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Combined use of Sentinel-2 images and Sentinel-1-derived moisture maps for soil organic carbon content mapping in croplands, South-western France

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In terms of agronomy, soil organic carbon (SOC) content is important for crop growth and development. From the environmental viewpoint, SOC sequestration is essential to mitigate the emission of greenhouse gases into the atmosphere. The use of sensors for carbon monitoring over croplands is a key issue in recent works. Sentinel-1/2 (S1, S2) satellites acquire data with regular frequency (weekly) and high spatial resolution (10 and 20 meters). Previous studies have demonstrated their potential for quantification of soil attributes including topsoil organic carbon content on single dates. Soil surface roughness and soil moisture influence the performance of spectral models according to acquisition date, particularly surface soil moisture (SM), as shown by multidate models of predicted SOC content (Vaudour et al., 2021). Still, the sensitivity of Sentinel-1/2 to SM must be better understood and exploited for a given single date. A possible solution to determine the influence of SM on single date model performance consists of including it as a covariate.

In order to predict the topsoil SOC content over croplands in the Pyrenees region, France (22177 km²), this study addresses: (i) the influence of the Sentinel image date and that of the soil sampling year; (ii) the contribution of SM products derived from the Sentinel-1/2 data (El Hajj et al., 2017) in the spectral models.

The influence of the image date and soil sampling date was analyzed for springs 2017 and 2018. Clouds, shadows and NDVI (> 0.35) values were excluded from the images. Best single performances (RPD ≥ 1.3) were scored for soil sampling sets collected in 2016-2018. The same dates were analyzed using either SM maps, or signal values of VV and VH polarizations from S1 images. SM or polarization values were extracted for each sample and integrated into the partial least squares regression (PLSR) models, respectively. The best performance (RPD = 1.57) was obtained with SM as a covariate in 2017, with lowest mean SM throughout the map.

References

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