Geophysical Research Abstracts
Vol. 16, EGU2014-1395, 2014
EGU General Assembly 2014

Soil-atmosphere and vadose zone water fluxes at the Wagna – lysimeter: Workflow, models, and results

Johann Fank

RESOURCES - Inst. of Water, Energy and Sustainability, JOANNEUM RESEARCH, Graz, Austria
(johann.fank@joanneum.at, 0043 316876 96001)

A precise knowledge of the water fluxes between the soil-plant system and the atmosphere is of great importance for understanding and modeling water, solute and energy transfer in the soil-plant-atmosphere system. Weighing lysimeters are precise tools to allow the determination of the hydrological cycle components in very short time intervals. Lysimeters with controlled suction at the lower boundary allow estimation of capillary rise and deep water percolation on short time scales. Evapotranspiration, rainfall, and irrigation can be computed from weight changes. In the last decades resolution and precision of the weighing systems have been substantially improved, so that modern lysimeters, resting on weighing cells can reach resolutions of up to 0.01 mm. Nevertheless, a lot of external effects (e.g. from maintenance, surface treatment) and small mechanical disturbances (e.g. caused by wind) became visible in the data. Seepage mass data are affected by water sampling and the emptying process of the seepage water container.

Increasing parts of corrected seepage mass data show deep water percolation, decreasing parts in dry weather periods can be interpreted as capillary rise. In the evaluation process of corrected lysimeter mass data every increase in system weight (lysimeter mass + cumulative seepage mass) might be interpreted as rainfall or irrigation, whereas every decrease in system weight is interpreted as evapotranspiration. To apply this concept correctly, the noise in both data sets has to be separated from signals using a filtering routine (e.g. Peters et al., 2013) which is appropriate for any event, including events with low disturbances as well as strong wind and heavy precipitation in small time intervals.

Based on the data set from the “Wagna” lysimeter in Austria with a high resolution of the scale ($\sim$ 0,015 mm) and very low noise due to low wind velocities for the year 2010 a lysimeter data preparation workflow will be executed: (a) correction of the lysimeter mass data set, (b) correction of the seepage mass data set, (c) definition of periods with congruent analyzable data sets, (d) computing upper boundary fluxes, (e) filtering of seepage mass, (f) filtering of upper boundary fluxes, (g) definition of the time step for data evaluation (e. g. hourly values, daily values). For every time step in the analyzable periods the data evaluation workflow follows the scheme: (1) computing change of stored water volume S from lysimeter weight, (2) computing rainfall and/or irrigation R from increasing upper boundary fluxes, (3) computing capillary rise C from decreasing seepage mass, (4) calculation of percolation water P from mass change of seepage + C, (5) calculation of evapotranspiration ET using the water balance equation (ET = R – P + C – S).

Based on the “Wagna” data set the accuracy of modern lysimeter measurements is shown as an effect of rime precipitation and rime evaporation on a cold winter day. Results are compared to the Penman-Monteith model for computing grass reference evapotranspiration. For January 27th 2010 rime precipitation was measured to 0.23 mm, evaporation was estimated to 0.33 mm. The estimation of ET was in a very good agreement with the Penman-Monteith computation of 0.34 mm. Results of lysimeter data evaluation (R, ET, P) using different time steps for the year 2010 are discussed. Estimation of R (1013.8 mm) is compared to measured precipitation using a tipping bucket (1013.6 mm) and a precipitation scale (900.4 mm) nearby the lysimeter.

Peters, A., Nehls, T., Schonsky, H., and Wessolek, G.: Separating precipitation and evapotranspiration from noise – a new filter routine for high resolution lysimeter data, Hydrol. Earth Syst. Sci. Discuss., 10, 14645-14674, doi:10.5194/hessd-10-14645-2013, 2013.