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Explainable deep learning to predict and understand crop yield estimates

Aleksandra Wolanin[1], Gonzalo Mateo-García[2], Gustau Camps-Valls[2], Luis Gómez-Chova[2], Michele Meroni[3], Gregory Duveiller[3], You Liangzhi[4], and Luis Guanter[5]

[1]GFZ German Research Centre for Geosciences, Potsdam, Germany (ola@gfz-potsdam.de)
[2]Image Processing Laboratory, Universitat de València, València, Spain
[3]European Commission, Joint Research Centre (JRC), Ispra, Italy
[4]Environment and Production Technology Division, The International Food Policy Research Institute (IFPRI), Washington, D.C., United States of America
[5]Centro de Tecnologías Físicas, Universitat Politècnica de València, València, Spain

Estimating crop yields is becoming increasingly relevant under the current context of an expanding world population accompanied by rising incomes in a changing climate. Crop growth, crop development, and final grain yield are all determined by environmental conditions in a complex nonlinear manner. Machine learning (ML), and deep learning (DL) methods in particular, can account for such nonlinear relations between yield and its drivers. However, they typically lack transparency and interpretability, which in the context of yield forecasting is of great relevance. Here, we explore how to benefit from the increased predictive performance of DL methods without compromising the ability to interpret how the models achieve their results for an example of the wheat yield in the Indian Wheat Belt.

We applied a convolutional neural network to multivariate time series of meteorological and satellite-derived vegetation variables at a daily resolution to estimate the wheat yield in the Indian Wheat Belt. Afterwards, the features and yield drivers learned by the model were visualized and analyzed with the use of regression activation maps. The learned features were primarily related to the length of the growing season, temperature, and light conditions during the growing season. Our analysis showed that high yields in 2012 were associated with low temperatures accompanied by sunny conditions during the growing period. The proposed methodology can be used for other crops and regions in order to facilitate application of DL models in agriculture.

References:

Wolanin A., Mateo-Garcıa G., Camps-Valls G., Gómez-Chova L. ,Meroni, M., Duveiller, G., You, L., Guanter L. (2020) Estimating and Understanding Crop Yields with Explainable Deep Learning in the Indian Wheat Belt. Environmental Research Letters.