Winter wheat yield model based on remote sensing data

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Accurate and timely crop yield forecasts are critical for making informed agricultural policies and investments, as well as increasing market efficiency and stability. Earth observation data from space can contribute to agricultural monitoring, including crop yield assessment and forecasting. This work presents a new EO-based empirical winter wheat yield model. It is based on the un-mixing of the wheat signal from a coarse resolution EO data at 1 km by using yearly crop type masks to a pure wheat signal (100% of wheat within the pixel). *This wheat signal is used to calibrate the model using as inputs the seasonal amplitude and length of the Difference Vegetation Index (DVI) peak extracted from Moderate Resolution Imaging Spectroradiometer (MODIS) data and the average of the evaporative fraction (EF) 30 days after the peak. The three regressors proposed are focused on the reproduction stage of the wheat (DVI amplitude and length) and the grain filling process (EF 30-days average). The model is calibrated at subnational level using historical statistics from 2001 to 2016. In each administrative unit, a different calibration coefficient (based on all possible combination of the three regressors in a linear model) is selected depending on the statistical significance of each variable. The model was applied to estimate the national and subnational winter wheat yield in the United States, Ukraine, Russia and France from 2001 to 2017. At the subnational level the model shows very good performance with a coefficient of determination higher than 0.7 and Root Mean Square Error (RMSE) lower than 15%. At the national level the model provides a strong coefficient of determination higher than 0.8 and a RMSE lower than 8%, which demonstrates good performance of the models at this scale. Additionally, it was also able to capture low winter wheat yields during years with extreme weather events, for example 2002 in US and 2003 in Ukraine.*

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