Lake-Watershed-Atmosphere Coupled Climate Modeling in the North American Great Lakes

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Inclusion of lakes in weather and climate models is important for at least two reasons. First, lake significantly influence weather and climate in many parts of the world, through the source of atmospheric moisture that they provide and through their action as a thermal reservoir that moderates temperatures. Second, lakes represent a unique biotic resource, and their ecosystems are responsive to weather and climate. Both of these reasons apply to the Laurentian Great Lakes of North America, which collectively contain about one-fifth of the world's surface fresh water.

This presentation will cover the formulation of the Coupled Hydrosphere-Atmosphere Research Model (CHARM). This will be followed by results from a pair of simulations using different concentrations of greenhouse gases (GHG), which shows that increased GHG concentration results in an apparent increase in net basin supply of water in the Great Lakes Basin, contrary to generally accepted results. Other experiments with changes in land surface roughness in the vicinity of the Great Lakes show changes in the magnitude and shifts in the location of lake effect precipitation. Discussion will also be presented of planned use of a full 3-dimensional model of lake and ice dynamics in the context of a weather and climate model, as well as application of a similar model to Lake Victoria in Africa. There will also be discussion of the inclusion of lakes as a component of the next-generation climate model now in development at the Geophysical Fluid Dynamics Laboratory, and of issues related to using air temperature as a proxy to approximate a calculation of evapotranspiration from land.