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Validation of the Craig-Gordon isotopic model for lake evaporation

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The theory on isotopic composition of evaporation (δE) of open water was first proposed by Craig and Gordon in 1965 (C-G model) and has since been widely employed in studies of isotope hydrology and ecology. In a typical application, the interfacial surface water layer is assumed to be well-mixed so that the isotopic composition of the evaporating surface is equal to that of the bulk water. To date, the C-G model and the associated well-mixed assumption have not been validated against field measurements over natural water bodies. In this study, in-situ measurement of δE was made on a near-continuous basis using the flux-gradient approach over Lake Taihu, a large shallow lake in East China. The key instrument was a water vapor analyzer based on the off-axis integrated cavity output spectroscopy. The analyzer switched between the two intakes at the 1.1 and 3.5 m height above water surface every 30s, measuring the water vapor mixing ratio and its 18O and D isotopic compositions. To eliminate the effect of non-linearity and signal drift, we calibrated the analyzer every 3 h against a water vapor standard of known isotopic compositions. Hourly δE was calculated using the gradient data. Supporting measurements included the isotopic compositions of the lake water and meteorological variables to provide inputs to the C-G model. The preliminary results indicate that the model underestimated δE by a mean amount of -136.1‰ for D.