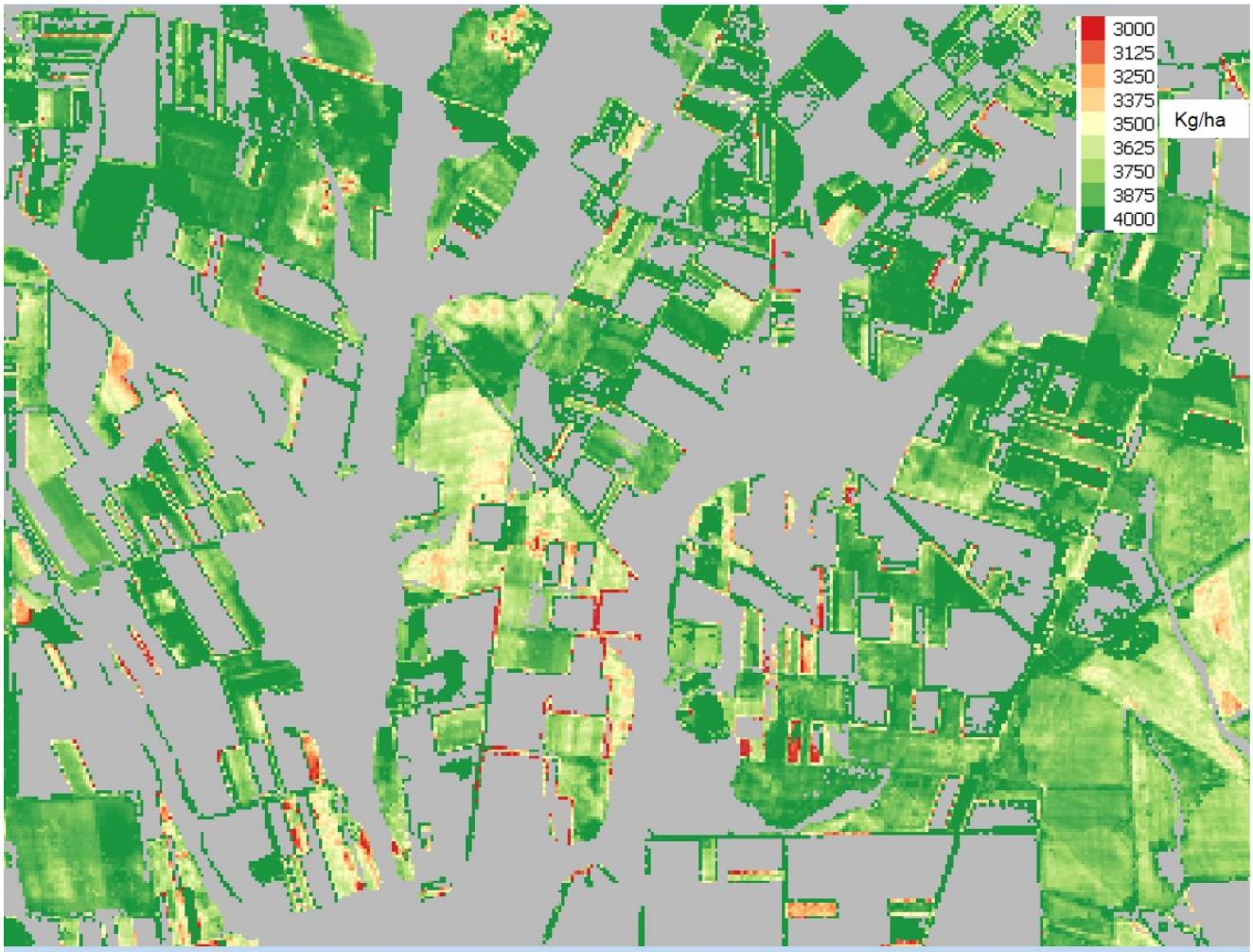
Crop mapping and crop production estimation using multi-source remote sensing data

*Sergii Skakun[1,2], Jean-Claude Roger[1,2], Belen Franch[1,2], Eric Vermote[2], Christopher Justice[1]

1. University of Maryland College Park, 2. NASA Goddard Space Flight Center

Remote sensing data from space is the essential source of information for enabling continous monitoring and quantification of crop state at global and regional scales. Crop mapping, state assessment, area estimation, yield forecasting and eventually crop production estimation are the main tasks being addressed within the Group on Earth Observation (GEO) Global Agricultire Monitoring Initiative (GEOGLAM). Efficiency of agriculture monitoring can be improved when heterogeneous multi-source remote sensing datasets are exploited. Here, we present several case studies of utilizing MODIS, Landsat-8 and Sentinel-2 data along with meteorological data for winter wheat yield forecasting, mapping and area estimation. Historical coarse spatial resolution data, such as MODIS, VIIRS and AVHRR, can provide daily global observations that coupled with statistical data on crop yield can enable the development of empirical models for timely yield forecasting at national level. With the availability of high-temporal and high spatial resolution Landsat-8 and Sentinel-2A imagery, course resolution empirical yield models can be downscaled to provide yield estimates at regional and field scale. In particular, we present the case study of downscaling the MODIS CMG based generalized winter wheat yield forecasting model to high spatial resolution data sets, namely harmonized Landsat-8 –Sentinel-2A surface reflectance product (HLS). Since the yield model requires corresponding in season crop masks, we propose an automatic approach to extract winter crop maps from MODIS NDVI and MERRA2 derived growing degree days (GDD) using the Gaussian mixture model (GMM). Validation for the state of Kansas (US) and Ukraine showed that the approach can provide accuracies > 90% without using reference (ground truth) data sets. Another application of yearly derived winter crop maps is their use for stratification purposes within area frame sampling for crop area estimation. In particular, one can simulate the dependence of error (coefficient of variation) on the number of samples and strata size. This approach was used for estimating the area of winter crops in Ukraine for 2013-2016. The GMM-GDD approach is further extended for HLS data to provide automatic winter crop mapping at 30 m resolution for crop yield model and area estimation.

Keywords: agriculture, crop mapping, crop yield, MODIS, Landsat-8, Sentinel-2



Winter wheat yield map derived from Landsat-8

