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Determining the soil water retention curve across the whole moisture range by combining HYPROP and WP4C data

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The soil water retention curve is the most important relationship in soil hydrology. It is obtained by fitting continuous functions to discrete data pairs of volumetric water content vs. matric potential (or suction). Its determination requires a combination of methods, because no single measurement technology is able to measure water potentials across the full moisture range, from full saturation to oven dryness. The traditional measurement methods rely on a combination of suction tables and pressure chambers. These methods are very time consuming and thus expensive. They furthermore yield sparse data that come from investigating different samples. Today, we see a transition towards measuring highly resolved retention measurements in the wet to medium range with evaporation experiments, boosted by the availability of commercial devices like HYPROP©. The data that are obtained with the evaporation method can be supplemented with discrete data in the dry range that are obtained with the dewpoint method, e.g. with the WP4C© device, which enables the measurement of very low water potentials far beyond the permanent wilting. The WP4C device was launched a few years ago by the DECAGON company and is today distributed by the METER Group.
There are several recommendations for preparing soil samples for the WP4 device. In the standard procedure, described by a DECAGON Application Note, a defined amount of water is added to air dry or even oven dry soil material and measured in the WP4C device after an equilibration period of at least 16 hours. Since the soil moisture characteristic is hysteretic, the water potentials of such humidified soils differ from those of the soils, which obtain the same water content by dehydration. An alternative is to use originally wet material that has been dried to some degree.
In our work, we directly combine HYPROP and WP4C measurements to determine a complete retention curve. After completion of the HYPROP measurements, the sample is divided into four layers and the water potential for each layer is determined using WP4C. We compare this procedure with three alternative methods and show how this affects the water retention curve data. As an outcome, we recommend an optimal operation protocol for the determination of soil water retention data over the whole moisture range.