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# Tracing of the Rhône River within Lake Geneva using stable isotope composition of water

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Determining the hydrodynamics of lake water is essential for a better understanding of nutrient transport but also of the distribution of potential pollutants through water reservoirs. The objective of this study is to understand the mixing of Rhône River water within Lake Geneva. During summer and autumn, when the lake thermally well stratified, the Rhône River water can potentially flow more or less directly towards and finally out of the "Petit Lac" (small lake basin close to Geneva) more than 55 km from its mouth. During winter, when stratification is weakened, the water from the Rhône River mixes more diffusively with the water of Lake Geneva. The aim of this study is to determine the path of the Rhône River through the lake more precisely and identify the thermal and meteorologic conditions favourable for different types of flows as suggested by physical circulation models of the Rhône River interflows.
Waters are sampled from different North-South transects across the lake. Bathymetric profiles are measured for temperature, pH, conductivity and oxygen concentrations. In addition, the H- and O-isotope compositions of water, the C-isotope composition of dissolved inorganic carbon and the major ions are analysed. Sampling campaigns are carried out every two months to study the hydrodynamics of the lake at varying thermal conditions.
The isotopic composition of water was already proven to be a powerful tool to trace the Rhône River interflow within the lake (Halder et al., 2013) but the details of this interflow remain debatable. It is the aim of the present study to use the isotopic tracer method in much more detailed cross-sections as a tool to both test and verify interflow models based on wind patterns and thermal dispersion of the waters.
The chosen cross-sections, to be sampled regularly and "event-based", that is after extended periods of similar meteorological conditions, should allow for more precise estimates of the path of the Rhône water interflow and the control of different wind conditions on the formation of resultant gyres of circulation within Lake Geneva. For example, an anticlockwise gyre forces Rhône River water to flow at intermediate depths towards the northern shore of the lake and a return interflow close to the southern shore of the lake. Isotopic mixing models coupled to physical hydrodynamic models of the lake will help constrain the flow paths of the Rhône.

References

Halder J., Decrouy L. & Vennemann T. 2013 : Mixing of Rhône River water in Lake Geneva (Switzerland–France) inferred from stable hydrogen and oxygen isotope profiles, Journal of Hydrology 477:152–164