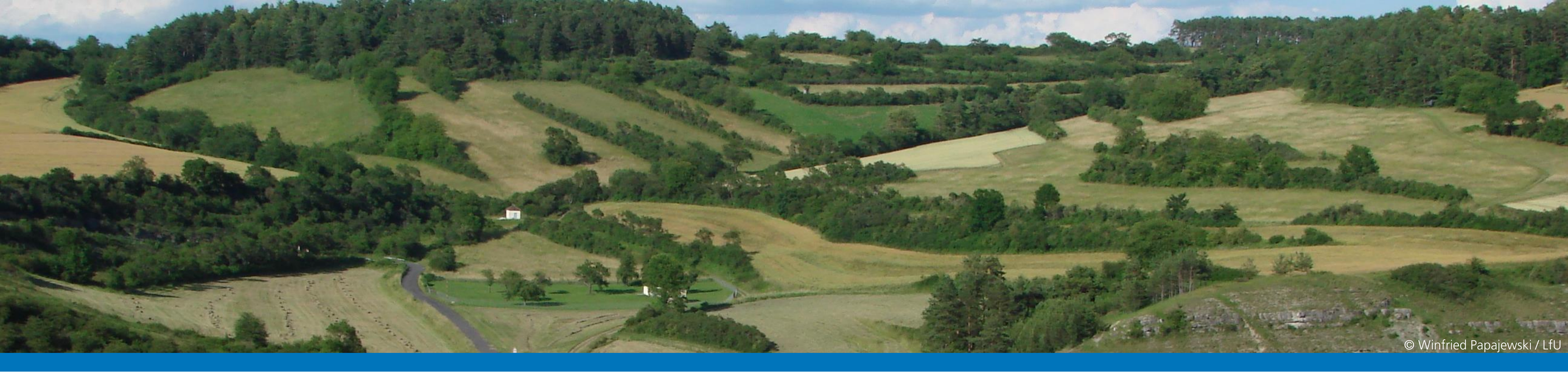

Downstream Service/Application Development for Monitoring of Environmental Indicators – Hedgerow Mapping

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MOTIVATION

Hedges

… provide valuable **habitats** for flora and fauna (hunting, resting and breeding places), regulate local **climate**, and prevent **erosion**.

… increasingly **disappear** from the cultural landscape.

… are mapped in-situ as part of a state-wide **biotope mapping** in Bavaria (Fig. 1).

… mapping is complex, expensive and repeated only every few **decades**.

Remote Sensing

… could strongly **support** biotope mapping through regular hedgerow detection over large areas.

… products such as HRL Small Woody Features are not suitable (incomplete).

… AI image processing methods for the detection of "hedge objects" are very promising but barely tested.

➢ **Aim: Areal mapping of hedges using IKONOS/aerial imagery and neural networks to support official biotope mapping**

Biotope mapping

Fig. 1: 320×320 m Ikonos tile with hedgerow outlines (red) provided by the Bavarian Environment Agency (LfU).

APPROACH

Data

- **Hedgerow outlines** from 2018 for parts of the county Freyung-Grafenau
- **IKONOS** data (1m resolution) from 2006 – 2008

Fig. 2: Workflow of data preprocessing and NN training, map generation and validation.

Check the paper!
Ahlswede et al. 2021

Neural Networks (NN)

- Comparison of two NN („**DeepLab v3+**" and „**Mask R-CNN**")
- Tests of different **band combinations** and of data from different **seasons**

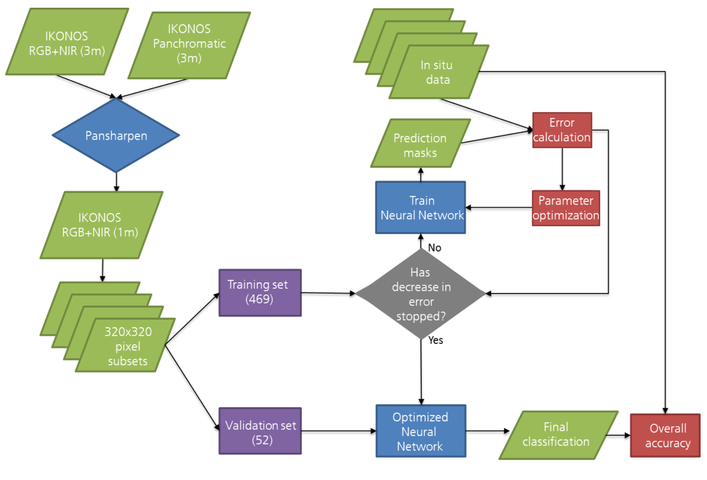

Image Augmentation

- Enlargement of training database
- Test of different **geometric** and **spectral** image augmentations (Fig. 3)

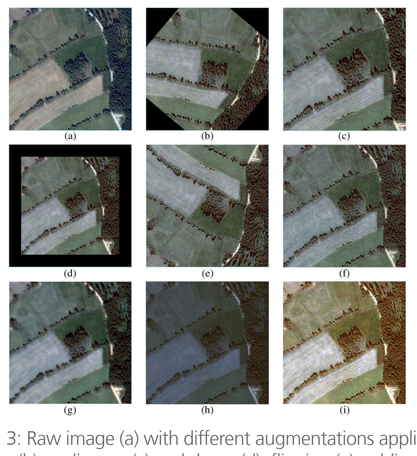

Fig. 3: Raw image (a) with different augmentations applied: rotation (b), scaling up (c) and down (d), flipping (e), adding noise (f), applying blur (g), decreasing brightness (h), log contrast (i).

RESULTS

- Neural networks are **suitable** for areal hedgerow mapping
- DeepLab v3+ (**75% F1-score**) outperforms Mask R-CNN
- **Geometric** image augmentation improves results (Fig. 4)
- Small differences between band combinations → **RGB** could be used

Next steps:

- Test of **aerial** images
- Expansion to entire state of **Bavaria**
- Characterization (e.g. **phenology**)
- Extension to **further biotope** types (e.g. field trees and scrubs)

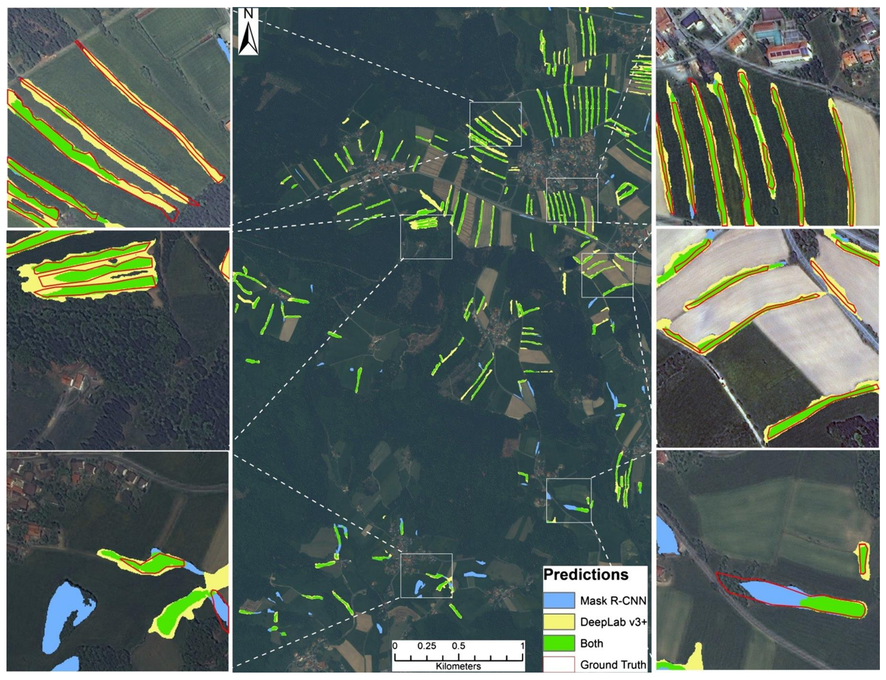

Fig. 4: Hedgerow detections at landscape scale within the study area using the Mask R-CNN (blue), the DeepLab v3+ (yellow), and hedgerows detected using both approaches (green).

The work is conducted within the FPCUP project, financed by the European Commission

Framework Partnership Agreement for Copernicus User Uptake