The potential of the Soil Composite Mapping Processor (SCMaP) for analyzing temporal changes of exposed soils in Germany between 1984-2014

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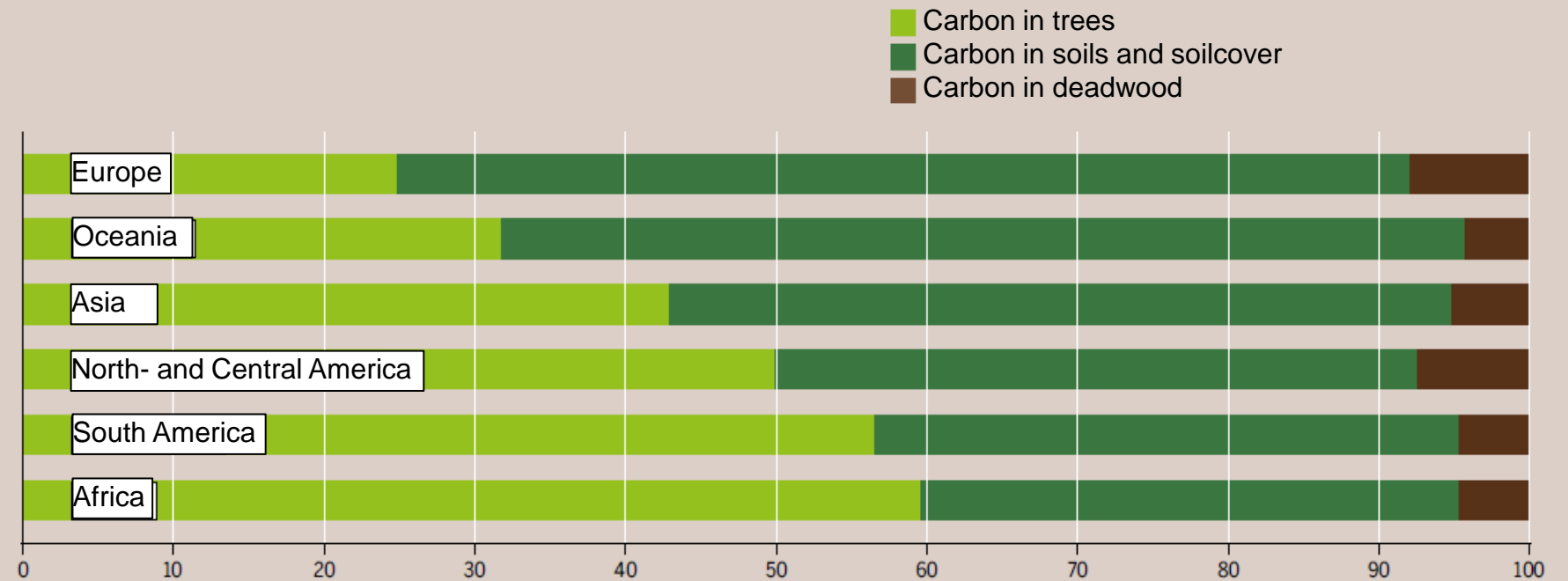3 Hyperspectral Intelligence Inc.

09.07.2018

Knowledge for Tomorrow

Motivation

Soil information with high spatial and temporal resolution is necessary to analyse SOC content and the developments respective to current land use changes.

Carbon in trees
Carbon in soils and soilcover
Carbon in deadwood

BODENATLAS 2015 / FAO

Europe
Oceania
Asia
North- and Central America
South America
Africa

0   10   20   30   40   50   60   70   80   90   100

Soil Composite Mapper – Mapping Soils is a Challenge
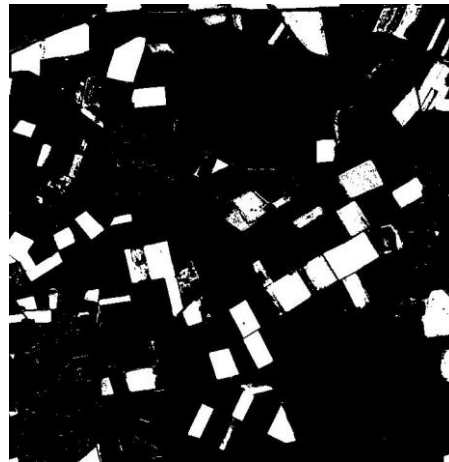

Expanding data base for soil analysis
Bare Soil Exposure =
47.9 %

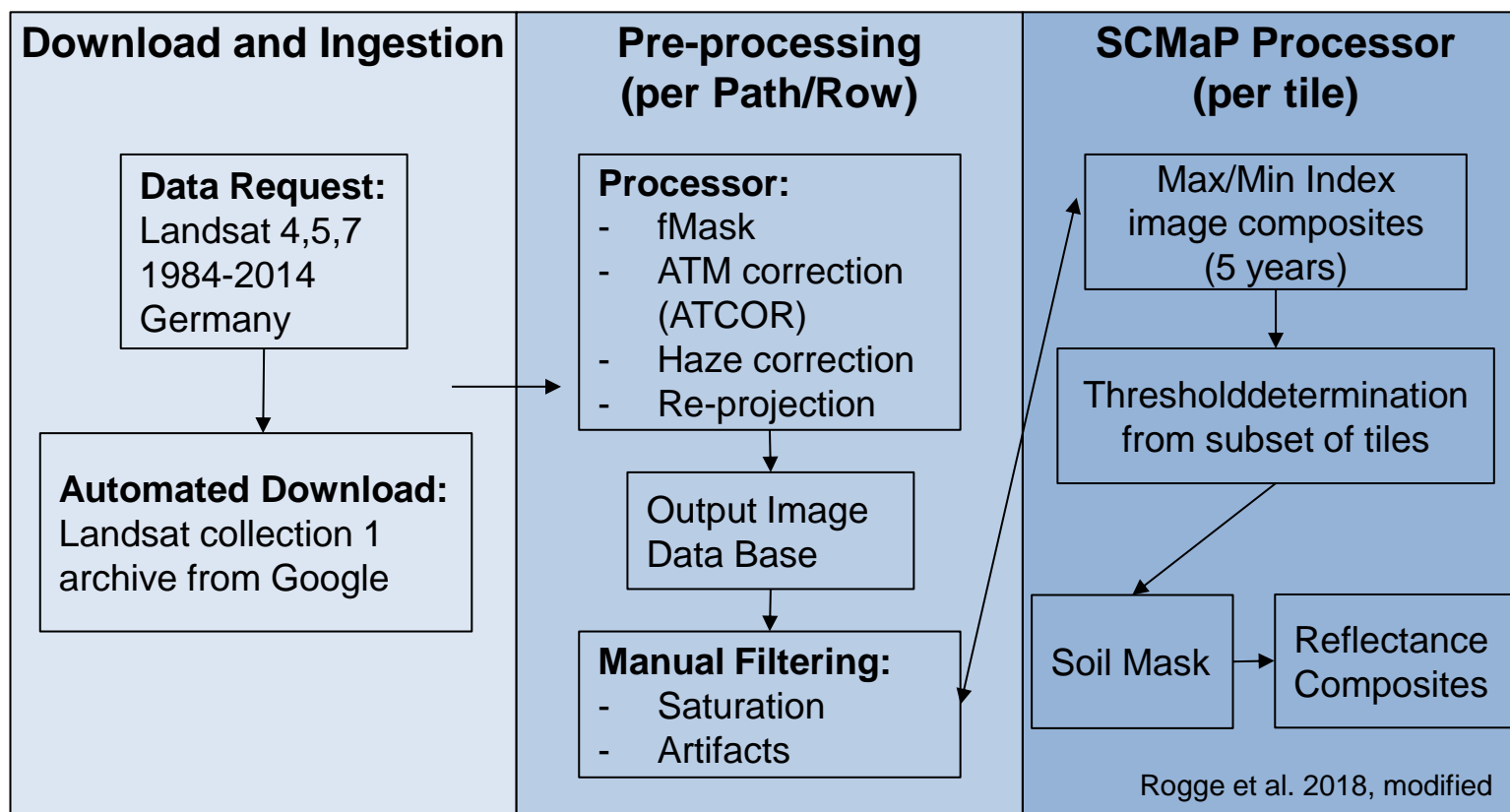April – 23.5%   May – 20.1%   July – 15.9%   September – 30.8%

Rapid Eye imagery example

SCMaP – Extraction of bare soils over time

• Overview of the Soil processor:

Download and Ingestion	**Pre-processing (per Path/Row)**	**SCMaP Processor (per tile)**
Data Request: Landsat 4,5,7 1984-2014 Germany	**Processor:** - fMask - ATM correction (ATCOR) - Haze correction - Re-projection	Max/Min Index image composites (5 years)
Automated Download: Landsat collection 1 archive from Google	Output Image Data Base	Thresholddetermination from subset of tiles
	Manual Filtering: - Saturation - Artifacts	Soil Mask → Reflectance Composites

Rogge et al. 2018, modified

Number of scenes	Process
18146 240 LT04 11263 LT05 2172 LE07	Downloaded and ingested files for pre-processing
9479 184 LT04 5880 LT05 3415 LE07	Fmask, atmospheric correction, haze removal, re-projection
9331	Manual Filtering

DLR   LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

SCMaP – Extraction of bare soils over time

$$PV\ Index = \frac{NIR-RED}{NIR+RED} + \frac{NIR-BLUE}{NIR+BLUE}\ \text{(Rogge et al. 2018)}$$
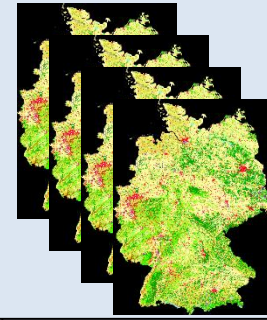
SCMaP – Extraction of bare soils over time

Thresholds:
Max: Urban
Min: deciduous forest

Automated selection

CORINE land cover: 1990/2000/ 2006/2012
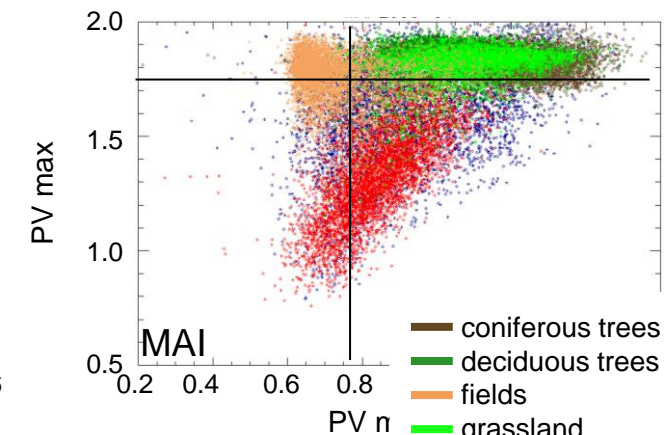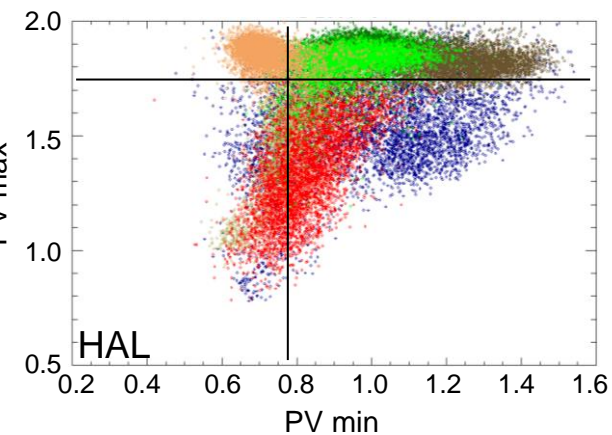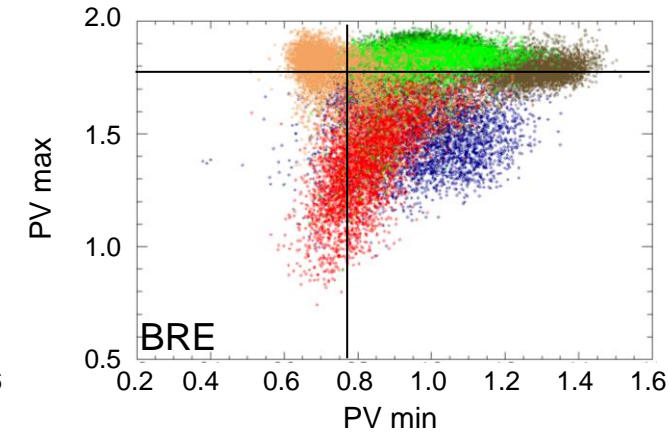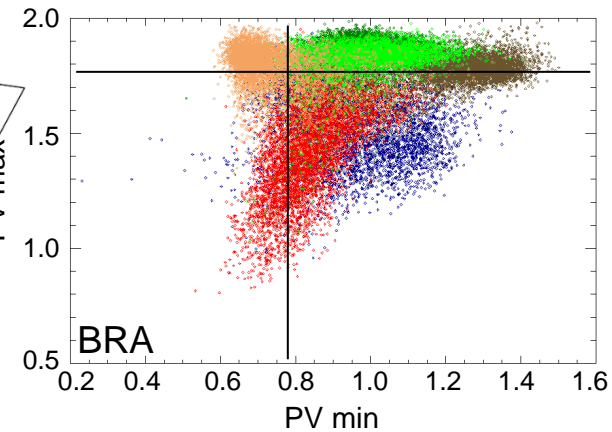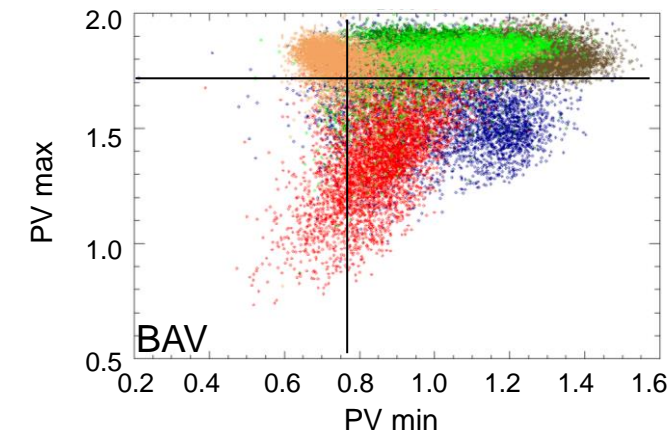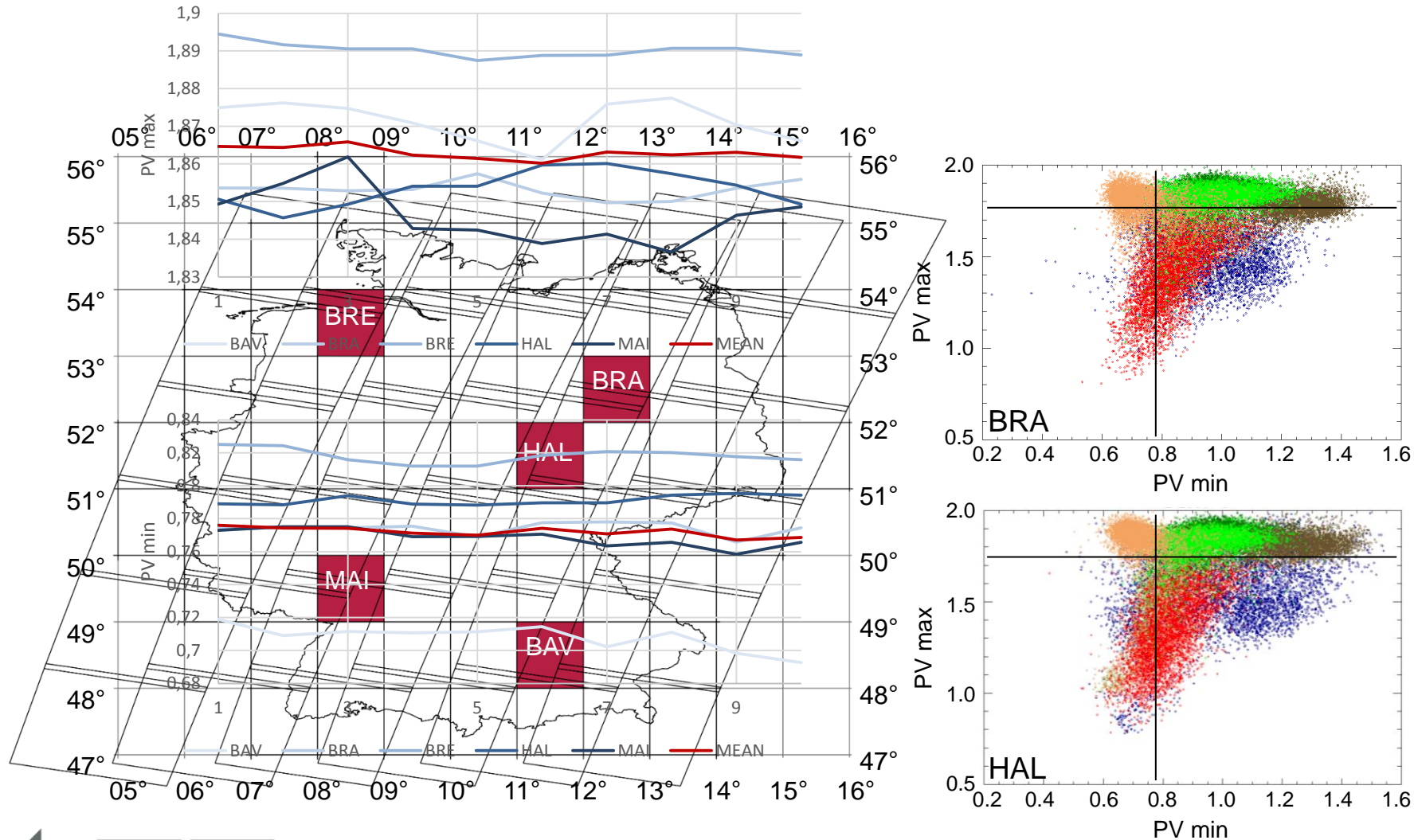
Temporally stable Pixel:
coniferous trees
deciduous trees
fields
grassland
shrub
urban
water

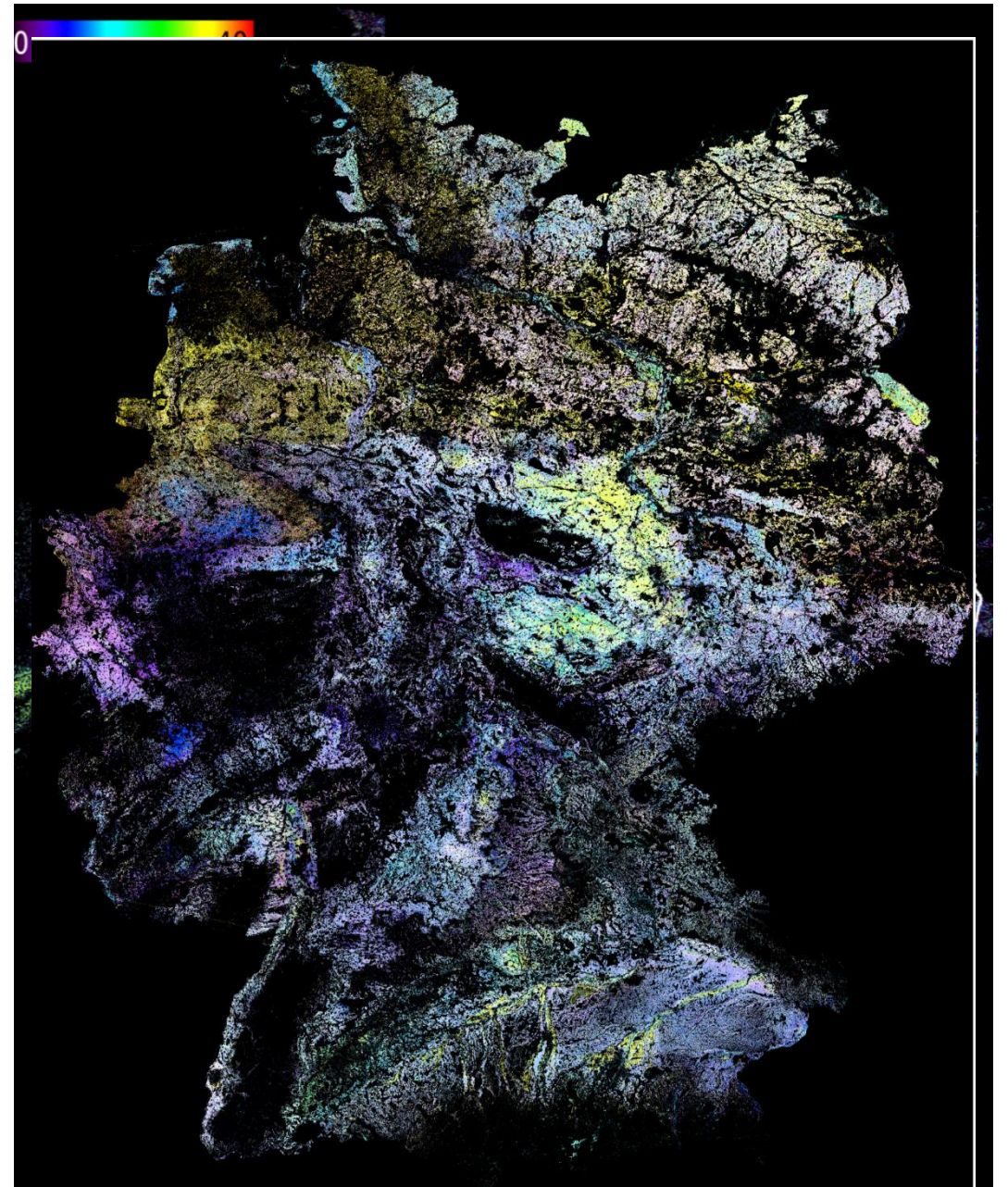Elimination of single pixel / edge pixel

Random selection: of 5000 pixel per class

SCMaP – Extraction of bare soils over time

SCMaP – Extraction of bare soils over time

SCMaP provides different product levels:

1. Binary maps
   - Permanent no vegetation
   - Permanent vegetation
   - Exposed soils
2. Statistical assessment of soils (frequency, productivity)
3. Reflectance Composites
   - Cloud free bare soil Reflectance composites
4. Higher order products
   - soil mineralogy
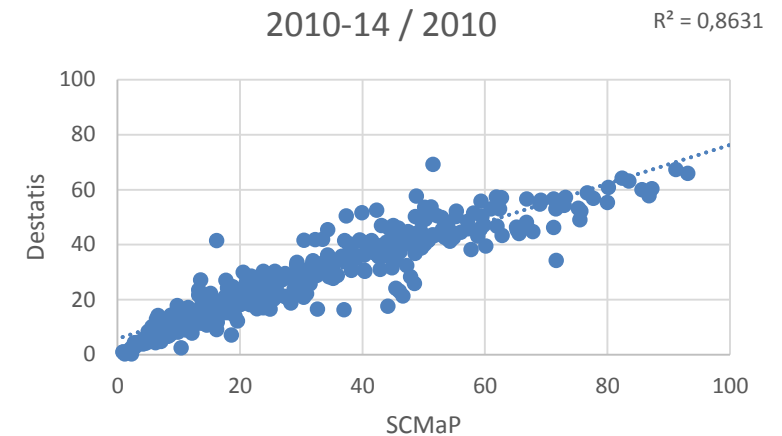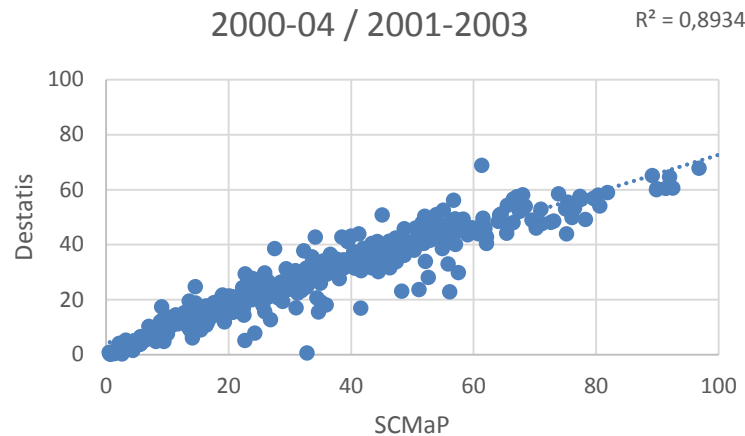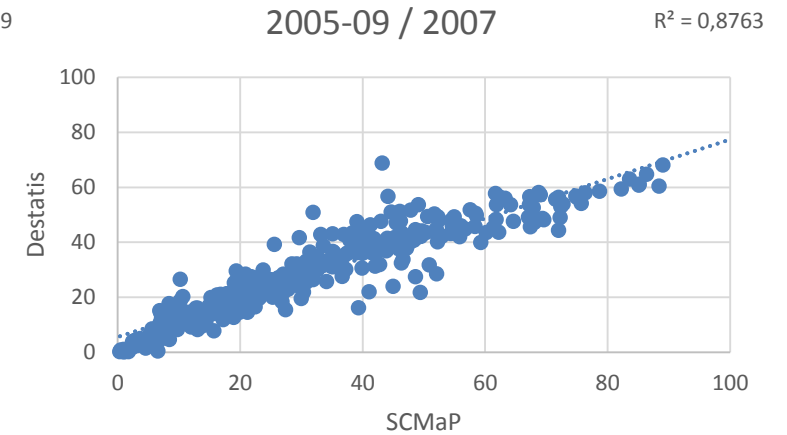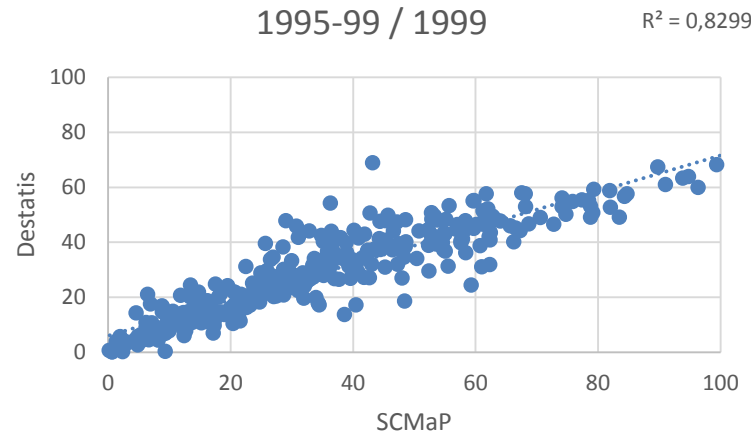   - soil organic carbon
   - soil functions

Exposure of bare soils over time

■ permanent no vegetation
■ permanent vegetation
■ soil

Validation I

- Statistical Data from DESTATIS (German Federal Statistical Office)
- Agricultural used areas (except permanent grassland)
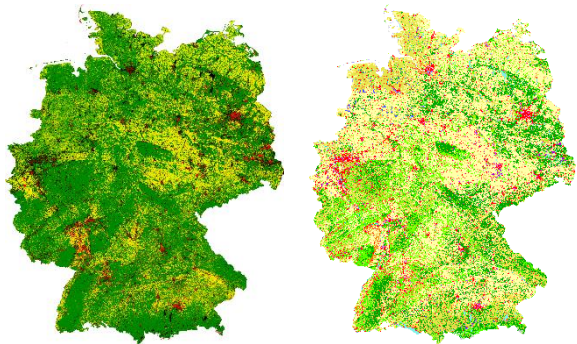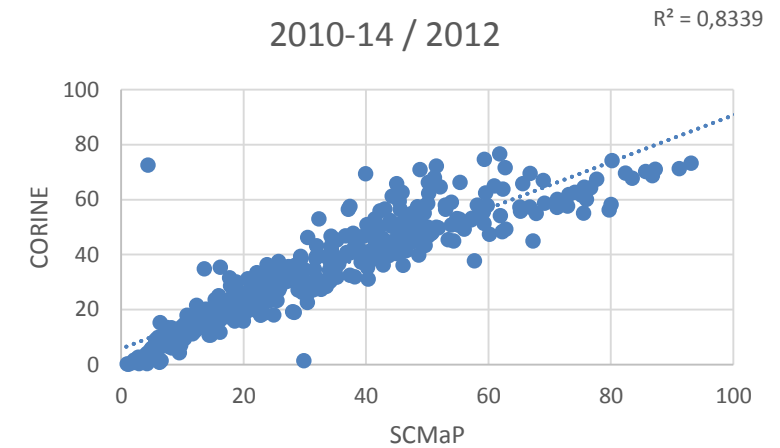- 1999, 2001, 2003, 2007, 2010
- Comparison on county level

Validation II

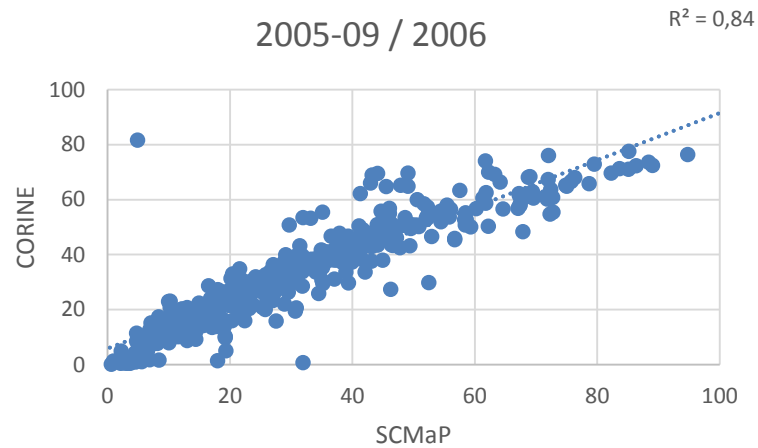- CORINE Land cover
- Arable land (except permanent grassland)
- 1990, 2000, 2006, 2012
- Comparison per pixel

Results

Results

Change of agricultural used areas
- < -10%
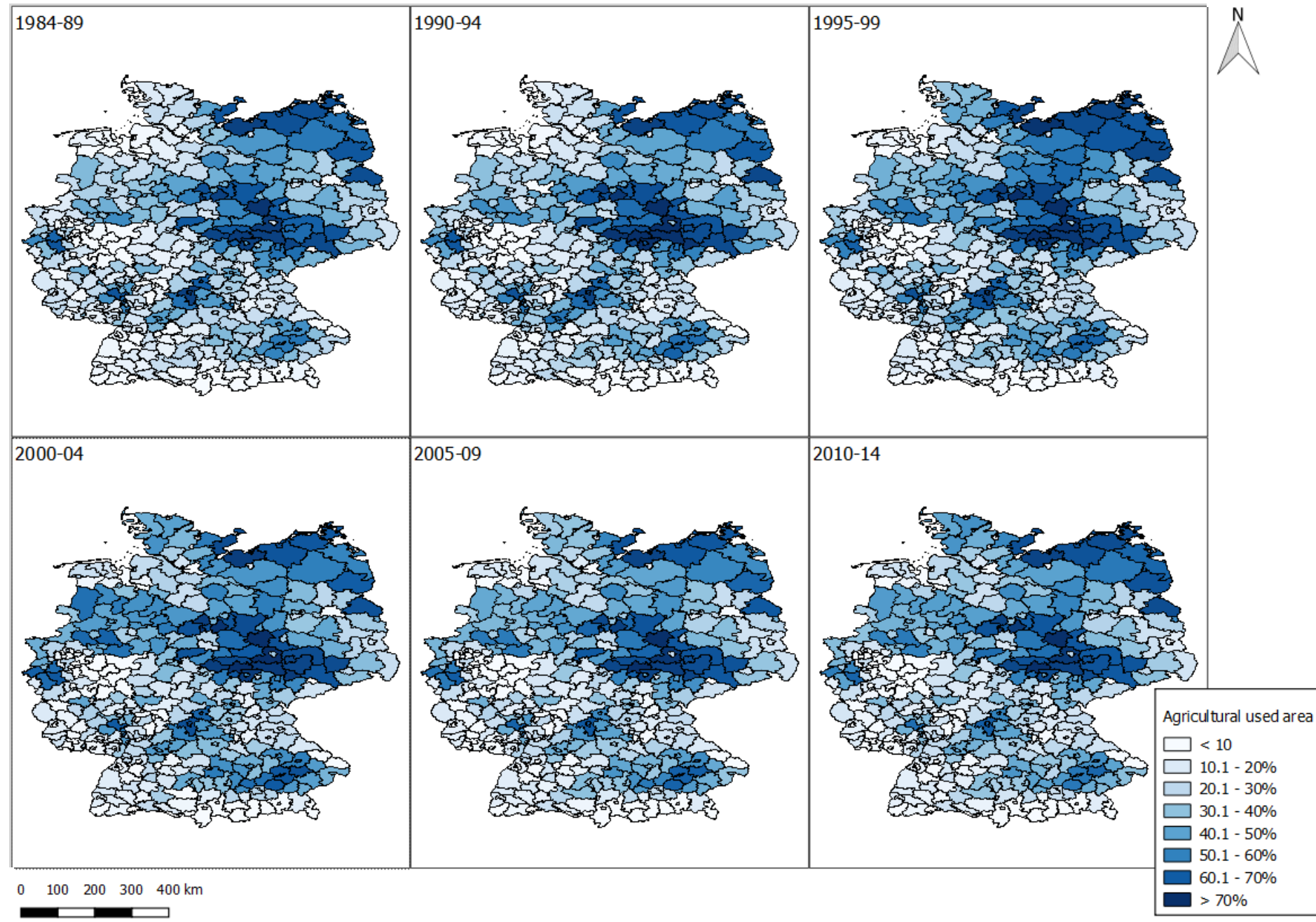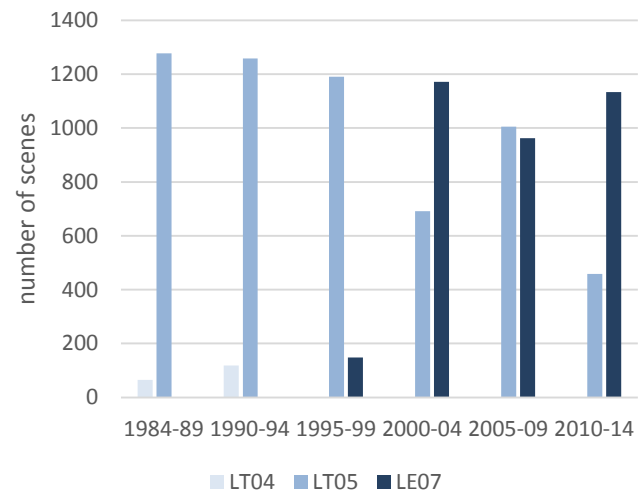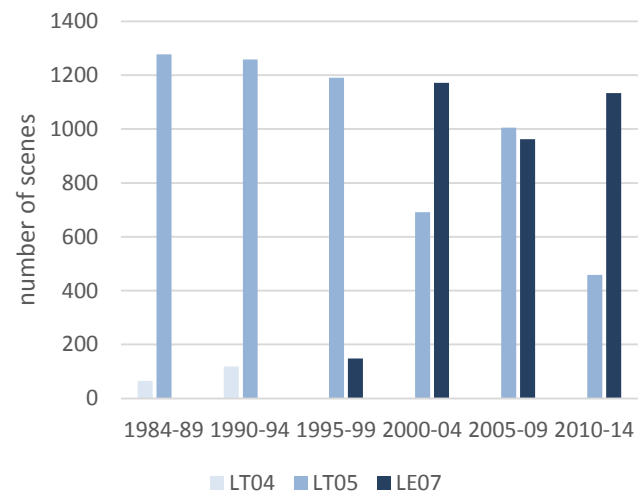- -9.1 - -5%
- -4.9 - -2%
- -1.9 - -0.1%
- 0%
- 0.1 - 2%
- 2.1 - 5%
- 5.1 - 10%
- > 10.1%

1984-89 -> 1990-94
1990-94 -> 1995-99
1995-99 -> 2000-04
2000-04 -> 2005-09
2005-09 -> 2010-14

0 100 200 300 400 km

number of scenes: 1400, 1200, 1000, 800, 600, 400, 200, 0

1984-89 1990-94 1995-99 2000-04 2005-09 2010-14

LT04   LT05   LE07

Conclusion & Outlook

Methodological improvements
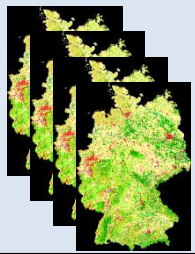

Automated selection
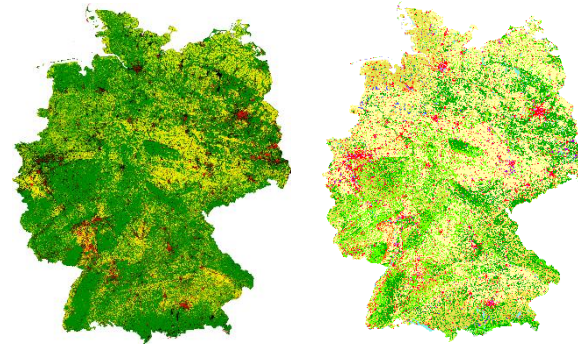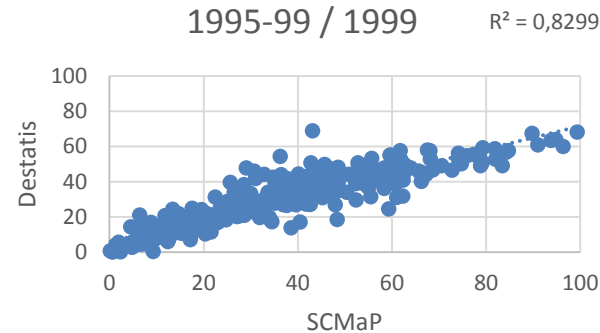
CORINE land cover:
1990/2000/
2006/2012

↓

Temporally stable Pixel:
coniferous trees
deciduous trees
fields
grassland
shrub
urban
water

↓
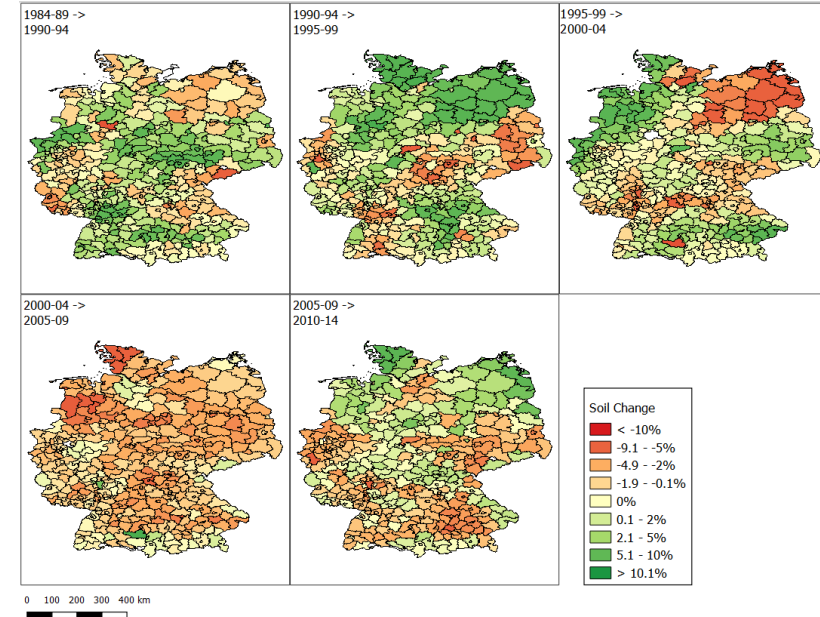
Elimination of single pixel / edge pixel

↓

Random selection:
of 5000 Pixel per class

Validation

1995-99 / 1999   R² = 0,8299

DESTATIS
wissen.nutzen.

Results

1984-89 -> 1990-94	1990-94 -> 1995-99
1995-99 -> 2000-04	2000-04 -> 2005-09
2005-09 -> 2010-14	

Soil Change
< -10%
-9.1 - -5%
-4.9 - -2%
-1.9 - -0.1%
0%
0.1 - 2%
2.1 - 5%
5.1 - 10%
> 10.1%

0 100 200 300 400 km

Outlook:
Link of reflectance composite with soil data to derive higher order products:
→ Minerology
→ SOC
→ ...

Thank you for your attention!

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