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Field data and unsaturated zone response in clay shale terrain, northern Apennine, Italy

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Soil moisture data collected at a field experimental site are presented and analysed to reveal the surface infiltration process and deep recharge in clayey soils. Soil moisture content profiles for the years 2004-2006 were measured in three locations along a hillslope by means of nested capacitance sensors at three different depths (10 to 80 cm). In the study area, low permeability clay soils are the product of progressive softening and weathering of clay shales. Shallow soils display a decreasing porosity with depth and occasional cracking during summer months. Volumetric water content data were used as observations for inverse optimization of soil hydraulic parameters for the Richards' equation. Inverse optimization has taken into account the curves of declining soil moisture at different depths in different seasons. Representative averaged curves have been used to investigate the sensitivity in simulated soil moisture content of different hydraulic parameters used in a one-dimensional unsaturated zone model based on Richards' equation. The estimated parameters show seasonal variation probably due to the presence of cracking phenomena. The comparison to their measured laboratory and in-situ equivalents also shows significant differences. Subsurface hydrological modelling has been used to clarify the soil moisture balance A simple process-based and a physically-based model have been tested versus the available soil moisture temporal series. From a water balance perspective, results indicate that regardless of the clay nature of soils, infiltration is limited by the saturation of the soil rather than attainment of infiltration capacity. The latter maintains rather high and is exceeded only by very high intensity rain, mostly summer rainstorms. Physically-based modelling enabled us to take into consideration a deeper horizon of soil and the complete seepage process along the profile. Results indicate that a traditional porous model, based on Richards' equation, can satisfactorily describe the process of infiltra-

tion and pore pressure growth at low depth but different parameters have to be used for the dry and wet season in order to reproduce satisfactorily experimental data.