Energy partitioning and evapotranspiration over a black locust plantation in the Yellow River Delta

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Abstract

Woody plantations play a curtail role in ecological security along coastal zones. Understanding of energy partitioning and evapotranspiration (ET) over black locust plantations can reveal land-atmosphere interaction process and help us to optimize this plantation for land management in the Yellow River Delta. In this study, we investigated energy fluxes, ET in particular, and their related biophysical factors using eddy covariance techniques over a black locust plantation in 2016, 2018, and 2019. Downward longwave radiation offsets 84%–85% of upward longwave radiation, upward shortwave radiation accounted for 12%–13% of downward shortwave radiation, and the ratio of net radiation (Rn) to downward radiation was 18%–19%in the three years. During growing seasons, latent heat flux was the largest components among radiation balance terms; during non-growing seasons, sensible heat flux was a dominant component. ET was mainly controlled by Rn, air temperature, vapor pressure deficit and leaf area index (LAI). Annual ET was smaller than the sum of precipitation and irrigation, and cumulative ET was larger than cumulative precipitation during non-growing seasons. The phenology of black locust influenced the seasonal variation in daily ET, mainly via LAI. ET was larger under sea wind than under land wind, mainly because soil water content at 10-cm depth was greater under sea wind in daytime. Seasonal patterns of daily evaporative fraction, Bowen ratio, crop coefficient, Priestley–Taylor coefficient, surface conductance (gs), and decoupling coefficient were mainly controlled by LAI, and the threshold value of daily gs was approximately 8 mm s-1 over the studied plantation.

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