HC27: Generic/Prototypical Soil Profiles

For grid-based regional-scale crop modeling applications

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Regional-scale modeling? What about soils?

Ecosystems models are being used in various types of impact assessment studies at different temporal and spatial scales, and their results often implicate policy and management decisions at multiple levels (e.g., from micro-level farm management to macro-level natural resource management). Soil information is often key input to the models, yet it is difficult to obtain extensive, quantitative, and geo-referenced soil property data for the areas (or regions) of interest. Global soil databases exist (e.g., Harmonized World Soil Database (HWSD) by IIASA/FAO/ISSCAS/ISRIC/JRC, 2009), but they do not provide all the required information for the models at specific site. Whereas, existing global soil profile databases (e.g., WISE by ISRIC, 2002) do not extensively cover large areas in developing world.

To overcome the limitation of location-specific soil profile data for crop modeling applications, we generated a set of generic soil profiles based on three criteria that crop models are most responding to: texture, rooting depth, and organic carbon content. By classifying three levels for each category and setting their boundary conditions (Box 1), 27 soil profiles, *HC27*, were generated in formats compatible with DSSAT and APSIM. The boundary conditions were defined based on soil profiles recorded in sub-Saharan Africa, thus are subject to further adjustments in other regions where extensive soil profiles are available.

Texture: Clay, Loam, Sand

Fertility
(soil organic carbon content)

Low:	less than 0.7 %
Medium:	between 0.7 and 1.2 %
High:	greater than 1.2 %

Rooting Depth

Shallow:	less than 90 cm
Medium:	between 90 and 150 cm
Deep:	deeper than 150 cm

Box 1. Classes and boundary conditions that define the 27 generic soil profiles

How to use the 27 soil profiles?

There will be multiple ways of utilizing HC27 in crop modeling applications. First, for a given site, users can choose which one best matches to the soils found in the area. It would be difficult to estimate values of all soil properties that crop models require, but selecting one out of 27 by answering three multiple-choice questions would be relatively straightforward to users with some level of agronomic knowledge. Secondly, model can be run with all 27 soil profiles for a given

site to create a set of simulation results, then narrow down to the most relevant one later as more site-specific information becomes available. Finally, based on additional information from other databases, a new kind of soil map that locates 27 soils can be generated and used in large-scale applications.

For example, Figure 1 is an example soil map indicating which one of 27 soils is predominantly distributed where, and this data layer was generated by 1) overlaying 10-km grids on HWSD v1.1, 2) computing zonal statistics of soils on grids, 3) determine predominant soil in each grid cell, and 4) match the soil with one of 27 soils, based on the predominant soil's texture, organic carbon content of top soil, and available water content classification (as the proxy of rooting depth) from the HWSD.

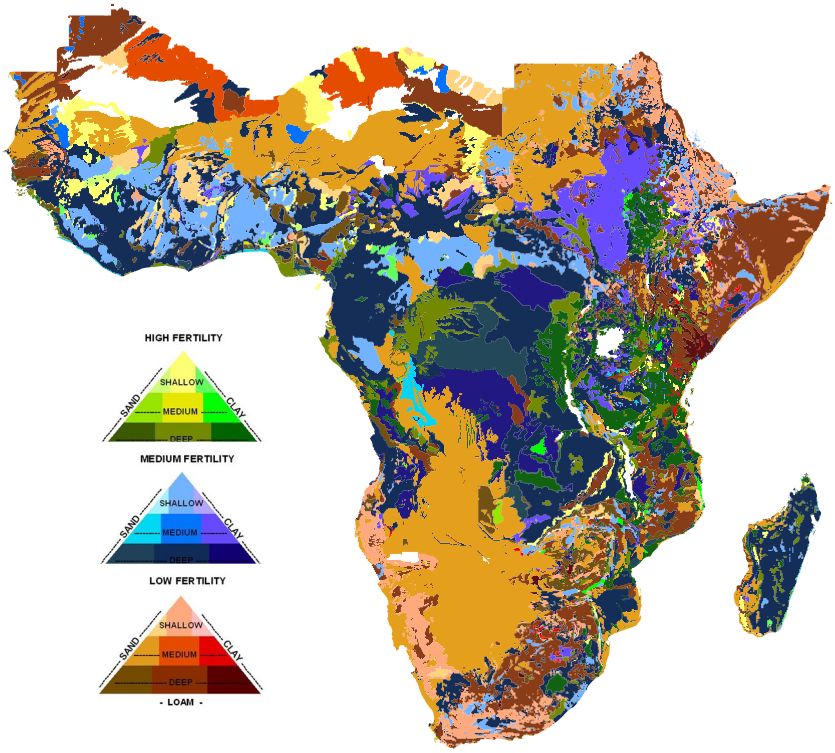

Figure 1. Spatial distribution of HC27 based on the pixilated HWSD v1.1 at 10-km grids and its predominant soil in each grid cell

Is HC27 the ultimate soil database?

The HC27 does not replace any existing high resolution soil mapping efforts nor duplicate site-specific soil measurements. Instead, this approach tries to address the need for a reasonably representative meso-scale soil profile database to be used in certain types of spatial crop systems modeling applications. For example, recently in 2009, HC27 was used in regional/global scale climate change impact assessment studies by IFPRI. However, due to the nature of "generic" characteristics, there will be applications that the use of HC27 may not be desirable where detailed soil property dynamics beyond the three criteria are emphasized.

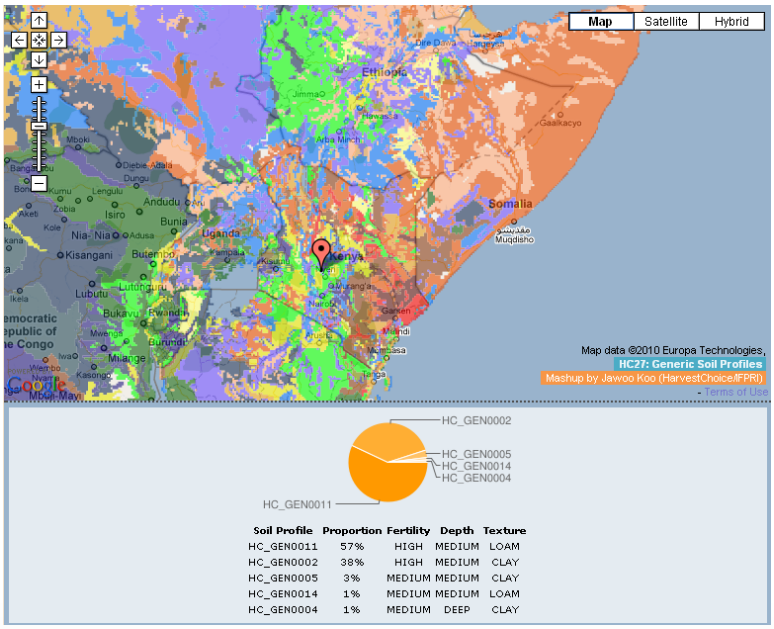

Figure 2. Web interface to explore and download HC27

Where to download HC27?

The latest version of HC27 can be explored and downloaded at http://droppr.org/data/map/hc27.

References

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