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非均匀灌溉棉田能量平衡特征研究

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A study on energy budget characteristics over a heterogeneously irrigated cotton field

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摘要 运用国际能量平衡实验(EBEX-2000)的湍流、净辐射和土壤观测资料,运用涡动相关法分析了非均匀灌溉引起的热内边界层发展条件下近地层感热、潜热通量特征,并对有无灌溉两种条件下的能量闭合度进行了对比分析.在计算感热、潜热通量过程中,分别将Schotanus订正和Webb订正纳入了考虑范围,研究了两种订正方法对计算湍流热通量的影响.研究结果发现,由于非均匀灌溉生成的热内边界层使得近地层感热通量受到抑制,潜热通量出现波动,该现象在8.7 m比2.7 m 更为显著.非均匀灌溉导致的热内边界层的存在使得近地层能量闭合度偏低,能量平衡比率约为0.65;而没有热内边界层存在时,近地层能量平衡比率约为0.70.本实验中,Schotanus订正使得感热通量显著减小,其订正量日平均值约为-8 W/m^2,占净辐射的近4%;Webb订正量日平均值约为2 W/m^2,对能量平衡的影响较小.

关键词 非均匀灌溉, 潜热通量, 感热通量, 土壤热通量, 土壤热储存, 能量闭合度

Abstract: This study uses turbulence, net radiation and soil data from International Energy Balance Experiment (EBEX-2000) to study the characteristics of sensible and latent heat flux under thermal internal boundary layer which is induced by heterogeneous irrigation. Energy balance closure on irrigated days was compared with that on non-irrigated days. Schotanus correction and Webb correction were applied when calculating turbulence heat fluxes and their influences were also analyzed. During this research, eddy covariance method is used. Results indicate that turbulence heat fluxes in the surface layer are affected by thermal internal boundary layer resulted from heterogeneous irrigation, this interaction leads to a decrease of sensible heat flux and a oscillation of latent heat flux. This phenomenon is more significant at 8.7 m than that at 2.7 m. The existence of thermal internal boundary layer induced by heterogeneous irrigation result in a decreased energy balance ratio of 0.65; while with no internal thermal boundary layer, the energy balance ratio is close to 0.70. Schotanus correction results in a significant diminution of sensible heat flux in this experiment. The daily average of Schotanus correction reach up to -8 W/m^2, almost 4% of the net radiation. The daily average of Webb correction to latent heat flux is about 2 W/m^2, having slight influence on energy balance closure.

Keywords heterogeneous irrigation, latent heat flux, sensible heat flux, soil heat flux, soil heat storage, energy balance closure

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