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MM5V3模式对IPCCA1B情景下中国地区极端事件的模拟和预估

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Evaluation and projection of extreme events over China under IPCC A1B scenario by MM5V3 model

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摘要

利用MM5V3区域气候模式单向嵌套ECHAM5全球环流模式,对中国地区1978—2000年及IPCC A1B情景下2038—2070年气候分别进行了水平分辨率为50 km的模拟试验.文章首先检验了模式模拟的当代极端气候结果,在此基础上对6个极端温度指数和6个极端降水指数的未来变化进行了预估.检验结果表明:MM5V3模式对中国地区当代日最高、最低温度及强降水(大雨和暴雨)日数的空间分布和概率特征均具有一定的模拟能力,但模拟的日最高温度在大部分地区偏低,日最低温度在南方地区偏低、西北地区偏高.概率统计结果显示日最高温度向低值频段偏移,日最低温度在0℃的峰值附近明显偏高.模式对大雨和暴雨年平均日数的模拟在东部地区偏多,概率统计结果则为一致偏大.未来中国地区极端气候预估结果表明:极端高温、极端低温和相对高温在全国范围内都将升高,且线性趋势均为上升;霜日日数则为减少,并具有下降趋势;暖日日数和相对低温在青藏高原和新疆部分地区有所减少、其它地区均为增加,且线性趋势暖日日数为上升,相对低温不明显.极端降水指数的变化具有区域特征,其中单日最大降水、连续五日最大降水、最长无雨期、强降水日数、简单降水强度和极端降水总量均在江淮、华南及西南地区有所增多,而在东北及内蒙古地区有所减少,未来中国南方地区降水的极端化趋势将更加显著.极端降水指数的线性趋势除最长无雨期外其它均为上升.

关键词 区域气候模式, 极端温度, 极端降水, 气候变化

Abstract:

Based on the regional climate model MM5V3 nesting in one-way mode within the general circulation model ECHAM5, two sets of the 50 km grid spacing simulation for present climate (1978—2000) and future climate (2038—2070) over China are conducted. Results for present extreme climate show that MM5V3 model can simulate reasonably well the spatial and probability distributions of daily maximum/minimum temperature and annual mean heavy and torrential rainy days when compared with observations. But the simulated maximum temperatures biased to cold over most part of China and the minimum temperatures biased to warm in northwestern China and to cold in southern China. Simulated probability distributions move to the lower frequency range for maximum case and significantly higher around the peak of 0℃ for minimum case. The heavy and torrential rainy days are overestimated obviously over eastern China and the probability distributions are both larger than observations. Under IPCC A1B Scenario, the results for climate change show that there would be increasing amplitudes in maximum 1d temperature, minimum 1d temperature, average temperature above 95th percentile of daily maximum temperature climosequence, but decreasing amplitudes in total number of frost days. The total number of hot days and average temperature under 5th percentile of daily minimum temperature climosequence would also increase over most part of China except the Tibetan Plateau and Xinjiang areas. Linear trends of extreme temperature indices would overall increase except the frost-days and average temperature under 5th percentile of daily minimum temperature climosequence. The changes for extreme precipitation indices indicate the regional characteristics. There would be the increasing amplitudes over Yangtze-Huaihe River Basin, southeast China,

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southwest China as well as decreasing amplitudes over Northeast China, Inner Mongolia areas for all analysis indices (maximum 1d precipitation, maximum 5d precipitation total, maximum number of consecutive dry days, No. of days with precipitation ⩾25 mm/day, simple daily intensity index and total precipitation above 95th percentile of daily precipitation climosequence). The precipitation over southern China would become more "extreme" in future. Meanwhile, the linear trends for extreme precipitation indices would also increase except the maximum number of consecutive dry days.

Keywords Regional climate model, Extreme temperature, Extreme precipitation, Climate change

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