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大气环流模式SAMIL模拟的夏季全球加热场和东亚夏季风

Performances of SAMIL on the Global Heating and the East Asian Summer Monsoon

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中文摘要:

各国科学家一直致力于从理论和数值模拟上对季风系统进行全面地研究。本文根据“热力适应”理论, 从分析中国科学院大气物理研究所大气科学和地球流体力学数值模拟国家重点实验室的最新版本大气环流谱模式(SAMIL2.4.7) 对全球非绝热加热场的模拟性能出发, 分析并解释了SAMIL对东亚夏季风 (EASM) 子系统的模拟情况。通过与再分析资料Reanalysis-2 (NCEP/DOE AMIP-II Reanalysis) 对比分析发现, SAMIL能很好地模拟出夏半球副热带地区加热场的四叶型分布 (LOSECOD), 但模拟的各加热场在强度上存在一定的偏差, 主要表现在感热加热在大陆上普遍偏高, 而潜热加热在印度半岛两侧、西太平洋地区(尤其在南北纬10°) 偏高, 赤道带、中南半岛、中国南海等地区偏弱。而对EASM子系统的分析发现, SAMIL能很好地模拟南亚高压; 较好地模拟西太平洋副热带高压的主体, 但西太平洋 (30°N附近) 潜热偏强使得模拟的副高强度偏强、 西伸脊点过于偏西; 模式也能较好地抓住夏季西风急流的两个中心, 但中纬度潜热、 感热的模拟偏弱造成急流两中心风速均小于Reanalysis-2资料 10 m/s左右。进一步的讨论可知, 造成感热和潜热偏差的主要原因是模式中云参数化方案和积云对流参数化方案的不足, 改进模式中相关的物理参数化方案将是SAMIL后续发展的首要工作。

Abstract:

The monsoon has great impacts on the regional and global climate to which many scientists dedicate themselves for better understanding it theoretically and numerically. Based on Thermal Adaptation Theory, the authors evaluate the performances on the global diabatic heating of the newest spectral atmospheric general circulation model (SAMIL, hereafter), developed at the State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics, Institute of Atmospheric Physics, Chinese Academy of Sciences (LASG/IAP), and further make some analyses and explanations on the simulations of the components of the East Asian Summer Monsoon (EASM). The results show that SAMIL has good performances on the quadruplet heating pattern (LOSECOD) in the boreal subtropics compared to the NCEP/DOE AMIP-II Reanalysis (Reanalysis-2), except for biases in strength. The sensible heating simulated by SAMIL is universally stronger over the continent, and the condensation heating is stronger on the two sides of the Indian peninsula and over the western Pacific (especially at 10°N and 10°S), whereas it is weaker near the equator and over the regions of the Indo-China Peninsula and the South China Sea. The authors further point out that the South Asia high can be well simulated and main features of the subtropical high over the western Pacific can be generally captured. But the subtropical high has stronger strength and more westward location, which are mainly caused by the stronger latent heating over the western Pacific (near 30°N). It also can exhibit the two centers of the westerly jet which is some 10 m/s smaller than that from Reanalysis-2 resulting from the weaker latent heat, sensible heat, and shortwave radiation. It further points out that the cloud parameterization and cumulus convective parameterization cause the biases in the sensible heating and latent heating. From this point, modifying and updating the physical parameterizations in SAMIL will be the priority in the near future.

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