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研究论文

涡度相关法研究土壤水分状况对沙地杨树人工林生态系统能量分配和蒸散日变化的影响

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摘要 为了解位于北京大兴区林场杨树人工林在不同的土壤水分环境条件下的水汽交换过程和能量的分配差异及其与环境因子关系，运用涡度相关（Eddy covariance, EC）法开路系统、常规微气象观测系统及土壤热通量板等设施对生态系统生长季内典型水分胁迫和无水分胁迫条件下蒸散日变化、能量分配以及与各环境因子的关系进行了测定分析和比较。结果表明，在水分严重胁迫日（以7月7日为例），蒸散日变化过程为单峰曲线，全天（24h）蒸散量为2.4 mm；而在无水分胁迫典型日（以7月25日为例），蒸散日变化过程呈多峰曲线，全天蒸散量为4.5 mm。能量平衡分析显示，无水分胁迫条件下潜热通量（*LE*）占净辐射通量（*Rn*）的比例远高于水分胁迫条件下潜热通量占净辐射通量的比例，说明水分充足时，能量的大部分用于蒸散。水分胁迫条件下蒸散速率与各环境因子的相关性均低于无水分胁迫条件下蒸散速率与环境因子的相关性。水分胁迫条件下，蒸散速率主要与净辐射和下垫面因子关系显著，而与其它因子的相关性较小；无水分胁迫条件下，蒸散速率与下垫面土体含水量和各气象因子均表现出较强的相关性。大气温度对于两个典型日蒸散速率的影响均很小；土壤含水量与水分胁迫日的蒸散速率几乎没有相关性，反应出土壤水分含量低至对蒸散几乎没有贡献了。

关键词 涡度相关法；土壤水分；蒸散速率；能量平衡；沙地杨树人工林

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Soil moisture affects energy allocation and diurnal evapotranspiration of a poplar plantation-an eddy-covariance-based study

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Abstract Eddy-Covariance（*EC*）open path system and microclimate monitor system were employed in this study to investigate energy allocation and diurnal variation of evapotranspiration (ET) in growing season of 2005. The study was located in DaXing District, Beijing on a sandy soil in an 11-year-old poplar plantation.The primary objective was to compare the energy fluxes, the relation of diurnal change of ET, and microclimate at ecosystem level before and post a precipitation event. Field data suggested that the diurnal variation of ET showed a single-peak curve under serious water stress with an average daily ET of 2.4 mm, while a multi-peaks curve with a daily average of 4.5 mm post the 56.89 mm precipitation on July 23, 2005. Our analysis of energy balance showed that the contribution of latent and sensible heats to the available energy (Rn-G) varied greatly before and after the rain event. Prior to the precipitation, LE/Rn ratio was lower than that of post rain event, averaging 54.88% and 83.80%, respectively. This suggested that the mos

t of energy was used for ET when soil water was sufficient in this ecosystem. Under water stres s, net radiation (Rn) and soil moisture played important roles in ecosystem ET, while other enviro nmental factors showed minor influence on ET. We also found high correlations between soil con ditions, microclimate, and Rn with ET under moist soil condition. Air temperature had little effec t on ET regardless of soil moisture condition. The correlation of soil moisture and ET was low pri or to precipitation, suggesting a minor role in affecting ecosystem ET.

Key words eddy covariance _ soil moisture _ evapotranspiration _ energy balance _ sandy soil _ poplar plantation

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