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Mapping Soil hydrologic features in a semi-arid irrigated area in Spain

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The lack of soil information is a managerial problem in irrigated areas in Spain. The Violada Irrigation District (VID; 5234 ha) is a gypsic, semi-arid region in the Middle Ebro River Basin, northeast Spain. VID is under irrigation since the 1940's. The implementation of the flood irrigation system gave rise to waterlogging problems, solved along the years with the installation of an artificial drainage network. Aggregated water balances have been performed in VID since the early 1980's considering average soil properties and aggregated irrigation data for the calculations (crop evapotranspiration, canal seepage, and soil drainage). In 2008-2009, 91% of the VID was modernized to sprinkler irrigation. This new system provides detailed irrigation management information that together with detailed soil information would allow for disaggregated water balances for a better understanding of the system.

Our goal was to draw a semi-detailed soil map of VID presenting the main soil characteristics related to irrigation management. A second step of the work was to set up pedotransfer functions (PTF) to estimate the water content and saturated hydraulic conductivity (Ks) from easily measurable parameters.

Thirty four pits were opened, described and sampled for chemical and physical properties. Thirty three additional auger holes were sampled for water holding capacity (WHC; down to 60 cm), helping to draw the soil units boundaries. And 15 Ks tests (inverse auger hole method) were made. The WHC was determined as the difference between the field capacity (FC) and wilting point (WP) measured in samples dried at 40ºC during 5 days. The comparison with old values dried at 105ºC for 2 days highlighted the importance of the method when gypsum is present in order to avoid water removal from gypsum molecules.

The soil map was drawn down to family level. Thirteen soil units were defined by the combination of five subgroups [Typic Calcixerept (A), Petrocalcic Calcixerept (B), Gypsic Haploxerept (C), Typic Xerorthent (D), and Typic Xerofluvent (E)] and six particle size families [Fine (1), Fine-silty (2), Fine-loamy (3), Coarse-loamy (4), Loamy Superficial (5) and Loamy-skeletal (6)]. Two great soil zones were defined: the more calcic glacis (A and B subgroups) dominated by coarse textures (4-6); and the more gypsic, fine textured valley floors (C, D and E) (1-2-3) with the exception of the superficial gypsic high lands (D5).

In all the soils in VID Calcium Carbonate Equivalent (CCE) was high (though lower in the valleys) and silt was the main textural fraction. The coarser textured glacis had low Gypsum Content (GC), lower WHC and higher Ks while the valley bottoms had high GC, fine textures and lower Ks. The soil water retention properties (FC and WP) could be calculated from textural properties (clay, and fine silt fractions) and the Ks could be related to sand and GC by means of meaningful PTF's.

The use of disaggregated soil information (combined with distributed irrigation data) may lead to improved water balance calculations and suggest management options for a better water use in VID.