Wildfire prediction and monitoring in Ukraine on base of Copernicus Land service

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The danger of wildfires continues to be one of a major threat emergencies. In the context of global climate change, risks and damage of wildfires are increasing. These reasons make it necessary to develop mechanisms to respond to a fire hazard in the local context.

The Global Land Service is a component of the Copernicus Land service that provides a series of bio-geophysical products on the status and evolution of land surface at global scale at mid and low spatial resolution. Production and delivery of the parameters take place in a timely manner and are complemented by the constitution of long term time series. The products are used to monitor the vegetation, the water cycle and the energy budget.

Copernicus Global Land Service provide an opportunity to monitor and predict the short-term fire risk in the region. As an area for prediction, we took the territory of Ukraine. The main source of monitoring data is a product Burnet Area 1 km and 300 m.

The Burnt Area product maps the burnt scars, and gives temporal information on the fire season. The maps of Burnt Area are recognized as an Essential Climate Variable (ECV) by the Global Climate Observing System (GCOS).

With implementation of the product with a resolution 300 m the quality of monitoring has improved and now makes it possible to highlight even small area of fires. This is important from the point of view of the possibility of constructing high-quality mathematical models of fire danger prediction. The models are based on the use of historical data, calculated data the main natural components of the territory of Ukraine, and such monitoring data Copernicus Global Land Service as a state of vegetation – Dry Matter Productivity, Normalized Difference Vegetation Index; and water content in the soil - Soil Water Index.

DMP, or Dry Matter Productivity, represents the overall growth rate or dry biomass increase of the vegetation, expressed in kilograms of dry matter per hectare per day (kgDM/ha/day). DMP is directly related to NPP (Net Primary Productivity, in gC/m²/day), but its units are customized for agro-statistical purposes.

The Normalized Difference Vegetation Index (NDVI) is an indicator of the greenness of the biomes. As such, it is closely linked to the FAPAR. Even though it is not a physical property of the vegetation cover, its very simple formulation

$$NDVI = (REF\_nir - REF\_red)/(REF\_nir + REF\_red)$$

where REF_nir and REF_red are the spectral reflectances measured in the near infrared and red wavebands respectively, makes it widely used for ecosystems monitoring.

The Soil Water Index quantifies the moisture condition at various depths in the soil. It is mainly driven by the precipitation via the process of infiltration. Soil moisture is a very heterogeneous variable and varies on small scales with soil properties and drainage patterns. Satellite measurements integrate over relative large-scale areas, with the presence of vegetation adding complexity to the interpretation.

For modeling uses complex hierarchical models, classification tree, which take into account the natural predisposition of territory to occurrence of fires and the stochastic component, which is modeled on the basis of regression relations, including geographically weighted regression between the monitoring data of fires, indices of vegetation and water content in the soil. This allows for predictive data layer of a potential fire hazard for the next decade of the month. This forecast is useful for public emergency services and local authorities. The situation in 2015 around the capital Kyiv in Ukraine, when the town for 2 weeks was covered with smoke burning peat, showed the importance of this prediction.

The app has a server architecture and is based on the use of PostgreSQL, PostGIS, GeoServer and Leaflet JavaScript library for web display. It is also possible to use data services via standard data WMS, WFS for other GIS applications. PostgreSQL is used to store data, which can be obtained via FTP access, and operational training using PostGIS. The server application allows the user requests to carry out mathematical processing of raster data and receive statistics. The data can be exported in the form of a table or a thematic map for future use as analytical materials. GeoServer is responsible for the publication of data in the Web -service format and make them available to the end user in the form of maps.

References

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