

气候系统模式对北极涛动的模拟

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收稿日期 2007-3-13 修回日期 2007-12-17 网络版发布日期 2008-3-20 接受日期

摘要 本文系统分析了参与IPCC AR4 “20世纪气候模拟”(20C3M)的23个气候系统模式模拟的1950~1999年冬季(JFM)北极涛动(AO).结果表明,在22个模式中,AO模态都表现为北半球中高纬大气年际变率的第一模态.不过,18个模式模拟的AO模态在北太平洋地区表现偏强,有两组模式结果均表明,提高模式的水平分辨率能够克服此偏差.所有模式模拟的AO指数均未出现与观测相当的增强趋势,只有两个模式(ECHO-G和UKMO-HadGEM1)模拟的AO指数与观测存在显著正相关.多数模式能够模拟出纬向风伴随AO位相变化在中高纬出现的偶极子异常特征,部分模式对平流层AO特征的模拟能力仍需要提高.对AO垂直结构模拟较好的模式,例如CCSM3、MRI CGCM2-3.2和UKMO-HadGEM1,能够较为合理地再现伴随AO指数增强出现的极区平流层变冷和中纬度对流层增暖现象.AO与欧亚大陆地表气温和降水的相关分布,在多数模式中有较好的体现,个别模式还对AO与东亚气候的相关关系具有一定的模拟能力.对AO各指标均有较好模拟能力的模式是UKMO-HadGEM1.本文结果为改进气候系统模式对北极涛动的模拟能力提供了依据,亦为学术界利用IPCC AR4的耦合模式数据、开展与AO相关的气候变率研究提供了基础参考.

关键词 [北极涛动\(AO\)](#), [IPCC](#), [20世纪气候模拟](#), [耦合模式](#)

分类号 [P467](#)

DOI:

The Arctic Oscillation in coupled climate models

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Received 2007-3-13 Revised 2007-12-17 Online 2008-3-20 Accepted

Abstract This study investigates the winter (JFM) Arctic Oscillation (AO) simulated by 23 global coupled climate models participating in the project “The Twentieth-Century Climate in Coupled Models” organized by IPCC AR4. Results show that almost all of the models capture the AO as the leading mode of the interannual variability for the extratropical atmosphere in the Northern Hemisphere. In most models, the North Pacific center of the AO mode is more pronounced in comparison with the observation. Such bias can be reduced with higher horizontal resolution of the AGCM, deriving from the intercomparison between two pairs of coupled models. None of the models can reproduce the upward trend of the AO index as strong as that observed in recent decades. Significant correlation of the AO index between the simulated and the observed only appears in two models (ECHO-G and UKMO-HadGEM1). Anomalies of the zonal mean zonal wind associated with the positive phase of the AO exhibit a dipole in the latitude, with westerly in the middle-high latitudes and easterly in the subtropical area. Such features can be generated in most of the models (20/21), although the ability of some models in simulating the AO feature in the stratosphere needs to be improved. The models with good performances in reproducing the vertical structure of the AO, for example, CCSM3, MRI-CGCM2.3.2, and UKMO-HadGEM1, can reasonably simulate the cooling stratosphere in the North Polar and the warming troposphere in the midlatitude at the positive phase of the AO. The majority of the models reproduce the significant influence of the AO on the temperature and the precipitation over the Eurasian continent. Several models can simulate the relationship between the AO and the East Asian climate to a certain extent. Overall, the model UKMO-HadGEM1 performs best among all the models in simulating the basic features of the AO. The above results provide a certain reference basis for the further improvement of the coupled models' capability in reproducing the AO. They are also the basic reference for researchers to investigate the climate variability associated with the AO using the output of the coupled climate models of IPCC AR4.

Key words [Arctic Oscillation \(AO\)](#), [IPCC](#), [Twentieth-century climate simulation](#), [Coupled General Circulation Model \(CGCM\)](#)

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