

Prediction of Canopy Cover Loss in German Spruce Forests Using a Spatio-Temporal Approach

Samip Narayan Shrestha ^{1,*}, Frank Thonfeld ¹, Andreas Dietz ¹, Claudia Kuenzer ^{1,2}

¹ German Remote Sensing Data Center (DFD), German Aerospace Center (DLR), Muenchener Strasse 20, D-82234 Wessling, Germany (* samip.shrestha@dlr.de)

² Institute for Geography and Geology, University of Wuerzburg, Am Hubland, D-97074 Wuerzburg, Germany

Motivation

Forest loss increased at an unprecedented scale, with increases in anomalies of temperature and precipitation [1]. Therefore, there is a need to explore the potential of dense spatio-temporal EO data to improve our understanding of canopy cover loss patterns and develop more accurate forecasting methods. We test the potential of the spatio-temporal matrix (STM) method to predict future spruce canopy cover loss using past spruce canopy cover loss data.

Methods

The STM method is a pixel-based approach for data augmentation developed by Wang et al. [2], used for urban growth prediction, where the spatial and temporal information of neighborhood pixels is utilized. Since, past canopy cover loss is a key predictor of future loss, we adapt the STM method to work with a canopy cover loss time series product based on EO data. We use a CNN-ANN combined model with 2 year STM, "no spruce" raster and percentiles of STM as input which gives a probability of loss in the next year.

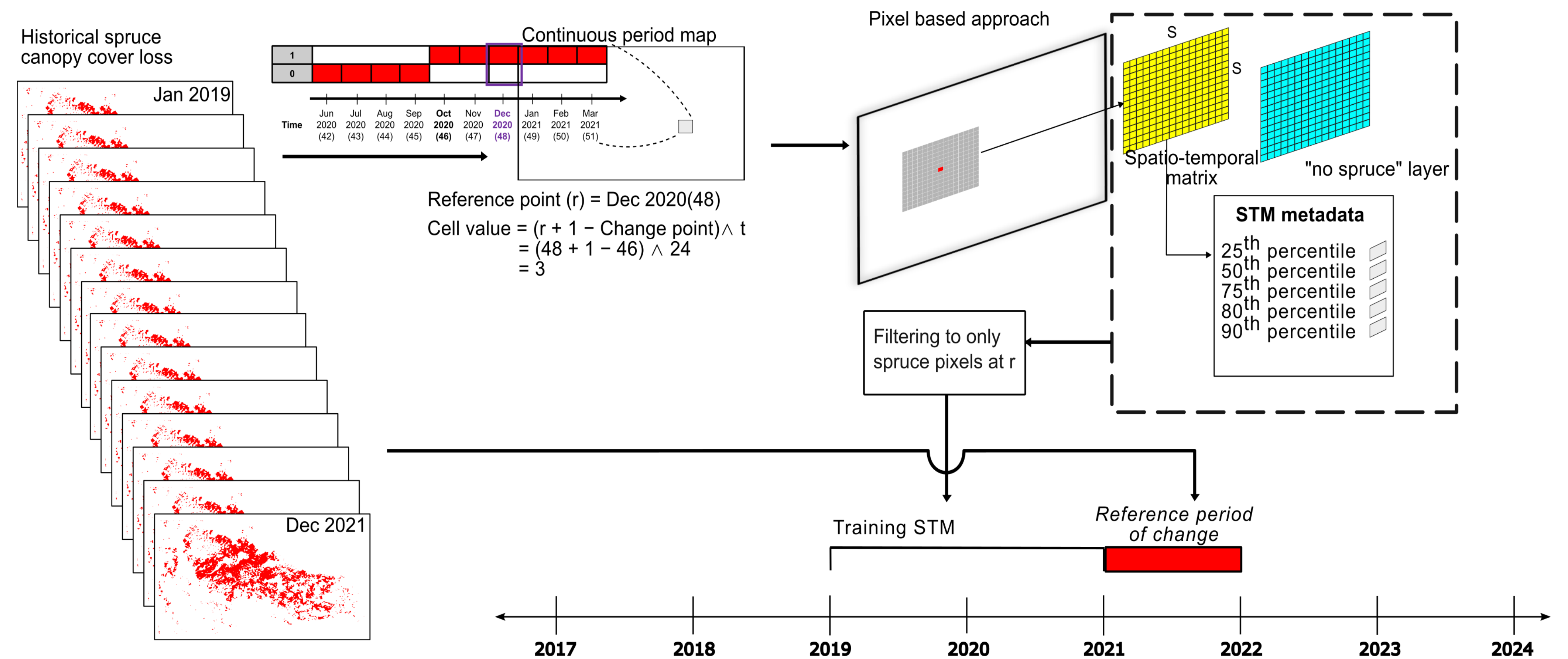


Figure 1. Calculation of STM data, "no spruce" data and reference data for each pixel used in model training.

Results

The results of models trained in different study regions are shown in the table, where the model output for prediction year 2022 (using 2020-2021 STM) and actual canopy cover loss are compared using the evaluation metric area under the curve (AUC) of receiving operating characteristic (ROC) [3].

Region	AUC [%]
Frankenwald	81.0
Harz	82.0
Siegen	82.1

We tested adding topographical and environmental variables of the two preceding years to the model in different predictor sets and found an improvement in AUC value in one case, when adding temperature and precipitation data which resulted in an AUC of the ROC space of 82.3% for Frankenwald [3].

Future canopy cover loss can be predicted with reasonable accuracy using open access EO time series data supplemented by environmental data.

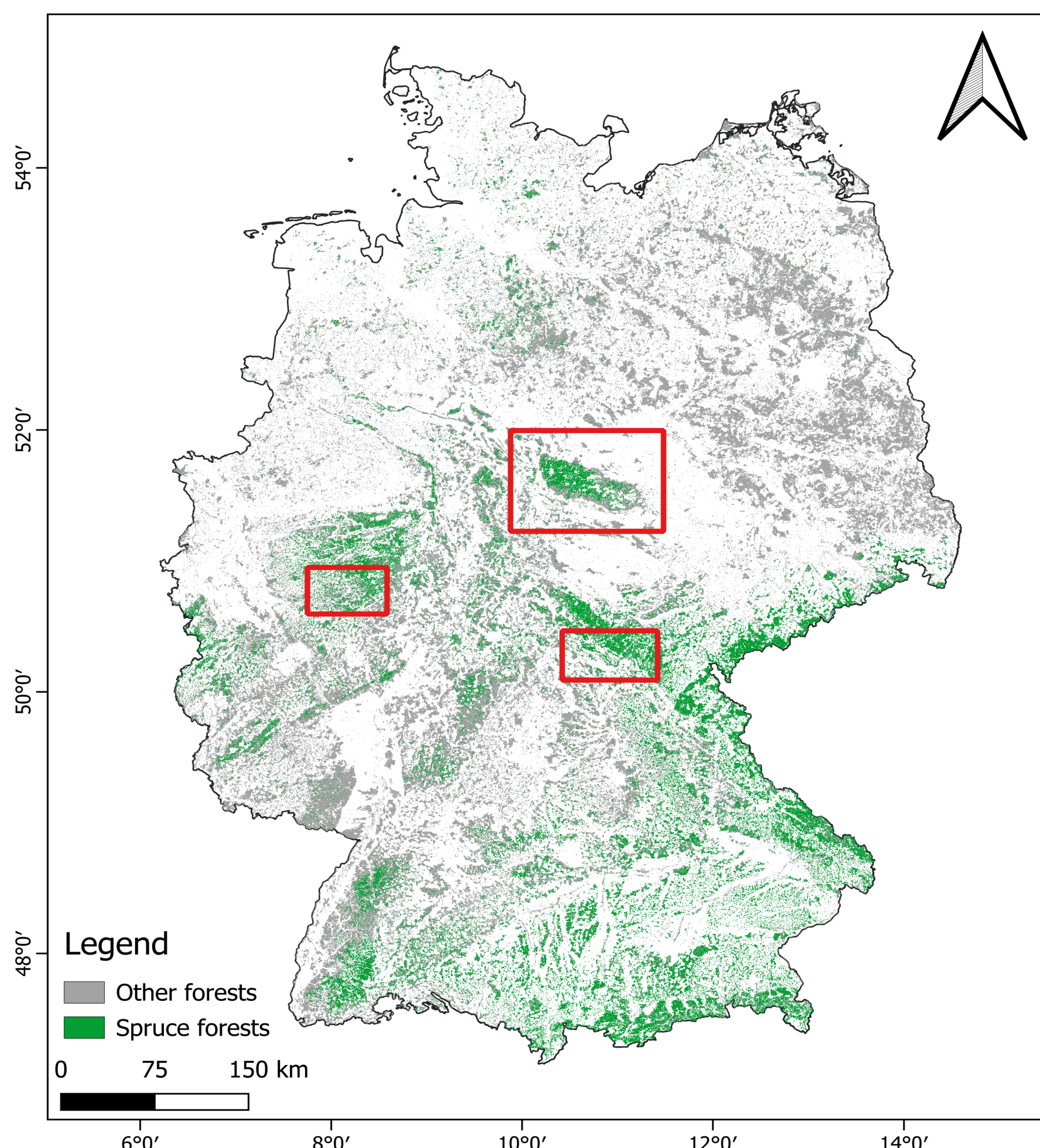


Figure 2. Study areas selected Harz, Siegen and Frankenwald (top to bottom)

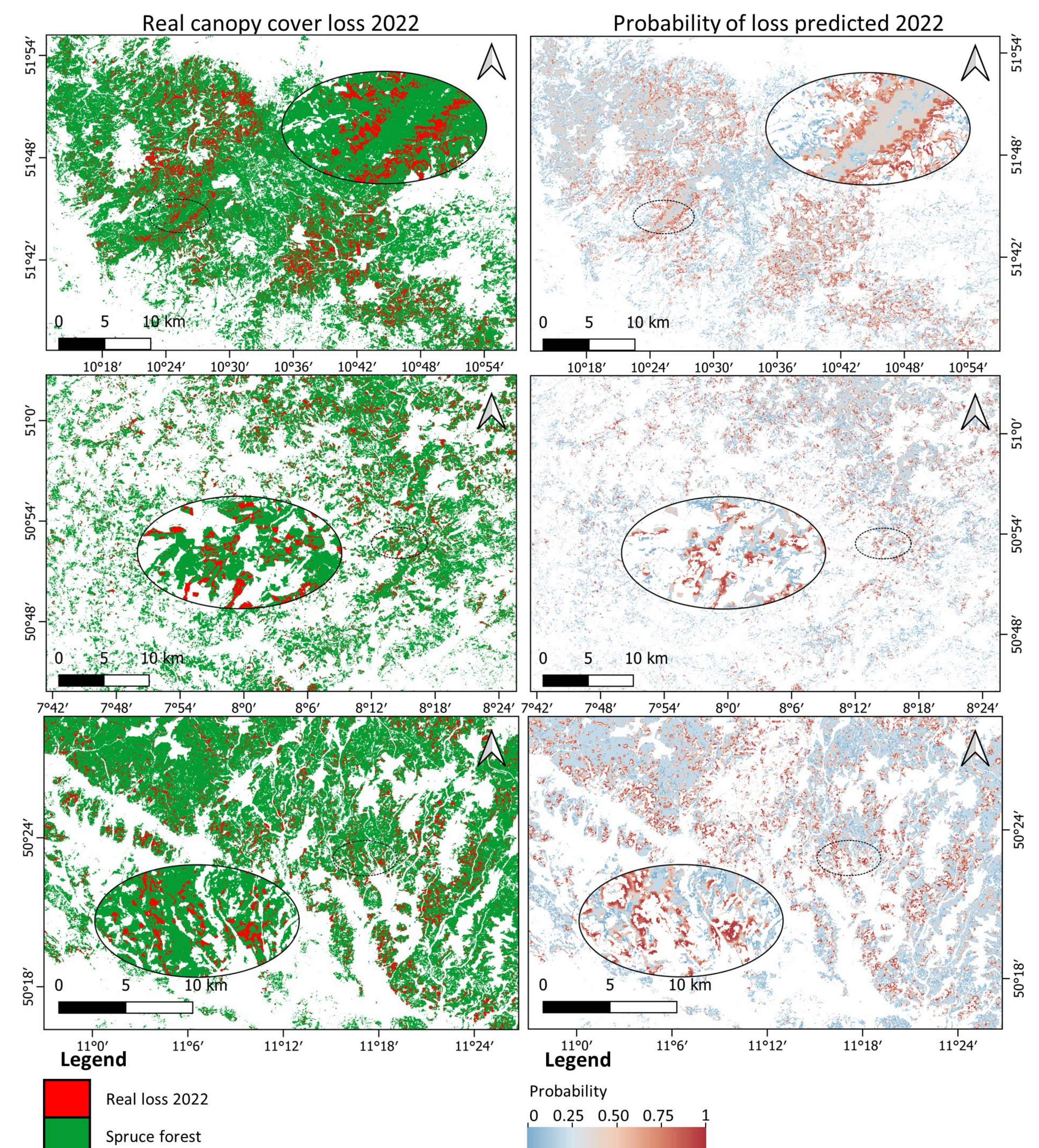


Figure 3. Real canopy cover loss and probability of spruce canopy cover loss predicted for Harz, Siegen and Frankenwald (top to bottom) in year 2022.

References
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