



VII EUROSOIL 2025
& X Congreso Ibérico
de la Ciencia del Suelo

SEVILLE-SPAIN 8-12 SEP

Advancing
soil knowledge for
a sustainable future
Book of abstracts



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Advancing Soil Knowledge for a Sustainable Future

Book of Abstracts
of the Communications
presented to the
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GT 11 - 803 - 0

PERFORMANCE OF ESA-CCI-SM SATELLITE PRODUCT FOR ESTIMATING SOIL WATER DEFICIT: A CASE STUDY IN NE PORTUGAL

GT 11. SOIL DEGRADATION, DESERTIFICATION, CONTAMINATION - CONSERVATION, MITIGATION, REMEDIATION / GT 14. SOIL DATA ACQUISITION, CURATION, SHARING & MODELLING

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The Mediterranean climate is characterised by hot and dry summers and water deficit in soils. Monitoring soil water deficit is of crucial importance in Mediterranean cropland, allowing a more cost-effective soil and water management. Satellite-borne data sources provide high temporal resolution information but usually lack the spatial resolution to adequately account for soil variability, namely on the physical-chemical properties that affect soil water storage capacity. As a case study located in Bragança, NE Portugal, the present work aimed at exploring the use of ESA-CCI-SM satellite product to estimate water deficit for a wide range of soil water storage capacities. A satellite-borne soil moisture data series (ESA-CCI-SM product) was clipped for Bragança area (25 x 25 km pixel). Temperature and precipitation (P) records of a weather station located in Bragança were used to compute monthly reference evapotranspiration (ET₀, Thornthwaite) and the soil water balance (SWB, Thornthwaite-Mather) along the same period (2003-2016, 168 months). SWB were computed for soil water storages (S_{max}) representing the S_{max} range of regional soils (25, 50, 75, 100, 150 mm). Following earlier work by the authors, monthly soil water deficit series (SWD), obtained for the 5 S_{max}, were analysed and compared with the SM monthly averages series, using basic statistical methods. Average annual P and ET₀ in the study period were 750 and 711 mm, respectively. In all years, SWD occurred from June to September, with peaks in July and August (ca. 110 mm each), but it was also recorded in February and in November (1 out of 14 years). Annual SWD decreased linearly with S_{max} increase (R²=0.994), from 400 mm (S_{max} 25 mm) to 290 mm (S_{max} 150 mm). The number of SWD months also decreased in the same range of S_{max}, from 77 to 74 out of 168. Linear regression models relating SWD to SM monthly data for each S_{max} were derived and applied to estimate SWD in dry months. Model performance declined with S_{max} increase, from S_{max} 25 mm (R²=0.928) to S_{max} 150 mm (R²=0.873), while SEE remained similar along the S_{max} range (23 mm). Model parameters are well correlated (R²>0.95) with S_{max}, allowing the integration in a single model the two variables (SM and S_{max}). Dry months (SWD>0) were discriminated from non-dry (SWD=0) by SM, respectively lower or higher than 0.21 m³ m⁻³, with 91% (S_{max} 25 mm) to 94% (S_{max} 150 mm) matching frequency. Median SM in the whole S_{max} range was 0.14 and 0.25 m³ m⁻³, for dry and non-dry months, respectively. Performance reached encourages the application of the regression models derived for estimating SWD from SM, still with a considerable uncertainty due to the high SEE obtained. As the range of S_{max} tested was quite large, the regression models can be applied to deliver remote-based estimates of SWD accounting for the variability of soil water storage capacities found in NE Portugal.

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GT 11 - 810 - 0

INTEGRATION OF DIGITAL SOIL AND CROP HEALTH MONITORING SYSTEM: A COMBINED APPROACH FROM THE WHEATWATCHER PROJECT – A CASE STUDY OF SILESIA REGION

GT 11. SOIL DEGRADATION, DESERTIFICATION, CONTAMINATION - CONSERVATION, MITIGATION, REMEDIATION / GT 14. SOIL DATA ACQUISITION, CURATION, SHARING & MODELLING

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The growing problems of climate change together with soil degradation and decreasing crop health require integrated scalable solutions for sustainable agriculture. The WHEATWATCHER Project fulfils this requirement through its development of a complete digital system for monitoring soil and crop health which focuses on wheat-based agroecosystems across various European testing sites. The project integrates ground-based soil sensors measuring soil nutrition, chemical, and biological factors, diverse sensor technologies, advanced machine learning models, and automated mapping techniques to enable simultaneous crop and soil health evaluations. One of the WHEATWATCHER task is to Monitor heavy metals and hydrocarbons contamination in the pilot area in Silesia, Poland. The aim of our studies will be a primarily recognition of the trace element content in the Silesia region.

To achieve this, we used DSM approach. We selected 73 30-m environmental covariates and the database of 1894 points with the values of Cd, Cu, Ni, Pb, and Zn. In the modelling process we used Boruta algorithm and 15-fold cross-validation in 10 repetitions. The maps are assessed in term of model efficiency and prediction uncertainty done by cross-validation of the data used in model fitting.

The studies formerly performed in the IUNG-PIB shown that current wheat crops can be located on the potentially contaminated soils, exceeding the Polish norms (Polish Journal of Laws, 2002). The mean Cd, Cu, Ni, Pb, Zn in the Silesia region were respectively 1.40, 13.90, 16.63, 58.09, 145.34, while for the wheat crops the means were respectively 1.18, 15.13, 18.35, 47.47, 119.76. Within the wheat crops, 33% may exceed the threshold of Cd, 0.5% may exceed the norm of Ni, 3.19% for Pb, and 2.66%. The analysis indicates that soils under the wheat crops may be unhealthy and be accumulated by plants. In the further tasks of the project, we aim to monitor the variation of total petroleum hydrocarbons (TPH) and heavy metal contamination, using advanced sensing, and modelling technologies. To analyse soil properties, samples will be collected automatically within selected field (>40 ha) altogether with the vary sensors, such as, bulk-density, vis-NIR, and gamma ray sensors. Within the field we will collect over 100 samples and analyse them for pH, SOC, P, K, Ca, Na, MC, heavy metals, PAH.

We believe that the studies will significantly contribute to the automatization of the soil monitoring to evaluate their health and safety for the food production. The WHEATWATCHER project contributes to create the infrastructure for the advanced and automatic field measurements. The planned task will help farmers to act towards the management decisions leading to safety crops and safety soil.

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