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Identification of nitrate sources, hot spots, and dilution in the Danube River Basin using a multitracer approach

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The Danube is Europe`s second longest river, stretching from Germany to the Black Sea. Water quality in the Danube River Basin is regularly monitored by the national authorities of all riparian countries and in addition for specific water quality data during the Joint Danube Surveys (JSD), which is organised by the International Commission for the Protection of the Danube River every 6 years.

This study presents the results of water stable isotopes and stable isotopes (¹⁵N and ¹⁸O) of nitrate as well as major ion analysis from 3 JDS (2001, 2007, 2019). Results indicate that water stable isotopes allow to trace differences in the amount of snowmelt contribution to the Danube and hence the dilution effects of pollutants e.g. nitrate. The oxygen and nitrogen isotope compositions of nitrate are clearly indicating that nitrate in the Danube main stream mainly derives from waste water effluents, which input is increasing along the stream. This can furthermore be confirmed by results of micropollutant studies that demonstrate an increase of widely consumed pharmaceuticals (carbamazepine, diclofenac and caffeine) at different sections of the Danube River affected by tributary inflows and discharge from urban settlements.

In summary, this study is an example of combining isotope techniques, hydrological methods but also emerging compounds in order to approach the fate of anthropogenically derived nitrate within the Danube Basin. The results of this study aim to support the 2021 update of the Danube River Basin Management Plan as well as water monitoring practices across the Danube countries.