

Mapping 30+ years of agricultural land use in Germany

Gideon Okpoti Tetteh¹, Vu-Dong Pham², **Marcel Schwieder**¹, Lukas Blickensdörfer¹, Alexander Gocht¹, Sebastian van der Linden², Stefan Erasmi¹

¹Thünen Institute of Farm Economics (Thünen Earth Observation), Braunschweig, Germany

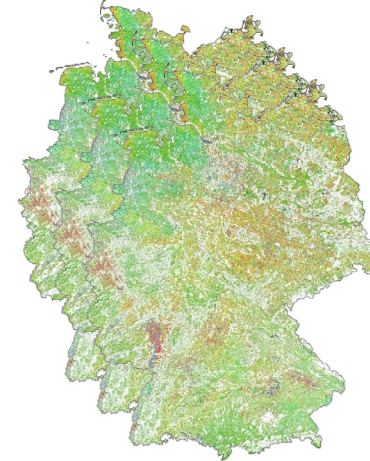
²University of Greifswald, Greifswald, Germany



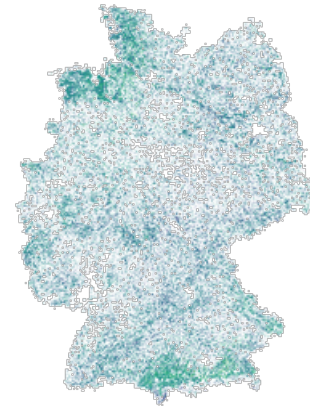
Background

- Thünen Earth Observation focuses on advancing land-use mapping to support reporting obligations and policy advise
 - Well-established pipelines for area-wide mapping based on Copernicus data (2017 – current)
 - Complementary to and consistent with national statistics
 - Lack of information before Sentinel era:
 - ➔ Temporal gaps in agricultural statistics
 - ➔ Reduced resolution and availability of EO data
- ➔ AI-based workflow using Landsat-archive

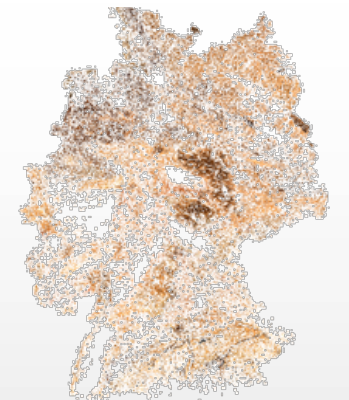
Crop type maps



Mowing events



Winter crop land cover



Bare soil reflectance

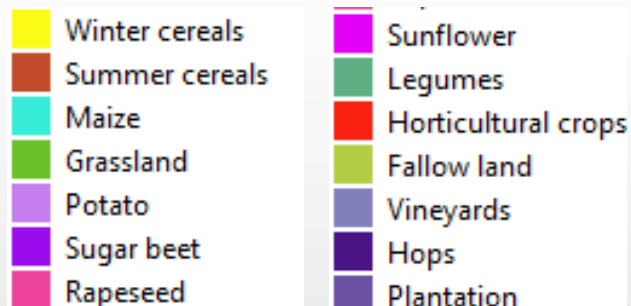
Data

Satellite data

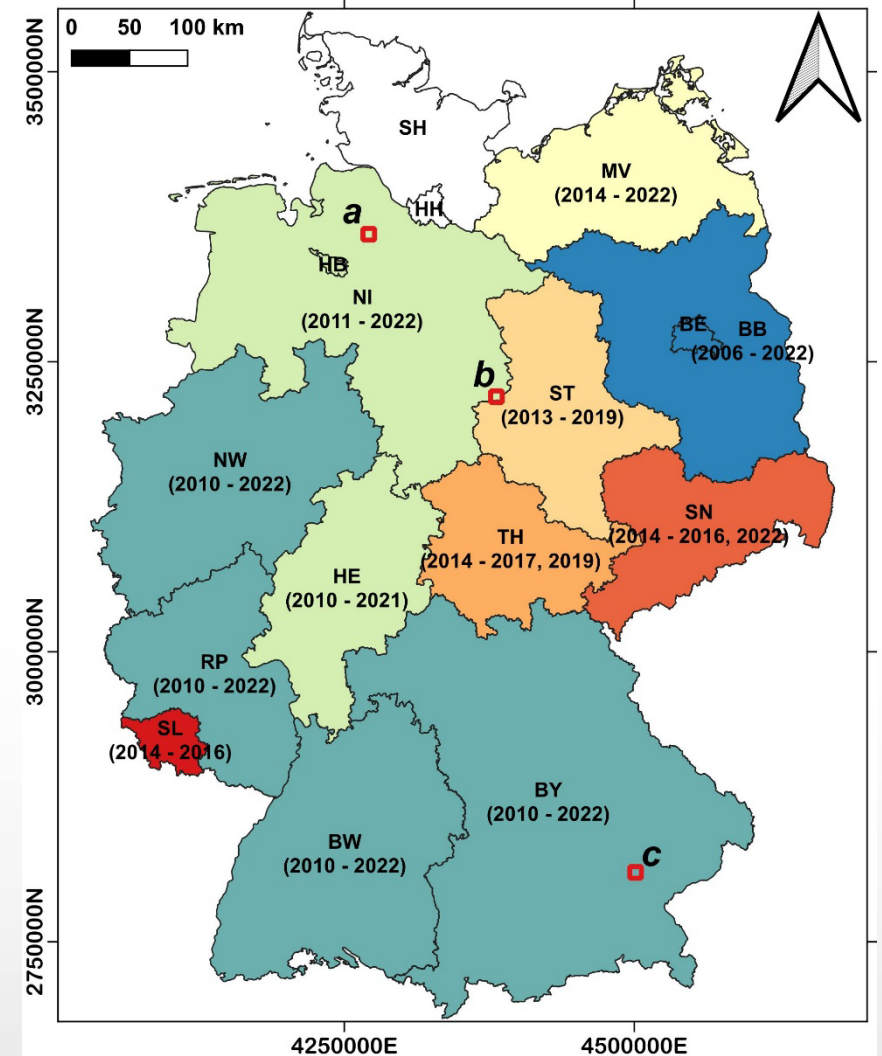
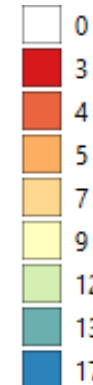
- Landsat (1990 – 2023)
- Sentinel-2 (2015 – 2023)
- Six bands (Blue, Green, Red, NIR, SW1, SW2)
- Three spectral indices (NDVI, NDWI, SAVI)

Reference data

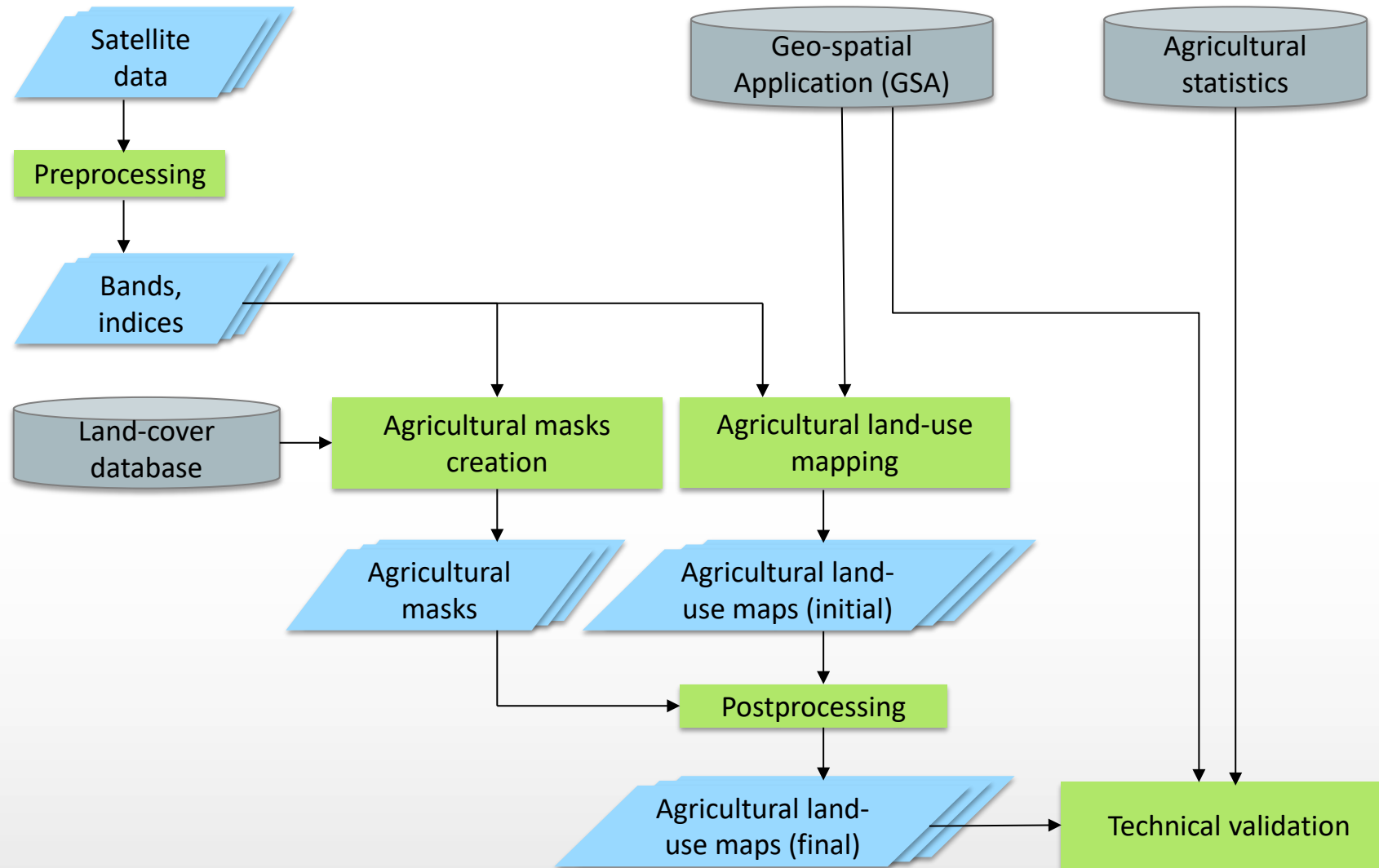
- 14 classes extracted from the Geo-spatial Application (GSA) of Germany from 2006 to 2022



No. of GSA datasets



Methodology (overview)

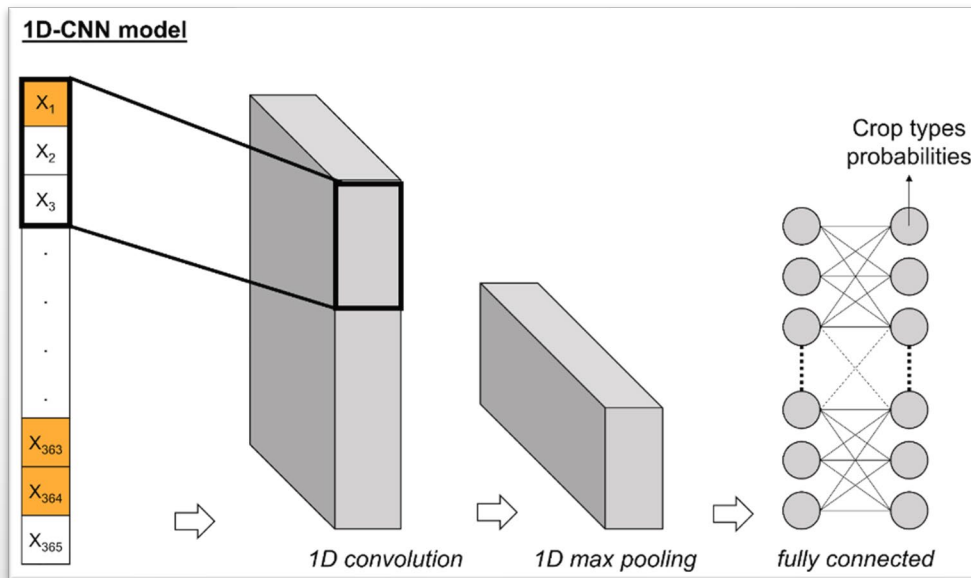
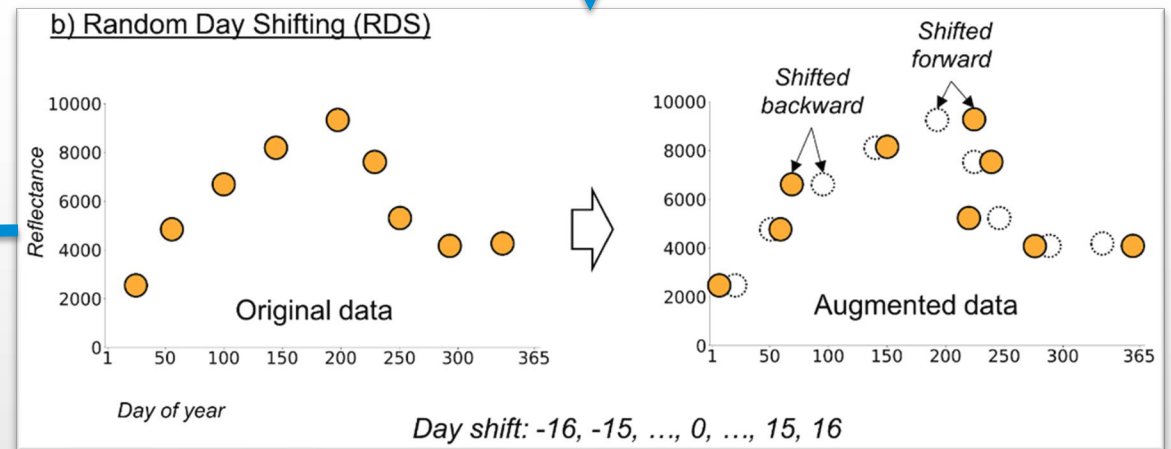
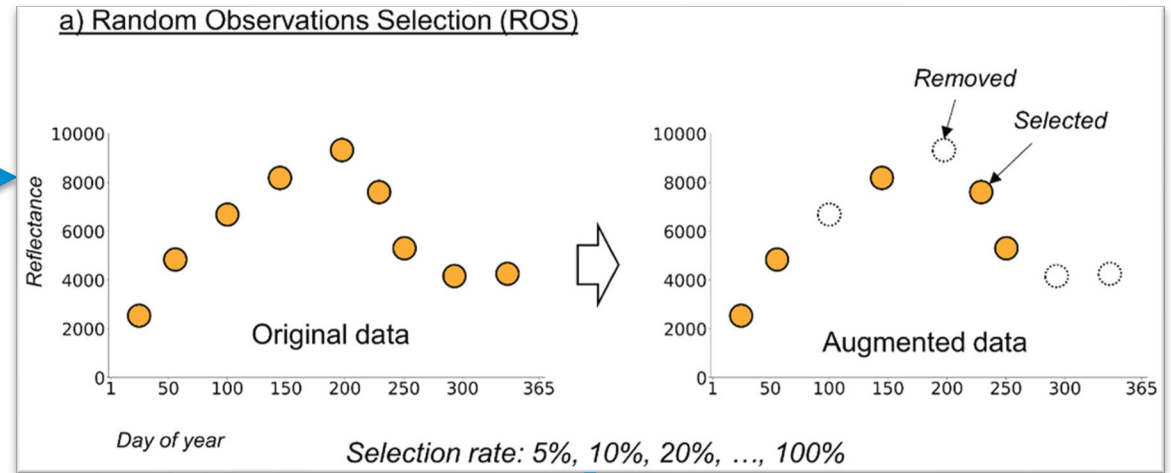
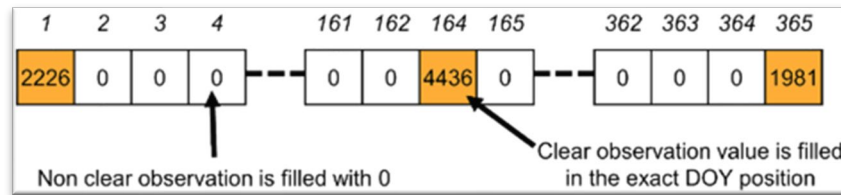


Tetteh et al. (in review)

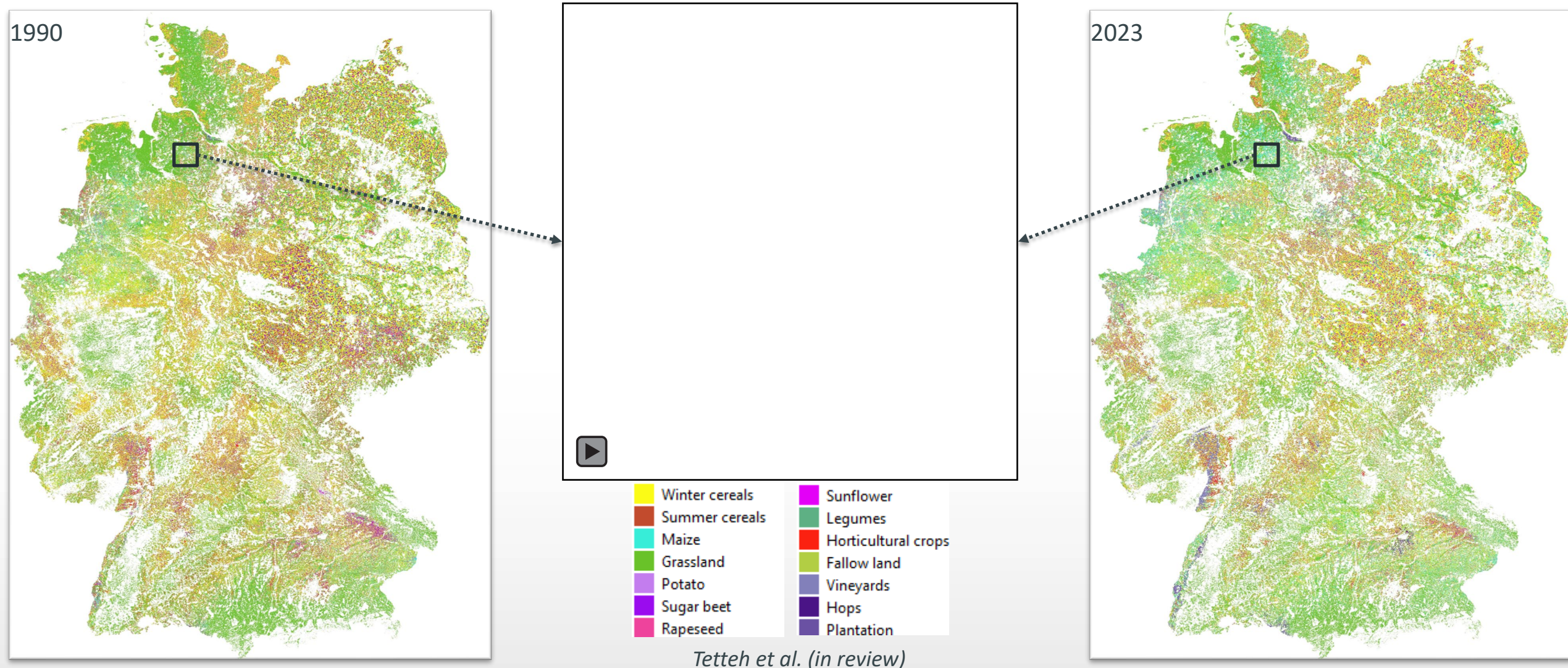


Methodology (transferable 1D-CNN)

Temporal Encoding

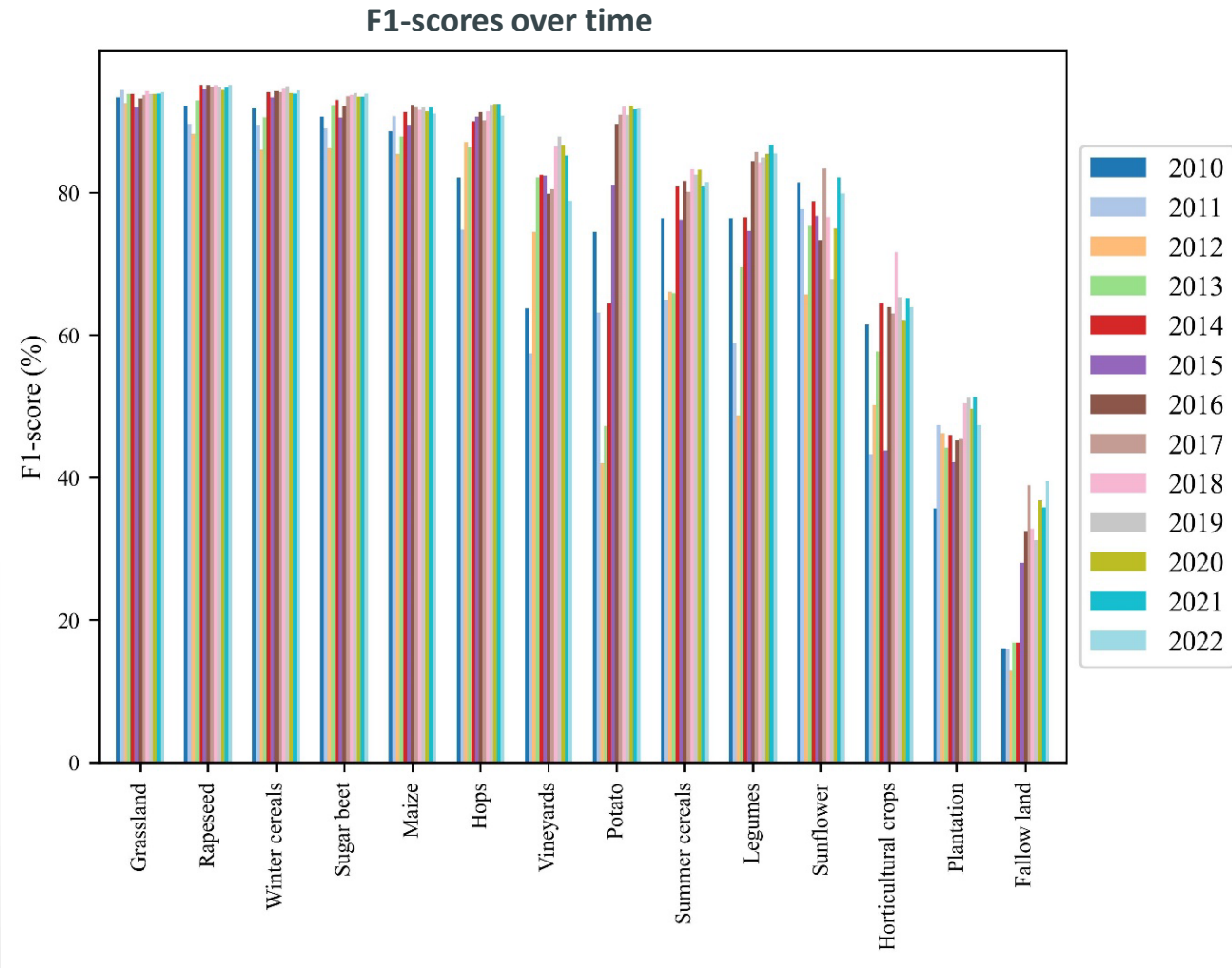


Results (agricultural LU maps)



Results (accuracy assessment)

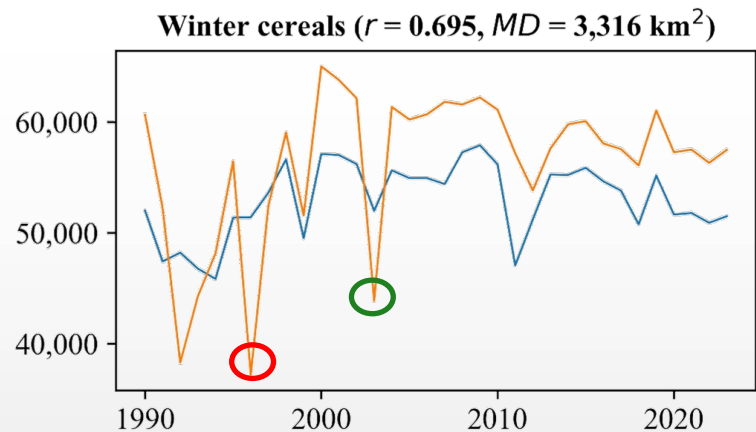
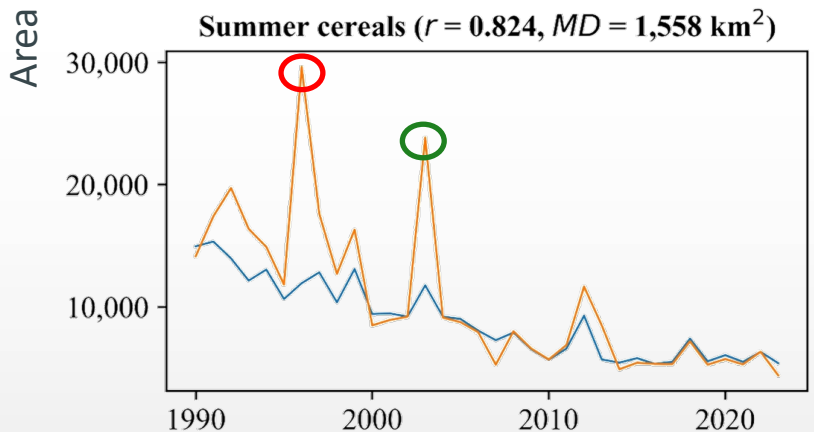
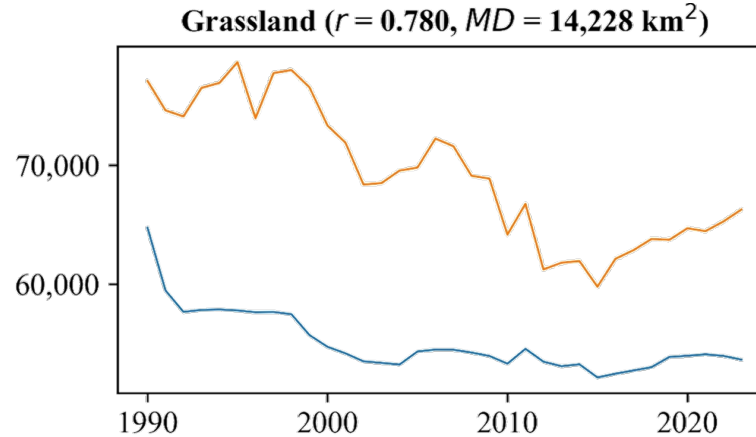
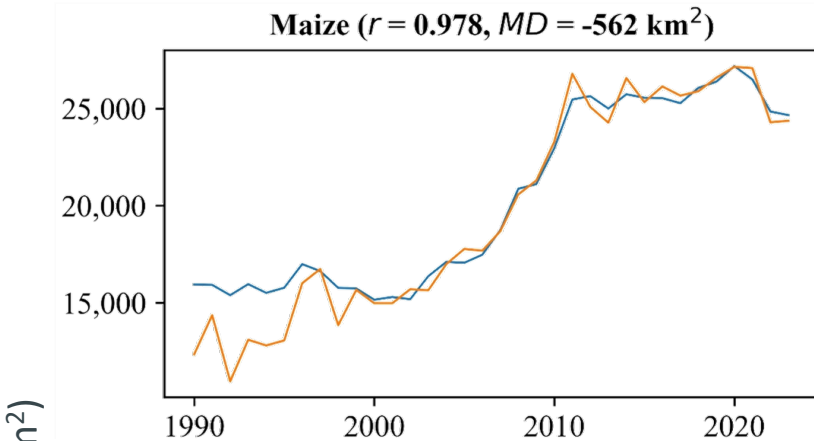
Year	Overall accuracy
2010	89.60%
2011	89.10%
2012	85.30%
2013	89.00%
2014	91.90%
2015	89.30%
2016	91.60%
2017	91.70%
2018	92.30%
2019	92.20%
2020	91.70%
2021	91.80%
2022	91.80%



Note: before 2010, the GSA was available only for 1 federal state in Germany (BB), hence excluded from assessment.

Tetteh et al. (in review)

Results (area assessment: high shares of agricultural areas)



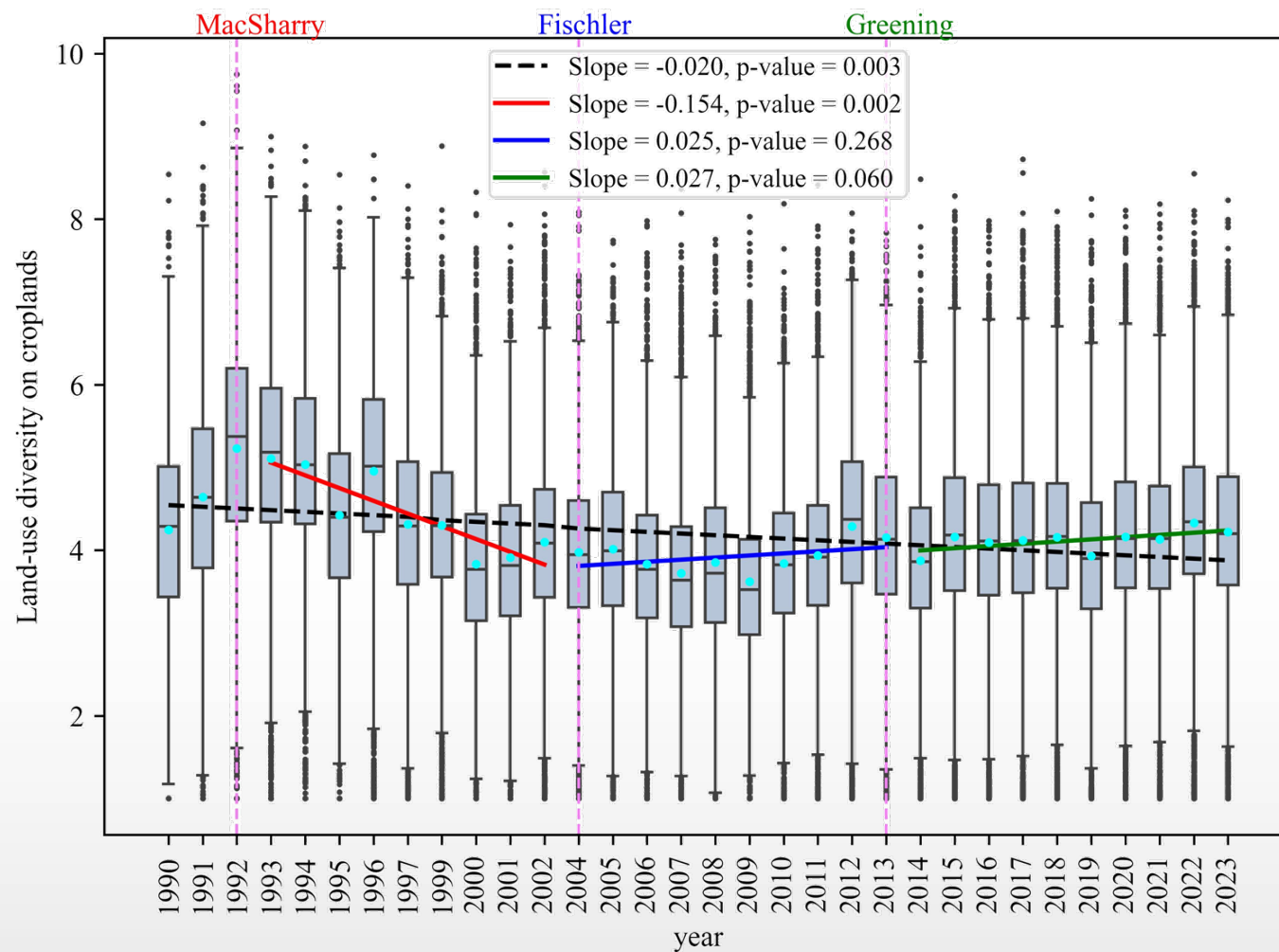
- High correlation between predicted areas and official statistics
- Maize = almost perfect match
- Grassland (generally underestimated in official statistics), but similar trends
- Underestimations in winter cereals = overestimations in summer cereals in some cases
- Time series reveals crop diversity patterns

— Reference areas (official statistics) — Predicted areas $r =$ Pearson correlation, $MD =$ Mean Deviation

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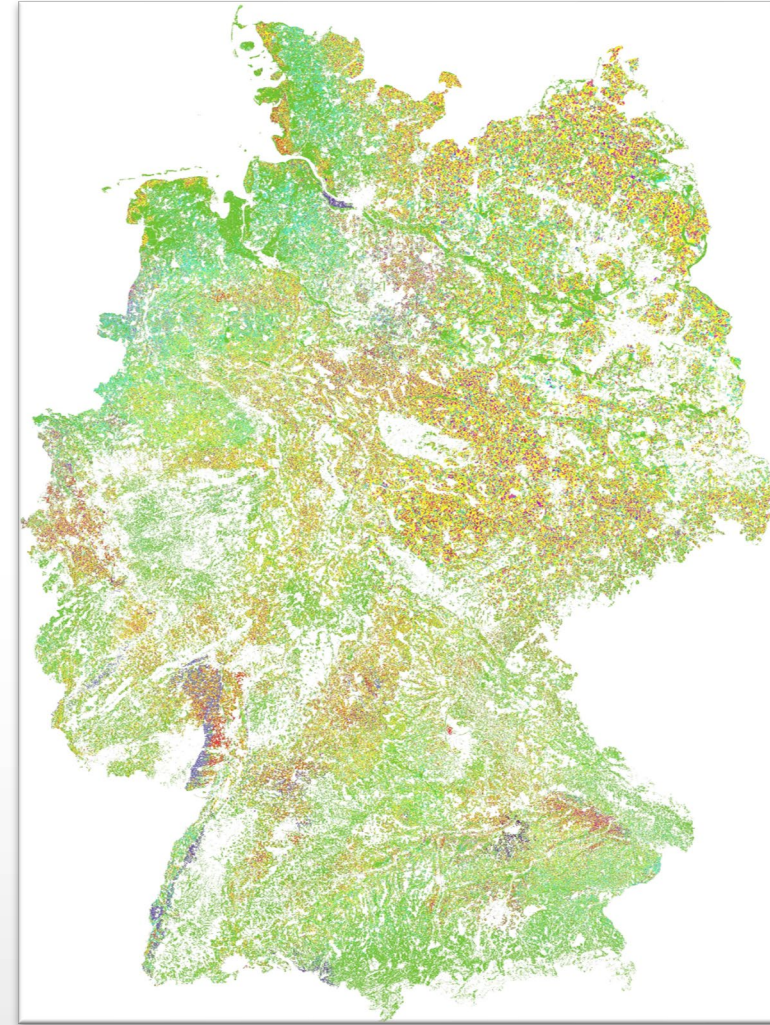
Application showcase

- Initial test to **identify crop diversity patterns** and relations to CAP
- Crop land diversity (Shannon) in Germany derived for **10 km x 10 km grids**
- Trends between **major CAP reforms**:
 - **1992 (MacSharry): direct payments, set-aside, ...**
 - **2003 (Fischler): decouple subsidies from production**
 - **2013 (Post-2013): greening, crop diversification, ...**



Summary and conclusion

- Long-term annual agricultural LU maps (30+ years) for Germany available
 - High overall and class-specific accuracies
 - High level of agreement with agricultural statistics for major classes
 - Future work: improving the prediction of small classes
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- High potential for CAP impact assessment & monitoring
 - Maps can aid the spatial and temporal disaggregation of agricultural statistics



Thank you for your attention!

marcel.schwieder@thuenen.de

Thünen Institute of Farm Economics, [Thünen Earth Observation \(ThEO\)](#)