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Characterizing water and CO_2 fluxes and their driving impact factors by using a hierarchical diagnostic geophysical monitoring concept

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Processes in soil, plants and near surface atmosphere interact with each other in a complex way. Soil is an environmental component and important part of our ecosystems. Parent material of soils determines the original supply of nutrients. However, environmental parameters such as meteorological and land use have also an influence to the soil conditions. The objective of our research work is the development of a hierarchical diagnostic monitoring concept for the characterization of water and CO_2 fluxes and their driving impact factors to provide information on structures and fluxes in the soil-vegetation- atmosphere system.
As part of this hierarchical diagnostic monitoring concept, several methods and technologies from different disciplines (such as chemistry, hydrogeology, and geophysics) will either be combined or used complementary to one another. Our approach will allow large spatial areas to be consistently covered, for efficient monitoring of increases in spatial and temporal resolutions. Firstly, remote sensing monitoring methods for large-scale application (more than 1km2) are used to obtain information about energy and matter fluxes in the atmosphere. A common spectroscopic method for analysis is FTIR spectroscopy, where chemical anorganic and organic compounds can be detected through their characteristic infra-red absorption frequencies or wavelengths. Open-path Fourier transform infrared (OP FTIR) spectrometry is a sensitive and non-invasive method to detect and quantify a wide range of gases simultaneously. Subsequently, meso-scale methods (0.01-1km2) can be employed which investigate subsurface characteristics to describe geological and soil structures and dynamics. Various soil parameters can be mapped using rapid, nearly non-destructive methods (e.g. geophysics, spectroscopy), for quasi-continuous 2D as well as 3D mapping of soil physical and hydrological properties. Finally, point measurements at plot scale (less than 0.01km2) enable high resolution investigations to take place at focal points. In-situ or surface permanent observations can monitor temporal variations in near surface areas affecting the ecosystem functions. Such permanent observations include soil moisture, soil temperature and soil gas fluxes (CO_2 and H_2O).