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沙漠陆面过程参数化与模拟

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Land surface parameterization and modeling over desert

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摘要

沙漠地区植被稀疏、干旱少雨,其陆面物理过程具有与全球其它地区显著不同的特点.本文利用巴丹吉林沙漠观测资料,分析和计算了地表反照率、比辐射率、粗糙度和土壤热容量、热传导系数等关键陆面过程参数,建立了适合于沙漠地区的陆面过程模式DLSM (Desert Land Surface Model),并与NOAH陆面过程模式的模拟结果和观测资料进行了比较.结果表明:巴丹吉林沙漠地表反照率为0.273,比辐射率为0.950,地表粗糙度为1.55×10^{-3} m,土壤热容量和热扩散系数分别为1.08×10^{6} J·m^{-3}·K^{-1}和3.34×10^{-7} m^{2}·s.辐射传输、感热输送和土壤热传导过程是影响沙漠地区地表能量平衡的主要物理过程.通过对这三种过程的准确模拟检验,DLSM能够较准确地模拟巴丹吉林沙漠地气能量交换特征;短波辐射、长波辐射和感热通量的模拟结果与观测值间的标准差分别为7.98,6.14,33.9 W·m^{-2},与NOAH陆面过程模式的7.98,7.72,46.6 W·m^{-2}的结果接近.地表反照率是沙漠地区最重要的陆面过程参数,地表反照率增大5%,向上短波辐射通量随之增加5%,感热通量则减小2.8%.本文研究结果对丰富陆面过程参数化方案,改进全球陆面过程模式、气候模式具有参考意义.

关键词 沙漠, 干旱区, 陆面过程参数, 陆面过程模式, 地表能量平衡

Abstract:

In desert, the climate is hot and dry, the vegetation is sparse, the land surface physical processes are significantly different from those in other regions. By using the data measured in Badanjilin desert, several key land surface parameters were revised. We established a Desert Land Surface Model (DLSM). The model was compared with Noah land surface model and observation data. In this study, the Badanjilin desert surface albedo is 0.273, the emissivity is 0.950, surface roughness is 1.55×10^{-3} m, the soil heat capacity is 1.08×10^{6} J·m^{-3}·K^{-1} and diffusivity is 3.34×10^{-7} m^{2}·s. Radiation transfer, sensible heat transfer and soil heat conduction are the key physical processes affecting land surface energy balance. With adequate parameterization of these three processes, the DLSM reasonably simulates the land atmosphere interaction processes over Bandanjilin desert. The root mean square errors of modeled solar radiation flux, longwave radiation flux and sensible heat flux were 7.98, 6.14, 33.9 W·m^{-2} respectively, which were comparable with the results, 7.98, 7.72, 46.6 W·m^{-2}, from NOAH. Surface albedo is the most important land surface parameter in desert. By increasing 5% of the albedo, the reflected solar radiation increased by 5%, and the sensible heat flux decreased by 2.83%. The results are beneficial to the study on land surface parameterization, modeling and climate simulation.

Keywords Desert, Arid region, Land surface parameter, Land surface model, Surface energy balance

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