An automated operational processor for the determination of fractional vegetation cover from DESIS observations

D. Marshall[1*], M. Bachmann[1], M. Habermeyer[1], U. Heiden[2], S. Holzwarth[1], T. Schmid[3]

[1] DFD-LAX, DLR, Münchener Straße 20, 82234 Weßling, Germany *david.marshall@dlr.de
[2] IMF-PBA, DLR, Münchener Straße 20, 82234 Weßling, Germany
[3] Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT), 28040 Madrid, Spain

Convention on Biological Diversity (CBD), Strategic Plan:

"By 2050, biodiversity is valued, conserved, restored, and widely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people."

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), Work Programme:

"strengthen the science-policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development."

Group on Earth Observations Biodiversity Observation Network (GEO- BON), Essential Biodiversity Variables

"Essential Biodiversity Variables are defined as the derived measurements required to study, report and manage biodiversity change."

Live cover fraction

the fraction of area covered by living organisms like **vegetation**, macroalgae or coral

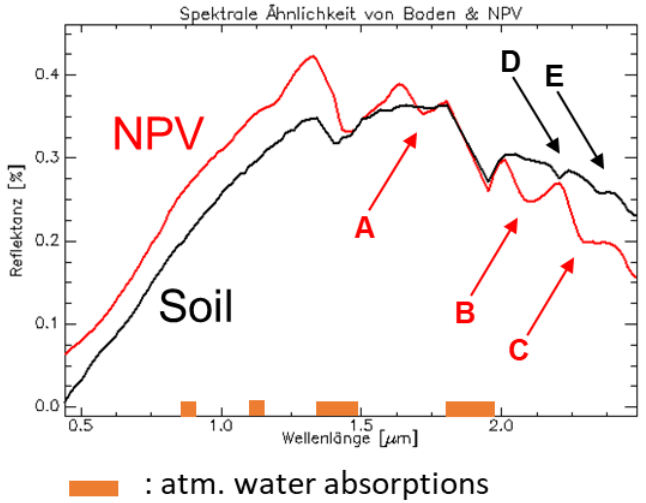
Fractional vegetation cover

- important measure in agriculture, forestry and ecology
- provides insights to Earth system processes
- highlights the relationship between human activities and the environment
- fractions for photosynthetically active vegetation (PV), non-photosynthetically active vegetation (NPV) and bare soil (BS)

HySpex – 400-2500 nm, 4-6 nm spectral resolution,
2 m spatial resolution (dep. on flight altitude)

DESIS – 400-1000 nm, 2.55 spectral resolution,
30 m spatial resolution

EnMAP – 400-2500 nm, 6-10 nm spectral resolution,
30 m spatial resolution

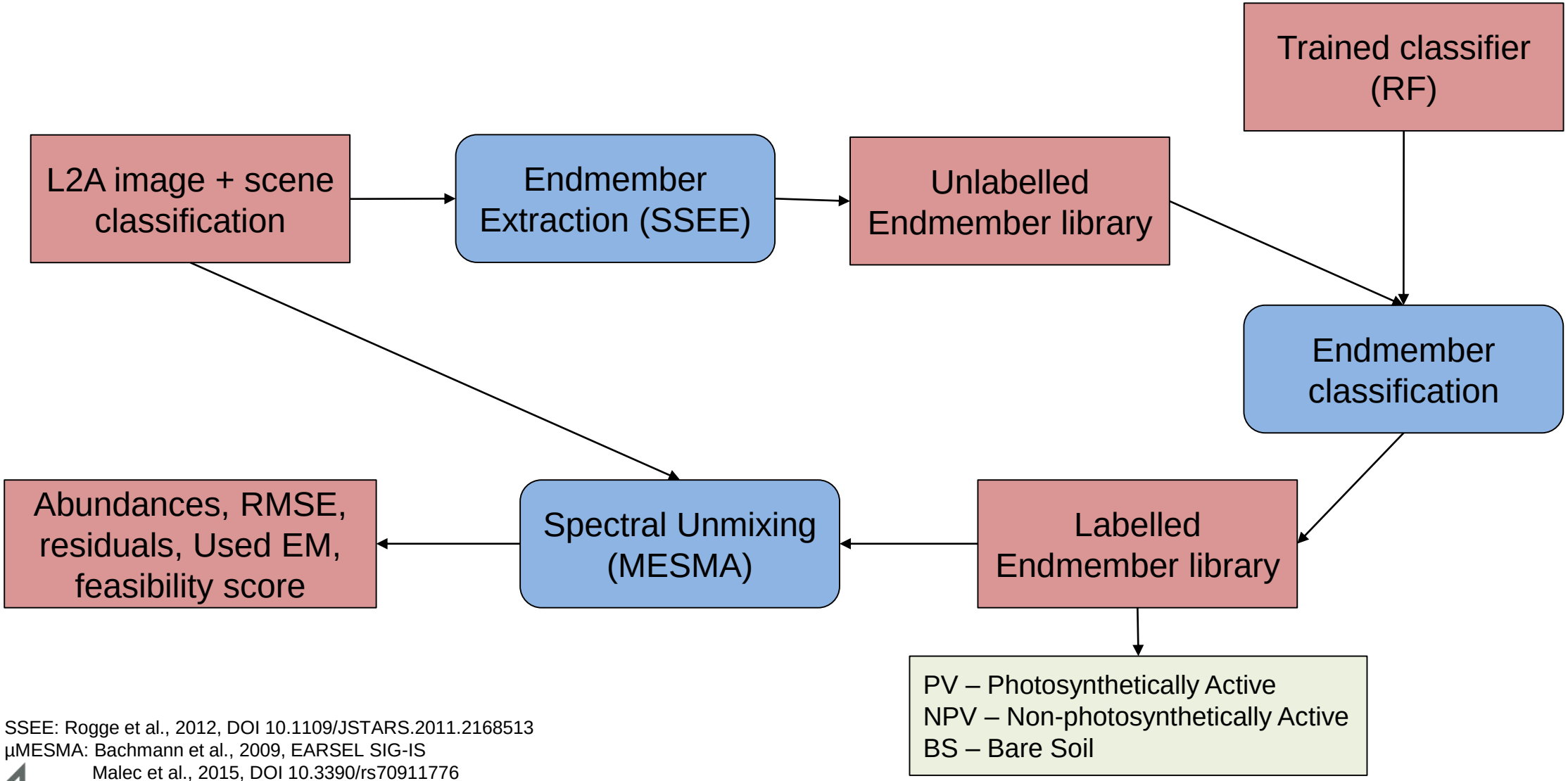


Absorption features of
A: Xylan & Cellulose
B: Lignin & Cellulose
C: Cellulose

D: Clay
E: Carbonates

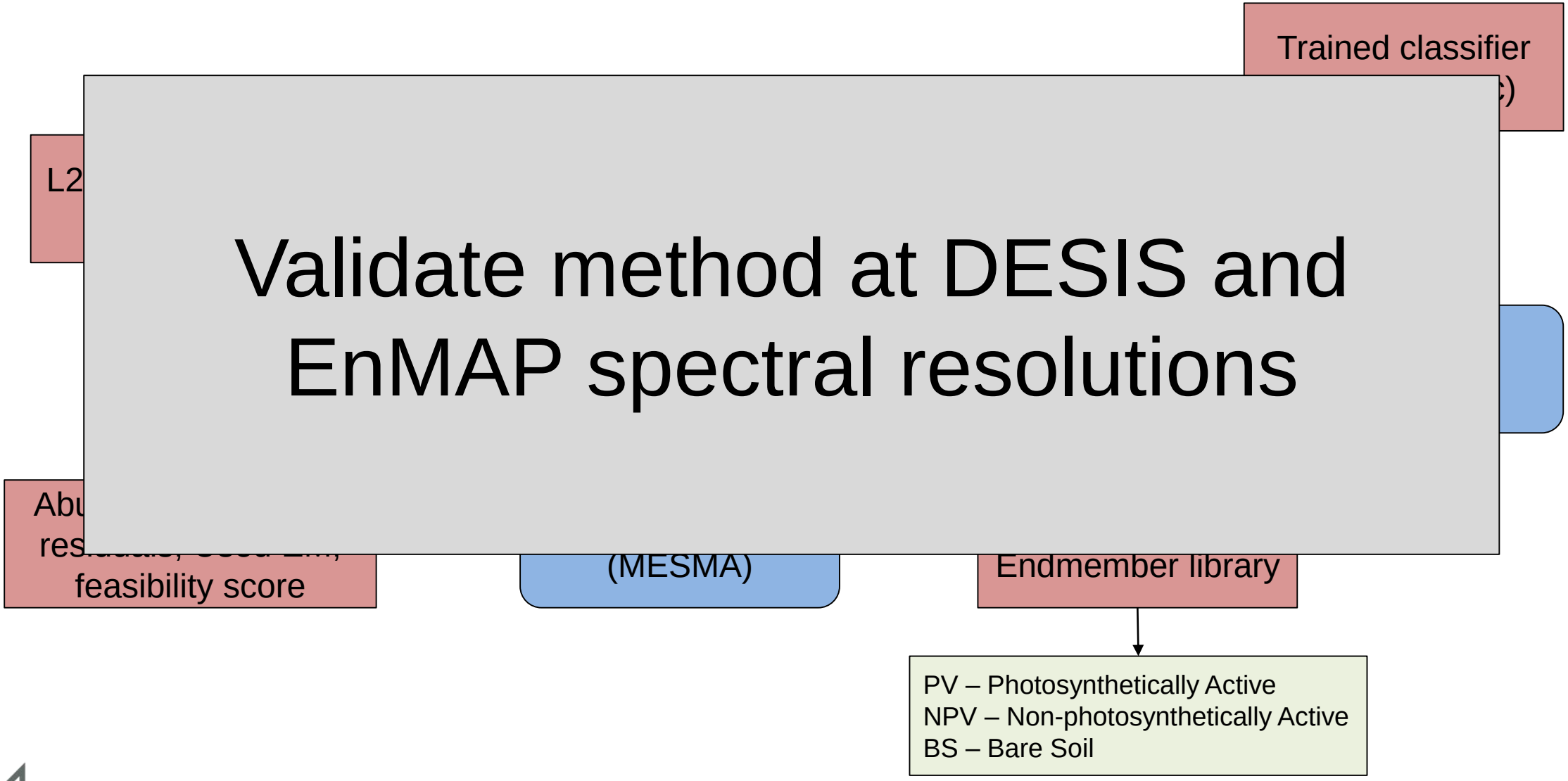
Methodology

Processing chain

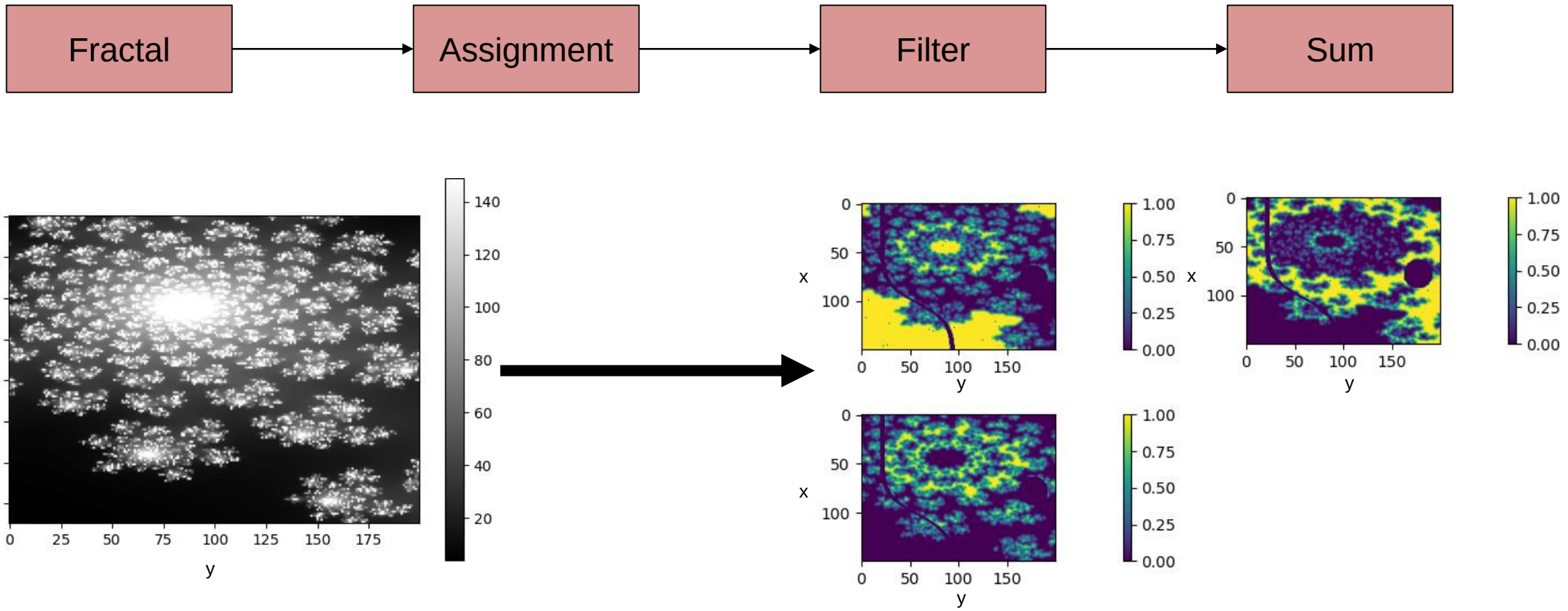


SSEE: Rogge et al., 2012, DOI 10.1109/JSTARS.2011.2168513
µMESMA: Bachmann et al., 2009, EARSEL SIG-IS
Malec et al., 2015, DOI 10.3390/rs70911776

Processing chain



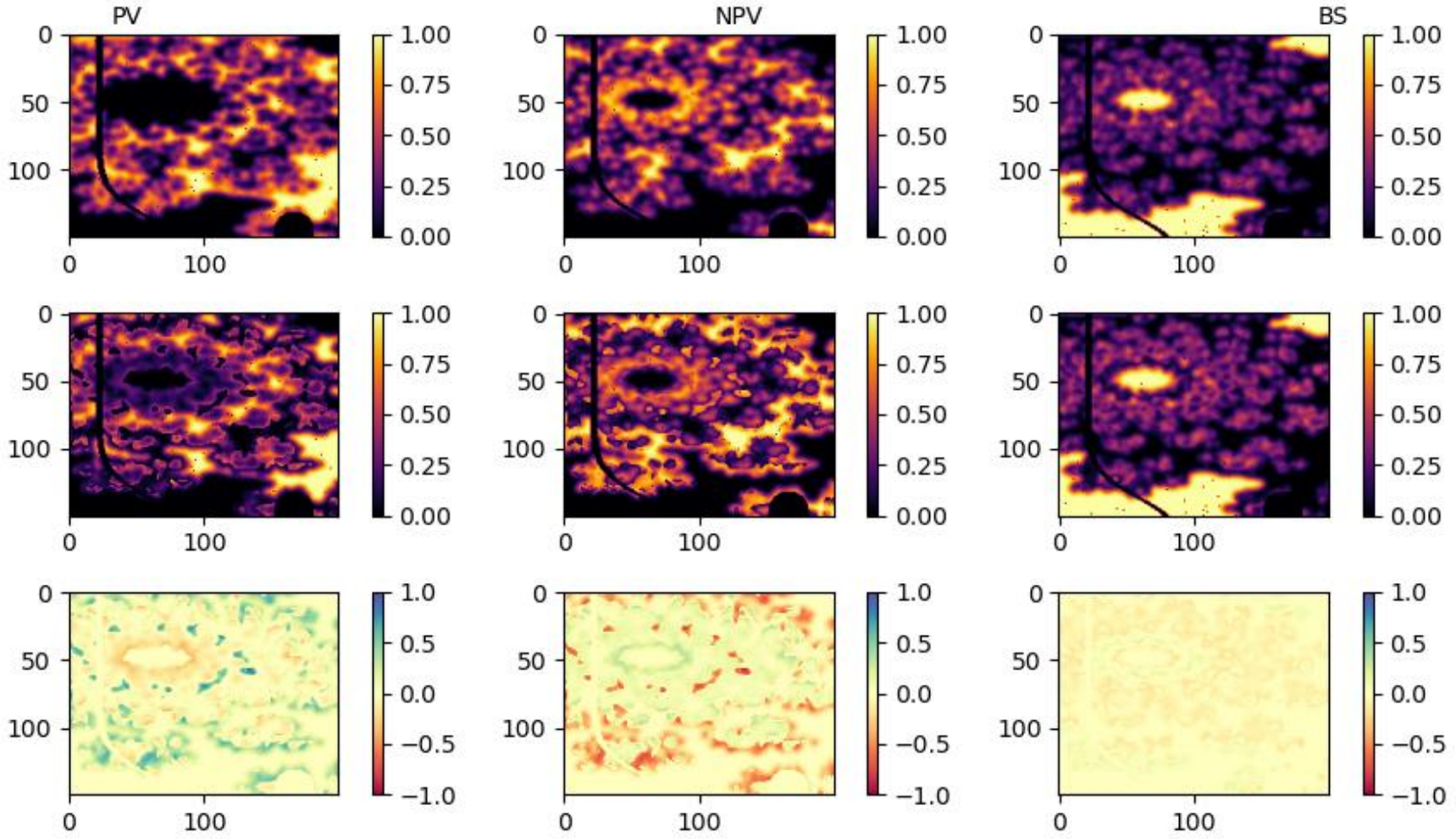
Fractal scene



Plaza et al., 2012 DOI 10.1007/s10851-011-0276-0

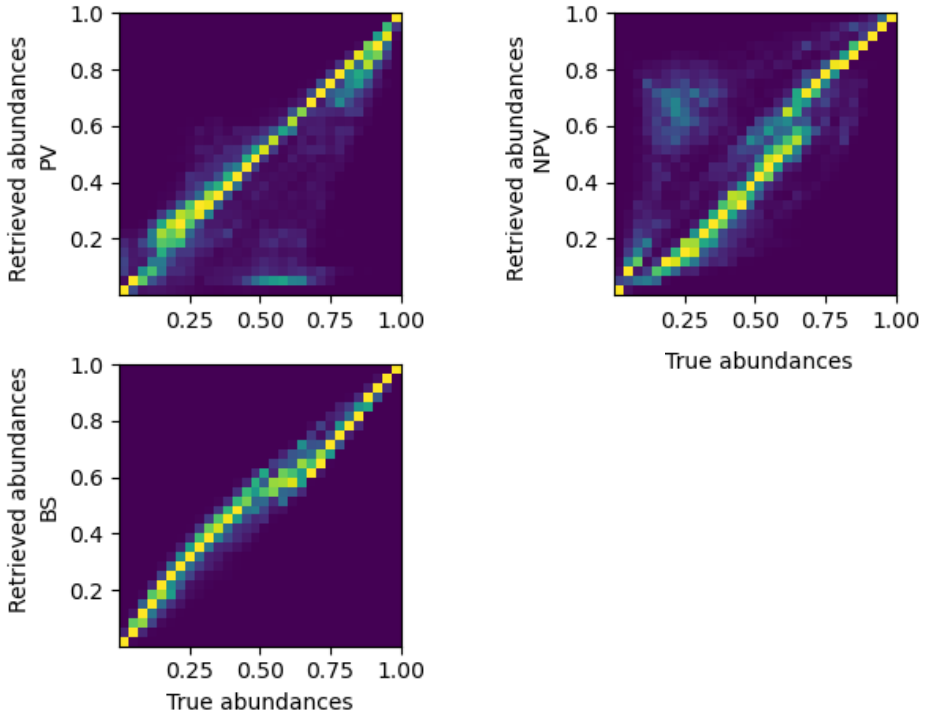
Validation Results

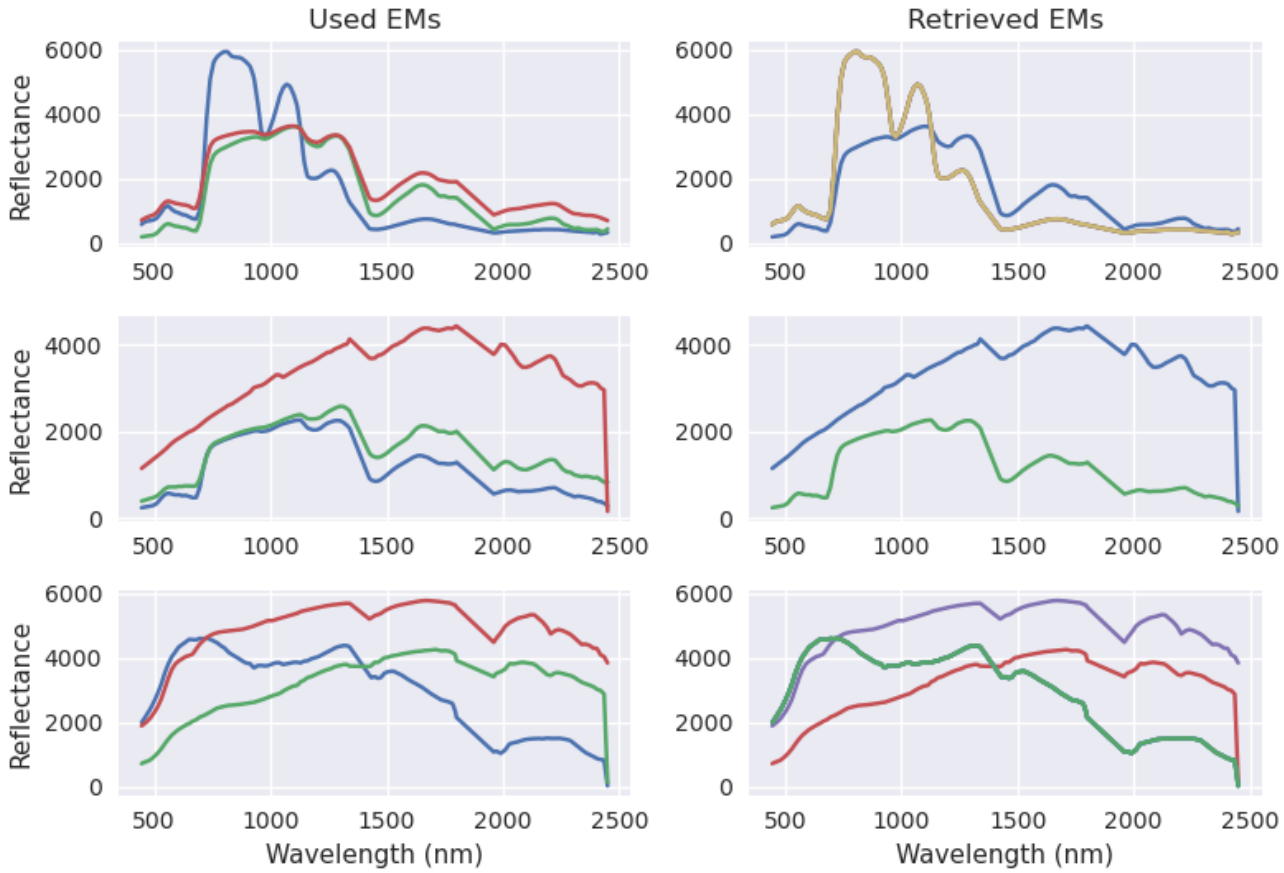
Results: EnMAP resolution



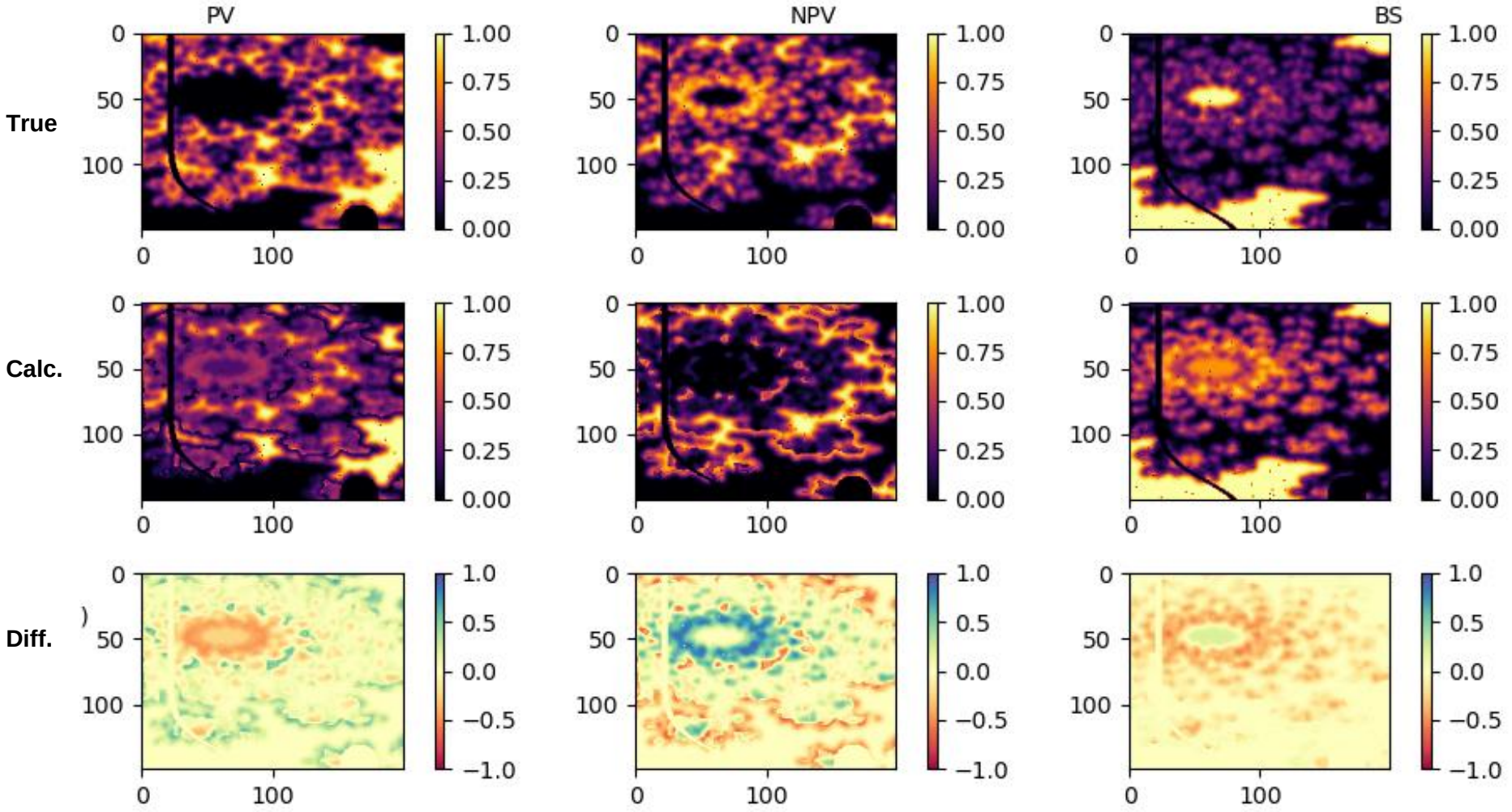
	RMSE
All	11%
PV	12%
NPV	14%
BS	4%

Results: EnMAP resolution



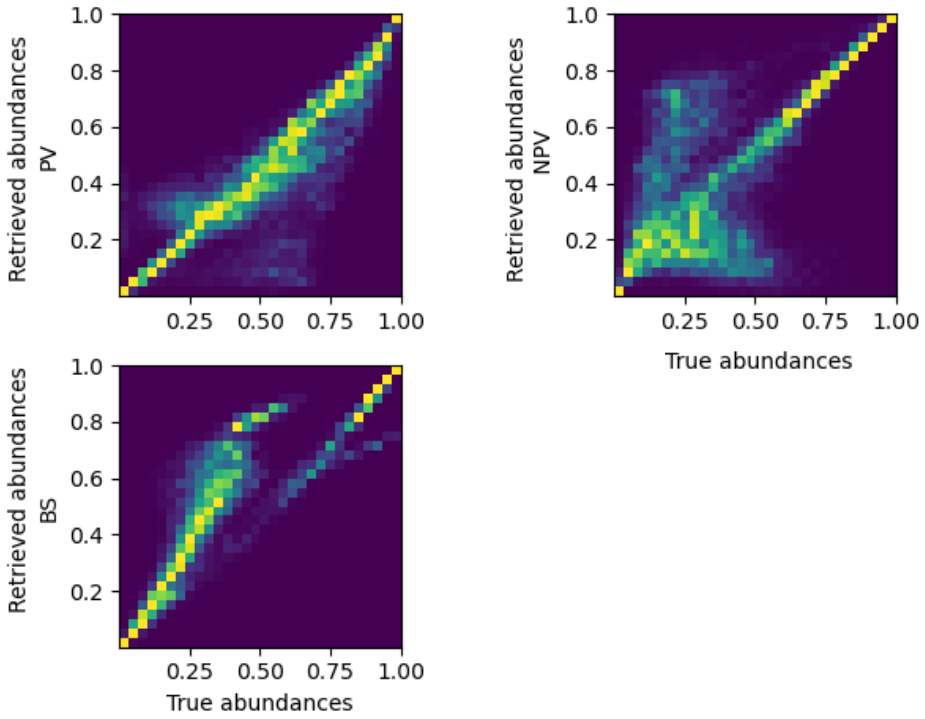


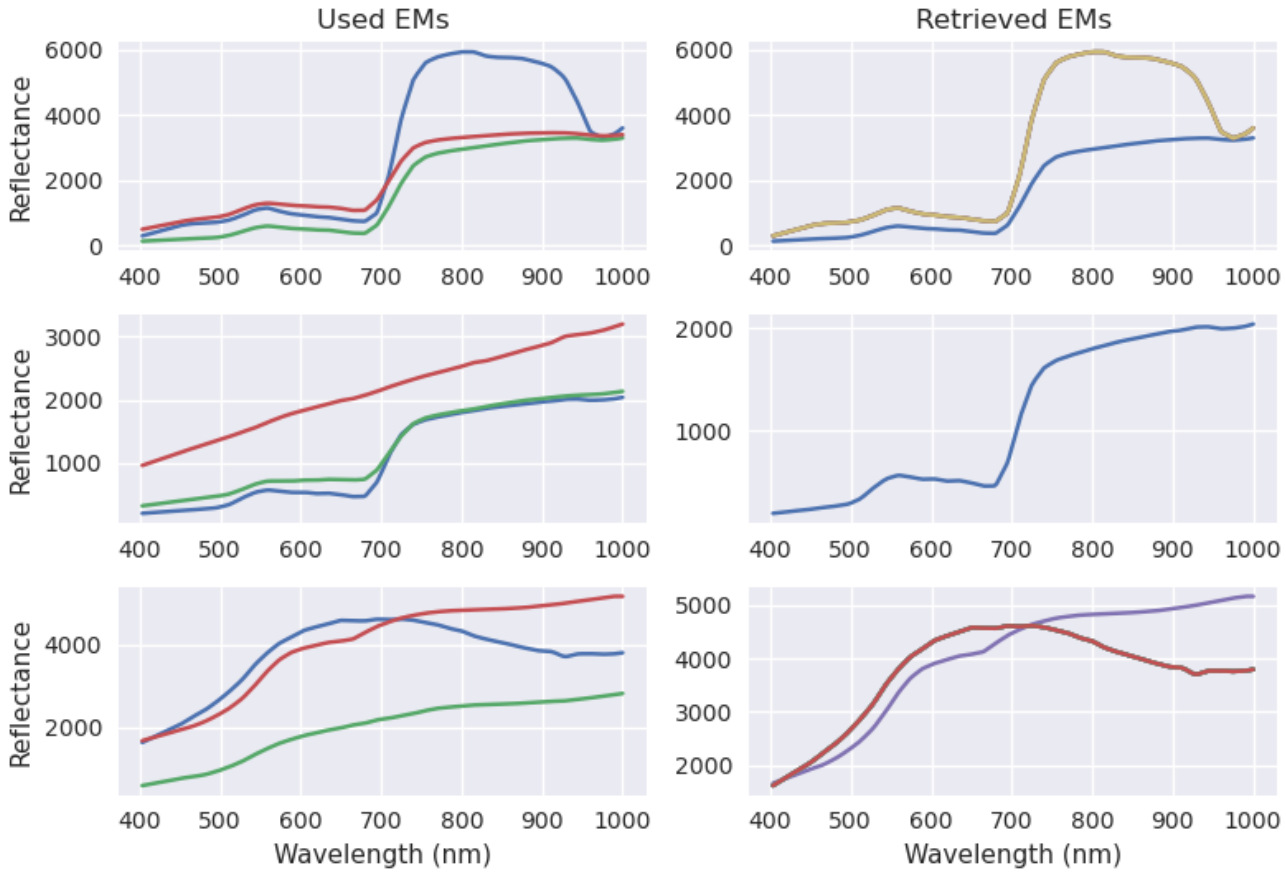
Results: DESIS resolution



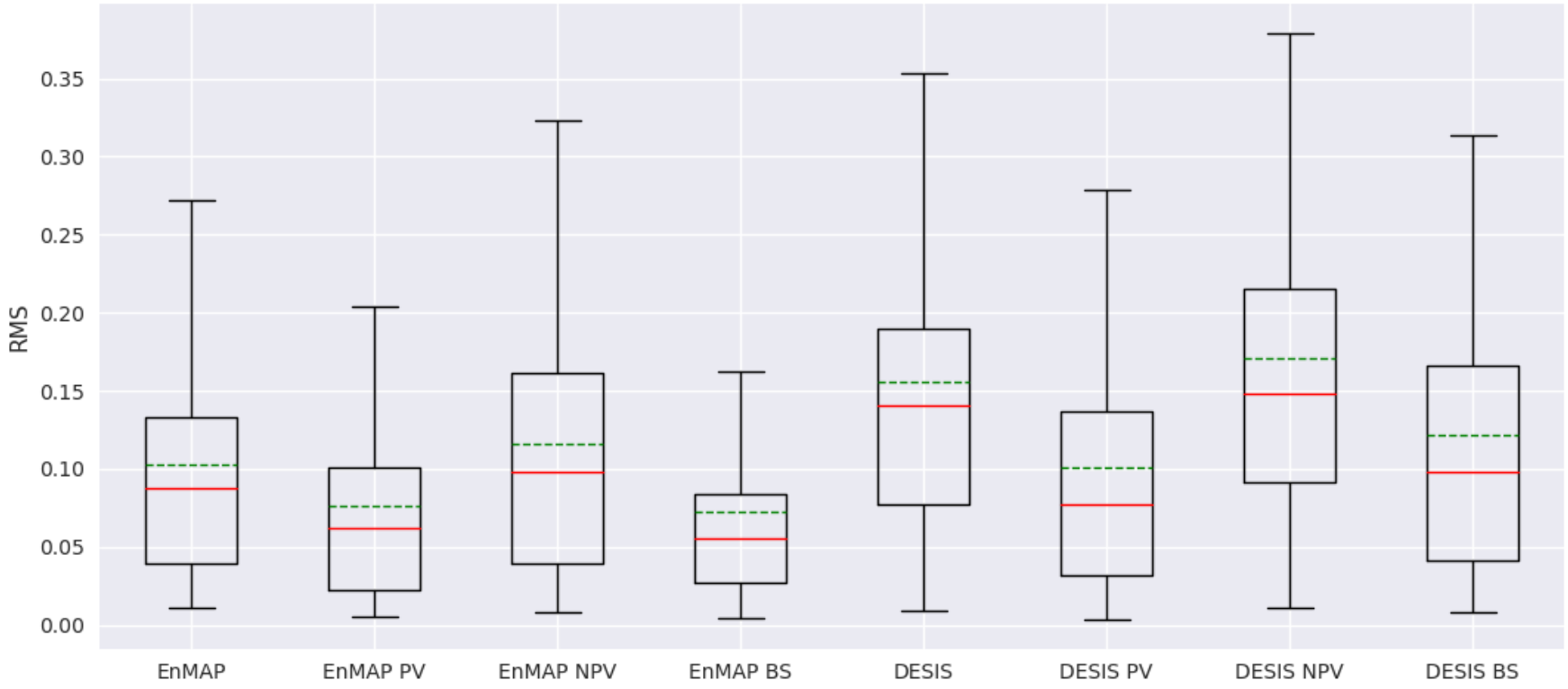
	RMSE
All	15%
PV	13%
NPV	18%
BS	9%

Results: DESIS resolution





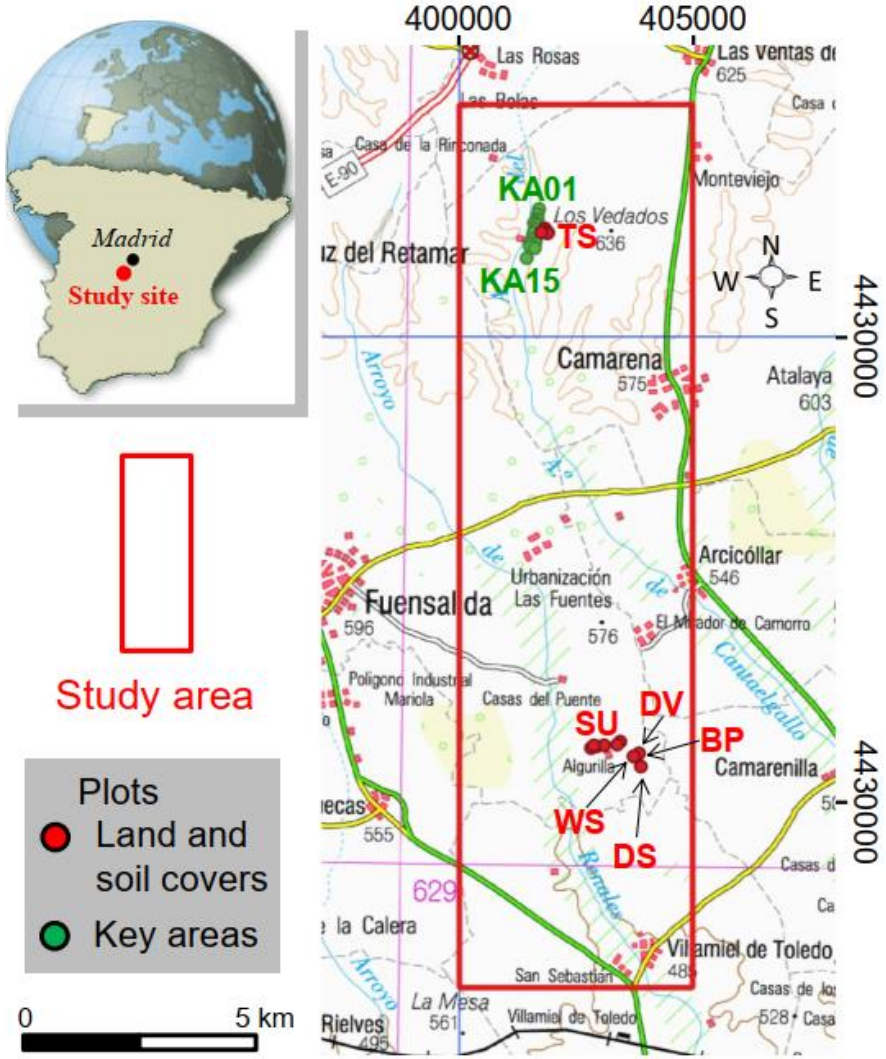
Results: RMS comparison

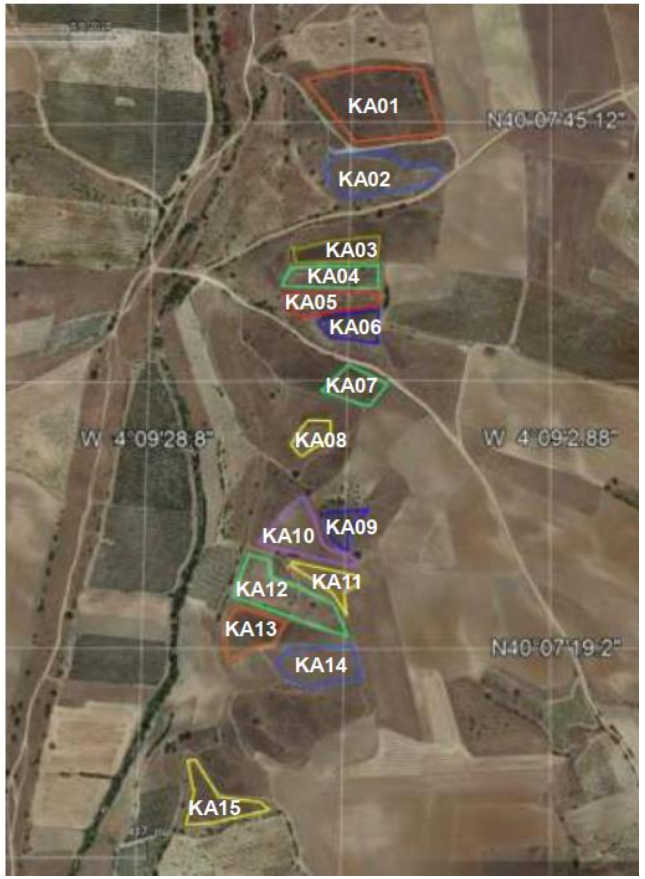


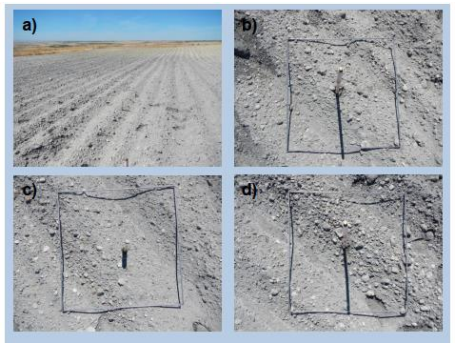
		RMSE
EnMAP	All	8%
	PV	7%
	NPV	10%
	BS	6%
DESIS	All	14%
	PV	8%
	NPV	15%
	BS	10%

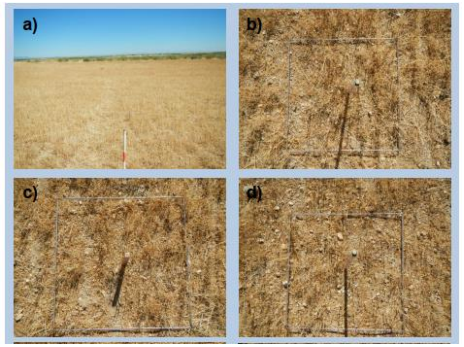
Case Study: Camarena

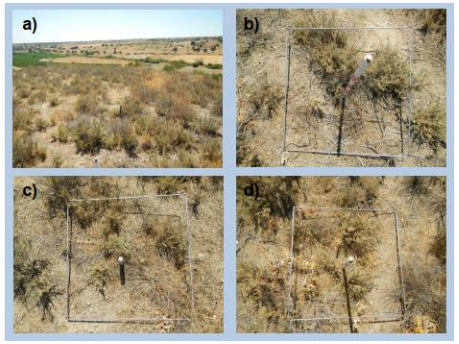
Camarena Field Work



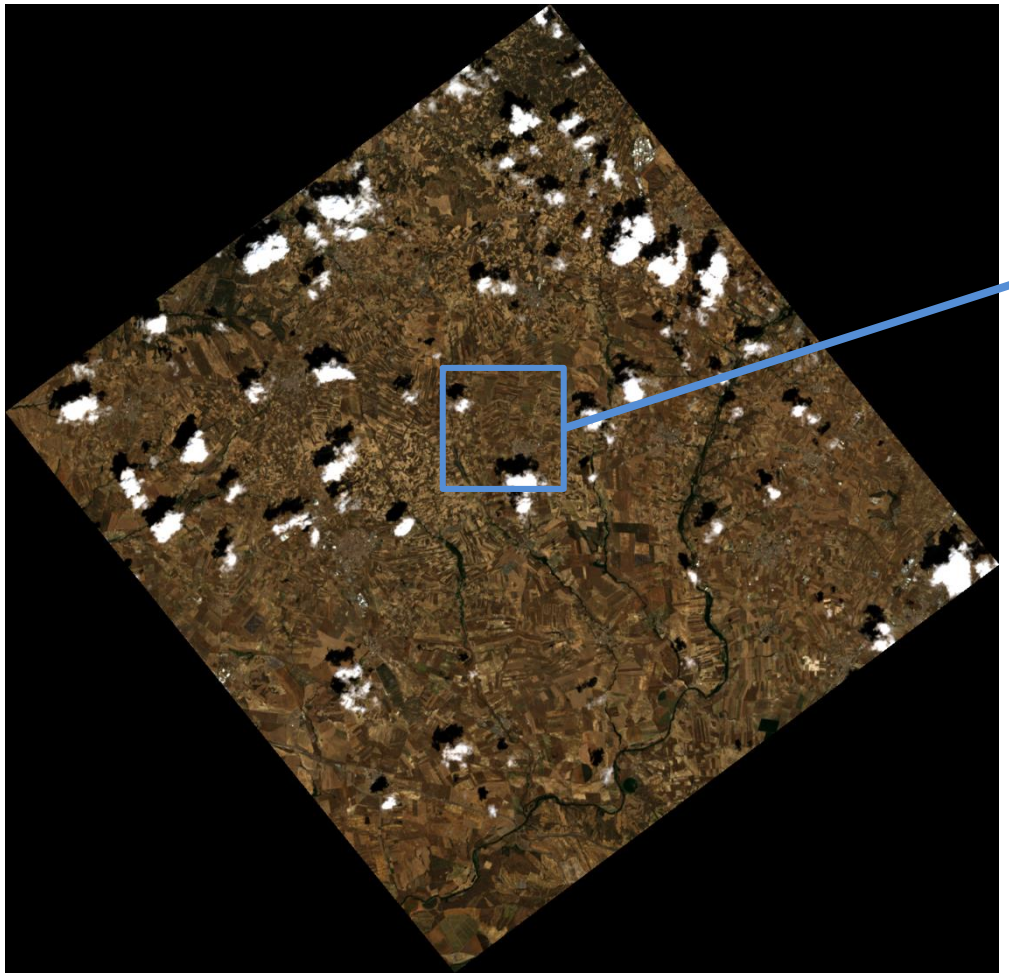


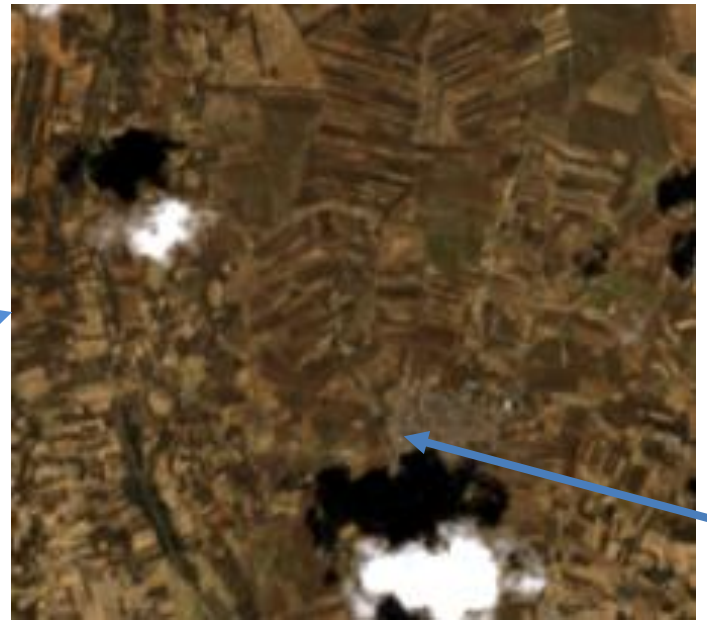


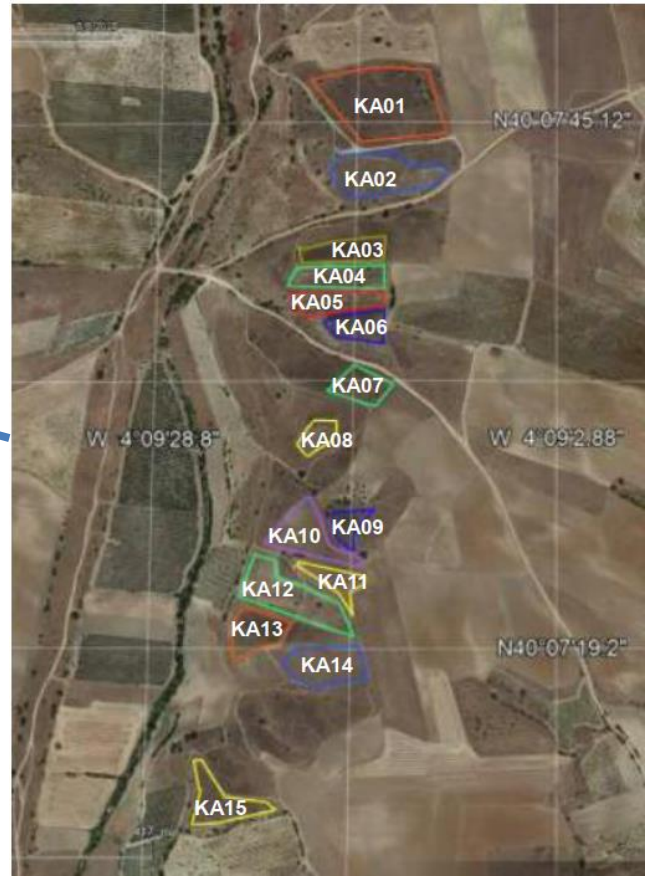




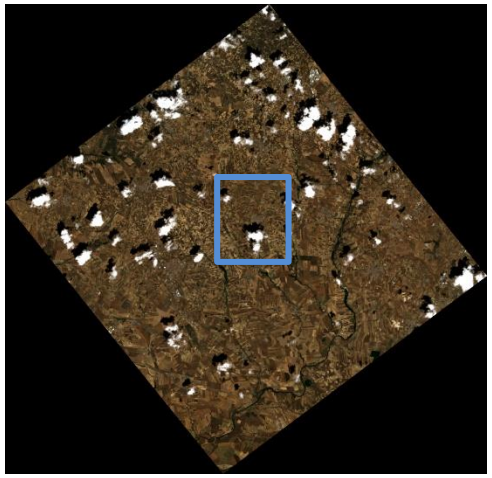
Camarena from DESIS

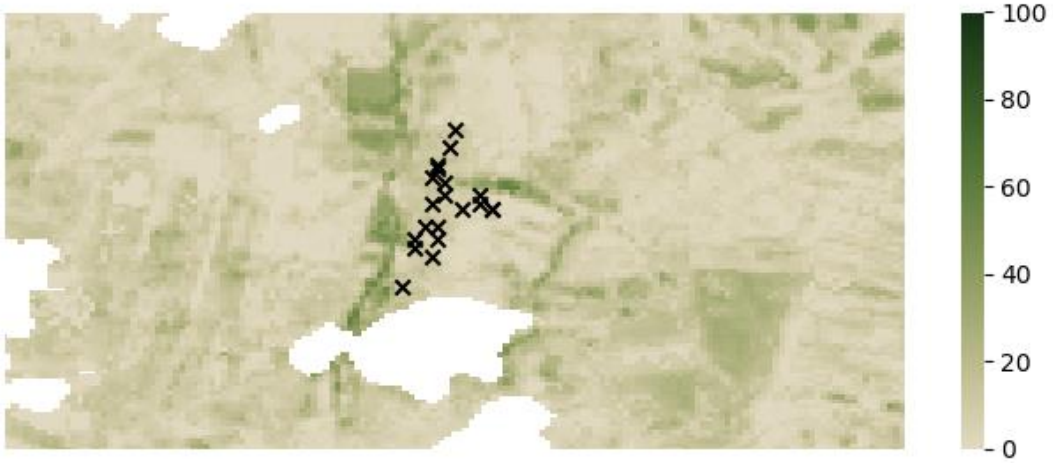






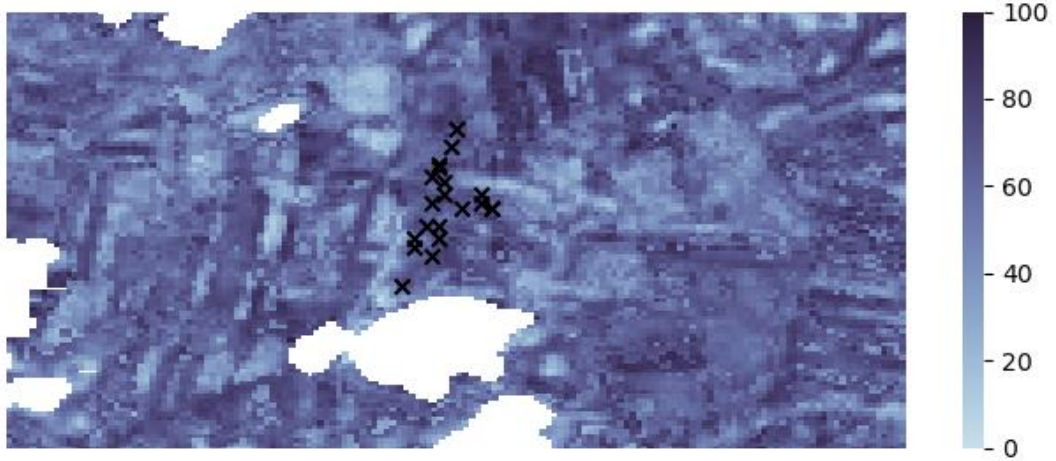
Camarena FVC

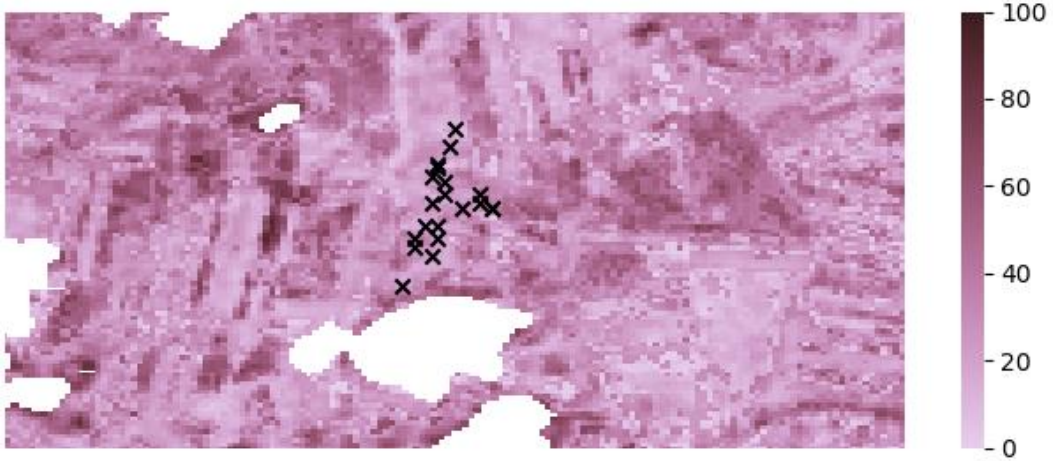




PV %

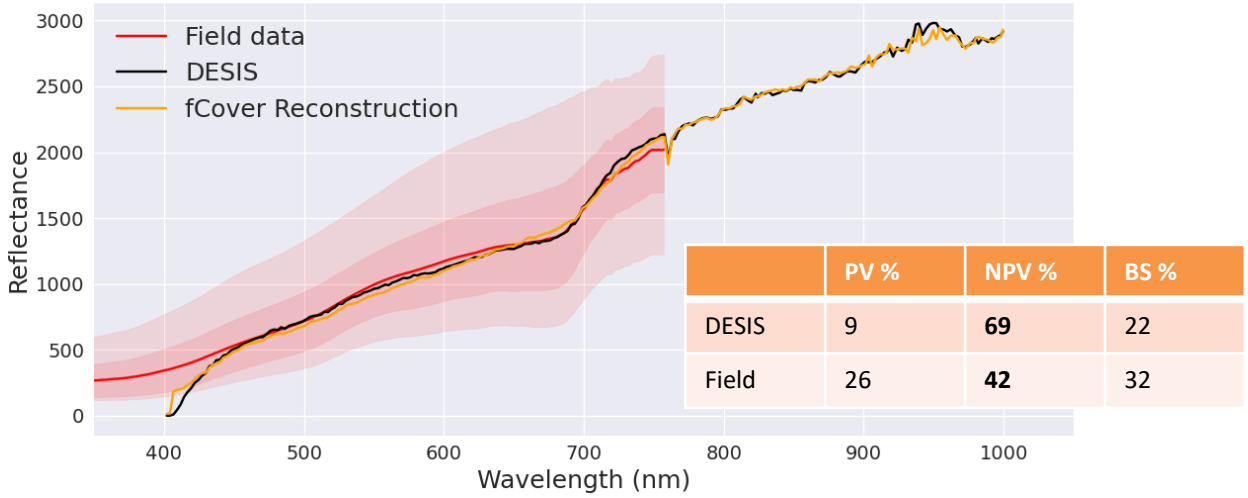
NPV %



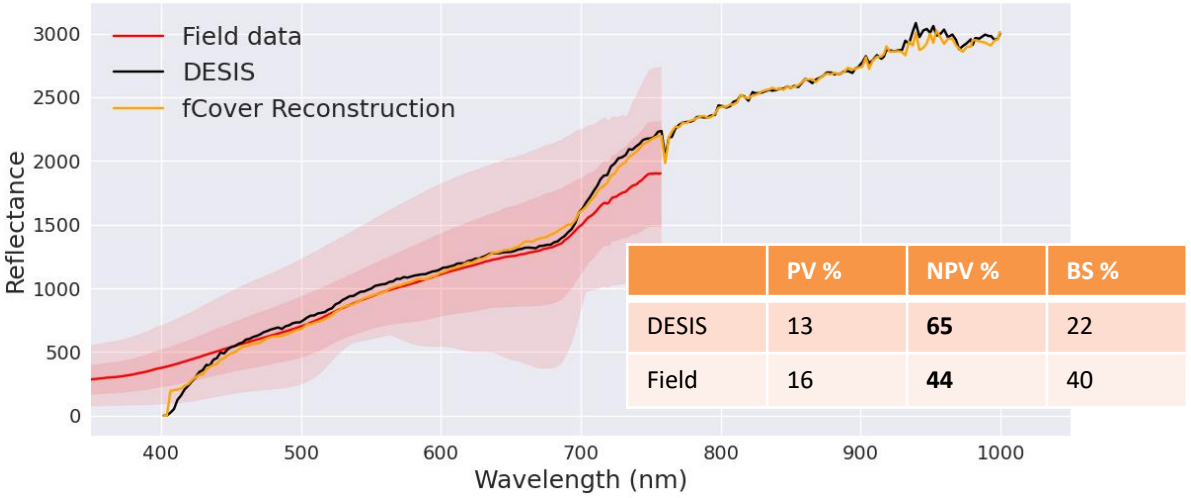


BS %

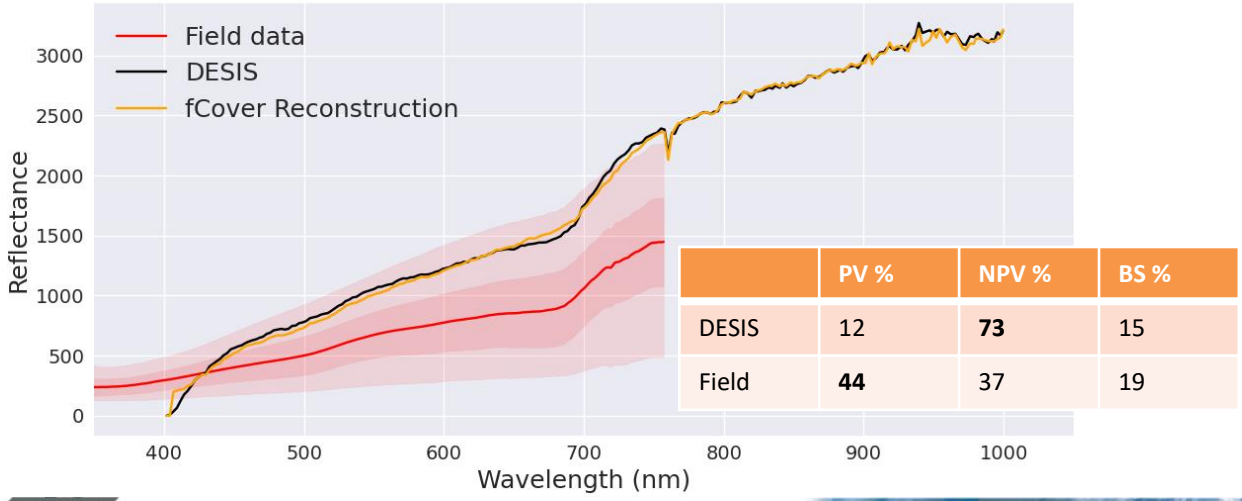
Camarena FVC KA02, KA05, KA13



	PV %	NPV %	BS %
DESIS	9	**69**	22
Field	26	**42**	32



	PV %	NPV %	BS %
DESIS	13	**65**	22
Field	16	**44**	40



	PV %	NPV %	BS %
DESIS	12	**73**	15
Field	**44**	37	19

Summary

Validation of FVC processing chain incl. EM extraction, EM classification, MESMA unmixing

Expected accuracies in FVCs (simulated scenes):
- EnMAP spectral res. & coverage (0.4 - 2.5µm): RMSE ~8%
- DESIS spectral res. & coverage (0.4 - 1.0 µm): RMSE ~14%

- Previous field studies using airborne sensors (0.4 - 2.5 µm): ~9%

With a reduction in spectral coverage (SWIR), the biggest accuracy losses are in the determination of NPV and BS (PV is almost unchanged)

Based on these simulation and case-study results, the potential and limitation of DESIS for FVC estimates is better understood.