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Estimation of sensible and latent heat fluxes over a hilly agricultural catchment by scintillometry

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Monitoring land surface fluxes is of paramount importance in semi-arid and arid agricultural areas, since vegetation production and water balance are strongly influenced by evapotranspiration. Beside eddy covariance devices, scintillometers allow spatially integrated estimates of the sensible heat flux, a major component of the surface energy balance. Nevertheless, the effect of topography on scintillometer measurements is still under debate.

The experiment was set within the agricultural Kamech catchment, located in the Cap Bon, north-eastern Tunisia [1]. A LAS scintillometer was installed along a 968 meter long transect, perpendicular to the V-shaped valley of the catchment. The above ground altitude of the optical path varied between 2 meters at its extremities and 55 meters in its middle. Scintillometer measurements were conducted from April (maximum of vegetation development) to July 2006 (dry bare soils). Two eddy covariance stations installed on each side of the watershed and located below the optical path provided estimates of the energy balance components at the field scale [2]. Monitoring of vegetation state and soil moisture was conducted on the other fields located around the optical path.

The footprint of the scintillometer measurements was evaluated by integrating the Host and Weill [3] approach along the optical path of the scintillometer. The effect of the distance between the ground surface and the optical path was accounted for following Lagouarde [4]. Spatially integrated estimates of the sensible heat flux provided by the scintillometer measurements were found to be consistent with the local measurements given by the eddy covariance stations, during both vegetated and bare soil periods, respectively corresponding to high and low levels of the latent heat fluxes. Scintillometer estimates of the sensible heat flux were found to be highly sensitive to optical path altitude, calculated over the footprint. Both footprints and altitudes varied strongly with the wind direction.

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