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Terrestrial hydrological Research and Geophysics: Quo Vadis?

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Geophysical methods may play an important role in managing our terrestrial environment and in maintaining ecosystem functioning and services. Especially, the application and further development of hydrogeophysical methods seem very promising to maintain and protect soil and groundwater quality. Hydrogeophysical methods may help to improve our control on storage, filter and buffer functions of soils and groundwater systems. Moreover, methods are needed that will help us to bridge the gap between the scale of measurements and observations and the scale at which management of terrestrial systems takes place. In this presentation several examples will be presented showing how hydrogeophysical research can contribute in meeting these challenges. Recent progress in the field of magnetic resonance imaging, electrical resistivity tomography and spectral induced polarisation to investigate flow and transport processes in soils will be presented. In the field of high frequency hydrogeophysics, advanced full-waveform forward and inverse modelling procedures have been developed for ground penetrating radar technology, which are now routinely used for high-resolution, real-time mapping of surface soil moisture at the field scale. Integrated inversion and data fusion strategies, where both geophysical and hydrological models are coupled, further extend information retrieval capabilities also in real-time, and permits advanced interpretation of time-lapse data for hydrological process identification, water dynamics monitoring and soil hydraulic properties determination. Advances in wireless and sensor technologies are increasing the feasibility of using distributed sensor networks for observing soil water and hydrological processes at the intermediate scale, bridging the gap between ground-based sensors and remote sensing platforms.