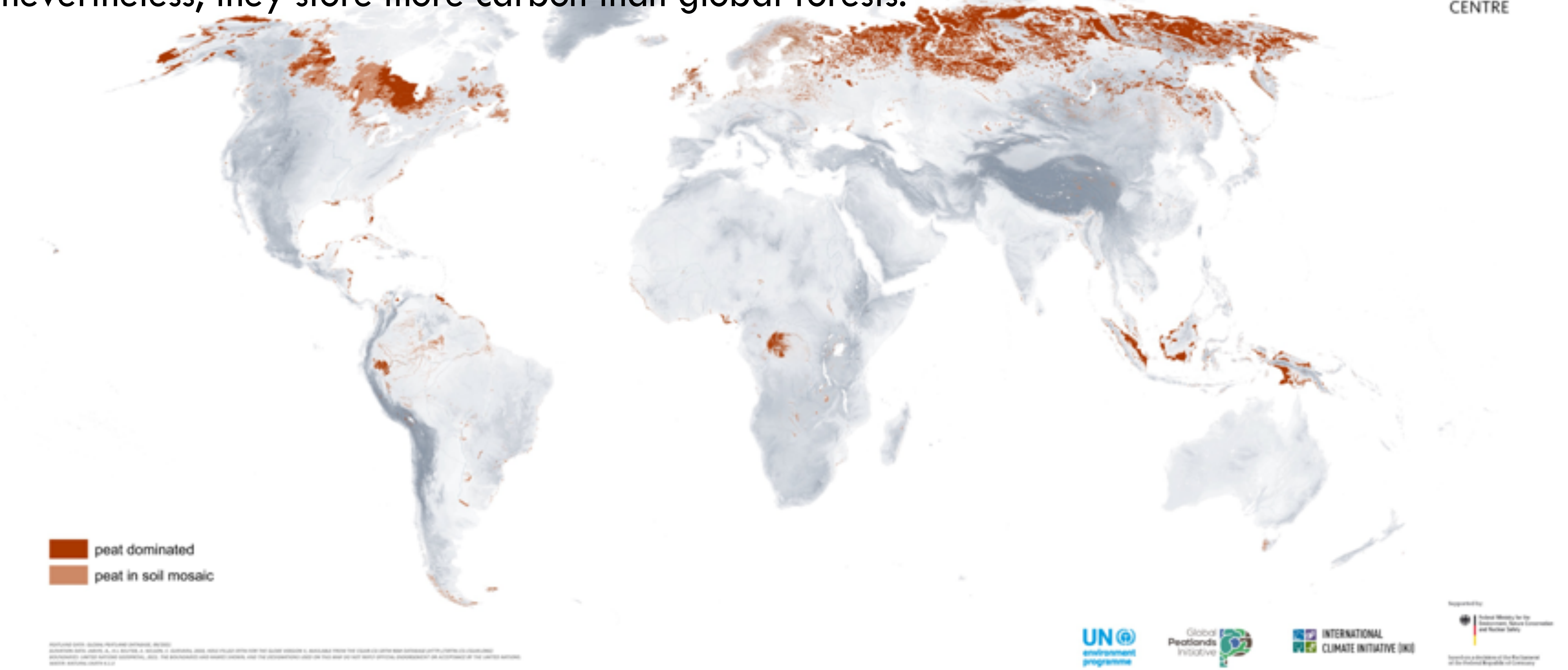
A comparison of hyperspectral and multispectral satellite data for peatland vegetation fraction mapping

Arasumani M, VD Pham, F Thiel, S van der Linden

INTRODUCTION

Peatlands make up 3% of the global land area (Parish et al. 2008; Joosten 2009), nevertheless, they store more carbon than global forests.



INTRODUCTION

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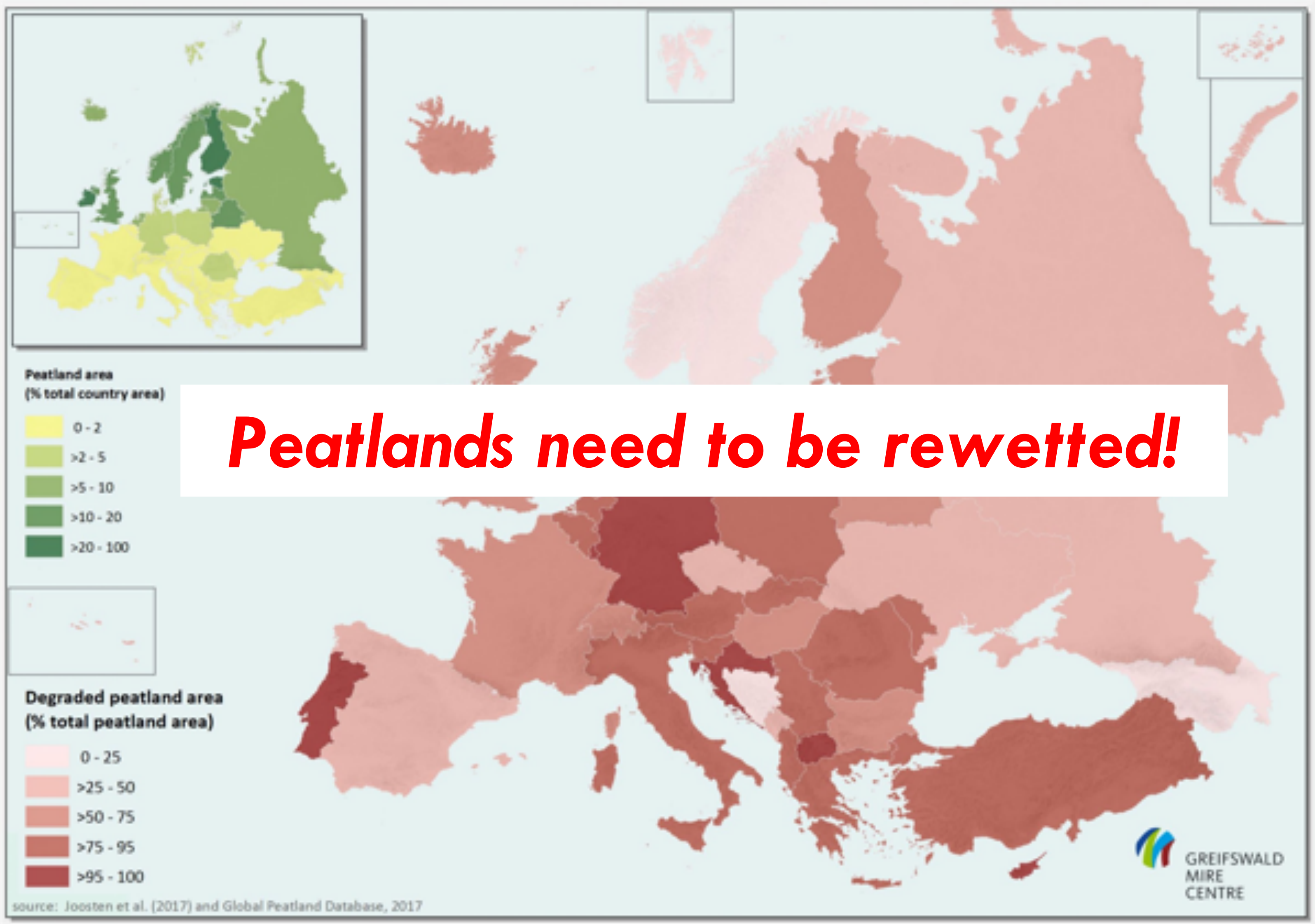
- Nearly 50% of the European peatlands are artificially drained (Tanneberger et al. 2017) and have been transformed into agricultural lands or plantations.
- More than 95% of the peatlands in Germany are dry.
- The drained peatlands cause substantial carbon emissions to the atmosphere.
- Peatland degradation reduces biodiversity and increases the fire risk.



PALUDICULTURE – *Typha* spp. (Cattail)

OBJECTIVE AND RESEARCH QUESTIONS

The overall research objective of this study is to test the existing spaceborne hyperspectral images (compared to multispectral data) for mapping the fraction of peatland vegetation at species level in order to monitor the success of peatland rewetting.

Specifically, we ask:

1) At what accuracy is it possible to estimate fractions of peatland vegetation communities in the rewetted areas using hyperspectral and multispectral images with a regression-based unmixing approach?

2) What temporal or spectral information is crucial for differentiating peatland vegetation communities?

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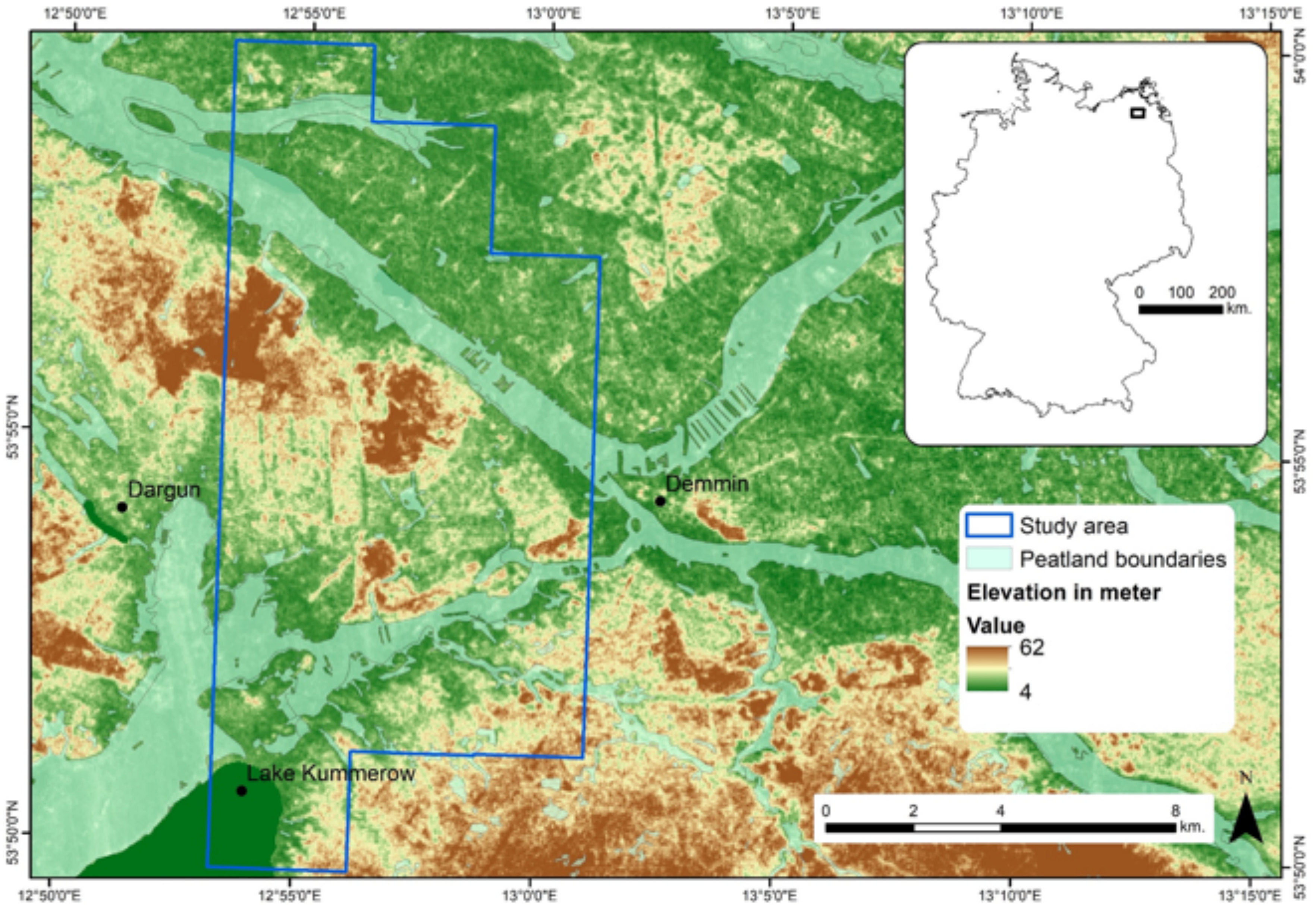
STUDY AREA

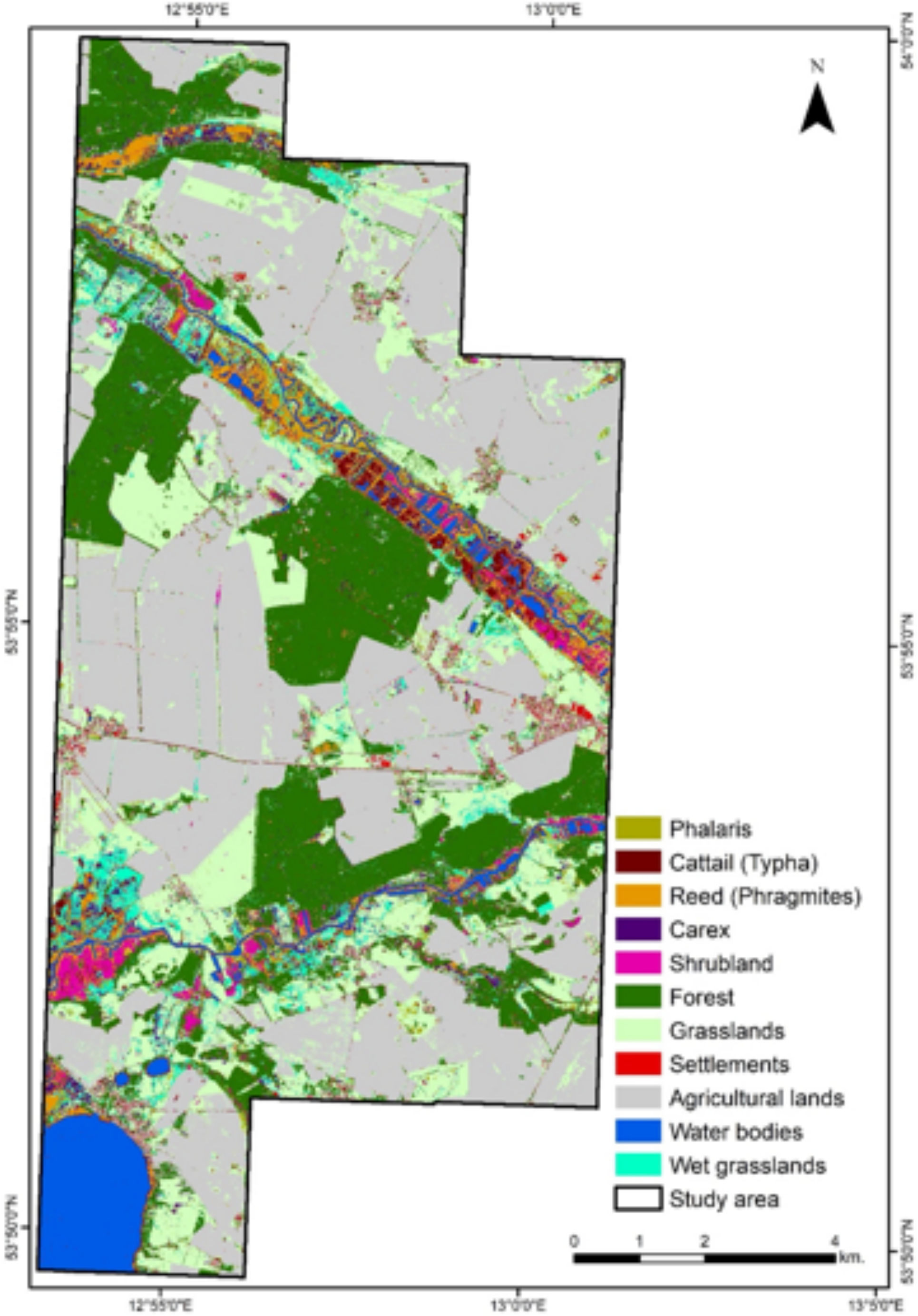


Located near DEMMIN

PREPROCESSING – PRISMA DATA

PRISMA Level 2D surface reflectance; April, June and August 2021
removed the water absorption and bad bands (1-5, 103-113, 147-164 and 225-234) → 190 spectral bands

The multitemporal PRISMA data had geolocation offsets. However, we co-registered the PRISMA datasets with PlanetScope images using AROSICS (Scheffler et al. 2017).



REFERENCE LAYER BASED ON AVIRIS-NG

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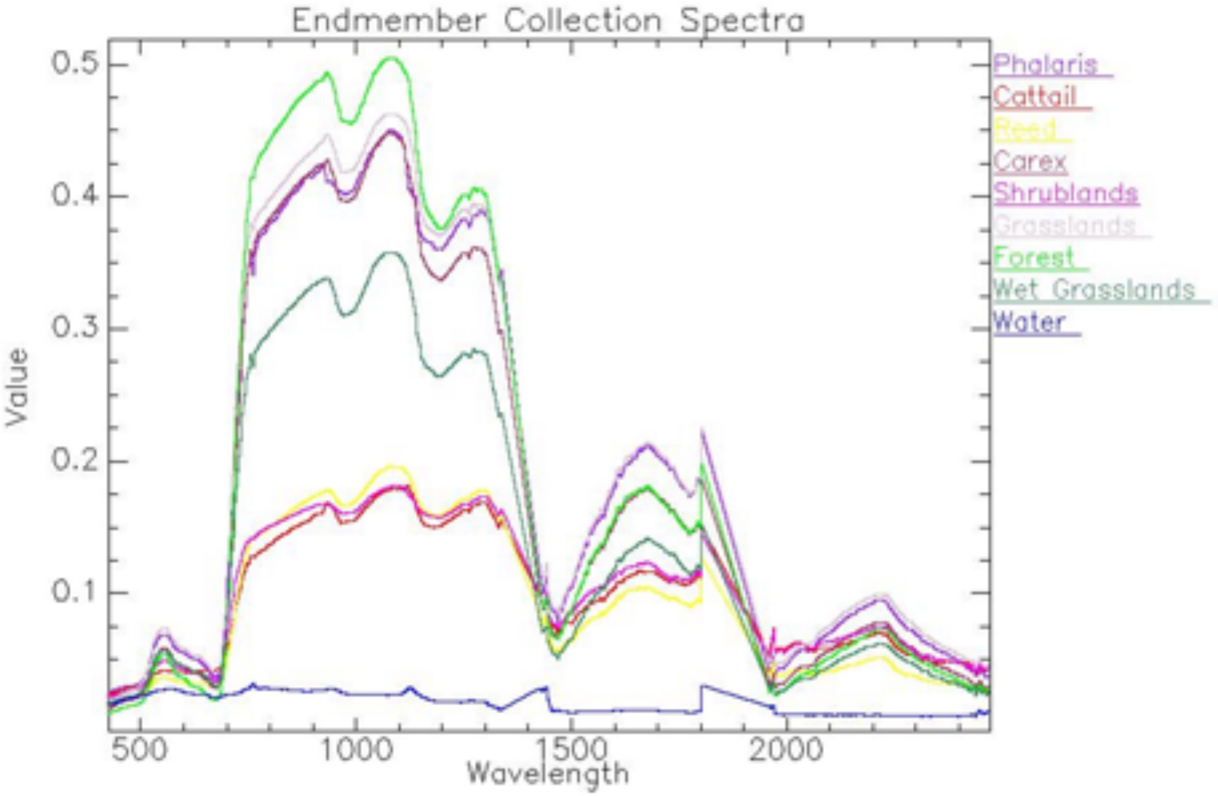

OVERALL ACCURACY – 90.9%

FRACTION MAPPING USING PRISMA DATASETS

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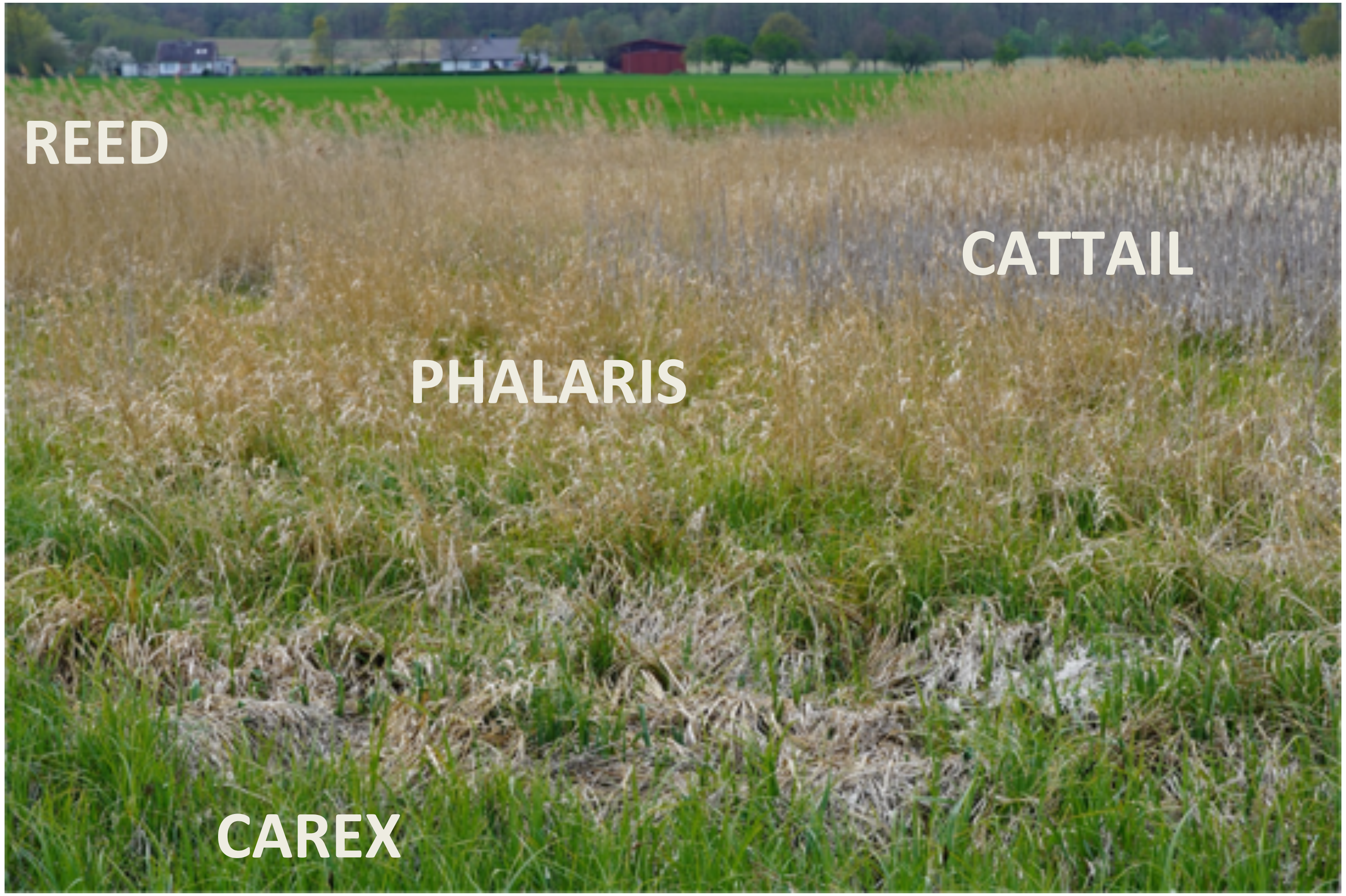
Target classes: Cattail, Reed, *Wet graslands*, Shrubs, Water, …

Regression-based unmixing with synthetic training data generation **(EnMAP-Box)**

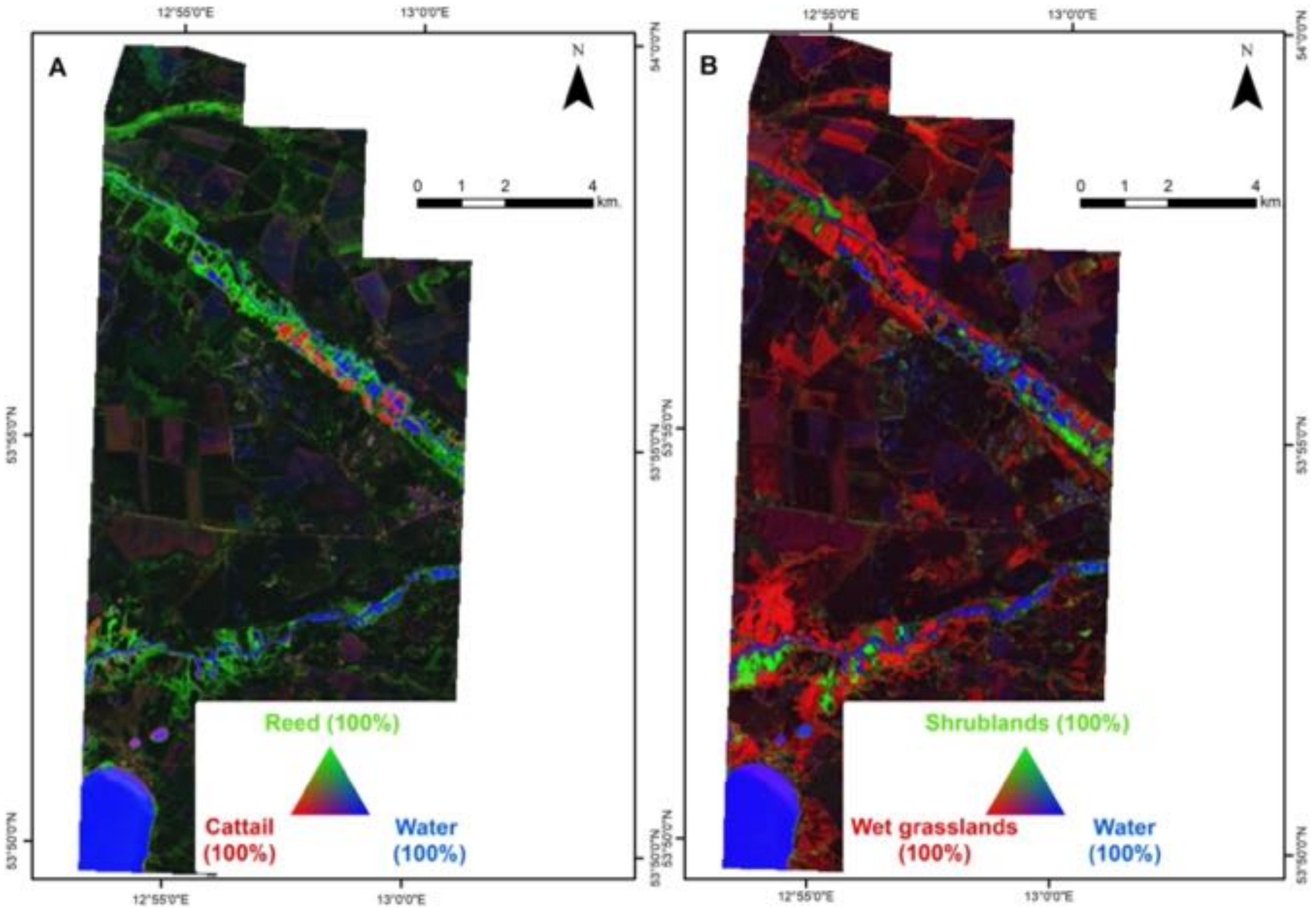
Finally, we validated the unmixing results using AVIRIS-NG classified output.



PRISMA

EnMAP-Box

https://enmap-box.readthedocs.io/en/latest/



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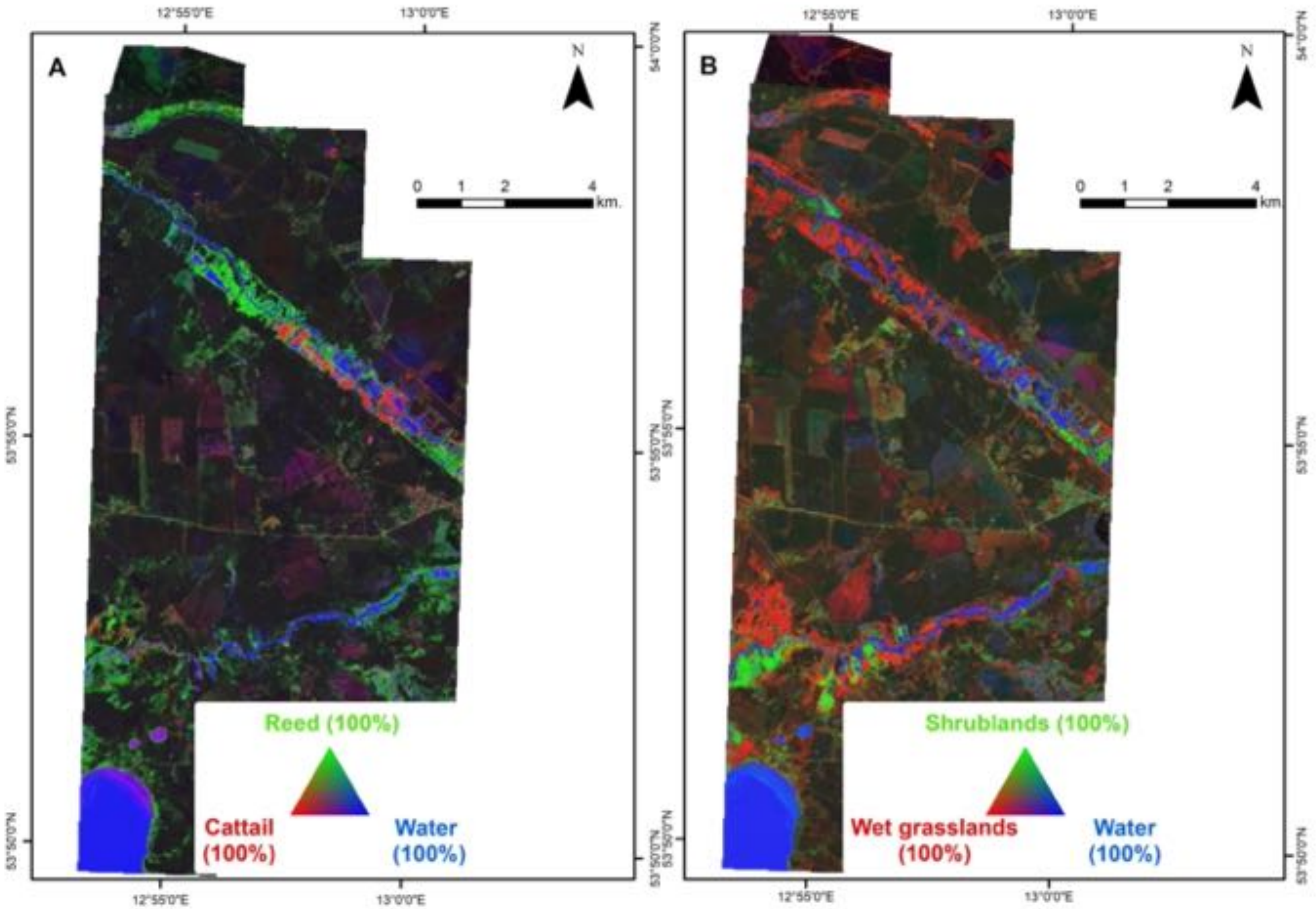
FRACTION MAP – PRISMA (APR, JUN & AUG)



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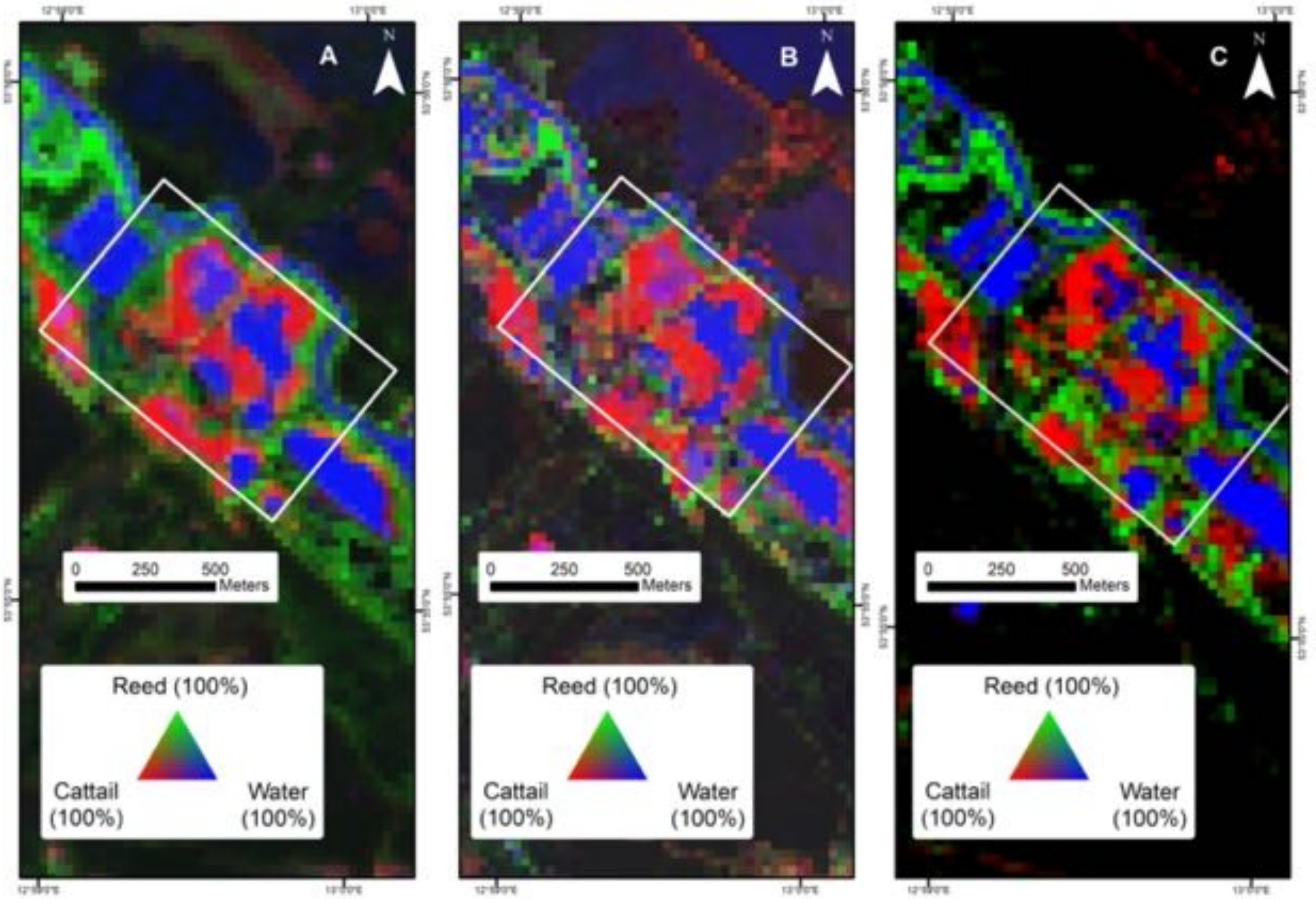
FRACTION MAP – LANDSAT + SENTINEL-2 STMs

FRACTION MAPS



A) PRISMA April, June and August

B) Intra-annual STMs derived from the Sentinel-2 and Landsat-8

C) Validation data

VALIDATION

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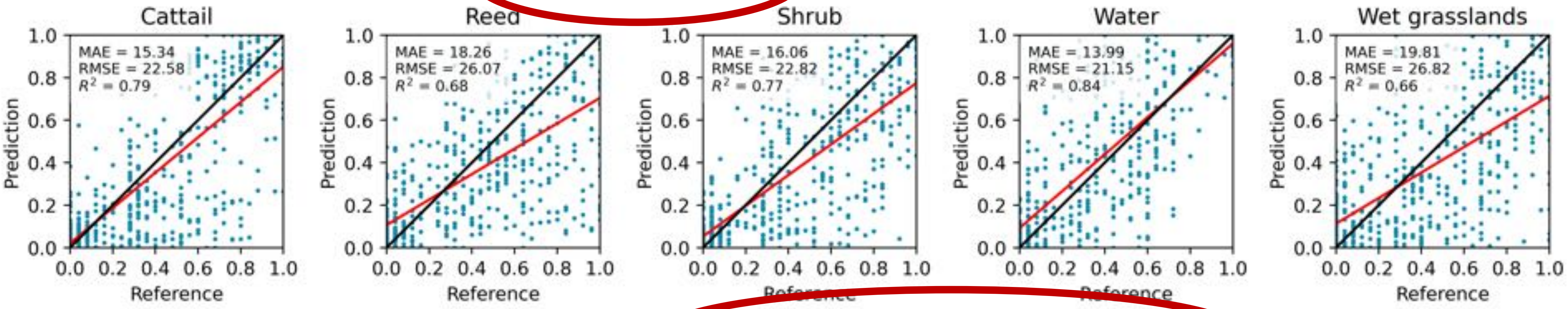
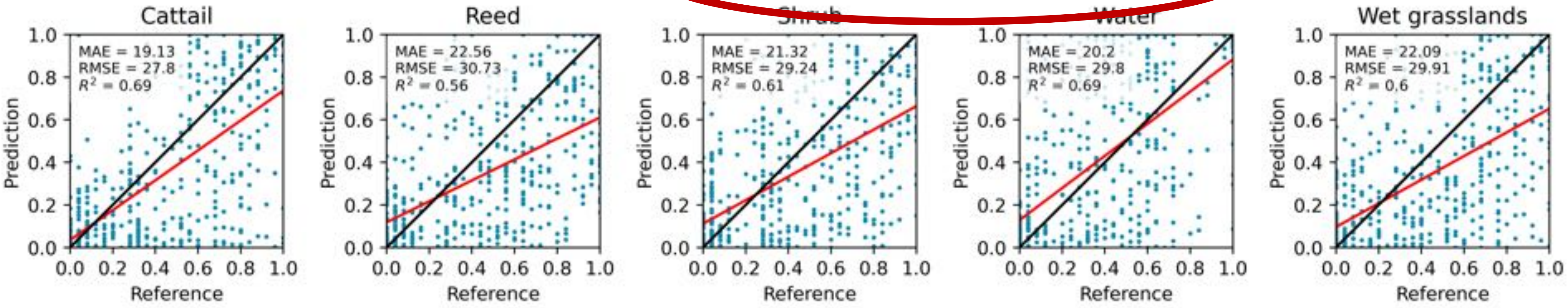
PRISMA April, June and August (mean MAE = 16.6 %, Δ MAE - 5.2 %)



LANDSAT + SENTINEL -2 intra-annual STMs (mean MAE = 21.8 %, Δ MAE + 5.2 %))



VALIDATION

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Datasets	Cattail (MAE %)	Reed (MAE %)	Shrublands (MAE %)	Wet grasslands (MAE %)	Water (MAE %)	Average (MAE %)
PRISMA-April, June and August	15.34	18.26	16.06	19.81	13.99	16.69
PRISMA-April and June	**14.94**	18.99	**15.49**	**18.26**	14.38	**16.41**
PRISMA-April and August	16.43	**17.98**	16.83	18.63	15.08	16.99
PRISMA-June and August	15.26	19.47	17.9	20.45	**13.57**	17.33
PRISMA-April	16.86	18.73	17.37	17.99	15.59	17.31
PRISMA-June	15.05	20.85	17.52	19.96	13.82	17.44
PRISMA-August	17.95	20.96	19.16	20.36	15.91	18.87
Landsat-8+Sentinel-2 (April & June STM)	19.16	22.36	21.14	22.69	19.91	21.05
Landsat-8+Sentinel-2 (annual STM)	22.16	23.78	20.87	22.17	20.02	21.8

DISCUSSION & CONCLUSION

- The regression-based unmixing approach allowed mapping the fractions of Reed and Cattail with 30-m-resolution hyperspectral data at significantly higher accuracy than with multispectral data
- When using multidate imagery, the errors improve. The combined datasets (April / June) produced the overall best results compared to other combinations and to single-date datasets
- Best singular observation dates vary by species

We conclude that

- Hyperspectral information contributes to an increased accuracy when mapping peatland vegetation on rewetted fens
- Higher temporal resolution from combined EnMAP-PRISMA time series will help extracting phenologies of peatland vegetation

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