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Establishing seasonal chronicles of actual evapotranspiration under sloping conditions

R. Zitouna Chebbi (1), L. Prévot (2), F. Jacob (3), and M. Voltz (2)

(1) LR GERE, INRGREF,Tunis,Tunisia (rimzitouna@live.fr), (2) UMR LISAH, INRA, Montpellier, France, (3) UMR LISAH, IRD, Montpellier, France

Estimation of daily and seasonal actual evapotranspiration (ETa) is strongly needed for hydrological and agricultural purposes. Although the eddy covariance method is well suited for such estimation of land surface fluxes, this method suffers from limitations when establishing long time series. Missing data are often encountered, resulting from bad meteorological conditions, rejection by quality control tests, power failures… Numerous gap fill techniques have been proposed in the literature but there applicability in sloping conditions is not well known.

In order to estimate ETa over long periods (agricultural cycle) on crops cultivated in sloping areas, a pluri-annual experiment was conducted in the Kamech catchment, located in North-eastern Tunisia. This Mediterranean site is characterized by a large heterogeneity in topography, soils and crops. Land surface fluxes were measured using eddy covariance systems. Measurements were collected on the two opposite sides of the Kamech V-shaped catchment, within small fields having slopes steeper than 5%. During three different years, four crops were studied: durum wheat, oat, fava bean and pasture. The topography of the catchment and the wind regime induced upslope and downslope flows over the study fields.

In this study, we showed that gap filling of the turbulent fluxes (sensible and latent heat) can be obtained through linear regressions against net radiation. To account for the effect of the topography, linear regressions were calibrated by distinguishing upslope and downslope flows. This significantly improved the quality of the reconstructed data over 30 minute intervals. This gap filling technique also improved the energy balance closure at the daily time scale.

As a result, seasonal chronicles of daily ETa throughout the growth cycle of the study crops in the Kamech watershed were established, thus providing useful information about the water use of annual crops in a semi-arid rainfed and hilly area.