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Distributed Sensing of Soil Heat Flux

Nick van de Giesen (1), Jop Jansen (1), Philip Stive (1), Scott Tyler (2), Susan Steele-Dunne (1), and Lucas Williamson (2)

(1) Delft University of Technology, Water Resources Management, Delft, Netherlands (n.c.vandegiesen@tudelft.nl), (2) University of Nevada, Reno, USA

Precision agriculture is an important tool to increase the sustainability of irrigated agriculture. Large differences are typically found within a field with respect to crop temperatures and evaporation. Methods are being developed to better monitor the uneven distribution of evaporation, mainly methods based on remote sensing of fields, farms, and irrigation systems. These remote sensing methods are based on energy balance estimations. Soil heat flux is in these cases mostly treated as the orphan of the surface energy balance. The absolute values of soil heat flux are estimated to be (very) low and one often assumes low spatial variability. Over long periods, the net contribution of soil heat flux is indeed low. However, for energy balance closures that depend on instantaneous values, such as those based on satellite observations, good soil heat flux estimates are essential. The standard measurement technique makes use of a heat flux plate that, at best, measures soil heat flux at one point. In this presentation, a method is presented that measures soil heat flux in a distributed fashion. A custom-designed plow system deploys three fiber optic cables at three different depths close to the soil surface. Distributed Temperature Sensing (DTS) is then used to gather temperatures with a spatial resolution of one meter and a temporal resolution of 30 seconds. The measurements clearly indicate large spatial variability in surface heat flux along the cables. Variations of up to 100% between points that are only 15 meter apart can be seen. There seems to be a clear need for distributed soil heat flux measurements if we want to understand better the spatial distribution of sensible and latent heat fluxes at field and farm level.