EGU25-19281, updated on 10 Sep 2025
https://doi.org/10.5194/egusphere-egu25-19281
EGU General Assembly 2025

From a regional to field scale - transfer learning for Earth observation based crop yield forecasts

Emanuel Bueechi[1], Felix Reuß[1], Miroslav Pikl[2], Vojtech Lukas[3], Miroslav Trnka[2], Lucie Homolova[2], and Wouter Dorigo[1]

[1]TU Wien, Mathematics and Geoinformation, Geodesy and Geoinformation, Wien, Austria
(emanuel.bueechi@geo.tuwien.ac.at)

[2]Global Change Research Institue CAS (CzechGlobe), Czech Republic

[3]The Department of Agrosystems and Bioclimatology, Faculty of AgriSciences, MENDELU, Czech Republic

Climate change is threatening food security, necessitating optimized resource management to ensure food availability. Field-scale crop yield forecasts, using machine learning and Earth observation data, have great potential for adaptive farm management, but the development of such models is curbed by the scarcity of field-scale training data. This strongly limits the applicability of traditional machine-learning approaches for field-scale crop yield modeling. However, increasingly popular transfer learning techniques provide a solution to improve this, since they can learn from a different domain than the one they are applied for. Here, we explore transfer learning to forecast crop yields on a field scale by training the model on a regional scale (where we have abundant data in Europe). We use Sentinel-1 and Sentinel-2 data with an artificial neural network to forecast maize, winter wheat, and spring barley yields in southern Czechia. We compared four model setups: two classical machine learning approaches trained and tested on a regional scale and one trained and tested on a field scale as a baseline. We compared these models to two transfer learning models that are trained on a regional scale and tested on a field scale, one with and one without fine-tuning the model using field-scale data. Forecasts were calculated at four lead times (1-4 months) before harvest. We showed that transfer learning with fine-tuning demonstrates superior performance, achieving correlations of approximately 0.75 at a one-month lead time for all crops. It outperformed the field scale-trained model by 0.05-0.12. In addition, transfer learning required significantly less field-level data to achieve a performance comparable to the model trained at the field level: 50% of the data for spring barley and maize, and only 25% for winter wheat. Therefore, this transfer learning approach improves the efficiency of crop yield data utilization and enhances field-level crop yield forecasting.

The work of this study was conducted in the frame of the project “Yield Prediction and Estimation from Earth Observation” (funded by ESA - Contract No. 4000141154/23/I-EF)