Geophysical Research Abstracts
Vol. 16, EGU2014-5437-1, 2014
EGU General Assembly 2014

Ensemble approach to wheat yield forecasting in Ukraine

Nataliia Kussul (1,2), Andrii Kolotii (1,2,3), Sergii Skakun (1,3), Andrii Shelestov (1,2,3), Olga Kussul (2), and Oleksii Kravchenko (1)

(1) Space Research Institute NASU-SSAU, Kiev, Ukraine (inform@ikd.kiev.ua), (2) National Technical University of Ukraine "Kyiv Polytechnic Institute", Kiev, Ukraine, (3) National University of Life and Environmental Sciences of Ukraine , Kiev, Ukraine

Crop yield forecasting is an extremely important component of the agriculture monitoring domain. In our previous study [1], we assessed relative efficiency and feasibility of using an NDVI-based empirical model for winter wheat yield forecasting at oblast level in Ukraine.

Though the NDVI-based model provides minimum data requirements, it has some limitations since NDVI is indirectly related just to biomass but not meteorological conditions. Therefore, it is necessary to assess satellite-derived parameters that incorporate meteorology while maintaining the requirement of minimum data inputs.

The objective of the proposed paper is several-fold: (i) to assess efficiency of using biophysical satellite-derived parameters for crop yield forecasting for Ukraine and select the optimal ones based on rigorous feature selection procedure; (ii) to assimilate predictions made by models built on various satellite-derived parameters.

Two new parameters are considered in the paper: (i) vegetation health index (VHI) at 4 km spatial resolution derived from a series of NOAA satellites; (ii) Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) derived from SPOT-VEGETATION at 1 km spatial resolution. VHI data are provided as weekly composites and FAPAR data are provided as decadal composites. The particular advantage of using VHI is that it incorporates moisture and thermal conditions of vegetation canopy, while FAPAR is directly related to the primary productivity of photosynthesis

It is required to find a day of the year for which a parameter is taken and used in the empirical model. For this purpose, a Random Forest feature selection procedure is applied. It is found that VHI and FAPAR values taken in April–May provided the minimum error value when comparing to the official statistics, thus enabling forecasts 2-3 months prior to harvest, and this corresponds to results derived from LOOCV procedure. The best timing for making reliable yield forecasts is nearly the same as it was for the NDVI-based approach ($\pm$16 days).

The most accurate predictions for 2012 were achieved using the FAPAR-based approach with the RMSE value of 0.56 t ha^{-1} (performance of VHI-based and NDVI-based approaches was 0.7 t ha^{-1} and 0.68 t ha^{-1}, respectively).
Therefore, we can conclude that performance of empirical regression models based on satellite data with biophysical variables (such as VHI and FAPAR) is approximately 20% more accurate (on datasets available at the moment) comparing to the NDVI approach when producing winter wheat yield forecasts at oblast level in Ukraine 2–3 months prior to harvest.

[1] F. Kogan, N. Kussul, T. Adamenko, S. Skakun, O. Kravchenko, O. Kryvobok, A. Shelestov, A. Kolotii, O. Kussul, and A. Lavrenyuk, "Winter wheat yield forecasting in Ukraine based on Earth observation, meteorological data and biophysical models," International Journal of Applied Earth Observation and Geoinformation, vol. 23, pp. 192-203, 2013.