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Investigation of the soil moisture distribution in different soil surface structure types on the field scale

M. Dimitrov, C. Steenpass, J. Vanderborght, and H. Vereecken
Agrosphere Institute, Forschungszentrum Jülich, Germany, (Email: m.dimitrov@fz-juelich.de)

The structure of the soil surface layer plays an important role for the water distribution in the soil and water exchange between the soil and atmosphere. Water content and soil temperature were monitored for a 4 month period in the top layer of three plots of a silty-loam soil. The plots differed in the treatment of the top 15 cm of the soil. The first plot was a reference plot in which the top soil layer was not disturbed. In the second plot, the top layer was dug with a spade to a depth of 15 cm and harked, mimicking the structure of a ploughed field. The third plot was harked after digging and compacted with a roller mimicking a prepared seedbed. In each plot, soil moisture and temperature sensors were installed at 2, 5, 10 and 30 cm depth. In addition, the surface temperature of the three plots was monitored with an infrared (IR) camera. The L-Band (1.4 GHz) brightness temperature of the ploughed plot was monitored with an L-Band radiometer.

First results indicate considerable differences in the soil moisture between the different plots. In the ploughed plot, the volumetric soil moisture was the lowest throughout the experimental period for the first two depths and varied the most spatially. In the seedbed plot, soil moisture was lower than in the reference plot at the beginning of the experiment but converged to the soil moisture in the reference plot later after major rainfall events. This indicates dynamic soil structure and soil hydraulic properties. A first comparison between surface soil moisture contents that were derived from L-Band radiometer measurements and in-situ measurements showed a good agreement if temporal changes in soil surface roughness were considered for the interpretation of L-Band brightness temperatures. Obvious changes of the brightness temperature were observed after high precipitations. The soil temperature measured at the seedbed plot showed more dynamic changes compared with the other two plots. The below surface soil temperatures were very similar between the different plots but clear differences could be observed in soil surface temperatures that were observed with the infrared camera. Highest surface temperatures were measured in the ploughed plot, whereas the reference plot showed the lowest temperatures. The different IR measured temperatures can be due to different evaporation rates and differences in surface albedo and IR emissivity. Simulations with a coupled water and heat flow model are used to unravel these effects.