NEW FOR 2014

HORIZON Hydraulics version 2

Cranfield UNIVERSITY

HORIZON Hydraulics includes very detailed descriptions of the hydraulic properties pertaining to each layer, or horizon for each of the national soil types. This data is based heavily on laboratory based analyses.

Why have we released a revised dataset?

The new version of the Soil Hydraulic Properties database (version 2.07) has been issued to replace the current version. The latter was created using a set of predictive equations derived by multiple regression analysis of a data set of measured values of the volumetric percentage of water content held at pressure heads of 0 kPa, -5 kPa, -10, kPa, -40 kPa, -200 kPa and -1500 kPa. The data set included measurements from soil horizons in England, Wales and Scotland. It was necessary to use predictive equations because the measured data set is not comprehensive enough to characterize the hydraulic properties of all relevant national soil series and land use combinations based solely on its measurements. The available measured data was therefore used to derive relationships between each physical parameter and the more widely available measured soil horizon data on mineral particle-size fractions and organic carbon content as well as bulk density.

Although the derived predictive equations gave a good general prediction of the measured water content at different pressure heads, with r^2 values of between 0.70 (for 0 kPa pressure head) and 0.79 (for -1500 kPa pressure head), recent analysis highlighted two main problems with the predicted values.

Firstly, for some horizons, water contents at sequentially larger pressure heads show anomalies, with the predicted value at a specific pressure smaller than that at the next larger one. Secondly, prediction of the water contents in horizons with relatively 'extreme' mineral particle-size, such as very clayey (clay contents of 60% or more), very fine sandy (sandy or loamy textures in which 85% or more of the particles are 100 μm esd or less) or sandy (silt + 2 x clay content is 30% or less), is poor. Such soils include extensive series such as Denchworth, Newport and Wisbech. This poor prediction is particularly important if the data is being used to parameterize 'capacity-type' models incorporating values such as available water capacity (AWC), the water content held between -5 (or -10) kPa and -1500 kPa. In such cases, even relatively minor errors in prediction at individual pressure heads can accumulate to give significant errors.

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The revised dataset

In order to correct the anomalies and to minimise the larger predictive errors, a new set of predictive equations has been derived using an expanded set of measured data from England, Wales, Scotland and Northern Ireland (Hollis *et al*, 2014). The methodology used to derive the equations has resolved the former problems with respect to poor prediction of water retention in soils with relatively 'extreme' mineral particle-size distributions. It has also substantially reduced problems relating to anomalies, between predicted values at increasing pressure heads. Any such remaining anomalies have been eliminated from the enclosed dataset.

As demonstrated in the paper, the new equations can be used to predict water contents at seven points on the water release curve between 0 and -1500 kPa pressure head and this is the data included in your dataset. It is derived from the predictive equations applied to soil series-land-use specific averages of soil particle-size, organic carbon and bulk density and thus represents national 'soil series-average' data. The additional pressure head -1 kPa (Thv1) has been added to the dataset plus the hydraulic conductivity (KSat), Van Genuchten and Brook-Corey parameters have been updated where required.

Use of the data

The enclosed data can be used to parameterize both continuous function and capacity-type models. Analyses undertaken in the paper, using the van Genuchten continuous function model and the capacity model for $AP_{cereals}$, indicate that such parameterization is likely to result in mean predictive errors of $\pm$ 15% and $\pm$ 17% respectively.

The method used to develop the predictive equations means that they are most appropriate when applied across the whole of the UK or at least across regions with a wide range of soil types / climates. As with any predictive equations derived from spatially extensive data, more 'accurate' local predictions could probably be made by deriving equations from relevant local soils data but these would then be less accurate if used elsewhere in the country.

As described in the paper by Hollis *et al* (2014), a second set of predictive equations incorporating an additional climatic parameter, the Potential Soil Moisture Deficit (PSMD) was identified as giving a significantly improved prediction of water retention for loamy and clayey soils in drier parts of the UK. These equations, which are also given in the paper, have not been used to derive the enclosed database because they are not suitable for calculating a single set of water retention values using national soil series average data. Rather, they are better suited to applications such as GIS-based digital mapping and modeling. It is emphasized that users wishing to apply them for this purpose should only do so using PSMD values calculated in the same way as those described in the paper.

Reference

Hollis, J. M., Lilly, A., Higgins, A., Jones, R. J. A. Keay, C. A. and Bellamy, P.H. (2014). Predicting the water retention characteristics of UK mineral soils. European Journal of Soil Science, 2014, doi: 10.1111/ejss.12186