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Data based models of lake delta-18O variability

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Lake oxygen isotope records are often used to reconstruct past climate and environment. However there are still questions as to the exact controlling mechanism of lake isotope systems and to what extent theses changes can be quantitatively understood. The only way to fully understand how lakes respond, in terms of speed and magnitude of response, to given climate changes is to monitor lakes over long periods. However this is difficult with constraints of time and money, and lakes which provide the most important palaeoclimate records may be too remote to allow regular monitoring. If models of lake oxygen isotope variability can be shown to correctly reproduce observed changes then these models can be used to explain hydrological variability in the present and through geological time.

Here we present monitoring data from a 5 year sampling project in the UK, over which time we measured monthly isotope variability in 2 hydrologically open and 2 hydrologically closed lakes and compared their response to common climate forcing. Local rainfall has also been sampled weekly throughout the sampling period and for 3 years atmospheric moisture was also collected daily and analysed. For the first 2 years of the sampling period we also regularly sampled 6 further lakes, across a broad hydrological gradient.

Mass balance models of delta-18O values in lake systems can be used to explain and quantify hydrological variability. With the duration of monitoring at these sites, and the measurement of lake, rain and atmospheric waters, we develop and test mass balance models. In particular we investigate the calculation of the isotope value of evaporation via a completely closed lake system, where delta-E is the only unknown. Using the regional picture developed in the first two years of the project we develop predictive models for the 4 lakes and compare model predictions and measured isotope variability.