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Agricultural drought risk monitoring and yield loss forecast with remote sensing data

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The World Meteorological Organization (WMO) and Global Water Partnership (GWP) have launched a joint Integrated Drought Management Programme (IDMP) to improve monitoring and prevention of droughts. In the frame of this project this study focuses on identification of agricultural drought characteristics and elaborates a monitoring method (with application of remote sensing data), which could result in appropriate early warning of droughts before irreversible yield loss and/or quality degradation occur. The spatial decision supporting system to be developed will help the farmers in reducing drought risk of the different regions by plant specific calibrated drought indexes.

The study area was the Tisza River Basin, which is located in Central Europe within the Carpathian Basin. For the investigations normalized difference vegetation index (NDVI) was used calculated from 16 day moving average chlorophyll intensity and biomass quantity data. The results offer concrete identification of remote sensing and GIS data tools for agricultural drought monitoring and forecast, which eventually provides information on physical implementation of drought risk levels. In the first step, we statistically normalized the crop yield maps and the MODIS satellite data. Then the drought-induced crop yield loss values were classified. The crop yield loss data were validated against the regional meteorological drought index values (SPI), the water management and soil physical data. The objective of this method was to determine the congruency of data derived from spectral data and from field measurements. As a result, five drought risk levels were developed to identify the effect of drought on yields: Watch, Early Warning, Warning, Alert and Catastrophe.

In the frame of this innovation such a data link and integration, missing from decision process of IDMP, are established, which can facilitate the rapid spatial and temporal monitoring of meteorological, agricultural drought phenomena and its economic relations, increasing the time factors effectiveness of decision support system. This methodology will be extendable for other Central European countries when country specific data are available and entered into the system. This new drought risk monitoring and forecasting method is an improvement for hydrologists, meteorologists and farmers, allowing to set up a complex drought monitoring system, where for a given period and respective catchment area the expected yield loss can be predicted, and the role of vegetation in the hydrological cycle could be more precisely quantified. Based on the results more water-saving agricultural land use alternatives could be planned on drought areas.