Geophysical Research Abstracts
Vol. 20, EGU2018-19277, 2018
EGU General Assembly 2018

Paths and mixing of Rhône River water in Lake Geneva : Seasonal tracing 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 in the lake. The Rhône River represents almost 70% of the total input of Lake Geneva, the largest lake of Western Europe. It supplies also most of the sediments and dissolved nutrients from its alpine catchment but also micropollutants.
The objective of this study is to understand the mixing of Rhône River water within Lake Geneva. During summer and autumn, when the lake is thermally stratified, the Rhône River passes through the metalimnion, directed by the surface currents as an interflow that can be detected for more than 60 km from its mouth. During winter, when stratification is weakened, the water from the Rhône River mixes more diffusively with the lake water. As part of this project the exact path of the Rhône River interflow through the lake is measured and compared to the thermal and meteorological conditions that control the actual flow and that are determined by physical circulation models.
Waters are sampled from a number of 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.
The present study focusses on using the isotopic tracer method in detailed cross-sections as a tool to determine the path of the Rhône water interflow and to compare these results to the control of different wind conditions on the formation of resultant gyres within the lake. 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.

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