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Long term evapotranspiration measurements at a semi-arid sandy grassland

Krisztina Pintér, Péter Kertész, János Balogh, and Zoltán Nagy

Institute of Botany and Ecophysiology, Faculty of Agricultural and Environmental Sciences, Szent István University, Gödöllő, Hungary (pinter.krisztina@mkk.szie.hu)

Evapotranspiration (ET) and net ecosystem exchange (NEE) of a semi-arid grassland (46.69°N, 19.60°E near Bugacpuszta, Hungary) have been measured since 2002 by eddy covariance (EC) technique.

The calculation of the turbulent fluxes from the raw (10 Hz) dataset was performed by the EddyPro® open source software. Gap-filling and flux partitioning was accomplished by the REddy ProcWeb online tool (Reichstein et al 2005).

Based on the 14 years (2003-2017) long dataset the annual mean evapotranspiration at the Bugac site is 488 mm (SD: 77 mm), while the mean annual precipitation for the same period is 566 mm. The annual sum of ET was less than the annual sum of precipitation except for two years (2011, 2012) following a wet extreme year (2010) showing a significant memory effect. Mitigating effect of water storage was significant on shorter time scales as well, since precipitation sums during the summer months were exceeded by those of ET in drought/heatwave years (2003, 2007, 2009, 2011, 2012). Strong coupling between transpiration and photosynthesis as shown by the strong correlation (R^2=0.8618) between the annual sum of ET and GPP was due to high LAI (closed canopy) and more or less constant cover.

EC based evapotranspiration data was compared to MODIS Evapotranspiration (MOD16). On annual basis MODIS ET is a close estimation of EC based ET, as the slope of the regression between the yearly sums (2003-2013) of MODIS based vs EC based ET is 1.0168 (R^2=0.6236, RMSE=43.03mm) . However, when considering the main growing season (1 May - 31 July) only, MODIS ET underestimated EC based ET by 10% (R^2=0.77, RMSE=22.74), showing that there is a bias on seasonal basis in the MODIS data. Goodness of fit for the regression of 8-days sums (temporal resolution of MODIS data) in the different years range between 0.6913 and 0.8879, while the slope ranges between 0.9271 and 1.2224.