Geophysical Research Abstracts
Vol. 17, EGU2015-5649-1, 2015
EGU General Assembly 2015

Soil property maps of Africa at 250 m resolution

Bas Kempen (1), Tomislav Hengl (1), Gerard B. M. Heuvelink (1), Johan G. B. Leenaars (1), Markus G. Walsh (2,3), Robert A. MacMillan (4), Jorge S. Mendes de Jesus (1), Keith Shepherd (5), Andrew Sila (5), Lulseged T. Desta (6), and Jérôme E. Tondoh (5)

(1) ISRIC - World Soil Information, Wageningen, Netherlands (bas.kempen@wur.nl), (2) The Earth Institute, Columbia University, USA, (3) Selian Agricultural Research Institute, Arusha, Tanzania, (4) LandMapper Environmental Solutions Inc., Edmonton, Canada, (5) World Agroforestry Centre, Nairobi, Kenya, (6) International Center for Tropical Agriculture, Lilongwe, Malawi

Vast areas of arable land in sub-Saharan Africa suffer from low soil fertility and physical soil constraints, and significant amounts of nutrients are lost yearly due to unsustainable soil management practices. At the same time it is expected that agriculture in Africa must intensify to meet the growing demand for food and fiber the next decades. Protection and sustainable management of Africa's soil resources is crucial to achieve this. In this context, comprehensive, accurate and up-to-date soil information is an essential input to any agricultural or environmental management or policy and decision-making model.

In Africa, detailed soil information has been fragmented and limited to specific zones of interest for decades. To help bridge the soil information gap in Africa, the Africa Soil Information Service (AfSIS) project was established in 2008. AfSIS builds on recent advances in digital soil mapping, infrared spectroscopy, remote sensing, (geo)statistics, and integrated soil fertility management to improve the way soils are evaluated, mapped, and monitored. Over the period 2008–2014, the AfSIS project has compiled two soil profile data sets (about 28,000 unique locations): the Africa Soil Profiles (legacy) database and the AfSIS Sentinel Site (new soil samples) database — the two data sets represent the most comprehensive soil sample database of the African continent to date. In addition a large set of high-resolution environmental data layers (covariates) was assembled.

The point data were used in the AfSIS project to generate a set of maps of key soil properties for the African continent at 250 m spatial resolution: sand, silt and clay fractions, bulk density, organic carbon, total nitrogen, pH, cation-exchange capacity, exchangeable bases (Ca, K, Mg, Na), exchangeable acidity, and Al content. These properties were mapped for six depth intervals up to 2 m: 0-5 cm, 5-15 cm, 15-30 cm, 30-60 cm, 60-100 cm, and 100-200 cm. Random forests modelling was used to relate the soil profile observations to a set covariates, that included global soil class and property maps, MODIS imagery and a DEM, in a 3D mapping framework. The model residuals were interpolated by 3D kriging, after which the kriging predictions were added to the random forests predictions to obtain the soil property predictions.

The model predictions were validated with 5–fold cross-validation. The random forests models explained between 37% (exch. Na) and 85% (Al content) of the variation in the data. Results also show that globally predicted soil classes help improve continental scale mapping of the soil nutrients and are often among the most important predictors.

We conclude that the first mapping results look promising. We used an automated modelling framework that enables re-computing the maps as new data becomes arrives, hereby gradually improving the maps. We showed that global maps of soil classes and properties produced with models that were predominantly calibrated on areas with plentiful observations can be used to improve the accuracy of predictions in regions with less plentiful data, such as Africa.