Geophysical Research Abstracts
Vol. 17, EGU2015-9566, 2015
EGU General Assembly 2015

Assessing reference evapotranspiration in a subhumid climate in NE Austria

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Computing reference evapotranspiration and multiplying it with a specific crop coefficient as recommended by the Food and Agriculture Organization of the United Nations (FAO) is the most widely accepted approach to estimate plant water requirements. The standardized form of the well-known FAO Penman-Monteith equation, published by the Environmental and Water Resources Institute of the American Society of Civil Engineers (ASCE-EWRI), is recommended as a standard procedure for calculating reference evapotranspiration. Applied and validated under different climatic conditions it generally achieved good results compared to other methods. However, several studies documented deviations between measured and calculated reference evapotranspiration depending on local environmental conditions. Consequently, it seems advisable to evaluate the model under local environmental conditions.

Evapotranspiration was determined at a subhumid site in Austria (48°12'N, 16°34'E; 157 m asl) using a large weighing lysimeter operated at (limited) reference conditions and compared with calculations according to ASCE-EWRI. The lysimeter had an inner diameter of 1.9 m and a hemispherical bottom with a maximum depth of 2.5 m. Seepage water was measured at a free draining outlet using a tipping bucket. Lysimeter mass changes were sensed by a weighing facility with an accuracy of ± 0.1 mm. Both rainfall and evapotranspiration were determined directly from lysimeter data using a simple water balance equation. Meteorological data for the ASCE-EWRI model were obtained from a weather station of the Central Institute for Meteorology and Geodynamics, Austria (ZAMG). The study period was from 2005 to 2010, analyses were based upon daily time steps.

Daily calculated reference evapotranspiration was generally overestimated at small values, whereas it was rather underestimated when evapotranspiration was large, which is supported also by other studies. In the given case, advection of sensible heat proved to have an impact. On the other hand, it could not explain the differences exclusively, as it was also shown that small net radiation in combination with small wind velocity produced by trend better results than small net radiation with a large wind velocity, which is somehow contradicting the principle of advection. Obviously, there were also other disregarded influences, for example seasonal varying surface resistance, albedo and soil heat flux. Generally, the ASCE-EWRI equation for daily time steps performed best at average weather conditions. The outcomes should help to correctly interpret reference evapotranspiration data in the region and in similar environments and improve knowledge on the dynamics of the influencing factors that caused the deviations.