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Methane and carbon dioxide emissions in the Danube Delta

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The Danube Delta is the second largest river delta in Europe, consisting of three main river branches and more than 300 lakes, connected by channels and wetland areas. Its role in the nutrient cycling has been subject of several studies in the past, but estimating the greenhouse gas (CO_2 and CH4) emissions remains a challenge because of the system's spatial heterogeneity and seasonal dynamics. As part of the EU Horizon 2020 project C-CASCADES, we attempt to close this knowledge gap by collecting monthly and seasonal greenhouse gas measurements from the Delta's main branches, lakes and channels.
We used a Membrane-Inlet Mass Spectrometer mounted on a swimming platform to obtain spatially resolved data of dissolved CO_2 and CH4 concentrations along a more than 200 km long journey through the delta in May and October 2017. The data are complemented by monthly dissolved gas and flux chamber observations at 19 individual sites throughout 2016 and 2017.
Our data revealed a strong seasonal variability of CO_2 and CH4 concentrations in the range of 10 to 21000 ppm for CO_2 and 20 to 5000 ppm for CH4. We also observed characteristic differences in carbon cycling between the different aquatic compartments (main river branches, channels, lakes): concentrations in the main branches were uniformly oversaturated with CO_2 across space and time. In contrast, lakes were undersaturated in summer months, owing to abundant macrophytes. Small channels showed the highest spatial and seasonal variability with a distinct hotspot area of greenhouse gas emissions in the southeastern part of the delta (flux maxima in the order of 500 mmol m-2 d-1 and 50 mmol m-2 d-1 for CO_2 and CH4, respectively). We find that despite their small surface area, channels contribute significantly to the overall greenhouse gas emissions of the delta.