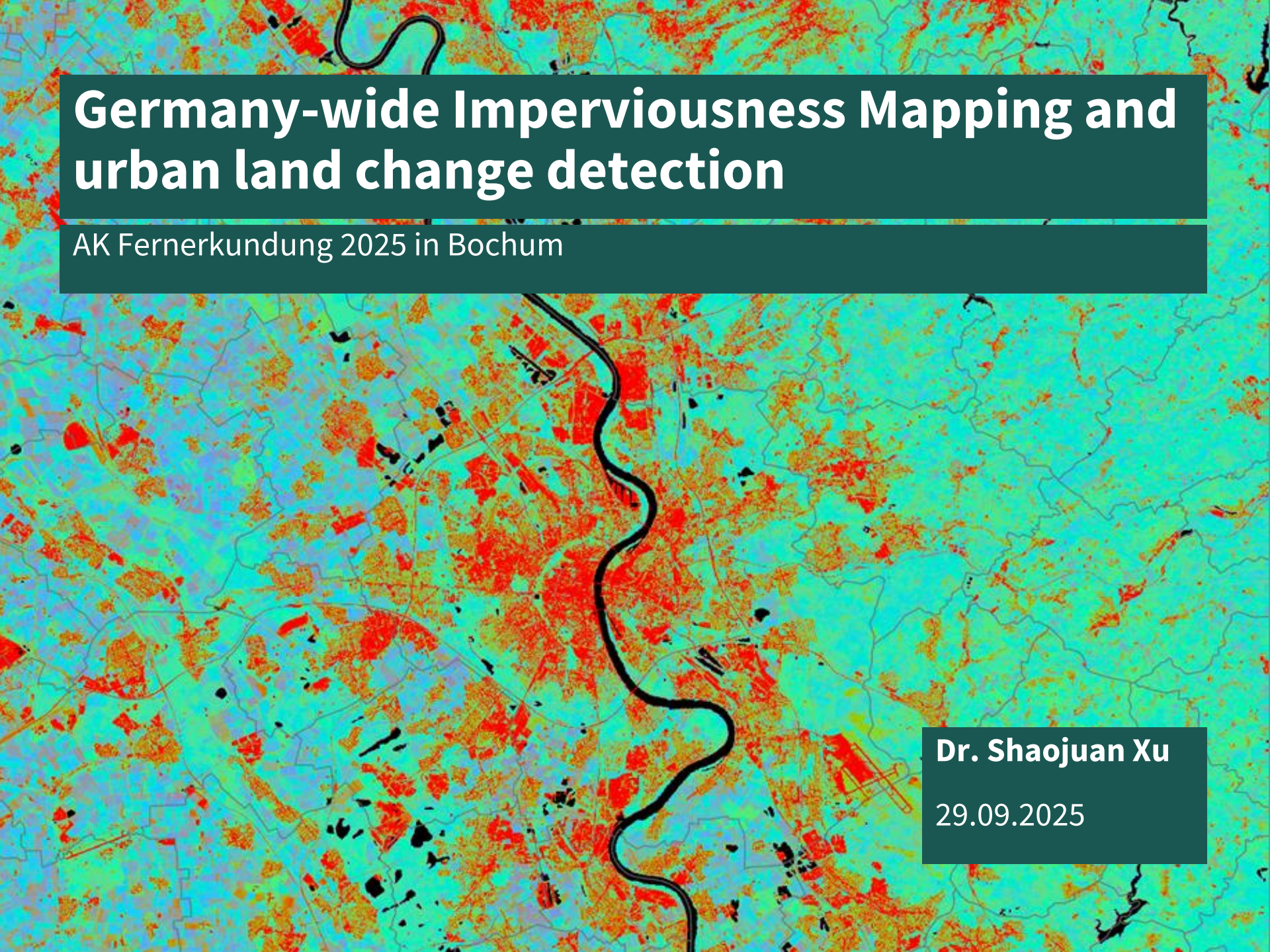




Germany-wide Imperviousness Mapping and urban land change detection

AK Fernerkundung 2025 in Bochum

Dr. Shaojuan Xu

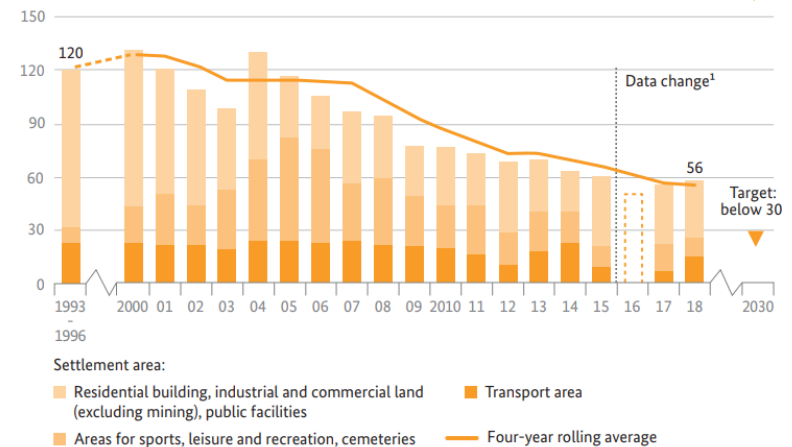
29.09.2025

Background

Reducing land take to 30 ha per day by 2030

- Copernicus Corine Land Cover
- Copernicus Imperviousness
- Copernicus Urban Atlas
- German ALKIS, ATKIS

Expansion of settlement and transport area
In hectares per day

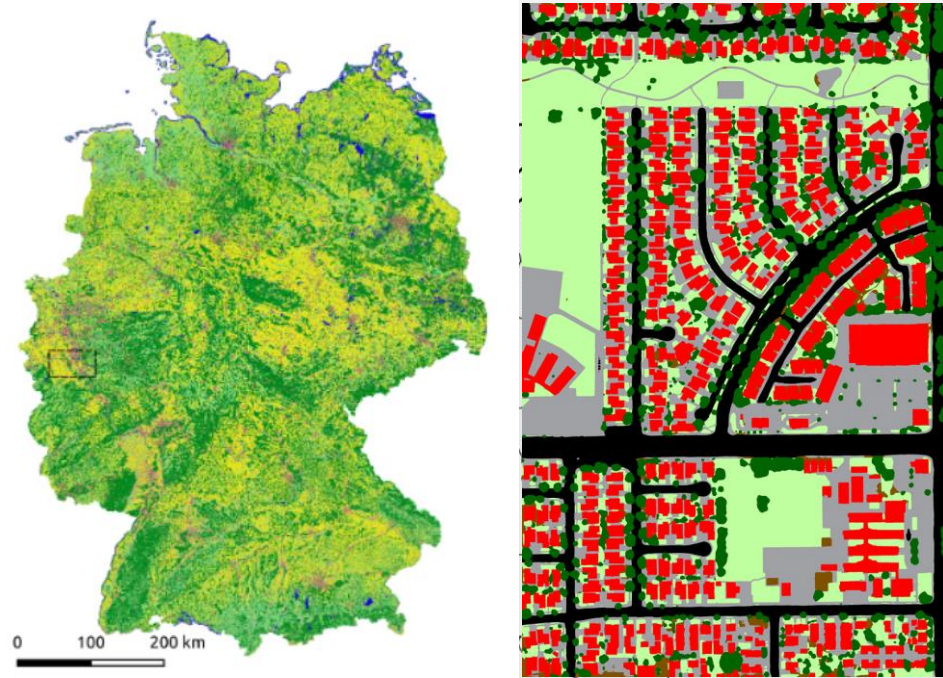


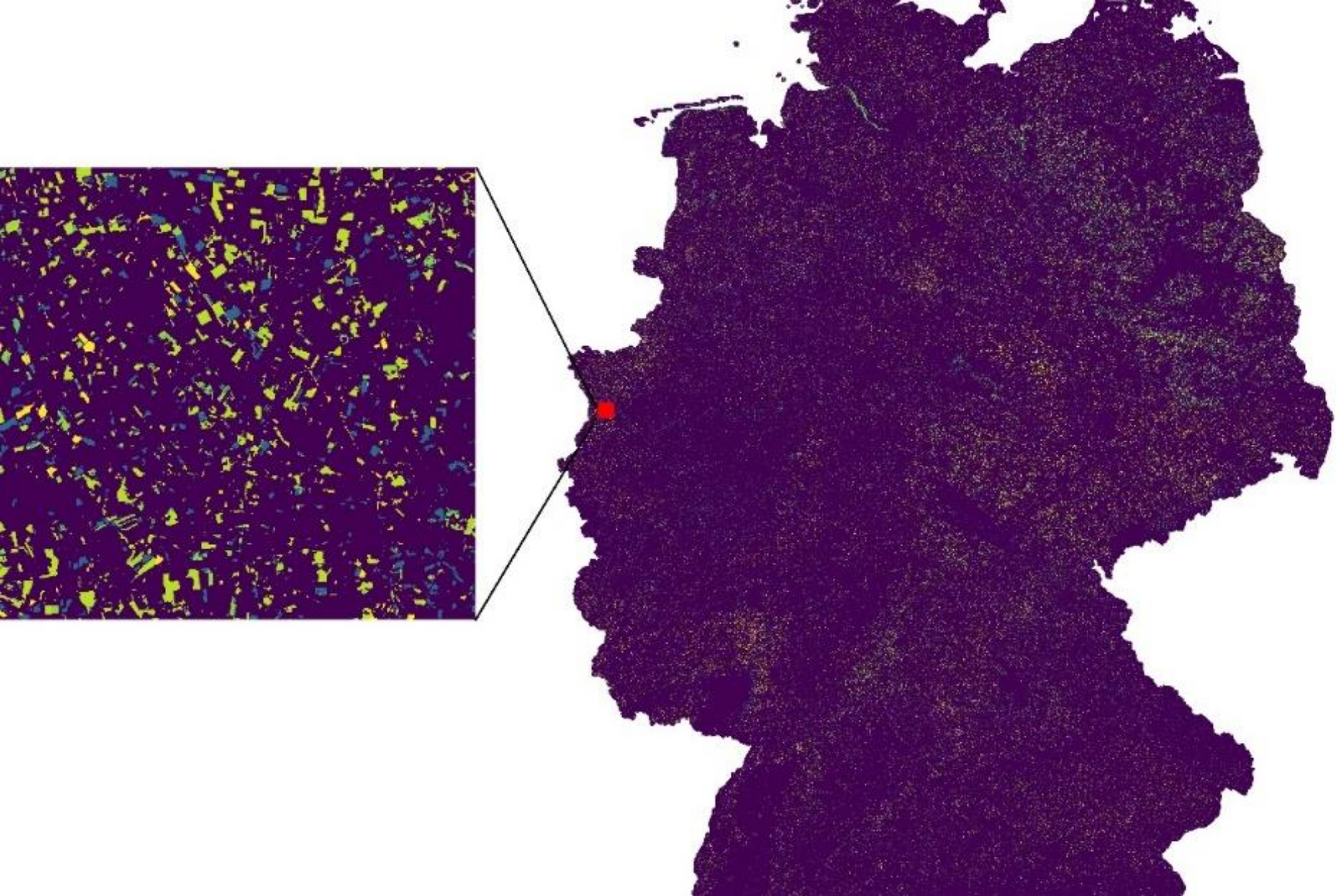
¹ The data for assessing settlement and transport land is taken from the official survey of land. Since 2016, the survey has been based on ALKIS, the official land register information system. As a result, the possibilities of comparison with previous years are limited and it is more difficult to calculate the extent of changes. The settlement and transport land covered after the switch largely encompasses the same categories of land use as before.

Source: Federal Statistical Office

Issues of AI and pixel-based image classification

- Random noises caused by different atmospheric conditions, sun angle, soil moisture or vegetation phenology change
- Difficulties in detecting subtle changes
- Mixed pixels problem
- Transfer the continuous spatial variation of urban land cover into discrete classes

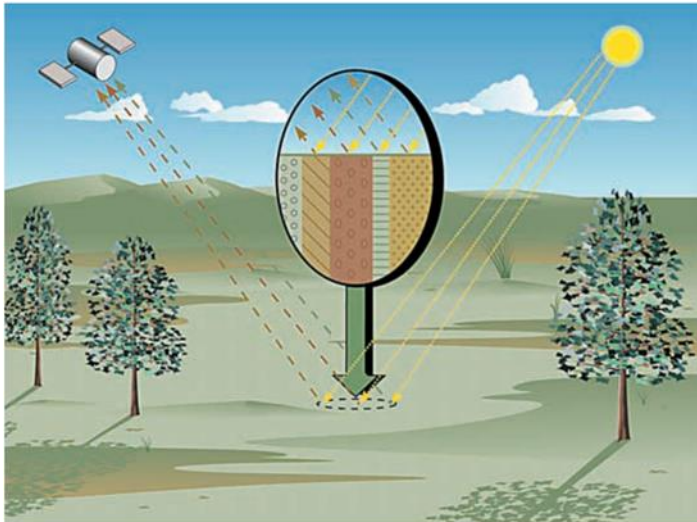




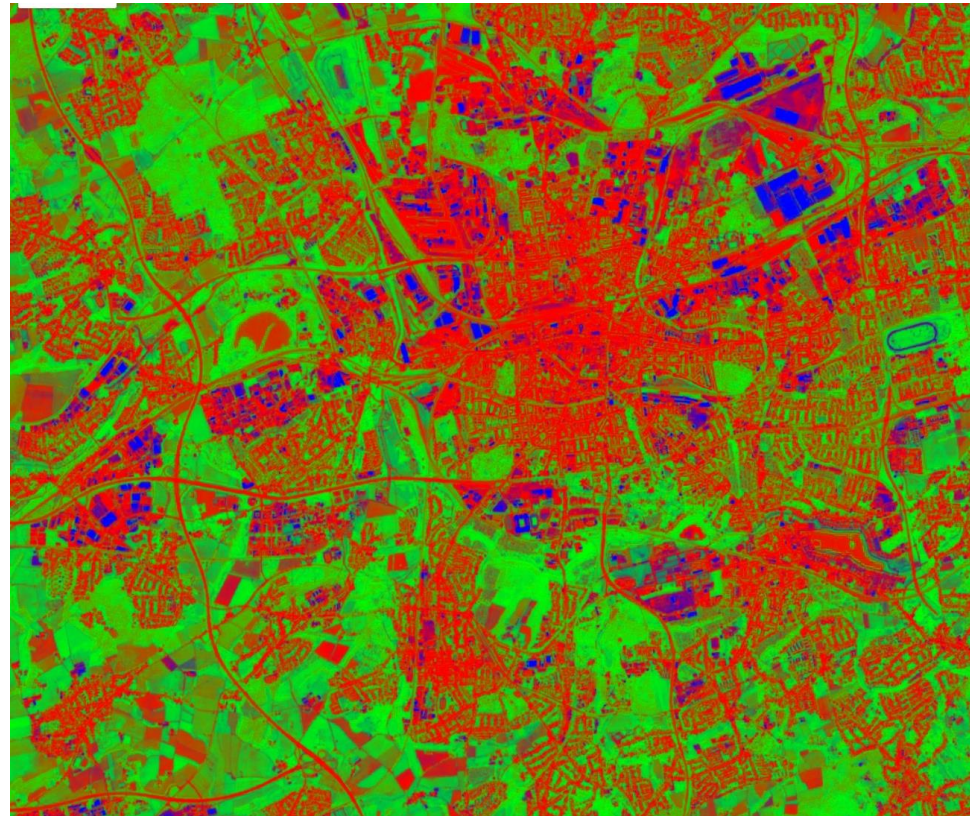
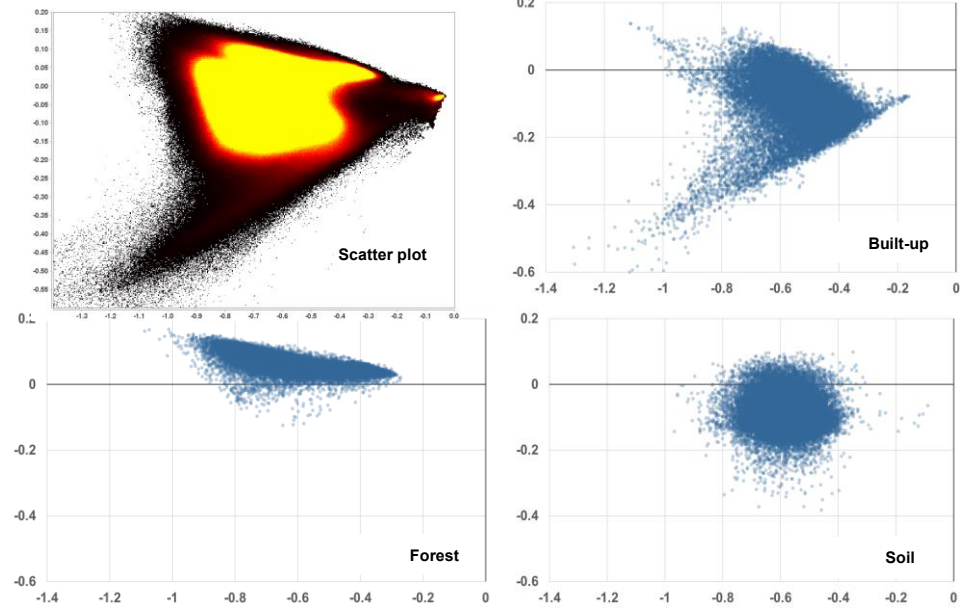
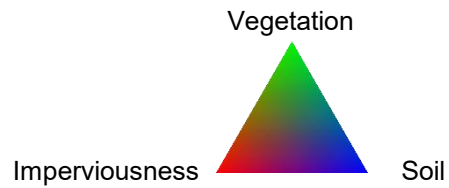
Imperviousness mapping



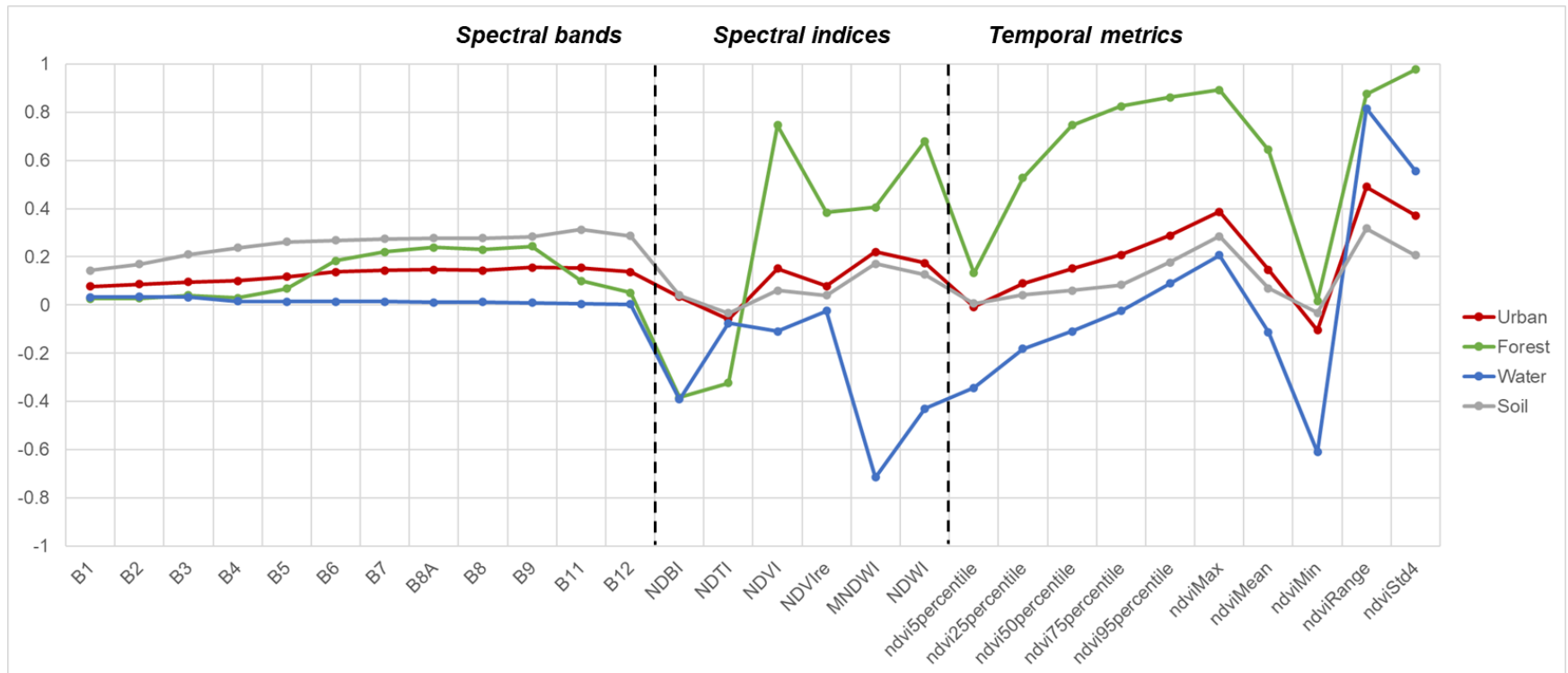
Spectral unmixing



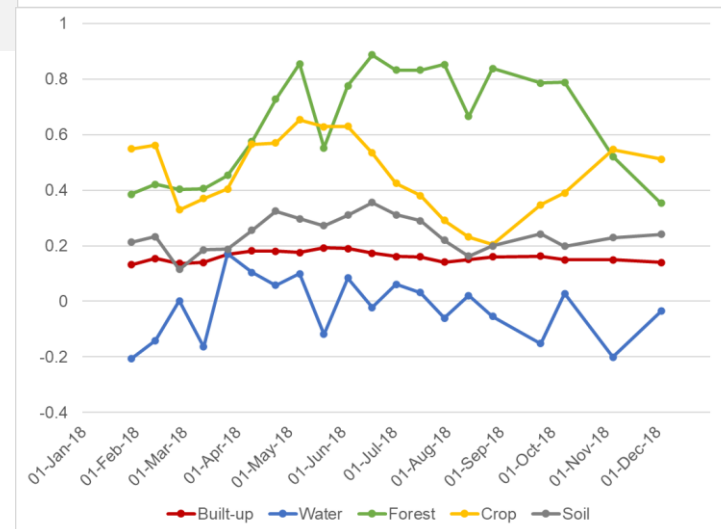
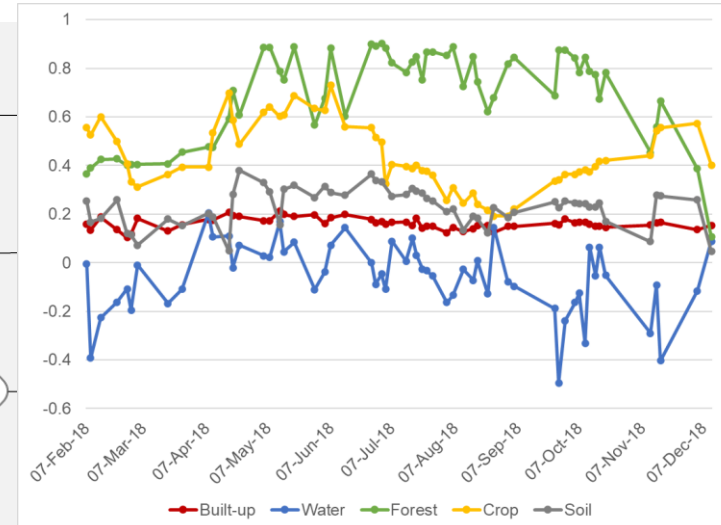
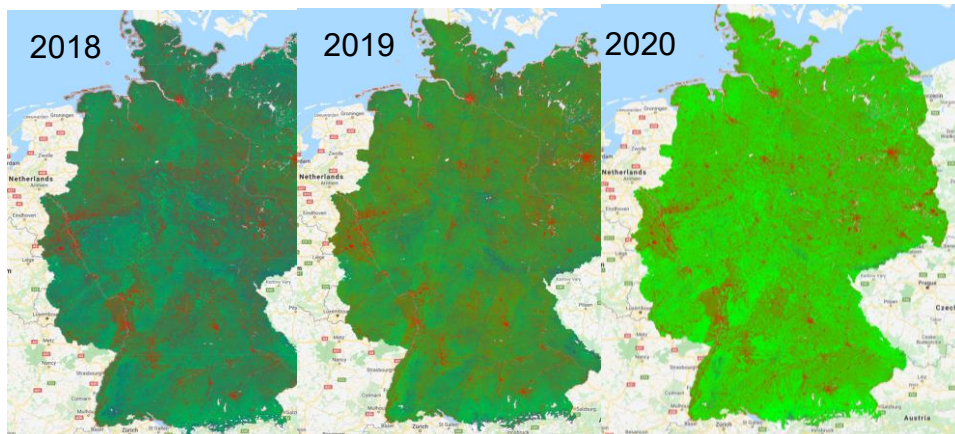
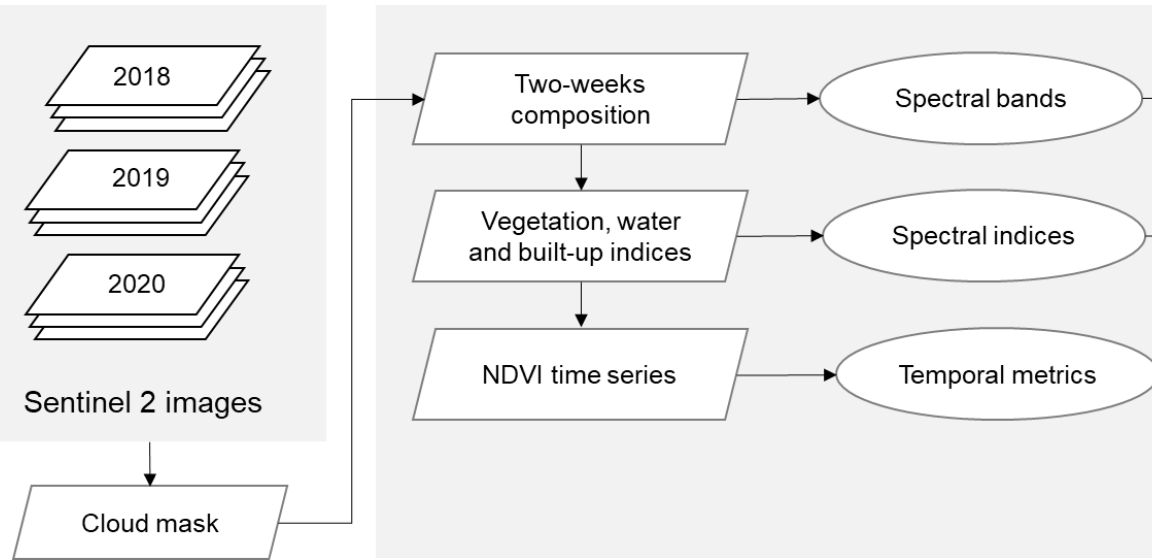
Source: Keshava & Mustard, 2002



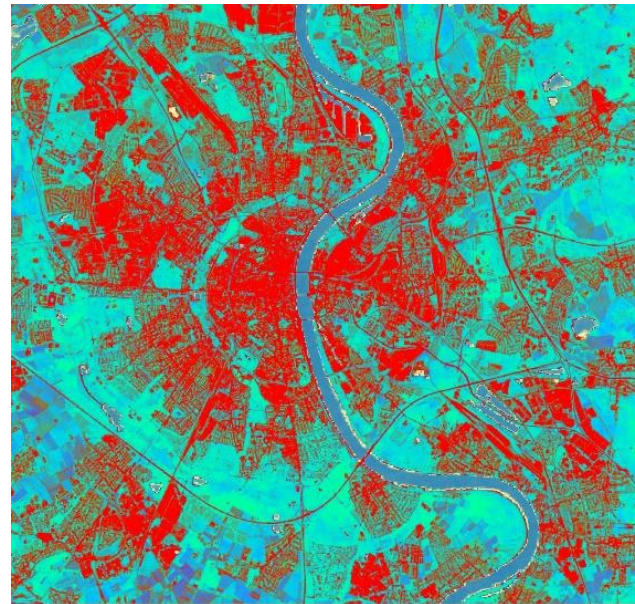
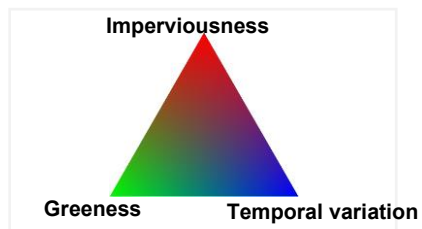
Integration of temporal information



Workflow

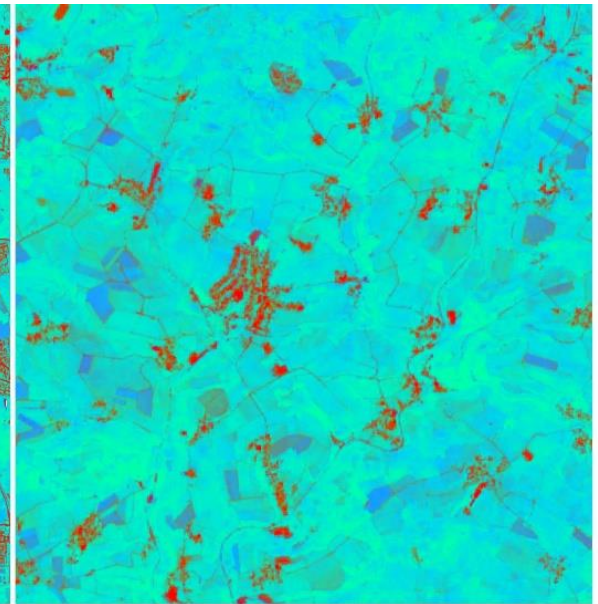


Imperviousness mapping result



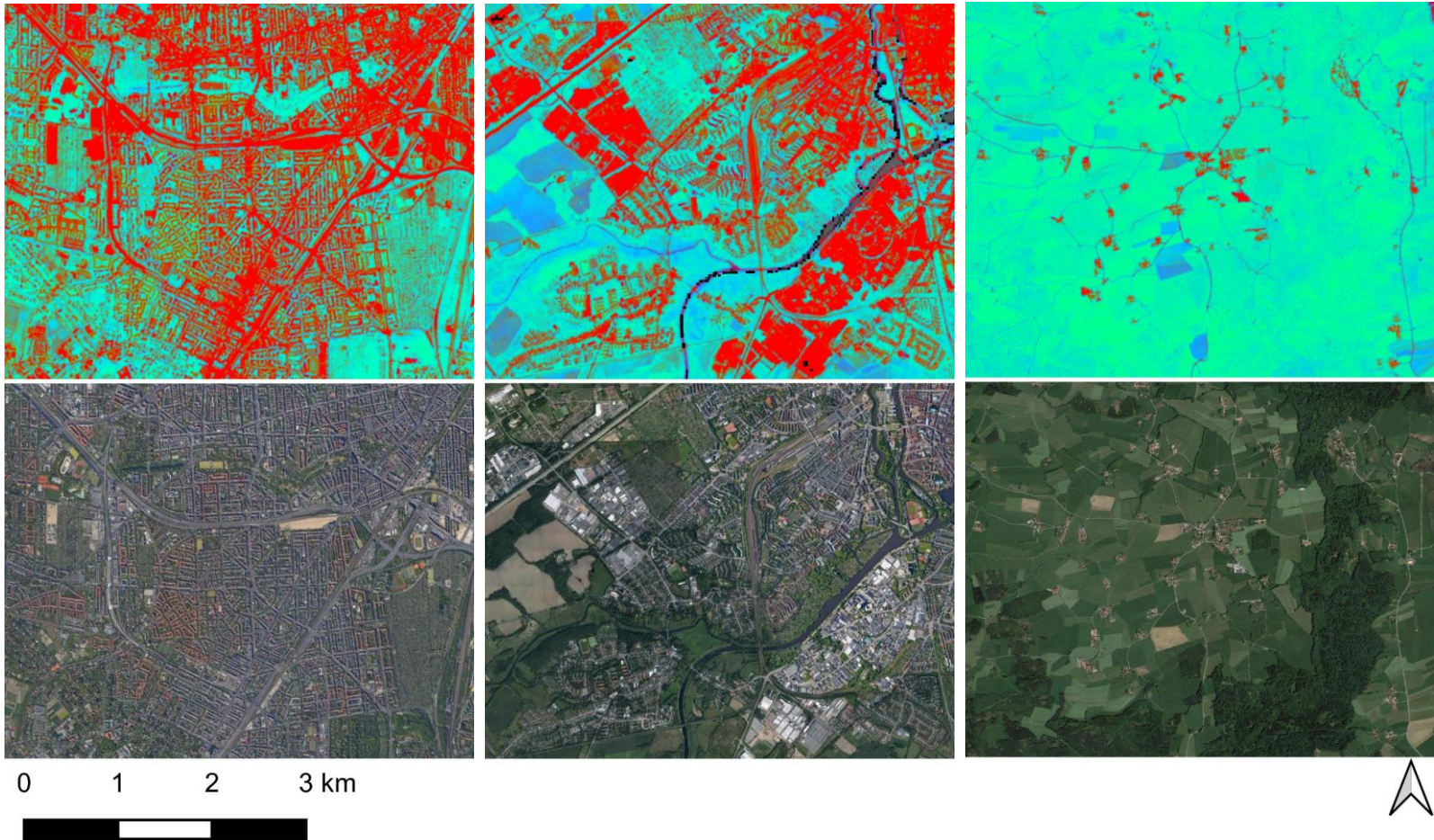
1: 150000

0 1 2 km

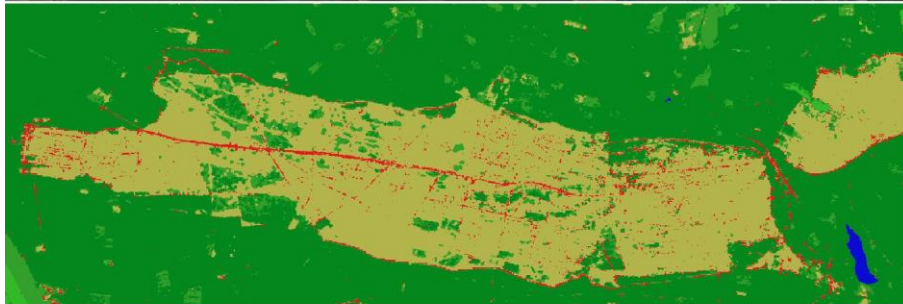
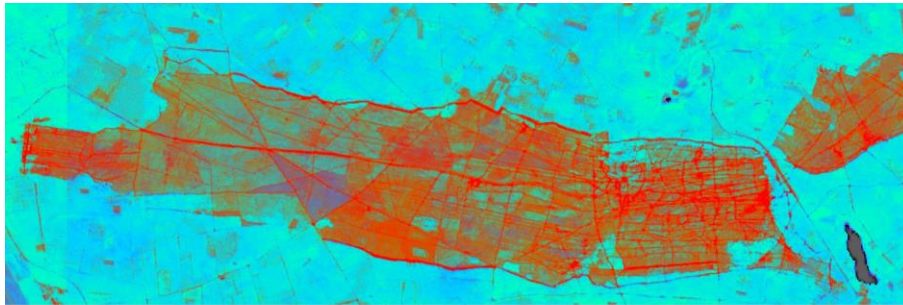


0 0.5 1 km

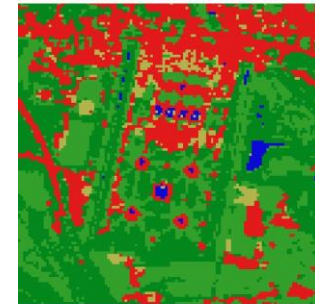
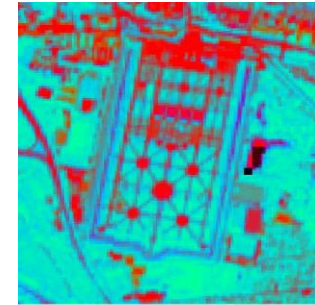
Comparison with aerial photos



Comparison with image classification



0 1 2 3 km



0 400 800 m

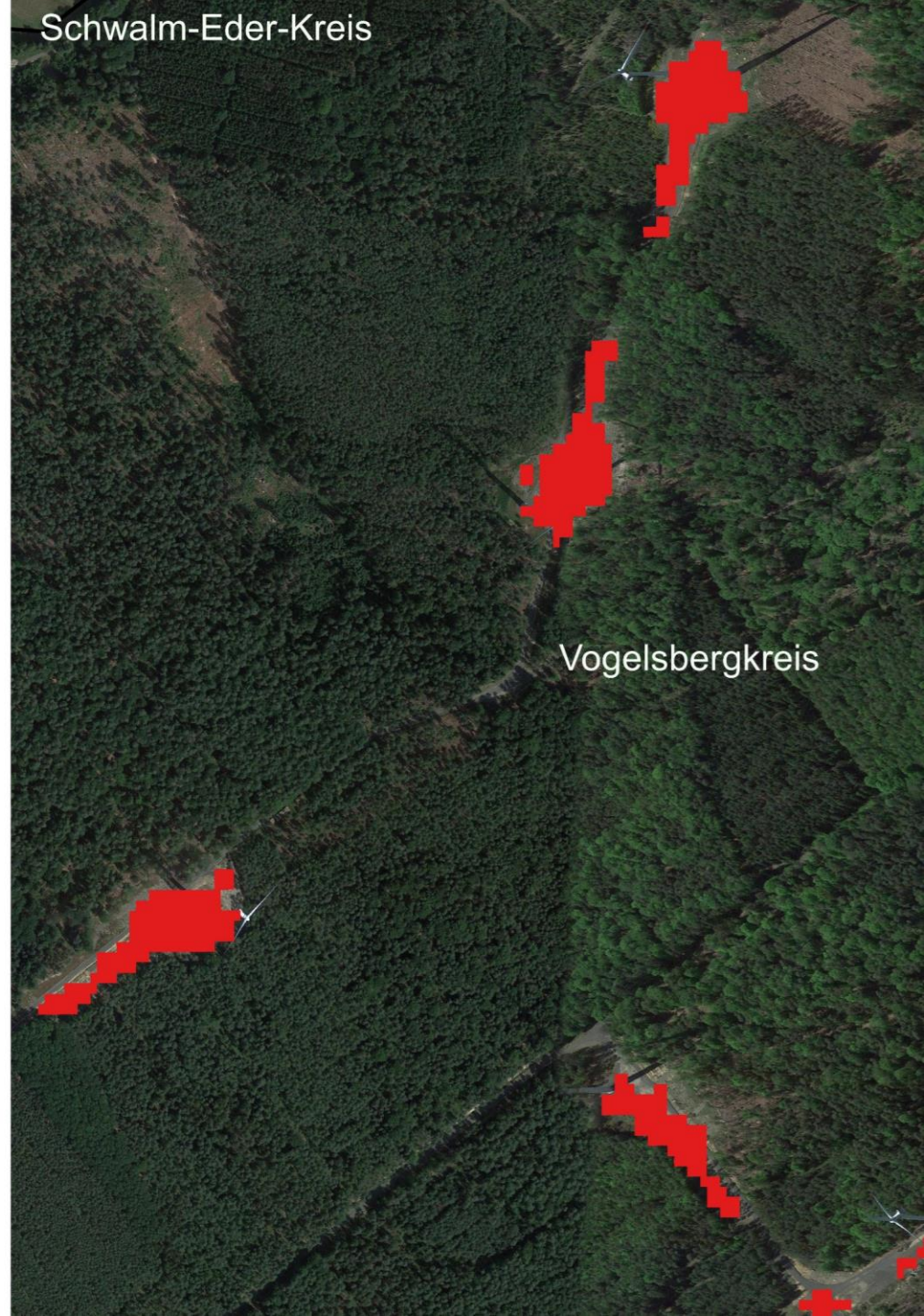


Change detection

Warendorf



Schwalm-Eder-Kreis



Vogelsbergkreis

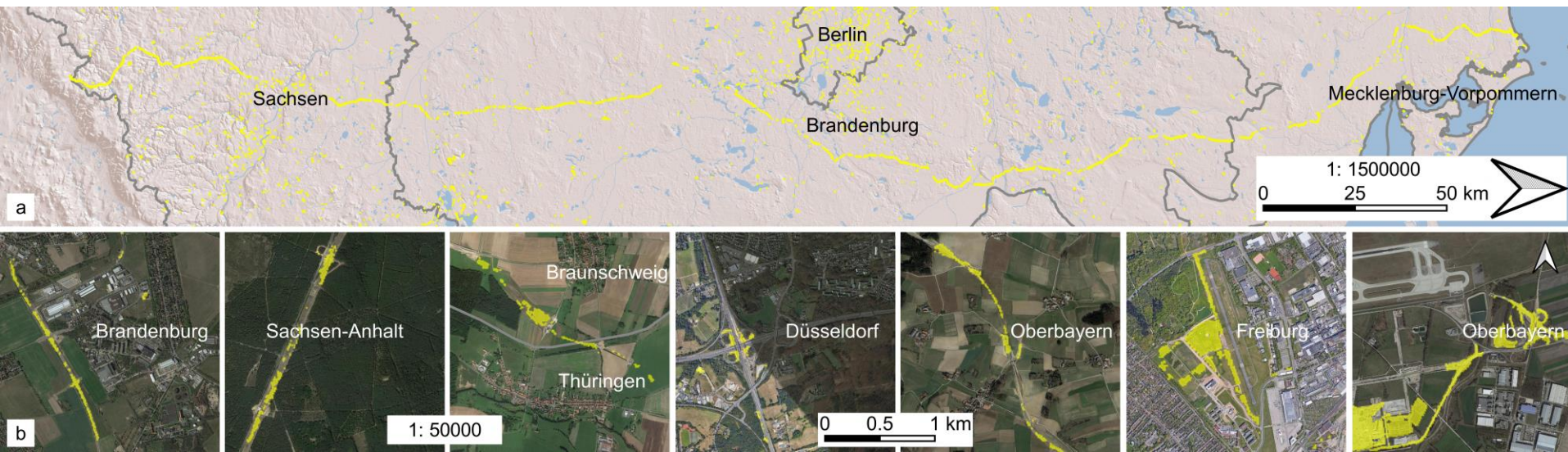
Change Detection in residential area



Change Detection in industrial areas



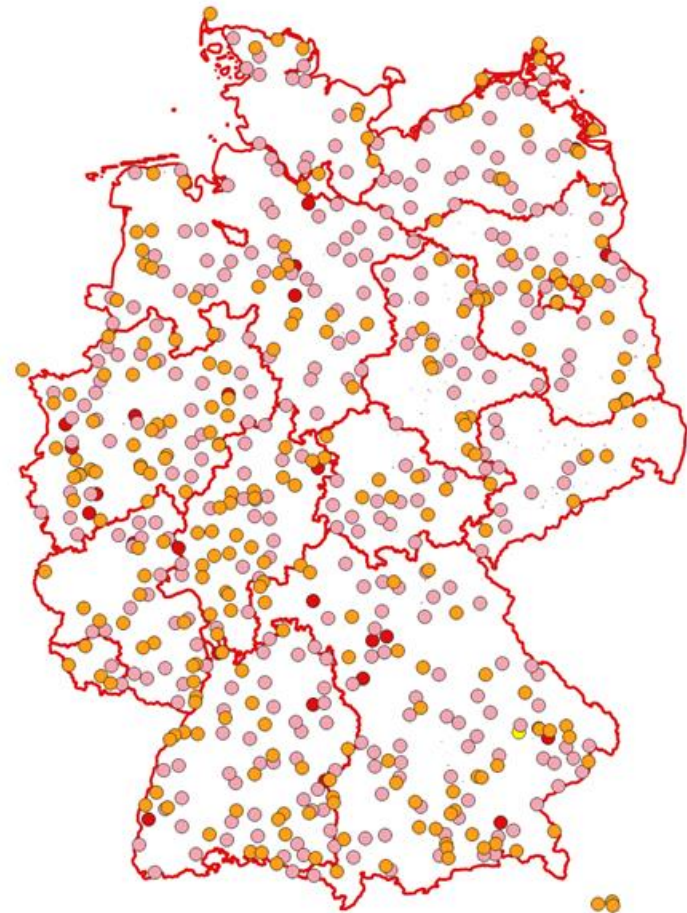
Change Detection in the transportation areas



Validation

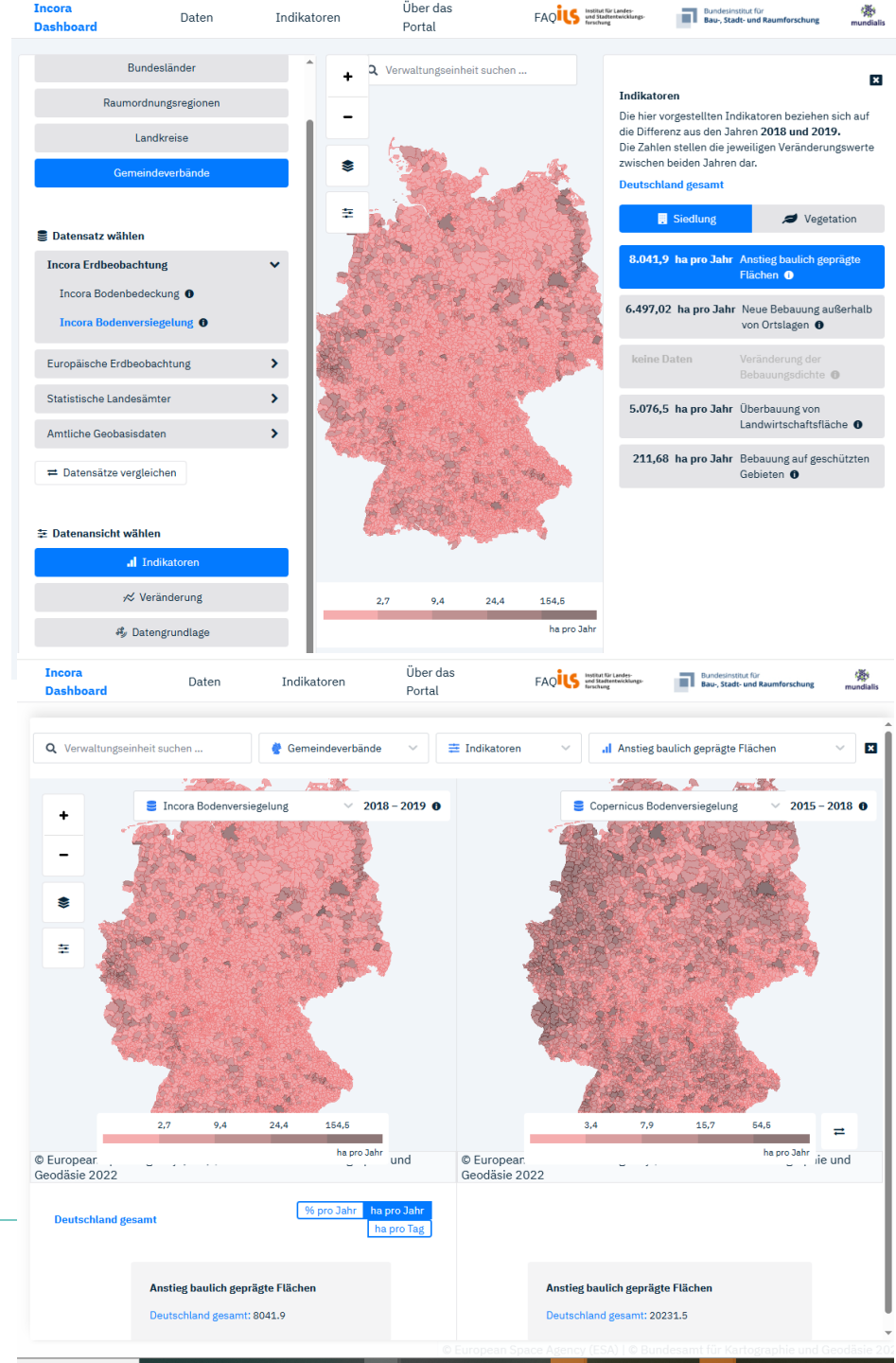
Binary error matrix			
Change map	Ground truth		Total
	No new built-up	New built-up	
No new built-up	0.50	0.00	0.50
New built-up	0.13	0.37	0.50
	0.63	0.37	1.00
Accuracy = 87%			

Change map	Ground truth		Total
	No change	Change	
No Change	0.50	0.00	0.50
Change	0.02	0.48	0.50
Total	0.52	0.48	1.00
Accuracy = 98%			



Summary

- Integration of temporal information improved imperviousness mapping accuracy
- Continuous index as a basis of comparison reduced random noise to 2%
- Remote sensing products as reliable instruments to support sustainable land use policy



Reference

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National-scale imperviousness mapping and detection of urban land changes

Shaojuan Xu ^{a b}  , Stefan Fina ^{a c}  

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Highlights

- Germany-wide imperviousness mapping and change detection.

Thank you

Research Institute for regional and Urban development

Brüderweg 22 – 24

44135 Dortmund

E-Mail: shaojuan.xu@ils-forschung.de

www.ils-research.de

Earth Observation Lab at Humboldt University of Berlin

Alfred-Rühl-Haus Rudower Chaussee 16

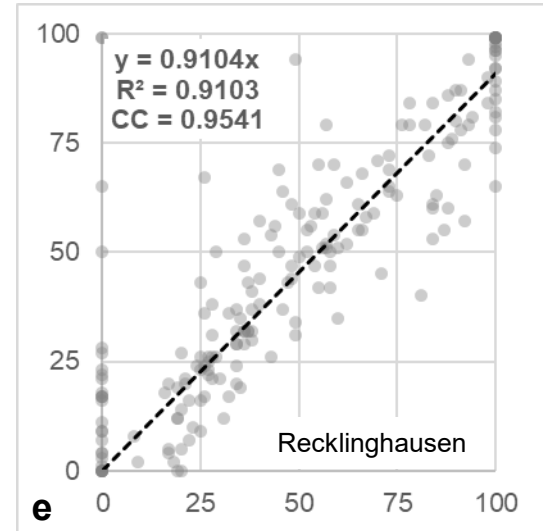
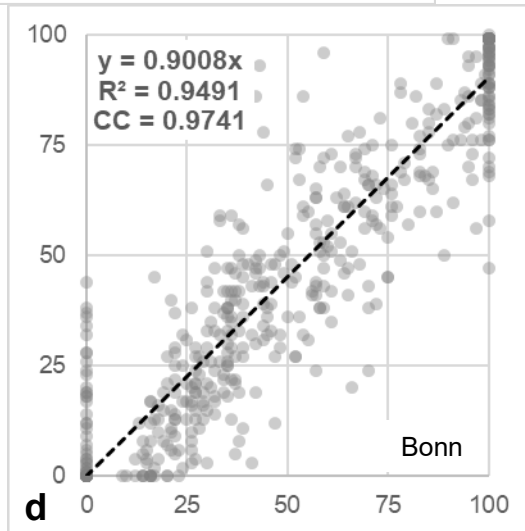
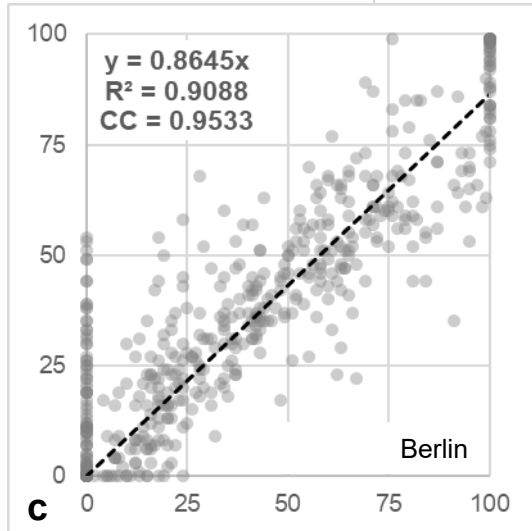
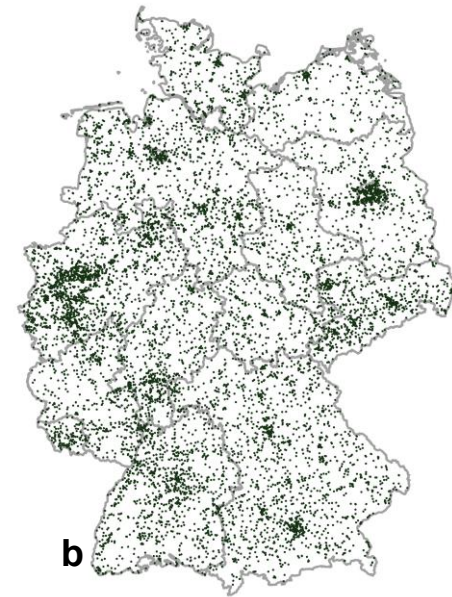
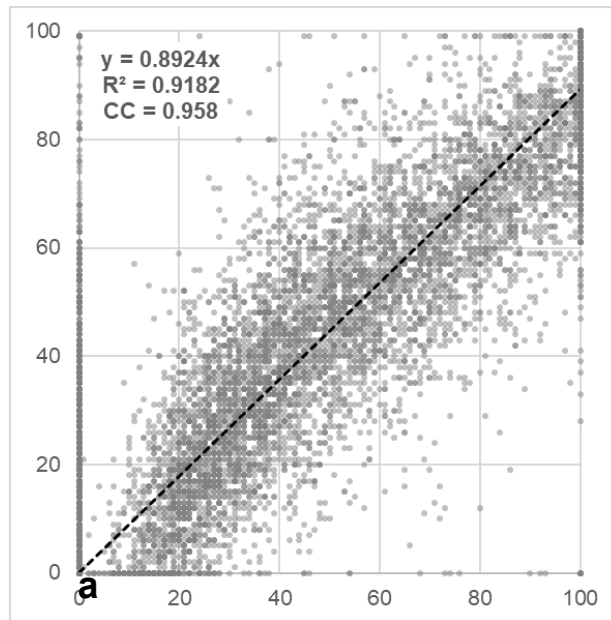
12489 Berlin

E-Mail: shaojuan.xu@hu-berlin.de

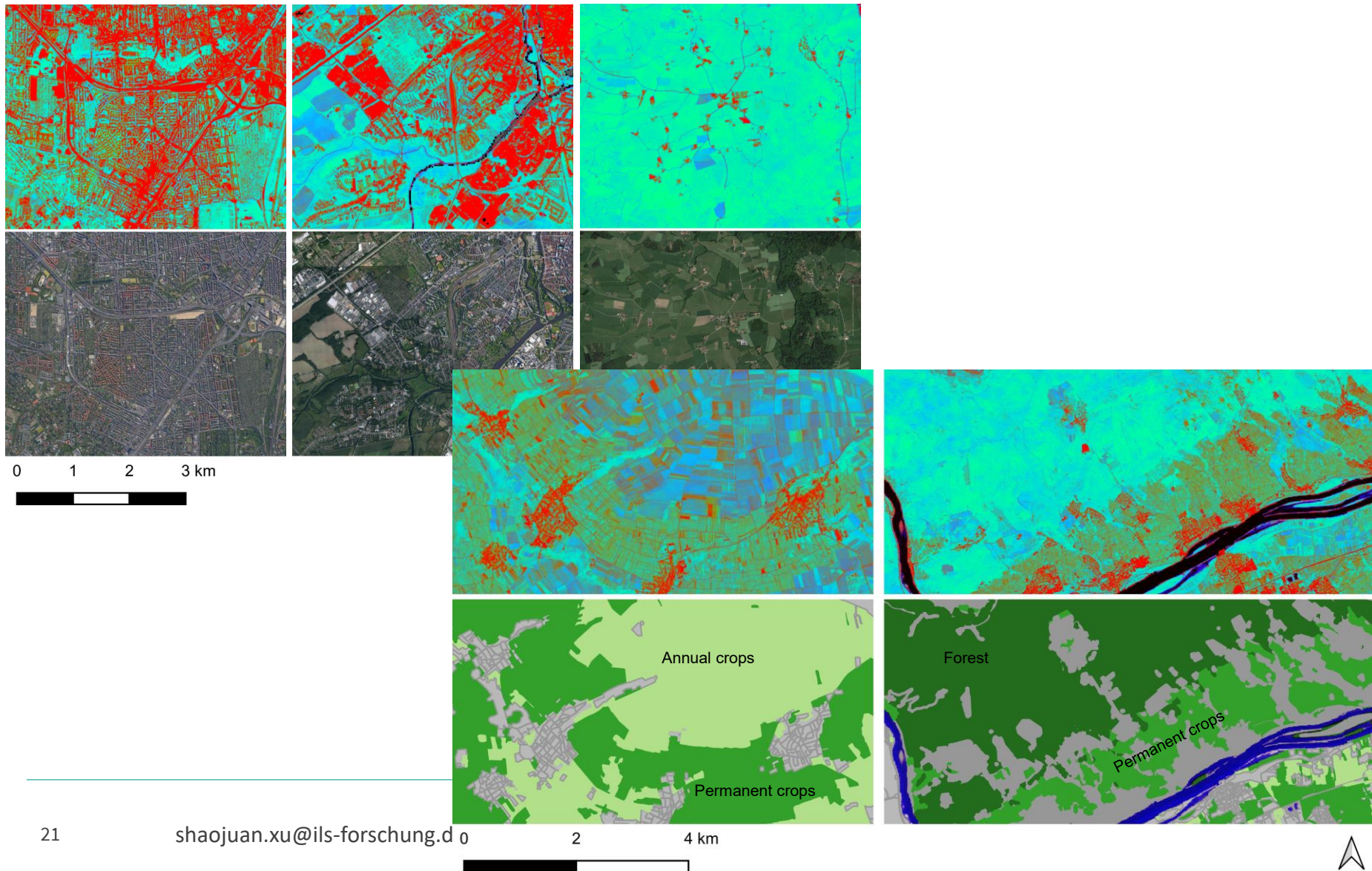
<https://eolab.geographie.hu-berlin.de/>



Validation of imperviousness



Urban and Vegetation



Imperviousness mapping result

