CROP CONDITION MONITORING AT FIELD LEVEL

Accurate and spatially explicit information on crop condition is essential for food security.

The challenge

Accurate and timely agricultural monitoring is essential for operational tasks such as yield prediction and crop condition monitoring. An improved understanding of the factors that can reduce agricultural yields and the overall production capacity of agro-ecosystems is crucial, especially at local and regional levels. This place-based crop condition information can be further used for decision making in the geographical areas which are more vulnerable to climate extremes, such as droughts. The complexity of these extreme events challenges its characterisation and spatially explicit representation of the drought impact over large areas.

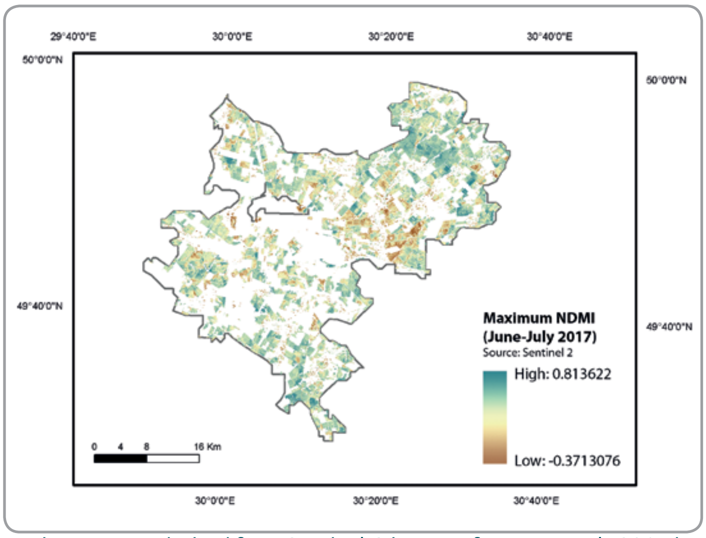
The space based solution

Even though in situ observations and statistical data can be used to monitor the condition of the crop, such data acquisition is time-consuming, labour-intensive and often costly. Earth Observation (EO) provides unprecedented opportunities for cost-effective crop condition monitoring over large areas.

Crop condition can be tracked by comparing the dynamic behaviour of time series for drought and non-drought years. The dissimilarity of time series can be a sign of drought-based changes in Vegetation Indices (VI). Furthermore, crop parameters such as maximum, minimum, amplitudes of VIs and backscattering intensity can be derived both for the overall growing season and during specific times of growth (e.g. the amplitudes within 20 days during vegetative and reproductive stages). One of the primary variables derived for our study area in the Ukraine were NDVI (Normalised Difference Vegetation Index) and NDMI (Normalised Difference Moisture Index). The combined use of freely distributed Sentinel-1 SAR series and multispectral Sentinel-2 observations (10-20 m spatial resolution) along with available Landsat-8 time series can give detailed information about crop condition.

Benefits to Citizens

The increasing number of freely distributed Copernicus satellite data offers opportunities to monitor intra-seasonal changes in croplands and track subtle changes in time series, which can be induced by drought. Spatially explicit drought information can be useful for the government to monitor yields, subsidy, and to support decision making such as the implementation of water management technologies in vulnerable areas. Overall, the evidence-based quantitative crop condition estimates can provide accurately estimated drought characteristics (such as start, duration, intensity) and impact to different stakeholders. Along with the remotely sensed derived Land Surface Temperature (LST) and with the integration of meteorological data, we can acquire a holistic view of the drought impact. High resolution data, derived from Sentinel-1 and Sentinel-2 sensors give valuable opportunities for cost-effective crop condition monitoring over large areas, such as in the Ukraine, where an increase in frequency and intensity



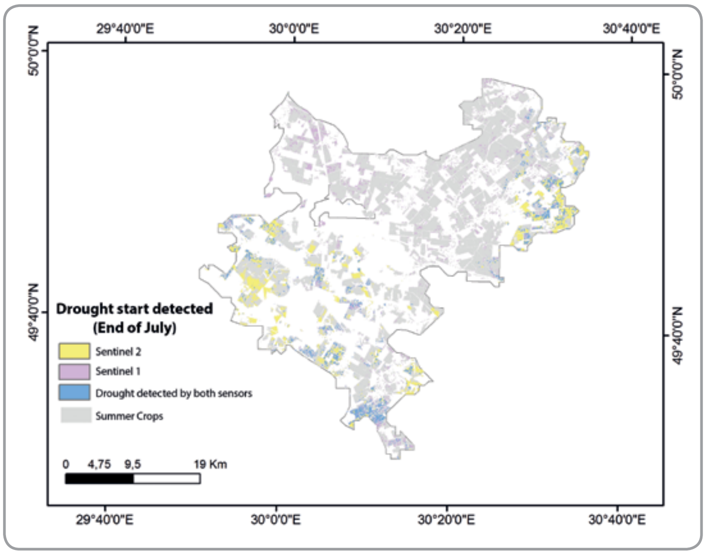
Maximum NDMI derived from Sentinel-2 imagery from June-July 2017 in Bila Tserkva region (Ukraine).
Credit: Contains modified Copernicus Sentinel data [2017]

Thematic Area	Region of Application	Sentinel mission used	Copernicus Service used	Usage Maturity Level
AGRICULTURE, FOOD, FORESTRY AND FISHERIES	BELA TSERKVA	S1 S2	–	1

of drought in recent years was reported. This was especially advantageous, as with the use of Sentinel-1 it was possible to acquire dense time series independent of atmospheric conditions.

Outlook to the future

To make the results accessible for a wide range of users a web application has been developed, where users can derive Copernicus based data products such as vegetation indices, SAR backscatter time series without coding or image processing for a defined area of interest and a preferred period. The computation is running on Google Cloud servers (using Google Earth Engine) and the results are returned to the user in an interactive interface. This will further contribute to the use of the data and will simplify data access for users with limited remote sensing experience, or with limited processing power.



Start of the drought Detected in July 2017 derived from time series of Sentinel-1 and Sentinel-2 n Bila Tserkva region (Ukraine).
Credit: Contains modified Copernicus Sentinel data [2017]

"The integration of satellite-based vegetation condition information especially with a higher spatial resolution will support the monitoring of the drought stress, and can facilitate further decision making."

Tatyana Adamenko,
Ukrainian Hydrometeorological Center

Acknowledgements

This study was conducted within the scope of the EvIDENz project which is supported by the German Federal Ministry for Economic Affairs and Energy (BMWi; grant No 50EE1541).

Gohar Ghazaryan[1], Olena Dubovyk[1],
Valerie Graw[1], Nataliia Kussul[2]
and Jürgen Schellberg[1,3]
1. Center for Remote Sensing of Land Surfaces, University of Bonn, Germany
2. Space Research Institute, Ukraine
3. Institute of Crop Science and Resource Conservation, University of Bonn, Germany
Email: gghazary@uni-bonn.de