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## Arable soil surface status as a factor affecting the quality of soil properties detection based on remote or proximal sensing technologies

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Due to short wavelengths, optical remote sensing data provides information about the properties of very thin soil surface layer. This is especially crucial for arable soils as their surface experiences intense impact of agricultural practices and natural conditions. In temperate zone atmospheric precipitation is one of the main natural factors affecting the surface state of arable soils. It causes the breakdown of soil surface aggregates and the redistribution of formed soil material resulting in surface sealing and the formation of soil crust.

We studied the properties of soil crust and its impact on the detection of soil properties on arable soils of European part of Russia.

Our research showed that the properties of soil surface crust (texture, mineralogical composition, organic matter content, content of microelements, spectral reflectance) differed from the properties of the rest of arable horizon. That discrepancy negatively impacted the performance and reproducibility of the models developed for the detection of arable soil properties and their monitoring on the basis of optical remote sensing data.

We found that the performance of the models for the detection of soil fertility indicators based on Sentinel-2 data varied depending on the acquisition date. Optimal dates were different for different fertility indicators. Introduction of information on soil surface state (% of crust and shadows/cracks) at different acquisition dates as predictors in the models developed based on Sentinel-2 data allowed improving their performance and stability.

Therefore, soil surface state is an important factor which should be considered when developing models for the detection and monitoring of arable soil properties based on optical remote sensing data or proximal sensing of soil surface. Usage of laboratory soil spectra libraries instead of field spectral data leads to less precise prediction models.

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