EGU2020-11080, updated on 08 May 2021
https://doi.org/10.5194/egusphere-egu2020-11080
EGU General Assembly 2020

Experiments on Machine Learning Techniques for Soil Classification Using Sentinel-2 Products

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Agricultural management relies on good, comprehensive and reliable information on the environment and, in particular, the characteristics of the soil. The soil composition, humidity and temperature can fluctuate over time, leading to migration of plant crops, changes in the schedule of agricultural work, and the treatment of soil by chemicals. Various techniques are used to monitor soil conditions and agricultural activities but most of them are based on field measurements. Satellite data opens up a wide range of solutions based on higher resolution images (i.e. spatial, spectral and temporal resolution). Due to this high resolution, satellite data requires powerful computing resources and complex algorithms. The need for up-to-date and high-resolution soil maps and direct access to this information in a versatile and convenient manner is essential for pedology and agriculture experts, farmers and soil monitoring organizations.

Unfortunately, the satellite image processing and interpretation are very particular to each area, time and season, and must be calibrated by the real field measurements that are collected periodically. In order to obtain a fairly good accuracy of soil classification at a very high resolution, without using interpolation methods of an insufficient number of measurements, the prediction based on artificial intelligence techniques could be used. The use of machine learning techniques is still largely unexplored, and one of the major challenges is the scalability of the soil classification models toward three main directions: (a) adding new spatial features (i.e. satellite wavelength bands, geospatial parameters, spatial features); (b) scaling from local to global geographical areas; (c) temporal complementarity (i.e. build up the soil description by samples of satellite data acquired along the time, on spring, on summer, in another year, etc.).

The presentation analysis some experiments and highlights the main issues on developing a soil classification model based on Sentinel-2 satellite data, machine learning techniques and high-performance computing infrastructures. The experiments concern mainly on the features and temporal scalability of the soil classification models. The research is carried out using the HORUS platform [1] and the HorusApp application [2], [3], which allows experts to scale the computation over cloud infrastructure.

References:

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