Estimates of lake water evaporation and residence time using stable isotopes for lakes across the United States

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Stable isotope ratios of water (delta18O and delta2H) can be very useful in large-scale monitoring programs because water samples are easy to collect and isotope ratios integrate information about basic hydrologic processes such as evaporation as a percentage of inflow (E/I) and water residence time (τ). Because of time constraints, measurements of these processes are often excluded from spatially-extensive monitoring programs such as Environmental Protection Agency's National Lakes Assessment (NLA). We used water delta2H and delta18O from ca. 1000 lakes sampled in 2007 and distributed across the conterminous U.S. to assess these hydrological variables and scaled them to the inference population (~50,000 lakes). For 50 % of lakes, evaporation was less than 26 % of inflow, with values ranging up to 113 %. Categorizing lakes by flow regime, 63.6% of lakes were flow-though lakes ($E/I < 0.4$), 36.3 % were restricted-basin lakes ($0.4 < E/I < 1$), while less than 0.1 % were closed basin ($E/I > 1$). While climate patterns drove some of the spatial patterns of E/I and τ, variation in lake depth was also a significant driver. Lakes in poor biological condition (based on a predictive model of planktonic taxa) were significantly more evaporated than lakes in good biological condition. We speculate that this link to lake condition came from a strong positive correlation between E/I and lake total nitrogen concentration. Water samples for isotopic analysis were collected during the 2012 National Lake Assessment, so temporal trends can begin to be assessed in the future.