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Regulation of the Seasonal Stratification of a Shallow Lake by Groundwater Input

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An extended time series of the temperature and biogeochemical properties of a shallow, hyper-eutropic broad in East Anglia, UK shows a seasonal stratification cycle typical of mid-latitude monomictic lake. Sediment temperatures indicate that there might be bottom heating in winter and bottom cooling in summer. The temperature difference between the bottom water and the underlying sediments shows a change of sign at approximately the time periods of the start and end of summer stratification. An energy budget study of the lake was conducted using a dense network of vertical profile measurements of temperature and atmospheric meteorological parameters. The results suggest that there is a significant input of ground water at the bottom of the lake and that it represents a leading term in the heat budget. There is little seasonal variation in the calculated groundwater volume flux and no obvious correspondence with rainfall variations (i.e., resolving the energy budget assuming that the groundwater temperature is equal to the average atmospheric temperature). These results are compared with a small but growing body of literature that indicates groundwater input to lakes may be more important than previously believed. Aside from special meromictic lakes, this is the first study to suggest that groundwater inputs may be a leading order determinant of the dynamics of lakes.