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SIGNAL : Water vapour flux variability and local wind field investigations within five differently managed agroforestry sites across Germany

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Optimising soil water uptake and ground water consumption in mono-specific agricultural systems plays an important role for sustainable land management. By including tree alleys into the agricultural landscape, called agroforestry (AF), the wind flow is modified leading to a presumably favourable microclimate behind the tree alleys. We expect that this zone is characterized by increased air temperature and atmospheric water vapour content, compared to mono-specific fields. This would extend the growing season and increase the yield production behind the tree alleys.

Within the SIGNAL (Sustainable Intensification of Agriculture through Agroforestry) project the evapotranspiration (ET) variability and the local wind field of agroforestry sites compared to mono-specific agricultural systems is investigated. Our study is based on the comparison of five differently managed agroforestry sites across Germany. All site feature one agroforestry plot and one reference plot, which represents a mono-specific cropped system. Each plot is equipped with an eddy-covariance tower, including a high frequency 3D SONIC anemometer and instruments gathering standard meteorological parameter as pressure, temperature, relative humidity, precipitation, ground heat flux, net- and global radiation.

The Surface Energy Budget (SEB) method will be used to calculate evapotranspiration Q_E as

$$Q_E = -Q_N - Q_H - Q_G - Res$$

by measuring the sensible heat flux, Q_H, with the eddy covariance method, the radiation balance, Q_N and the ground heat flux, Q_G. Q_H and Q_N will be measured continuously long-term. We will quantify site specific energy balance non-closure, Res, by temporarily measuring Q_E, using eddy covariance and a roving tower and then solving the SEB equation for Res. The short term Res will be used to then continuously derive Q_E from the SEB method.

We will compare measured evapotranspiration rates from the SEB method to modelled evapotranspiration of the agroforestry systems through upscaling of an one dimensional two layer SVAT model of the Shuttleworth and Wallace type to the agroforestry system. Finally, the evapotranspiration, calculated by the SEB method and modelled with the SVAT model will be used as an input to the LES model ASAM (All Scale Atmospheric Model) to simulate the three dimensional wind field around the complex agroforestry system.