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Estimating the best spatial resolution of remotely sensed surface soil moisture based on their uncertainty

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Validation of remotely sensed soil moisture is a well-known issue. Reference data with the correct spatial and temporal resolution on large scales are sparse and lack spatial representativeness. Moreover, due to the heterogeneity of soil moisture in both space and time, even reference data cannot be considered to be “ground truth”. As such, uncertainties are difficult to quantify. Additionally, in remotely sensed soil moisture there are trade-offs between spatial resolution and temporal resolution, resolution and accuracy, and resolution and computing time. Here, we try to identify the best spatial resolution for Sentinel-1 based soil moisture estimation, considering the trade-off between product resolution and accuracy. We use the uncertainty of the soil moisture estimate as a guide parameter, and focus on how product accuracy depends on factors as soil wetness, and characteristics of the vegetated canopy. To this end, we compare Sentinel-1 soil moisture estimates to both in situ data and global reference data sets with a lower spatial resolution. Remotely sensed surface soil moisture data were obtained by applying the MULESME algorithm (Pulvirenti et al., 2018) on Sentinel-1 data throughout 2020. An extensive field campaign was performed, where TDR data and volumetric soil samples were gathered. A nearby setup of permanent soil moisture probes additionally provided continuous measurements of soil moisture at different depths, from 10 to 60 centimetres. Global datasets were obtained from the SMOS satellite constellation, GLDAS, MERRA-2 and ESA CCI.

Pulvirenti, L., Squicciarino, G., Cenci, L., Boni, G., Pierdicca, N., Chini, M., Versace, P. & Campanella, P. (2018). A surface soil moisture mapping service at national (Italian) scale based on Sentinel-1 data. *Environmental Modelling & Software*, *102*, 13-28.