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Synergistic use of Sentinel-1 and Sentinel-2 data for the retrieval of surface soil moisture using a variational data assimilation approach

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Human society increasingly depends on information derived from Earth Observation (EO) data. In particular, there is a growing demand for information facilitating agriculture, forestry, soil moisture and hydrology. To this purpose the number of space-borne satellites is projected to increase dramatically over the next years, through international scientific missions from various agencies but also small cube-sat constellations. The general trend currently is to create individual land surface (in particular soil moisture) products for each satellite mission. In that regard, a variety of products is derived by single-sensor retrievals for similar land surface variables such as soil moisture. However, such single-sensor approaches do not take into account potential synergies between different sensors and frequencies which might enhance the retrieval. Furthermore, due to inconsistencies in between the individual methodologies, no consistency between the different products is guaranteed.

In this presentation, we present results of a joint retrieval of land surface parameters over agricultural landscapes such as Soil moisture LAI, and FAPAR by means of a weak constraint variational data assimilation approach. Here we invert two physically consistent radiative transfer models in the microwave and optical domain using Sentinel-1 and Sentinel-2 data respectively and employing prior information about the land surface provided by the Joint UK Land Environment Simulator (JULES). In addition we include (in the form of a weak constraint) our expectations of the temporal evolution of the land surface state. Outputs are generated in terms of target variables such as soil moisture, LAI and FAPAR as well as their associated uncertainties.

Results are validated against field measurements over the Munich-North-Isar site, Germany. It will be shown that the retrieval of bio- and geophysical parameters from remote sensing data greatly benefits from a joint retrieval from optical and microwave data especially in terms of uncertainty reduction and by providing a consistent retrieval of the spatiotemporal dynamics of land surface variables such as soil moisture.