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华北低丘山地人工林蒸散的季节变化及环境影响要素

Seasonal variations and environmental control impacts of evapotranspiration in a hilly plantation in the mountain areas of North China

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中文摘要:

基于2007-2008年涡度相关观测资料,分析了华北低丘山地近30年生栓皮栎-刺槐-侧柏人工林生态系统蒸散的变化特征及其环境影响要素。结果表明,2007-2008年实验区气候较常年偏暖、偏旱。*ET*表现出单峰季节变化特征,秋冬季节较低,春夏季节(4-9月)蒸散旺盛。全年最高值出现在每年5月份,日峰值出现于13:00左右。2007-2008年平均蒸散量为546.1 mm,降水量为354.1 mm,夏季(7-8月)和冬季(12-1月)的日蒸散量分别为2.19 mm/d和0.44 mm/d。温度是驱动*ET*季节变化的主要环境因子,饱和差也是影响蒸散季节变化的重要环境要素。土壤含水量对*ET*季节变化的影响并不显著,有近1/3日数的土壤含水量为0.16-0.18 m^3/m^3,期间日蒸散量平均值为1.0 mm/d。年蒸散量均高于降水量,蒸散量高于降水量的部分来自深层土壤水分的供给。

English Summary:

Evapotranspiration (*ET*) is an important component of ecosystem water and energy balances. Improved understanding of the water and energy fluxes between vegetation and atmosphere is therefore important for prediction of the impact of climate change on terrestrial ecosystem. Plantation plays an important role in regional water cycle and budgets. China has the largest plantation area in the world. It is necessary to study the response of plantation *ET* to environmental factors in China. In this study, water vapor flux was measured continuously through the eddy covariance technique in a nearly 30-year old aged mixed plantation (Xiaolangdi site; 35° 01'N, 112° 28'E, 410 m) in the hilly zone of the North China in 2007 and 2008. Meteorological measurements were carried out synchronously. The major tree species are *Quercus variabilis*, *Robinia pseudoacacia* and *Platycladus orientalis*. The diurnal and seasonal variations of *ET* and the environmental impacts on *ET* were analyzed. The results showed that it was warmer and drier in 2007 and 2008, compared with the long-term averaged values. *ET* showed a single peak seasonal variation, which was low in fall and winter and relatively high in spring and summer. The yearly maximum *ET* appeared in May in both years, and the diurnal peak values occurred at about 13 pm. The averaged annual *ET* and precipitation were 546.1mm and 354.1mm, respectively. The daily average *ET* in summer (July-August) and winter (December-January) were 2.19mm/d and 0.44mm/d, respectively. Year with more rainfall (2007) was also with relatively high *ET*. *ET* of the growing season in 2007 was higher than that in 2008, which led to the higher annual *ET* in 2007. Temperature (*T*) was the main environmental factor driving the diurnal and seasonal dynamics of *ET*. Water vapor pressure deficit (*D*) also had significant impacts on the diurnal and seasonal variations of *ET*. The relationship between photosynthetic active radiation (Q_p) and *ET* was significant at the daily scale but not at the monthly scale. There was no significant impact of soil water content (*W*) on *ET*. The averaged daily *W* was among the range of 0.16-0.18 m^3/m^3 for nearly 1/3 days of the two years, during which the averaged daily *ET* was 1.0mm/d. Annual *ET* was higher than annual precipitation in both years. Annual precipitation accounted for 90.0%, 62.9% of annual *ET* in 2007 and 2008, respectively. Soil moisture from deep soil layer was likely to contribute the difference between *ET* and precipitation. Annual *ET* of the plantation ecosystem in Xiaolangdi site (broad-leaved plantation) was lower than that of some conifer plantation with similar latitude and that of some tropical or subtropical forests, and was higher than that of some boreal forests. Two year data were used in this study, which led to the difficulty in discussing the mechanism driving the interannual variation of *ET*. Impact of other factors reflecting the vegetation growth, such as leaf area index (*LAI*), will be analyzed in the future. And the response of *ET* to environmental factors under drought stress will be discussed.

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