Present and future impact of the African Great Lakes on the regional climate

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Although the African Great Lakes are important regulators for the East-African climate, their influence on atmospheric dynamics and the regional hydrological cycle remains poorly understood. We aim to assess this impact by conducting a regional climate model simulation which resolves individual lakes and explicitly computes lake temperatures. The regional climate model COSMO-CLM, coupled to a state-of-the-art lake parameterization scheme and land surface model, is used to dynamically downscale the COSMO-CLM CORDEX-Africa evaluation simulation to 7 km grid spacing for the period 1999-2008. Evaluation of the model reveals good performance compared to both in-situ and satellite observations, especially for spatio-temporal variability of lake surface temperatures and precipitation. Model integrations indicate that the four major African Great Lakes almost double precipitation amounts over their surface relative to a simulation without lakes, but hardly exert any influence on precipitation beyond their shores. The largest lakes also cool their near-surface air, this time with pronounced downwind influence. Furthermore, Lake Victoria has profound influence on atmospheric dynamics and stability as it induces cellular motion with over-lake convective inhibition during daytime, and the reversed pattern at night. Additionally, we examine the impact of climate change on hazardous thunderstorms over Lake Victoria. We present the first high-resolution regional climate projection for the African Great Lakes region under a non-climate policy scenario, and show that the future increase of the strongest precipitation extremes is amplified over Lake Victoria relative to the surrounding land, despite a regional average decline in precipitation.

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