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Combined use of Sentinel SAR and optical data for soil moisture estimation

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This work investigates the performance of two soil moisture retrieval methods using optical and radar satellite data. The study was conducted in areas with predominant agricultural land use since soil moisture is one of the parameters of interest in a wider study for water resource optimization in agricultural practices such as irrigation scheduling.

The two methods considered are based on the identification of changes in the investigated parameter between two acquisition dates. The implemented methods have been applied to study areas characterized by different orographic complexity and land use heterogeneity. Data from the European Space Agency (ESA) Sentinel 1 and Sentinel 2 missions were used, and results were validated with field measurements from the International Soil Moisture Network (ISMN).

At first, the methods were applied in a mountainous area of an irrigation consortium in Trentino (Italy), where the results pointed out the complexity of the study and the limitations of the current models in these contexts. Factors such as orographic complexity, type and physiological state of crops make the reduction of SAR data particularly complex to model.

The methods were then tested in a simpler orographic context such as that of the Po Valley in Bologna (Italy), also characterized by agricultural land use.

Finally, the methods were applied in a lowland with agricultural vocation located in Spain, for which an extended archive of soil moisture measurements distributed by the ISMN is available. In this context, the models were analyzed and were evaluated both functional and parametric adjustments of the models on the basis of the previous case studies.

Some of the results obtained are of high quality, while others highlight the complexity of the problem faced and the need for further investigation: increasing the number of case studies and using optical or SAR vegetation index different from the mainly used NDVI, could enhanced the models used for soil moisture retrieval.