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Projection of hot nights, very hot days and cold days in Hong Kong
based on CMIP6 Models

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基于 CMIP6 模式的香港热夜数目、酷热日数及寒冷日数之推算

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摘要

联合国政府间气候变化专门委员会 (IPCC) 在 2021 年 8 月发表了《第六次评估报告》(AR6) 的第一工作组 (WGI) 报告, 重申人为导致的气候变化正处于严峻形势, 并透过 IPCC WGI Interactive Atlas 网站发布了一套基于国际耦合模式比较计划第六阶段 (CMIP6) 模式的最新全球气候推算, 当中也包括一些利用当代统计方法、从 CMIP6 模式输出推导所得的推算参数, 例如温度高于某阈值的日数。

本研究取得 CMIP6 模式的历史模拟及推算数据, 运用 IPCC AR6 采纳的当代统计方法, 即 ISIMIP3¹, 去推算香港的热夜数目、酷热日数及寒冷日数。研究发现 ISIMIP3 在计算每日最高与最低气温之统计分布的表现不错。我们亦探讨使用分位映射法来推算上述三个参数, 验证结果表明两种统计方法给出的 2015-2021 年推算相当不错。揉合两种统计方法作集成推算, 结果显示在非常高温温室气体排放情景下, 香港在本世纪最后二十年之平均每年酷热日数约为 150 天。假如我们想避免未来气候变化带来的严重影响, 推算结果凸显出减排的迫切需要。

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Abstract

The United Nations Intergovernmental Panel on Climate Change (IPCC) released the Working Group I (WGI) contribution to the Sixth Assessment Report (AR6) in August 2021, reaffirming the dire situation of human-caused climate change and delivering the latest set of global climate projections based on models participating in Phase 6 of Coupled Model Intercomparison Project (CMIP6) via the IPCC WGI Interactive Atlas website. Projection parameters derived from CMIP6 model output, e.g. days exceeding a certain temperature threshold, using contemporary statistical methods were also provided.

¹ 为 Inter-Sectoral Impact Model Intercomparison Project 所发展及使用的偏差修正及统计降尺度工具。

In this study, historical simulation and projection data of CMIP6 models were obtained and the contemporary statistical method adopted by IPCC AR6, namely ISIMIP3², was employed to generate projections of hot nights, very hot days and cold days in Hong Kong. It was found that the ISIMIP3 method did a good job in producing the distributions of daily minimum temperature and daily maximum temperature. The method of quantile-quantile mapping was also explored to generate projections of the above three parameters. Verification results showed that both methods did reasonably well for the period 2015-2021. Taking an ensemble approach for the two statistical methods, the average annual number of very hot days in Hong Kong for the last two decades in the 21st century would be around 150 under the very high greenhouse gas emissions scenario. The projection result highlights the urgent need for emissions reduction if we want to avoid severe climate change impacts in the future.

² A bias adjustment and statistical downscaling tool developed for use in the Inter-Sectoral Impact Model Intercomparison Project.