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Assessing the use of deep learning for acid sulfate soil mapping

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Mapping the occurrence of acid sulfate soils enables targeting hot spot areas at field, catchment or regional extent. The following step is to carry out the detailed mapping of different soil properties in the previously defined strategic areas. Considering the spatial variability of key soil properties (e.g. incubation pH and titratable acidity), in particular according to the depth, is critical for the management of environmental risks related to acid sulfate soils. Recently, two Digital Soil Mapping studies demonstrated that a specific deep learning model could predict a soil property at different depths while preserving the interrelation between depths. Deep learning also accounts for complex, non-linear relationships between environmental covariates and target soil attributes.

The present study aims at assessing the use of deep learning for the predictive mapping of different soil properties measured at multiple depths in a 50 ha acid sulfate soil agricultural field located in western Finland. Relatively limited input data is available: soil observations from 13 locations (with samples taken every 20 cm down to 2 m depth, so 130 soil samples in all) and a few environmental covariates (i.e. inverted electromagnetic data originally collected from a DualEM proximal sensor, a LiDAR-based Digital Elevation Model and different terrain derivatives). For comparison, a classical Artificial Neural Network will be applied on the same input data. Although deep learning techniques primarily handle large datasets, we suggest that they are able to deal with limited data if the network parameters (e.g. activation function, learning rate, filter size) are carefully selected and adjusted.