An adaptive adversarial domain adaptation approach for corn yield prediction

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Abstract

Recently, statistical machine learning and deep learning methods have been widely explored for corn yield prediction. Though successful, machine learning models generated within a specific spatial domain often lose their validity when directly applied to new regions. To address this issue, we designed an unsupervised adaptive domain adversarial neural network (ADANN). Specifically, through domain adversarial training, the ADANN model reduced the impact of domain shift by projecting data from different domains into the same subspace. Also, the ADANN model was designed to be trained in an adaptive way, which guaranteed the model can learn the domain-invariant features and perform accurate yield prediction simultaneously. Informative variables including time-series vegetation indices and sequential weather observations were first collected from multiple data sources and aggregated to the county level. Then, we trained the ADANN model with the extracted features and corresponding reported county-level corn yield from the U.S. Department of Agriculture (USDA). Finally, the trained model was evaluated in four testing years 2016-2019. The U.S. corn belt was used as the study area and counties under study were grouped into two diverse ecological regions. The experimental results showed that the developed ADANN model had better performance than three other state-of-the-art machine learning models in both local experiments (train and test in the same region) and transfer experiments (train and test in different regions). As the first study using adversarial learning for crop yield prediction, this research demonstrates a novel solution for improving model transferability on crop yield prediction.

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