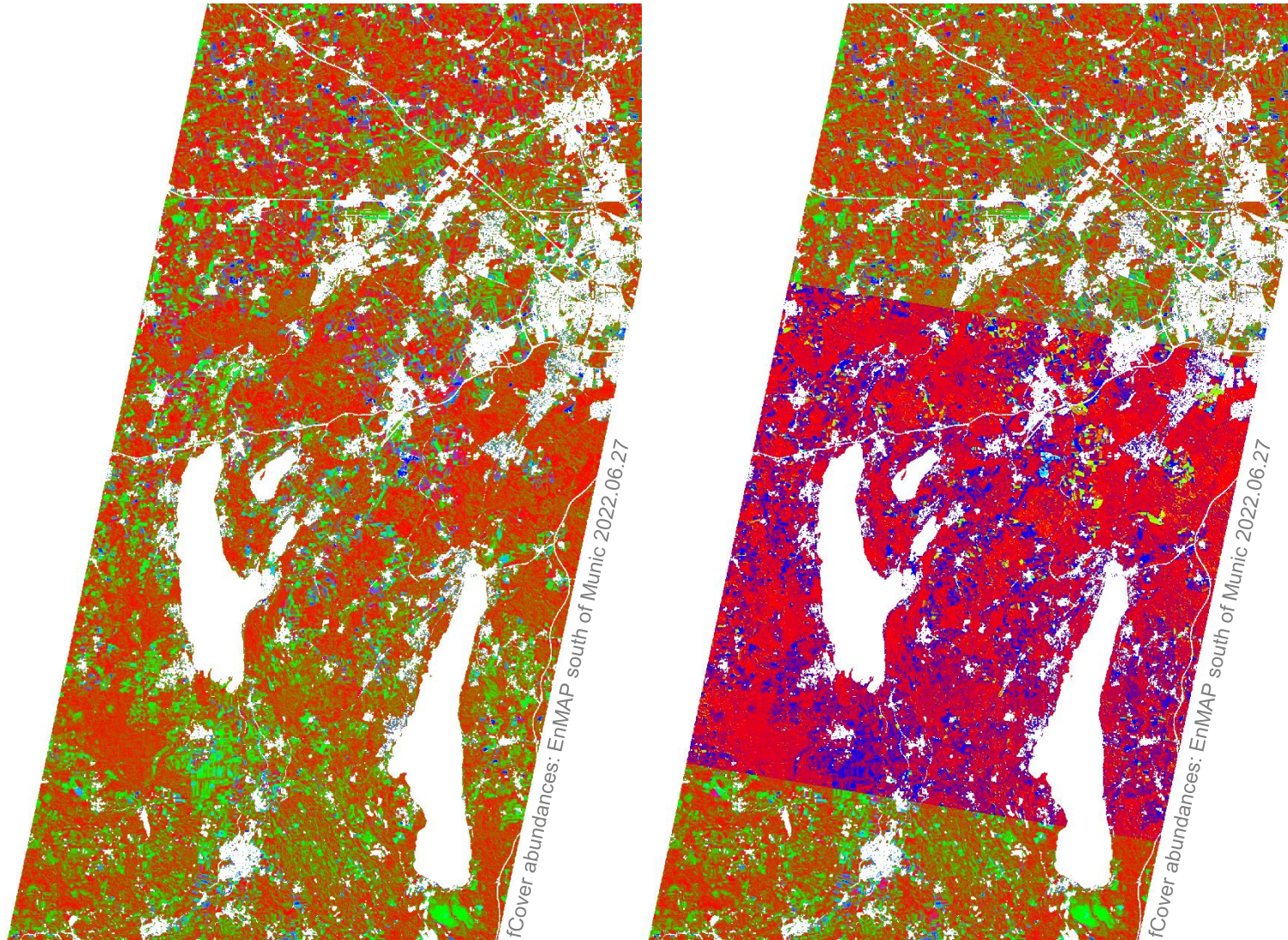
Calculating fCover from Single Scene

- First large-scale processing of single scenes reveals:
  - High spectral similarity, leads to difficulties in EM extraction.
  - Unexpected use of wrong class EM.
  - Unidentified and unmasked clouds/haze have a major impact on the unmixing process.
  - As a result sometimes, inconsistent unmixing over multiple images within one strip



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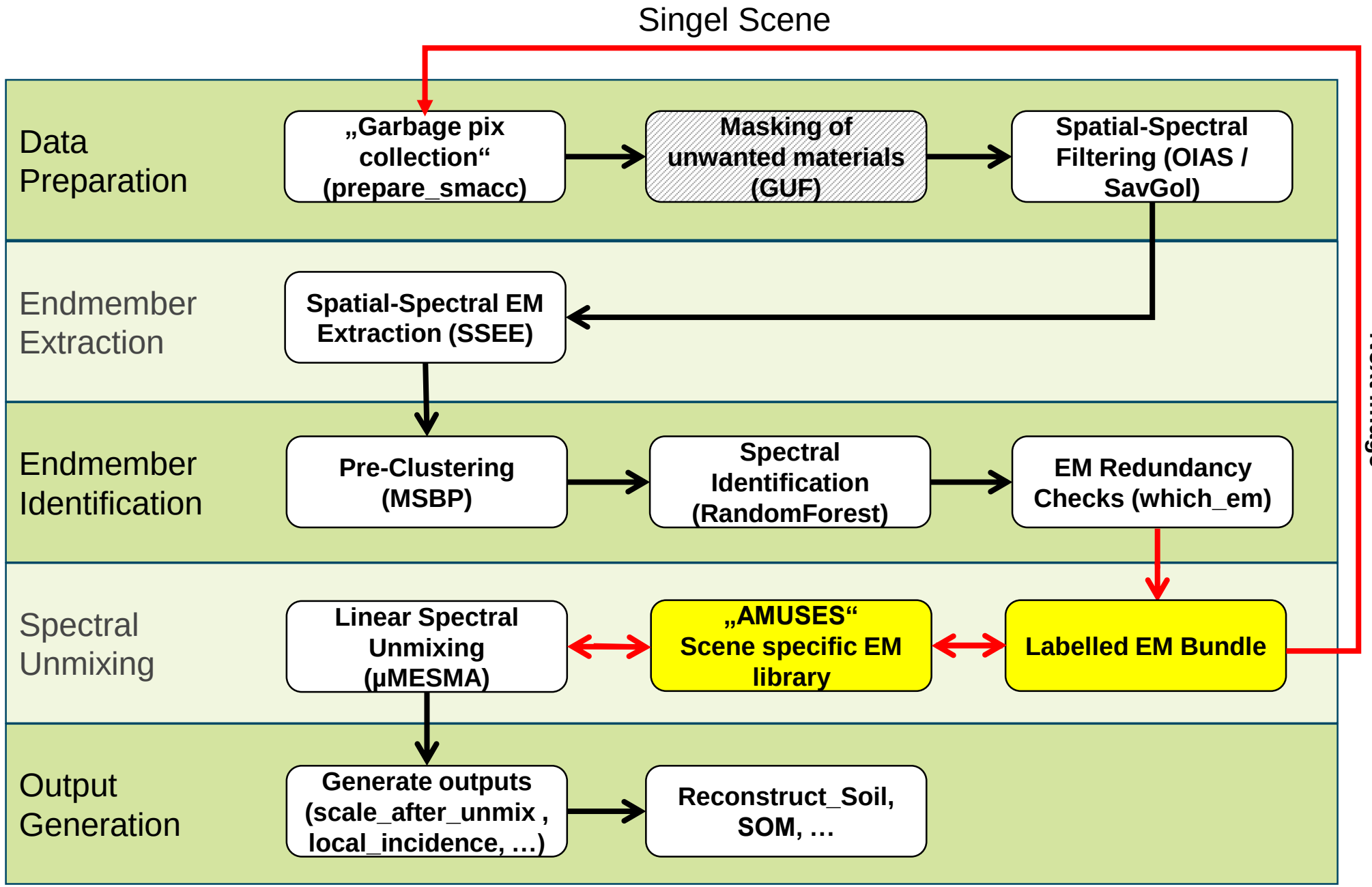
Adjustment of existing fCover methodology



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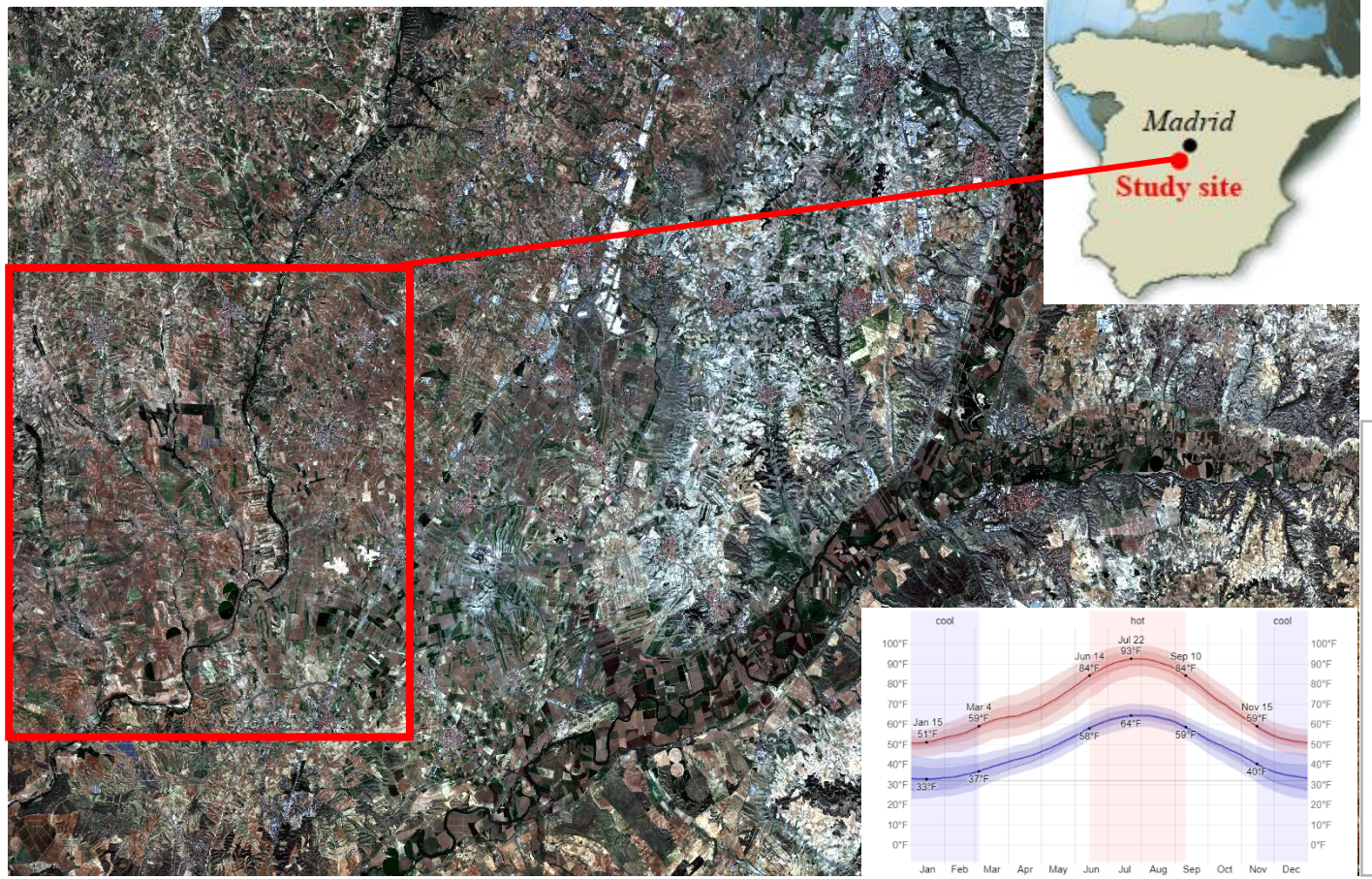
Study Site Camarena

- Land is mainly used for rainfed agriculture
- Semi-arid region
- High risk for soil erosion
- Low soil organic carbon content



Sentinel 2 Stack 05.10.2023, RGB:4,3,2; 10m

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Comparison

	DESIS	EnMAP
Spectral range	400nm -1000nm VNIR	420nm - 1000nm VNIR 900nm - 2450nm SWIR
Spectral resolution:	2.55nm	6-10nm
Spectral channels:	235VNIR	95VNIR 135 SWIR
Ground resolution	30m x 30m	30m x 30m
Orbit:	Non-sun-synchronous	Sun-Synchronous / 97.96°
Launch Date:	29.06.2018	01.04.2022

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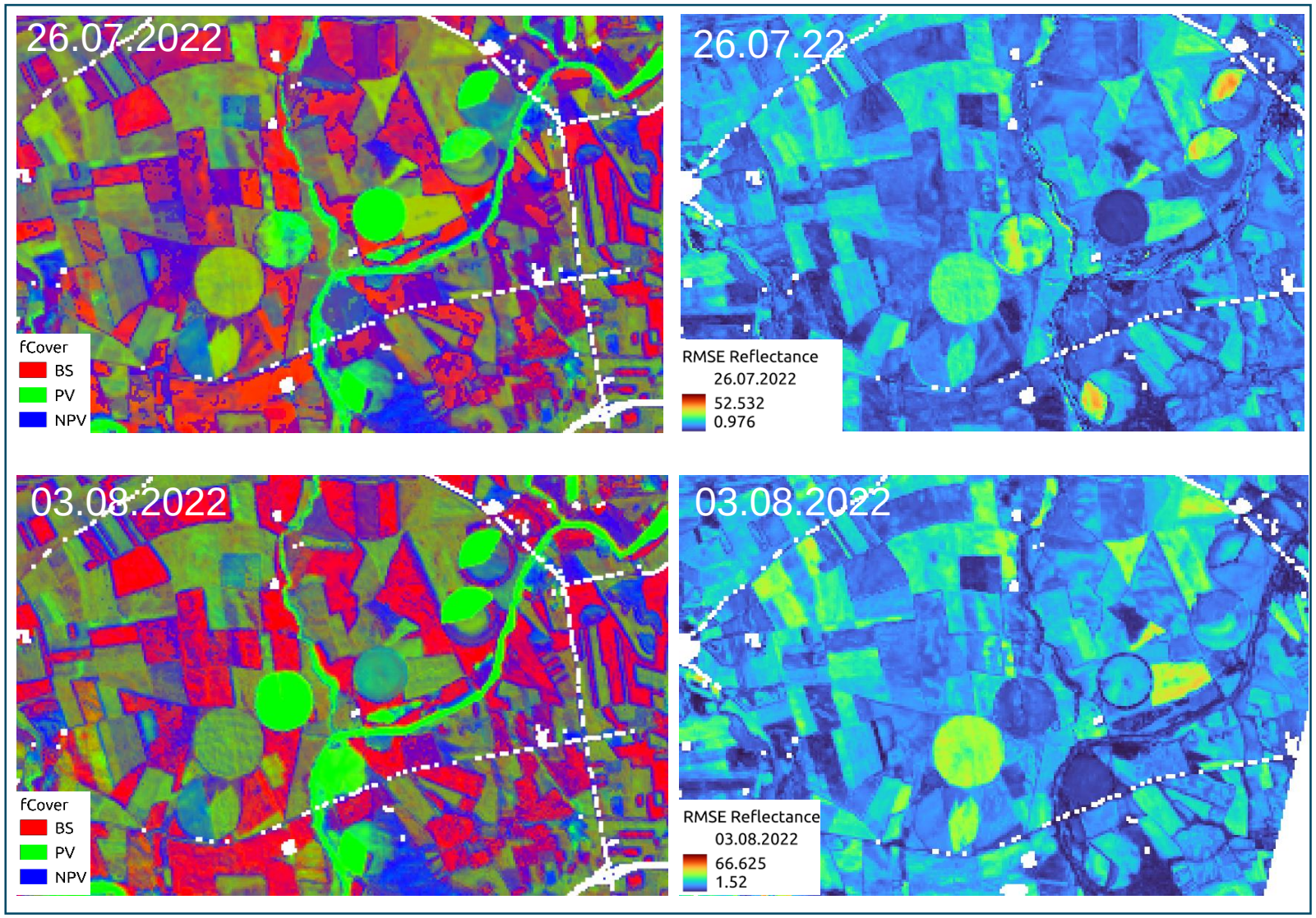
EnMAP - Camarena
fCover Abundances(EM Bundle)



- Green **PV** - Red **BS** - Blue **NPV**
- Sub-pixel information about the abundances of PV,NPV and BS
- Color gradients consist of more than one class
- Area-wide consistent unmixing over all classes
- Excellent identification/separation of individual cultivation areas
- Good representation of NPV at field edges and dry patches
- Overall low RMSE
- Lower RMSE for Soil & pure PV

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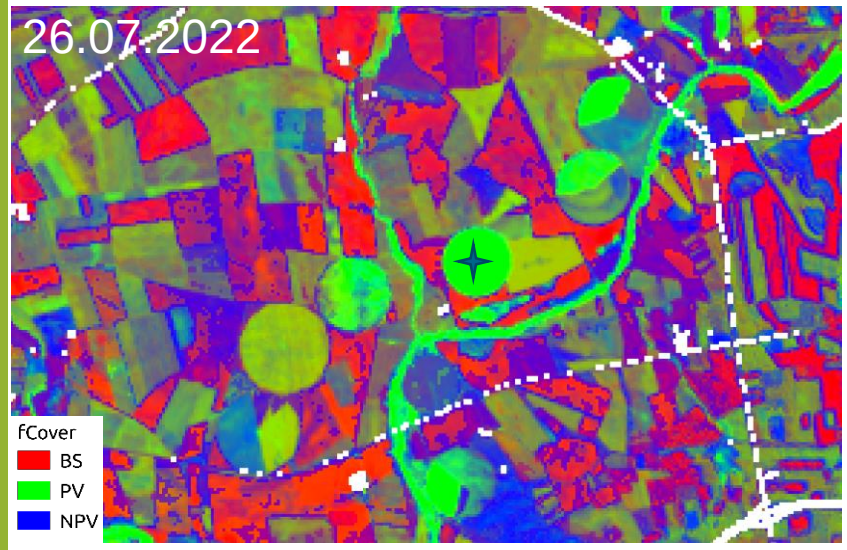
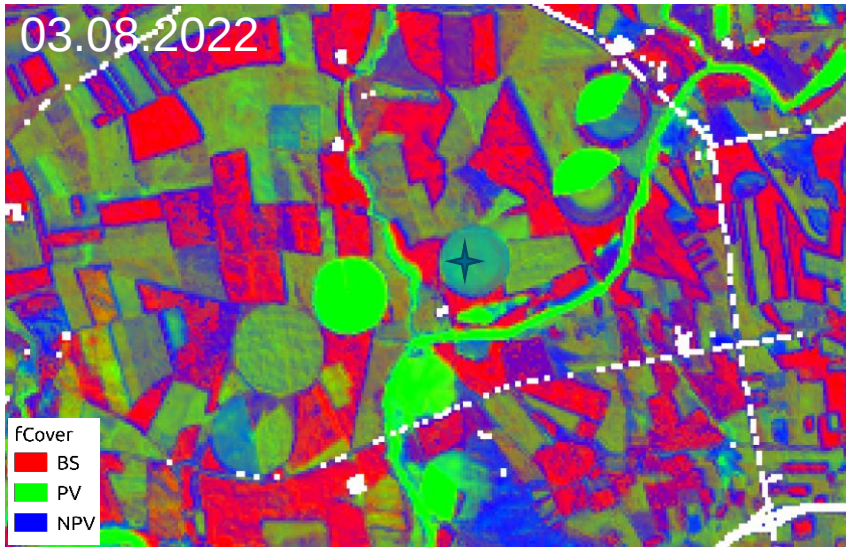
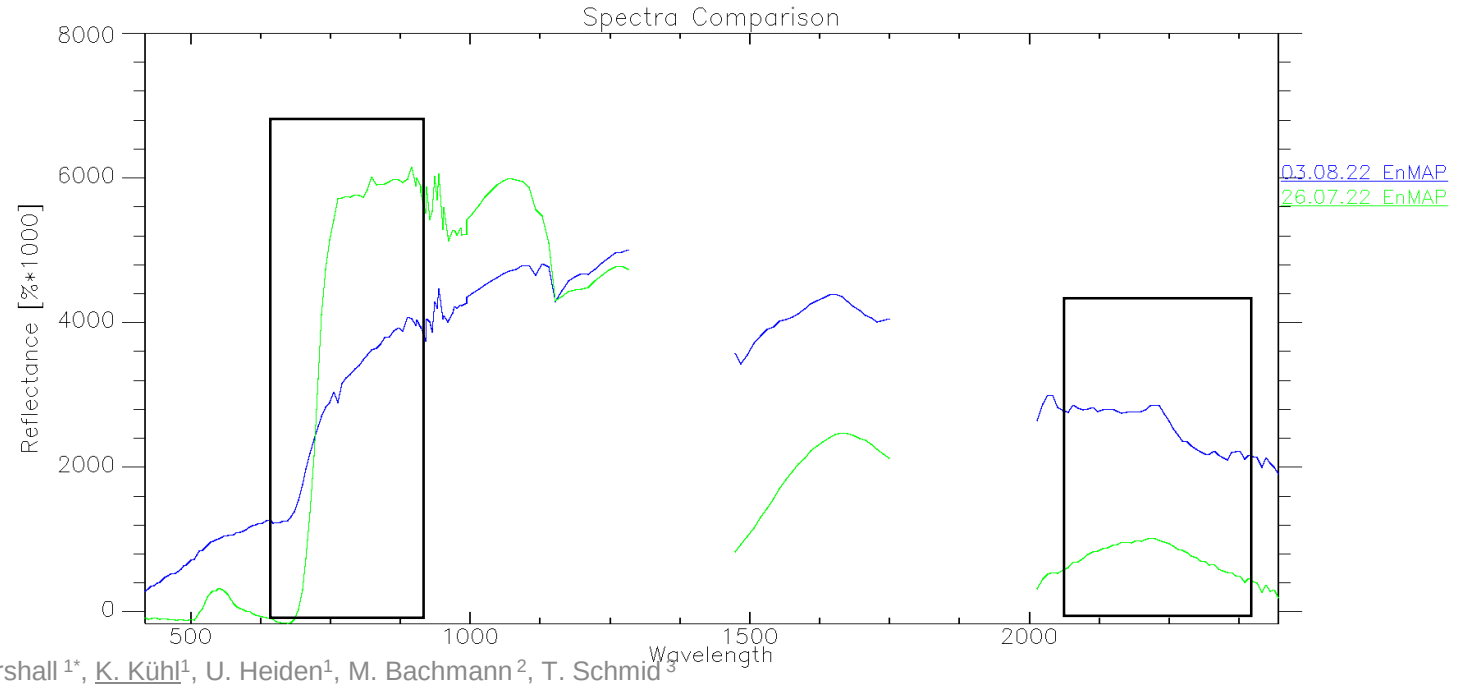
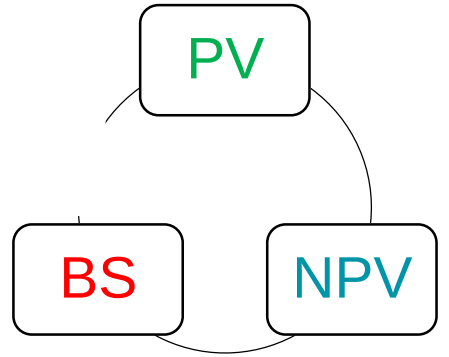
EnMAP - Camarena

fCover Abundances(EM Bundle)









- Measurable transition from PV to NPV
- Clear NPV patches within fields
- Ability to detect & measure rapid changes in vegetation
- Possibly conclusions about plant health conditions

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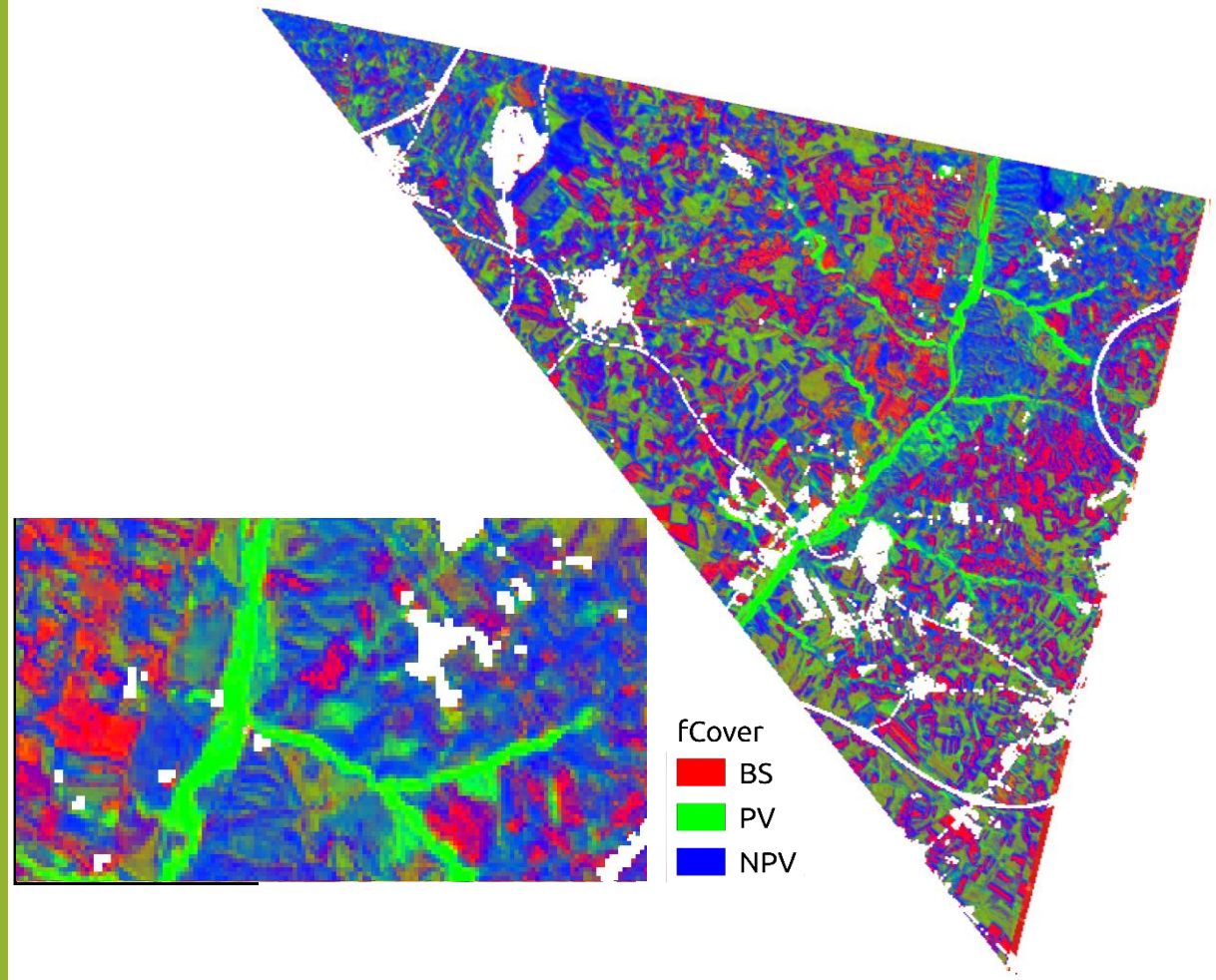
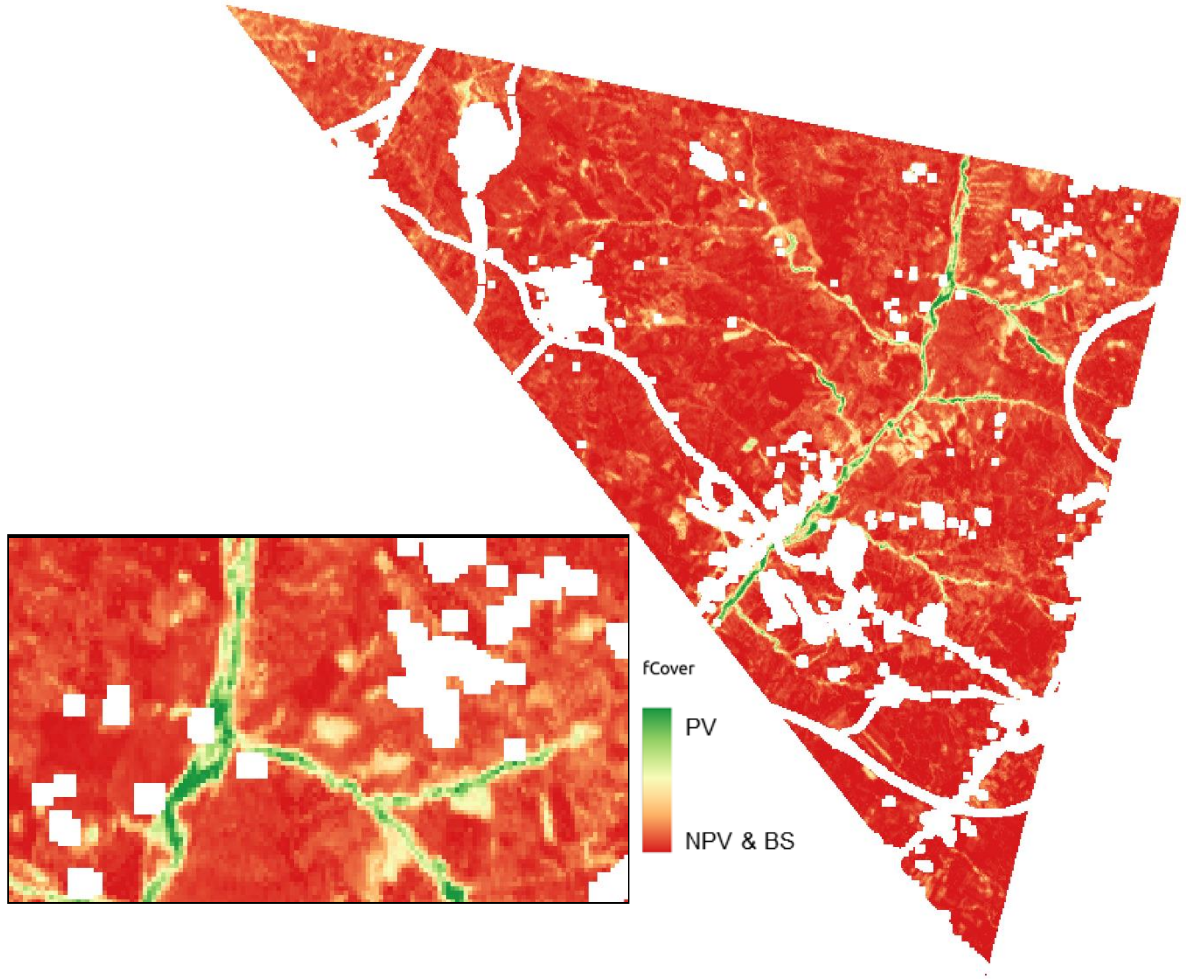
Comparison EnMAP - DESIS (EM-Bundle)

EnMAP
2022.08.03



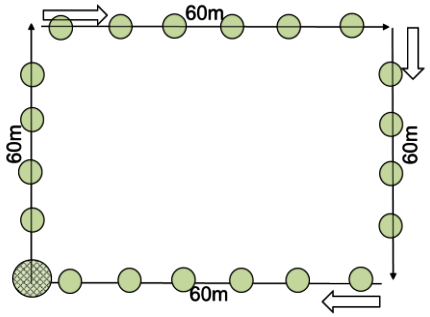
DESIS
2022.08.02

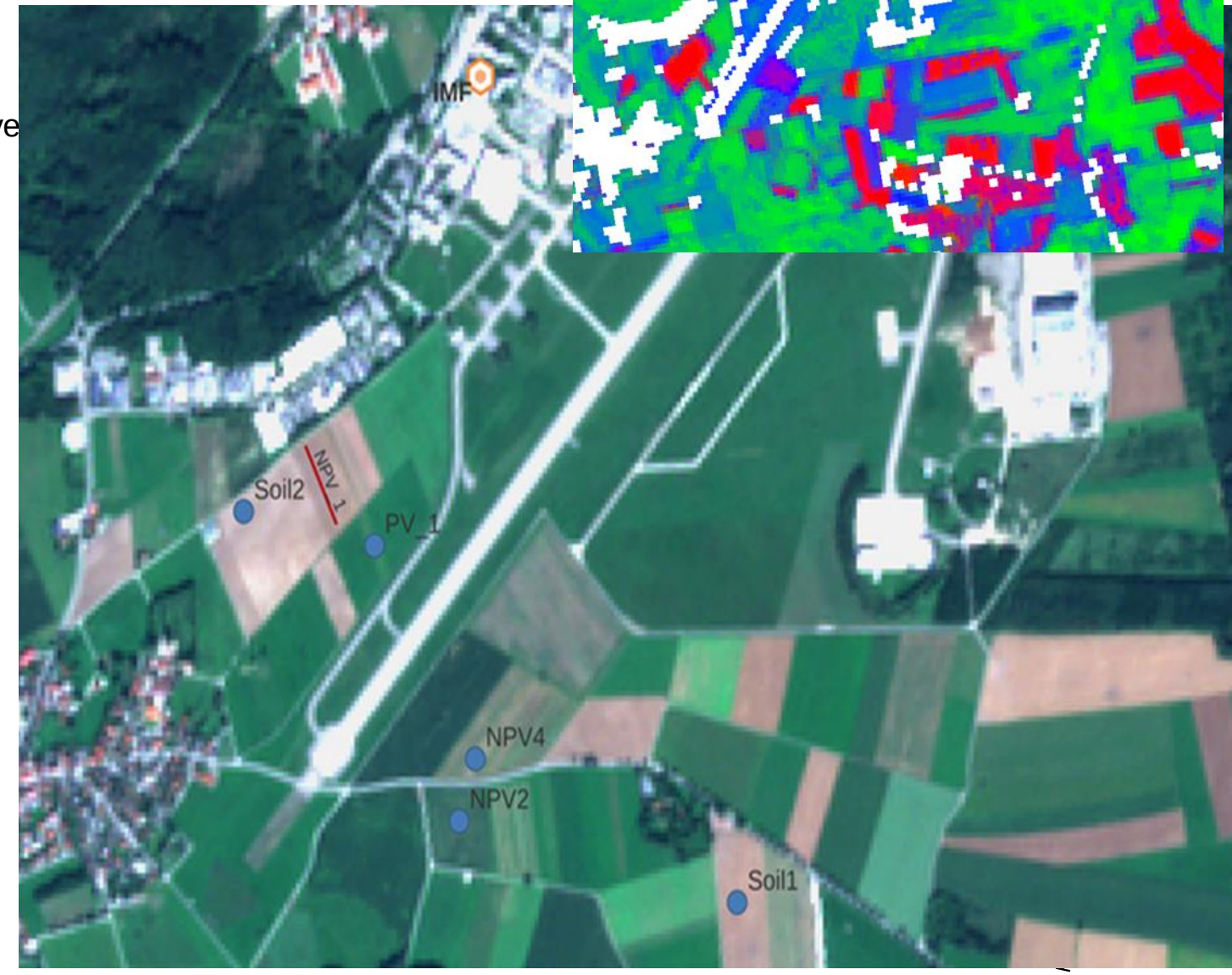


Validation Campaign EnMAP 25.09.23

- Overall 5 Campaigns since June 2023
  - Recorded spectra on over 20 sites
  - Different recording techniques tested and improve
- EnMAP overflight on 25.09.2023 / 11:55am
- Collected ASD spectra on 6 different fields
- Smartphone & UAV Data

- Settings:
  - No Fore Optik
  - **Continous measurements**
- Measurement sequenc:
  - OP→DC→R→P→T[55]→R-P
- Total ASD **T**arget **M**easurements: 55
  - File Name: Soil2.txt
- Total Qfield measurements: 2
  - File Name:
- Measurement line distance: 240m
- Average Sampling point distance: 4,36m
- Location Description
  - Cloud: **N**o **C**louds (NC)
  - Cloud Type: -
  - Sky: **L**ight **b**lue (LB)
  - Haze: **Cl**ear (CL)
  - Surface Cover: Soil 90%, Stones 5%, NPV 5%
- Surface description:
  - Vegetation:
  - Soil:
- Context of site within surrounds:
  - --





Sentinel 2: 29.09.2023 RGB

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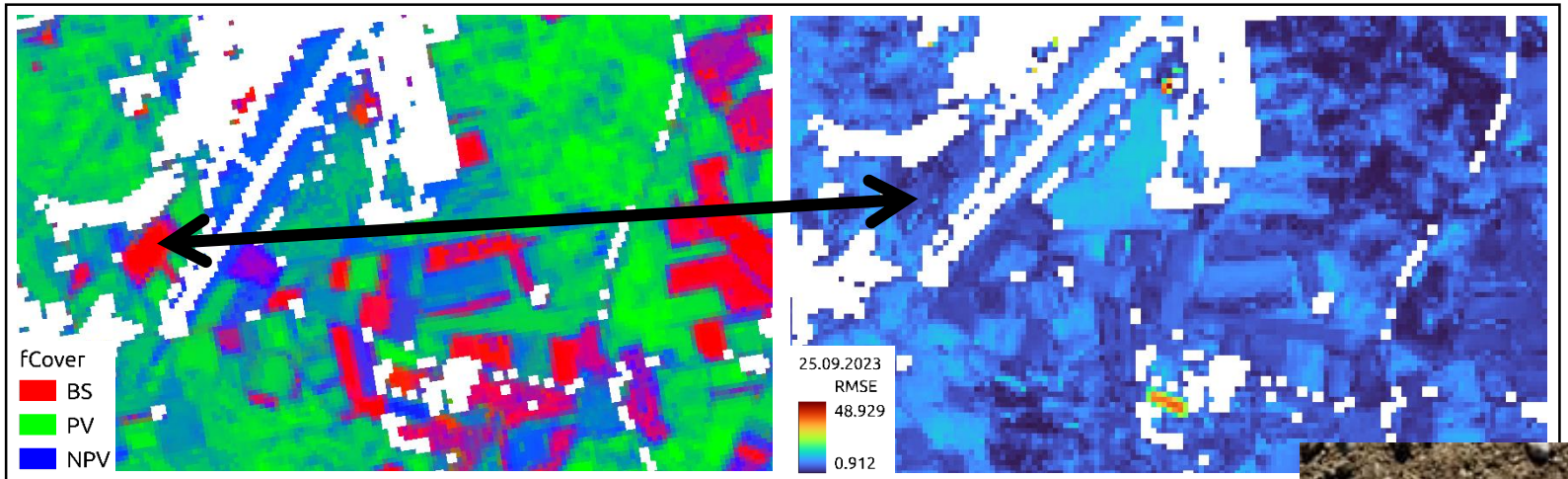
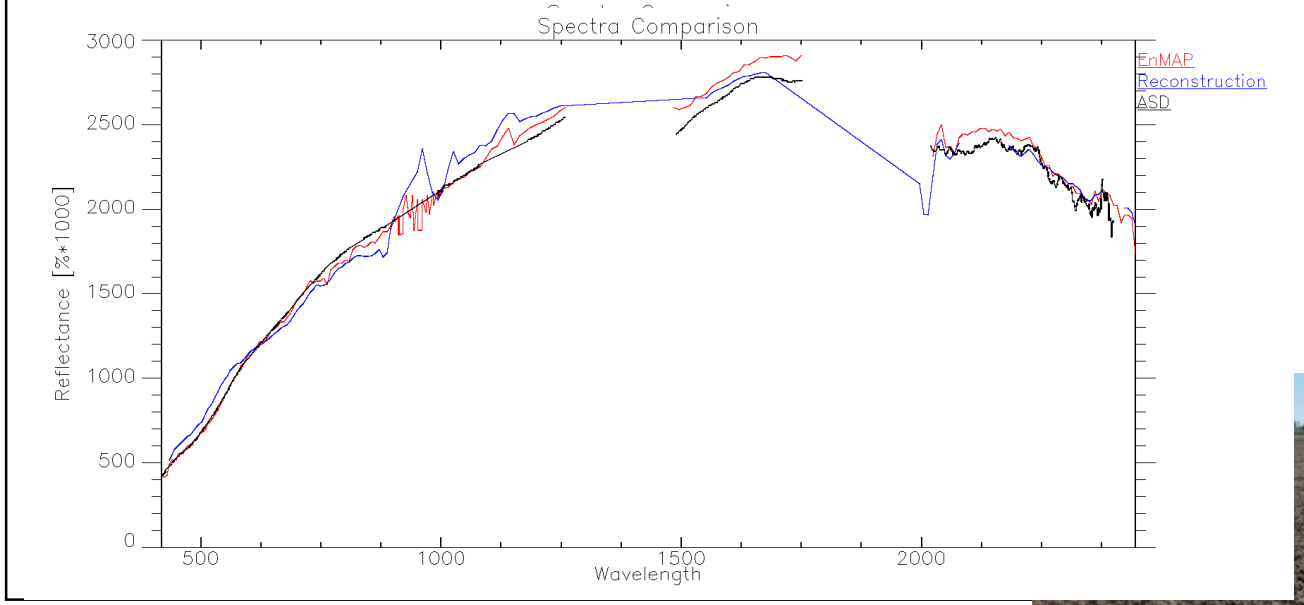
Validation Campaign EnMAP 25.09.23

25.09.2023





- One 30*30 EnMAP Pixel spectra
- Subpixel abundances:
  - 93 % Bare Soil
  - 7% NPV
  - 0% PV
  - 4.55 RMSE

- 55 ASD spectra
- ASD, EnMAP & reconstructed spectra are well in line
  - EM extraction & selection works pretty good (SSEE+AMUSES)
  - Overall low RMSE
- Cellphone & UAV data support the calculated abundances of the fCover-Processor

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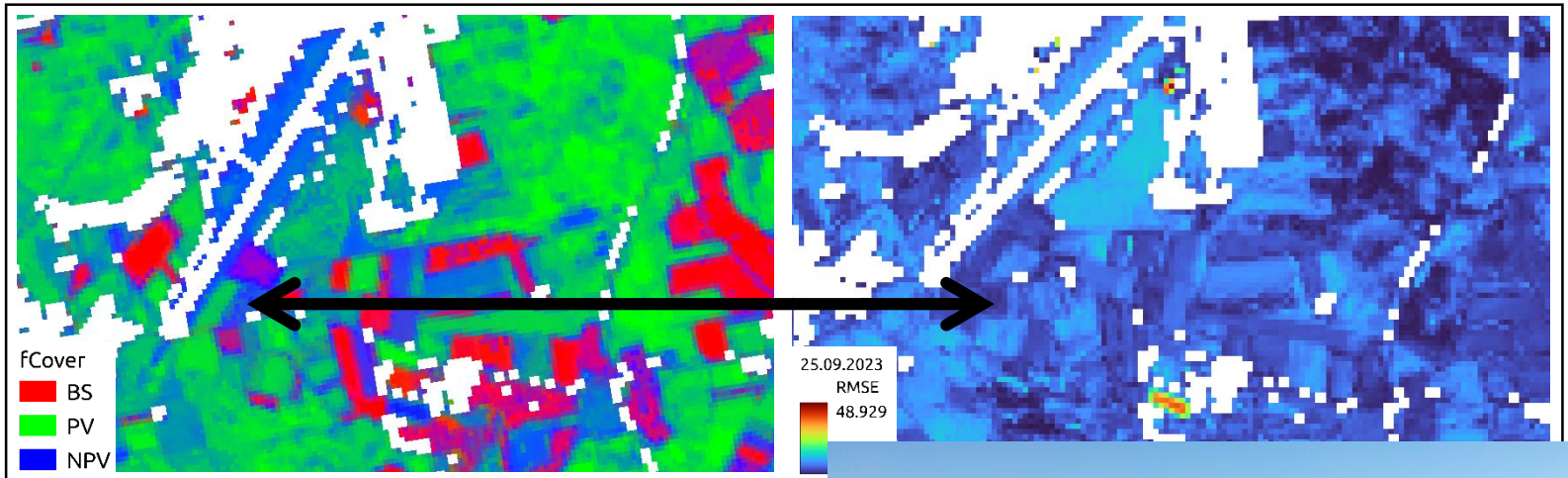
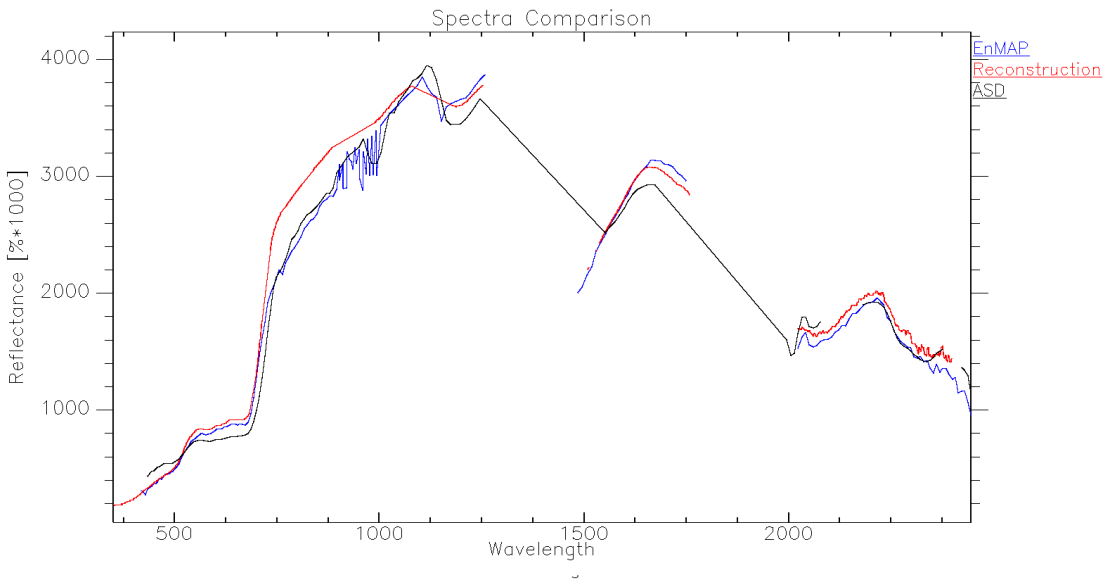
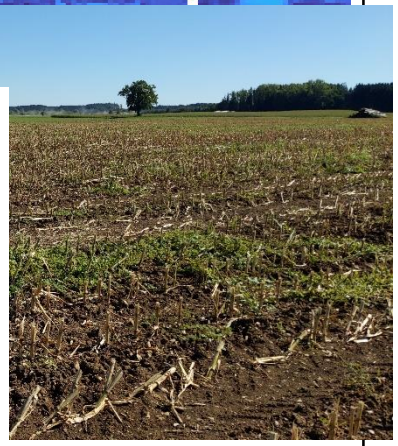
Validation Campaign EnMAP 25.09.23

25.09.2023







- One 30*30 EnMAP Pixel spectra
- Subpixel abundances:
  - 28 % Bare Soil
  - 56% NPV
  - 16% PV
  - 9.42 RMSE

- 41 ASD spectra
- ASD, EnMAP & reconstructed spectra are well in line
  - EM extraction & selection works pretty good (SSEE+AMUSES)
  - Overall low RMSE
- Cellphone & UAV data support the calculated abundances of the fCover-Processor

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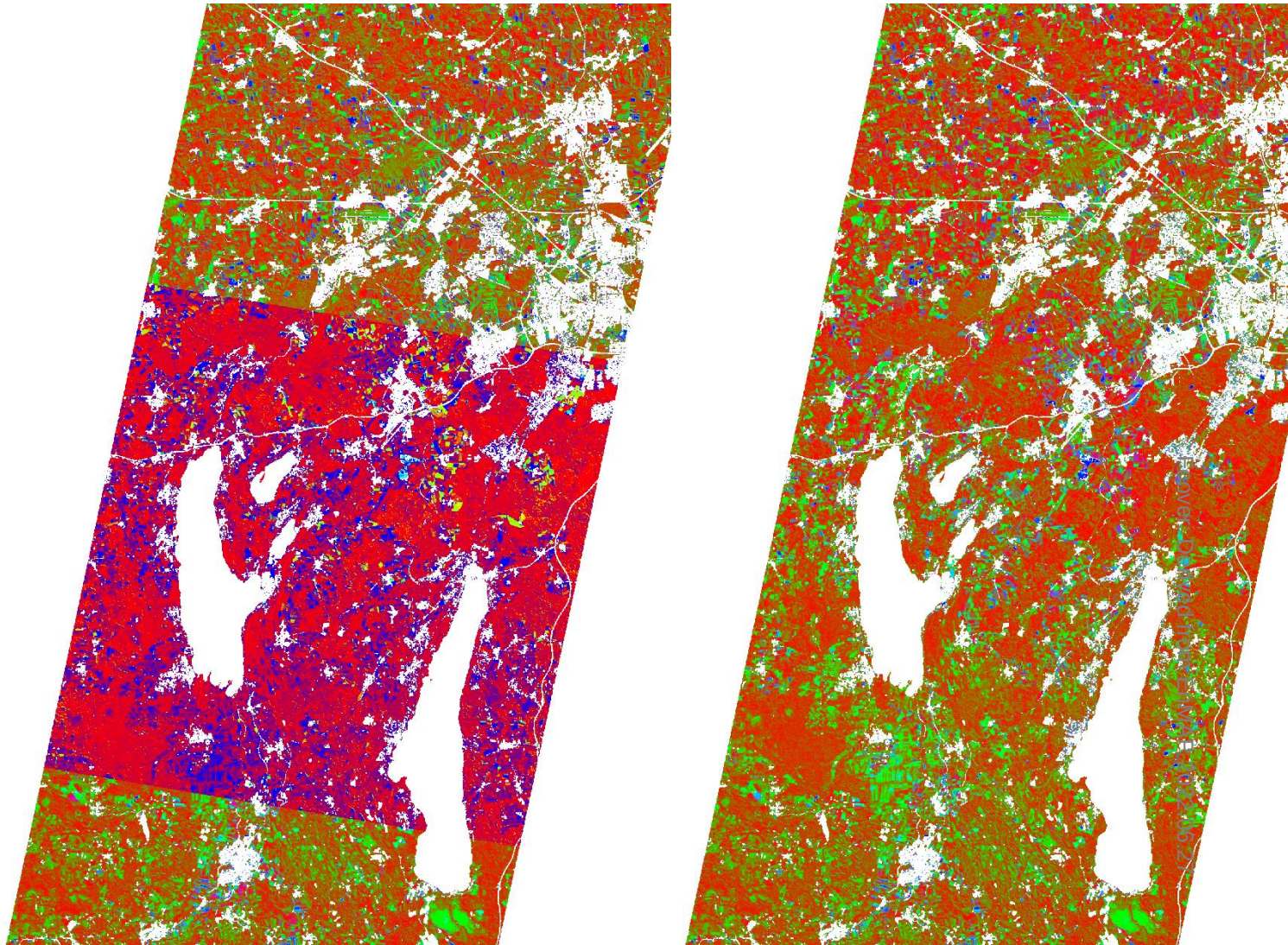
Conclusion

- Coherent unmixing of successive scenes
- Minimizes the use of "incorrect" Endmembers
- Higher unmixing accuracy + lower RMS values
- Preserves the greatest possible spectral variability within and between classes
- Creation of region-specific Endmember libraries



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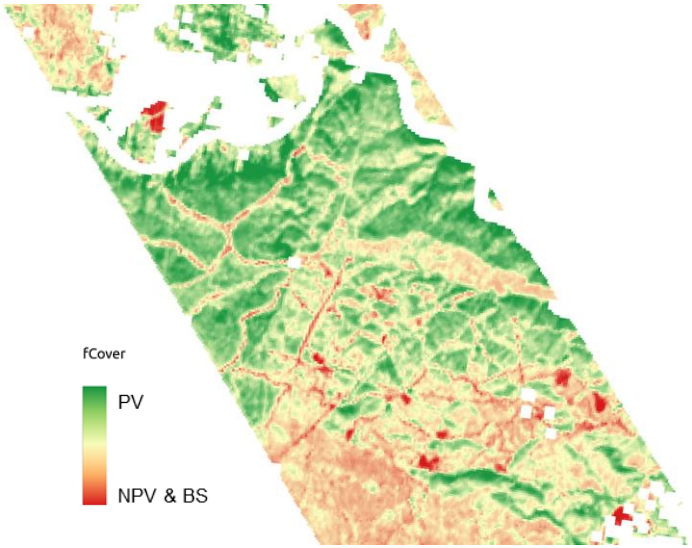
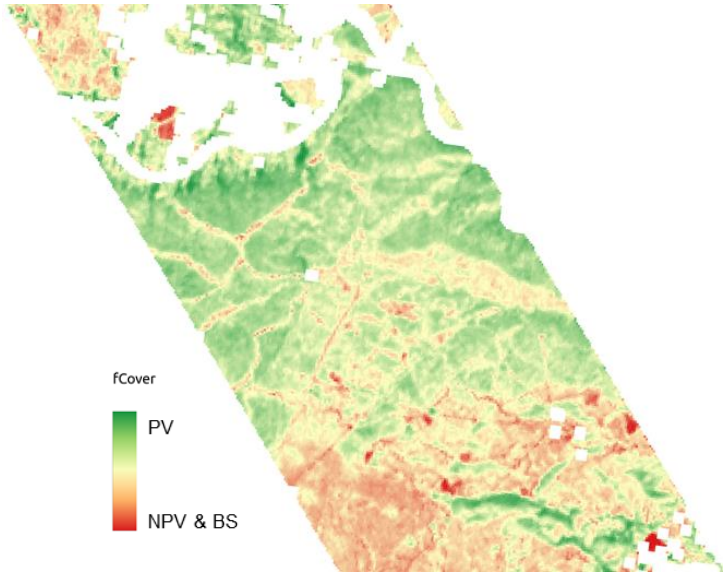
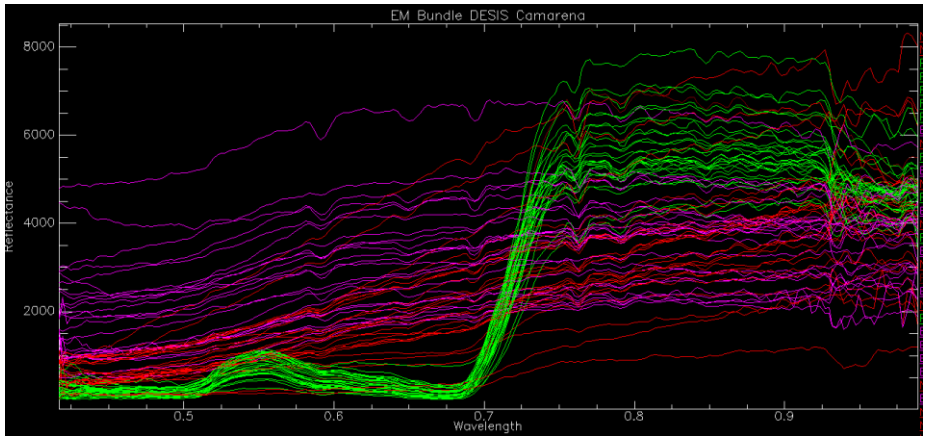
DESIS – fCover Abundances
26.07.2022 vs 03.08.2022

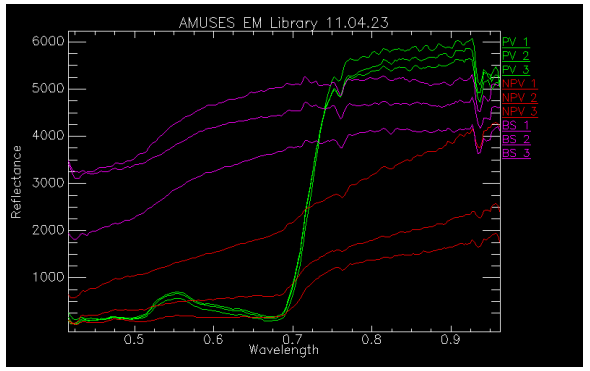
07.04.2023



11.04.2023







Two classes PV & NPV+BS
- Due to missing SWIR
- No direct soil detection possibility

- Area-wide consistent unmixing over all classes

- Overall low RMSE (Reflectance)

- Haze increases RMSE values
  - Leads to higher or lower subpixel fraction values

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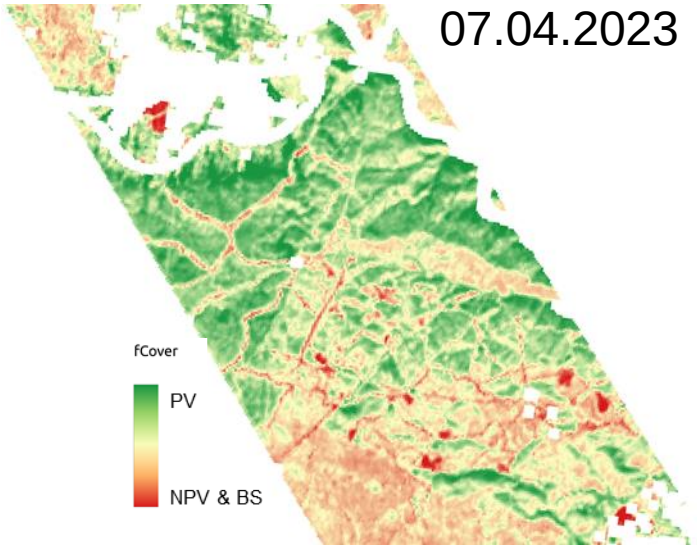
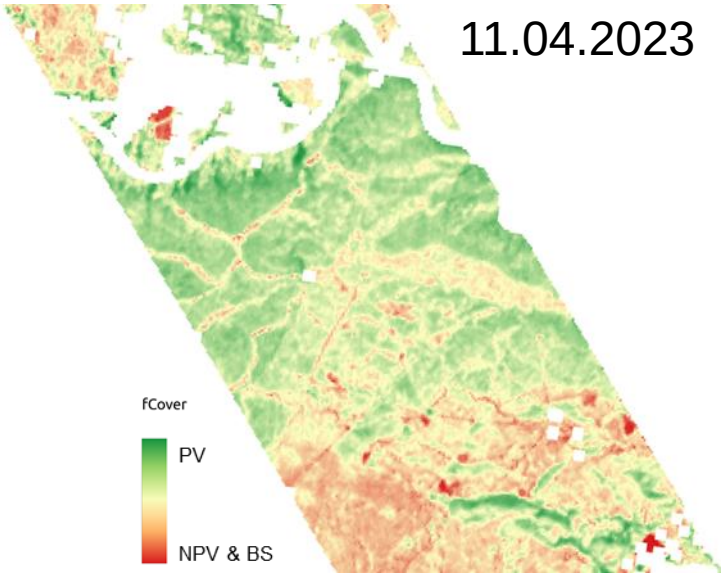
DESIS – AMUSES - fCover Abundances
26.07.2022 vs 03.08.2022

07.04.2023



11.04.2023



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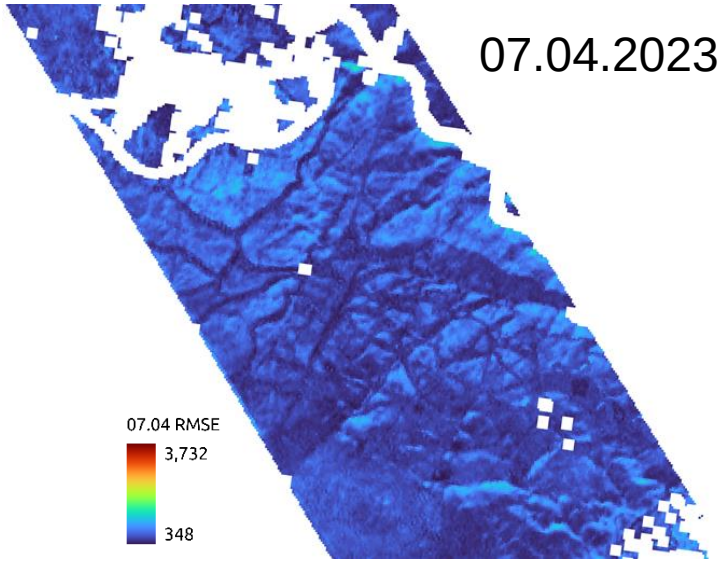

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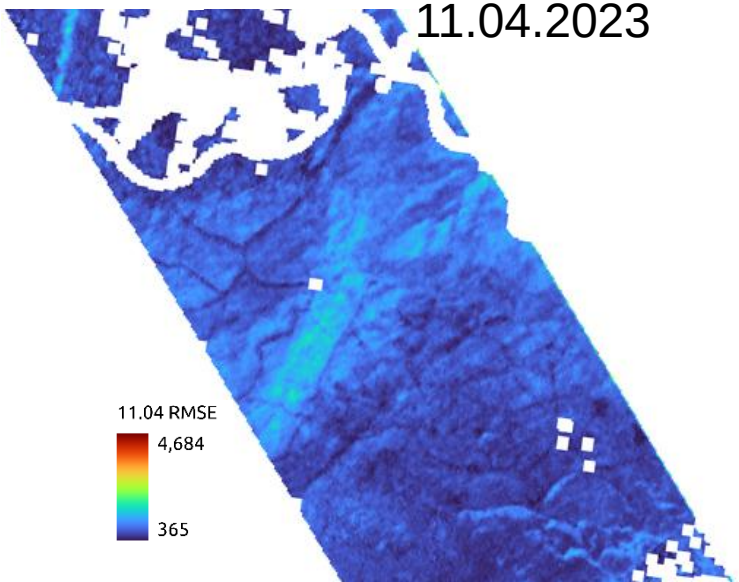

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