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Innovative methods for soil moisture monitoring on different spatial scales

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The temporal and spatial variability of soil moisture is one of the important parameters within the soil-atmosphere system, influencing both the hydrology on small to medium scales as well as the availability of moisture within the atmosphere. The latter may have significant influence on the local and the mesoscale, e.g. concerning the initiation of thermally induced wind regimes and in connection with the initiation of mesoscale convective systems. In spite of the importance, there is an almost complete lack of operational soil moisture observations within the hydrological and meteorological community. The general lack of data is probably because spatial soil moisture variability is large, depending strongly on soil type, surface characteristics, land use and vegetation. Soil moisture can vary significantly over spatial scales of even a few cm, making an operational measurement network for meteorological purposes difficult.

For soil moisture monitoring purposes two approaches are common: (1) spatially integrating remote sensing methods on larger scales and (2) in-situ measurements on smaller scales (point measurements), the latter being generally more accurate, but limited to the near-field of the probe/sensor. In recent years hydrogeophysical methods are additionally applied on an intermediate scale, because of their applicability for 2- and 3-dimensional problems (penetration depths of several meters) and their flexible spatial scales (between the centimetre scale and a few kilometres).

As a precursor study for a large experimental and modelling investigation of the influence of soil moisture variability on convection initiation in orographic terrain, a num-

ber of innovative soil moisture measurement methods on different spatial scales were tested for their applicability in local and mesoscale atmospheric monitoring networks. The methods range from point measurements using the new simplified soil moisture probe SISOMOP, via spatially integrating TDR-measurements and spatially resolving geophysical measurements (Electrical Resistivity Tomography, Ground Penetrating Radar) at different scales, to experimental techniques which integrate the surface soil moisture signal over footprints ranging between the local and the satellite-resolving scale (FreeLineSensor, reflected GPS). In addition, soil-atmosphere transfer modelling with models of different complexity were performed. In this contribution we present first results and introduce several new techniques for both, spatially integrating and spatially resolving soil moisture measurements, as well as innovative sensors for large monitoring networks.