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Standards and protocols for the reflectance measurements of soils in the laboratory: Influence of different laboratory humidity conditions and set-ups

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Imaging spectroscopy (IS) has largely demonstrated its capabilities for the quantitative derivation of several top-soil properties remotely. Upcoming spaceborne hyperspectral sensors that will be put in space in 2019-2020 (PRISMA, EnMAP, HISUI) and in the following years (e.g. SHALOM, the NASA mission SBG/HypsIRI, the ESA candidate mission CHIME) will open the way for the global mapping and monitoring of soils. Nonetheless, the potential of IS for soil applications at large scale has not been yet fully exploited. In particular, an avenue of development is toward global harmonized soil databases such as global soil spectral libraries. These databases are crucial since they can allow the development of robust calibrations for the multivariate prediction of soil properties applicable from regional to global scale. To date there are many spectral libraries that are being developed at the country scale (e.g. France, Israel, Brazil, China, Australia, Denmark), at the continent scale (EU-wide LUCAS soil database), or at the global scale (World Soil Spectral Library of Viscarra-Rossel et al). One of the main issues in the development of such spectral libraries is about the use of standards and protocols and production of harmonized data bases so that (i) data are controlled and reproducible, and (ii) current databases acquired at different locations with different protocols can be merged.
In this study, we tested the application and robustness of the Internal Soil Standard (ISS) method for the spectral alignment and correction of spectral measurements on an extended number of soil samples acquired at different laboratories. Furthermore, we tested how the ISS commonly used sand standards, Lucky Bay (LB) and Wylie Bay (WB) samples, almost pure quartz sands from Australia, perform in different humidity laboratory conditions. Currently, most users of the ISS method use the LB sample. Then 71 soil samples from Israel with different mineralogical background and variable soil organic matter contents were scanned at Tel-Aviv (TAU, Israel) and Potsdam (GFZ, Germany) laboratories. The scanning took place with different spectral measurement protocols and extreme diverse conditions in terms of laboratory humidity and moist. All scans were completed by the repeated scans of the two Australian white sands through all scan batches to harmonize the spectral measurements. The results showed that the ISS minimized the visual spectral variation, aligned the minor and extreme systematic changes of the protocols, and made them more stable. Also, it showed that the LB and WB did not exhibit equal performance regarding to relatively dry and humid conditions. The WB standard provided more stable and satisfactory results in humid condition. However, the high performance of the LB sample in spectral correction was still obvious, particularly in laboratories with lower moist. Accordingly, these analyses suggested that during the ISS procedure, attention to the laboratory relative moist conditions must be taken, and in humid laboratory conditions, the WB sample is more reliable to be used than the LB sample.