Geophysical Research Abstracts
Vol. 19, EGU2017-7377, 2017
EGU General Assembly 2017


# Assessing factors that influence deviations between measured and calculated reference evapotranspiration

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Evapotranspiration (ET) is a fundamental component of the hydrological cycle, but challenging to be quantified. Lysimeter facilities, for example, can be installed and operated to determine ET, but they are costly and represent only point measurements. Therefore, lysimeter data are traditionally used to develop, calibrate, and validate models that allow calculating reference evapotranspiration ($ET_0$) based on meteorological data, which can be measured more easily. The standardized form of the well-known FAO Penman-Monteith equation (ASCE-EWRI) is recommended as a standard procedure for estimating $ET_0$ and subsequently plant water requirements. Applied and validated under different climatic conditions, the Penman-Monteith equation is generally known to deliver proper results. On the other hand, several studies documented deviations between measured and calculated $ET_0$ depending on environmental conditions. Potential reasons are, for example, differing or varying surface characteristics of the lysimeter and the location where the weather instruments are placed. Advection of sensible heat (transport of dry and hot air from surrounding areas) might be another reason for deviating ET-values. However, elaborating causal processes is complex and requires comprehensive data of high quality and specific analysis techniques. In order to assess influencing factors, we correlated differences between measured and calculated $ET_0$ with pre-selected meteorological parameters and related system parameters. Basic data were hourly $ET_0$-values from a weighing lysimeter ($ET_{0\_lys}$) with a surface area of 2.85 $m^2$ (reference crop: frequently irrigated grass), weather data (air and soil temperature, relative humidity, air pressure, wind velocity, and solar radiation), and soil water content in different depths. $ET_{0\_ref}$ was calculated in hourly time steps according to the standardized procedure after ASCE-EWRI (2005). Deviations between both datasets were calculated as $ET_{0\_lys} - ET_{0\_ref}$ and separated into positive and negative values. For further interpretation, we calculated daily sums of these values. The respective daily difference (positive or negative) served as independent variable (x) in linear correlation with a selected parameter as dependent variable (y). Quality of correlation was evaluated by means of coefficients of determination ($R^2$). When $ET_{0\_lys} > ET_{0\_ref}$, the differences were only weakly correlated with the selected parameters. Hence, the evaluation of the causal processes leading to underestimation of measured hourly $ET_0$ seems to require a more rigorous approach. On the other hand, when $ET_{0\_lys} < ET_{0\_ref}$, the differences correlated considerably with the meteorological parameters and related system parameters. Interpreting the particular correlations in detail indicated different (or varying) surface characteristics between the irrigated lysimeter and the nearby (non-irrigated) meteorological station.