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Modeling the regional climate impact of boreal lakes

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It has long been known that the land surface plays a crucial role in the global climate system. Processes governed by complex topography or heterogeneities in surface vegetation and soil properties are frequently analyzed using high resolution regional climate models coupled with elaborate soil-vegetation-atmosphere transfer (SVAT) schemes. Such schemes model the moisture and energy balance of soil, vegetation and snow, generally incorporating a sophisticated treatment of radiative and turbulent exchange with the overlying atmosphere. One surface type that is normally disregarded in climate models is lake, even though it is well known that fluxes of heat, moisture, and momentum can be significantly different in the presence of open water. This is due to the large difference in heat capacity, roughness length, and albedo of water compared with nearby soil and vegetation, as well as differences in the vertical transfer of heat in the water column compared with that on land.

In this study, the impact of boreal lakes on the regional climate is evaluated though a series of multi-year regional climate model experiments over central Canada. High resolution (˜ 25 square km) is achieved through a cascading sequence of simulations in order that the boreal lakes are resolved on the model grid. Lake surface temperatures and ice cover are specified in this initial series of experiments based on the NOAA/University of Miami's 4 km resolution AVHRR Pathfinder project, and the gross impact of the lakes on the local boreal climate is estimated by comparison with control simulations where the lakes have been replaced by soil and vegetation consistent with the nearby land surface. Because most boreal lakes are sub-grid scale in current generation climate and numerical weather prediction models, the development of a 1-dimensional lake parameterization module for the SVAT used in Canadian models, known as the Canadian Land Surface Scheme (CLASS), will also be discussed.