Direct and Indirect Contributions of Meteorological Factors to Evapotranspiration over a Maize Ecosystem

Zhou, Li, Chinese Academy of Meteorological Sciences, No. 46, Zhongguancun South Street, Haidian District, Beijing 100081, China, 86-10-58995256; jasmine@ibcas.ac.cn

Wang, Yu, Henan University of Science and Technology
Zhou, Guang-Sheng, Chinese Academy of Meteorological Sciences

Evapotranspiration (ET) is frequently a major component of water balance for agriculture ecosystems, and is a nexus of the water, energy and carbon cycles. Ecosystem measurements of evapotranspiration from farmland are important for informing water resource decision making and validation of crop models. We measured ecosystem ET over a rainfed maize ecosystem in northeast China using the eddy covariance method for 10 years (2005-2014). Evapotranspiration at annual scale varied from 333mm in 2007 to 444 mm in 2005, with an average of 397 mm, which was 70% of the local annual precipitation. Daily ET varied considerably throughout the growing season of maize. It was associated with the seasonal development of leaf area index (LAI), and highly dependent upon net radiation (Rn), air temperature (Ta), and atmospheric vapor pressure deficit (VPD). Variations of meteorological condition not only directly affected the seasonal variability in daily ET but also indirectly drove it by changing the net ecosystem exchange (NEE). Based on the path analysis, we found that the combination of Rn, Ta, VPD, and NEE could predict 61% of the variation in daily ET. Specifically, Rn and NEE had significantly direct positive effects on ET, whereas VPD exerted a direct negative effect significantly. Meanwhile, Rn, Ta, and VPD had indirect effects by mediating NEE. Taking direct and indirect effects together, Rn was the most important predictor of daily ET over the maize ecosystem. The direct and indirect contributions of meteorological factors to ET were given. Identifying these direct and indirect paths revealed the underlying mechanisms of ET dynamics.