Predictive modelling of the soil water retention curve for soils in New Zealand

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There is increasing demand for quantitative information from S-map – New Zealand's soil survey database, including estimates of the soil properties that support irrigation and nutrient management. An empirical model for the soil water retention curve (WRC) has been developed based on soil sample data available from the New Zealand National Soils Database (NSD), which provides water content measurements at tensions of 0 (total porosity), 5, 10, 20, 40, 100, and 1500 kPa. For each sample, texture (sand, silt, clay fractions) data are available, as well as the soil classification, and other factors describing the soil sample. The new empirical model, or pedotransfer function (PTF), uses a vector generalised linear model (VGLM), where the estimated water content at one of the specified tensions is formed from the VGLM prediction for 1500 kPa, plus a succession of differences for lower tensions. An estimate of the predictive uncertainty is generated by simulation of the response.

The new PTF is then applied to S-map siblings to obtain an estimate of the volumetric water content at the key tensions of 0 (total porosity), 10 (field capacity) and 1500 (wilting point) kPa. This in turn is combined with the horizon thickness and stone content to give a depth measure of the soil available water. We discuss the application of the WRC model to S-map siblings. Predictions are only made where the predictive uncertainty is judged to be acceptable. A Monte Carlo approach is used to derive a confidence interval for an estimate of profile available water that accounts for error in the WRC model as well as variability within the soil sibling.

Modelling of soil properties is becoming more of an ongoing iterative process, which allows us to take advantage of new measured data, covariate information, modelling techniques and advances in soil science. The new PTF is a more complicated model than the current one, and provides a better fit to measured data, and better conformance to known physical constraints in soil behaviour.