In-situ observations of water vapor isotopes in near surface air over Lakes Superior and Michigan

LISA WELP[1], ALEXANDRA MEYER[1], TIM GRIFFIS[2], XIAHONG FENG[3], ERIC POSMENTIER[3]

[1]Department of Earth, Atmospheric, and Planetary Sciences, Purdue Unviersity, lwelp@purdue.edu
[2]Department of Soil, Water and Climate, University of Minnesota
[3]Department of Earth Sciences, Dartmouth College

Evaporation from lakes is difficult to quantify, and the factors controlling lake evaporation are not fully understood. Common isotopic tracer methods used to study lake evaporation, lake mass balance and downwind precipitation signatures, require accurate estimates of the isotopic composition of evaporation from the lakes. Traditionally, evaporation is assumed to follow the Craig-Gordon model of isotopic fractionation. Uncertainty remains in the kinetic fractionation effect, the self-influence of the lake evaporation on the atmospheric water vapour isotopic composition, and the contribution from sea spray. The isotopic composition of evaporation has been measured in the marine environment but on few lakes. To our knowledge, evaporation on the Great Lakes has not been examined through direct isotopic measurements. Here the evaporation flux strongly influences the moisture in the air above the lake, similar to a marine setting, but perhaps the atmospheric closure assumption is not valid. We made measurements of the hydrogen and oxygen isotope ratios at 5 m and 15 m above the surface of Lakes Superior and Michigan during 3 days in June 2016 using an LGR triple water vapor isotope analyzer. Lake temperatures were frequently cooler than the air temperature, thereby suppressing the evaporation flux in the spring. The isotopic values of evaporation calculated from the flux gradient method agree more closely with equilibrium with the lake than from the Craig-Gordon prediction. This suggests regional atmospheric isotopic equilibration with the lakes even in the absence of strong evaporation fluxes.