



Chemical stratification in thermally stratified lakes: A chloride mass balance model

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ABSTRACT: In thermally stratified lakes, nutrient-enriched hypolimnion and a nutrient-depleted epilimnion is a common feature. Vertical mixing between these layers affects geochemical and biological processes. We used chloride ion as an inert tracer to model the main factors controlling the chemical stratification and to identify lake-wide mixing processes. The stratified lake is treated as two completely mixed reservoirs separated by the thermocline. Based on the long-term records of temperature, hydrochemical, and hydrological data from Lake Kinneret (Israel) and Lake Biwa (Japan), monthly hypolimnetic and epilimnetic chloride concentrations were predicted and tested against measured chloride concentration profiles. Water-volume exchange between the layers during the thermocline deepening was calculated using mass balance. We found that changes in the epilimnetic and hypolimnetic inventories of an inert tracer (chloride) correspond quantitatively to the calculated water mass exchange, and as such, reflect mixing. Our inert-tracer-approach provides a basis for an operational means of quantifying the vertical mixing process in thermally stratified lakes independently from the heat budget.

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