High-resolution dataset assessing methane concentrations and modelling the carbon dynamics within Europe's second largest delta, the Danube River Delta

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Wetlands are known to be significant sources for CH₄, yet vary between potential sources and sinks for CO₂. However, in regards to the budgets and processes, they are still considered to have high uncertainties, inconsistencies and a general lack of data overall. One key wetland region in Europe is the Danube River Delta. It is the second largest delta in Europe, consisting of the vastest compact reed bed zone in the world, intertwined with rivers, lakes and channels. It is sourced with water from a drainage basin of 817,000 km², with the Danube River originating in Germany before travelling 2,857 km to the Black Sea. However, considering the potential pollution effects within this terminal zone, as well as the delta being one of the most important wetlands in Europe for its ecological value alone (and therefore fragile), few studies have focused on the dynamics within the carbon cycle. During 2017, three field campaigns across three seasons measured high resolution, small-scale spatial and temporal variability for pCO₂, CH₄, O₂ and ancillary parameters within the lakes, rivers and channels with the use of a surface water flow-through package. Given the flexibility of the system, we were able to conduct day-night cycles and extensive mapping transects. We discovered day-night cycles showing significant variation of CH₄ concentrations within the lakes and channels, as well ‘hot spot’ anomalies showing potential ground water sourcing and extreme CH₄ concentrations flowing in from the reed beds. Although reasoning for supersaturation in surface waters are under continuous debate, we conclude a potential reason for such dynamic diel variation within the lake may be due to biomass decomposition and extensive macrophyte concentrations creating a temporarily anoxic zone during the day with mixing during the night, such as previously suggested. On top of this, with the use of discrete data collected from the same water source simultaneously, we were able to model alkalinity, dissolved inorganic carbon and pH to examine both 24 h cycles across lakes and day-night dynamics, giving an in-depth glimpse into the carbonate system. Through the extensive mapping, we successful extracted diel variations for pCO₂ and the carbonate species across the lakes with the use of just day-light data, allowing for spatial and temporal variations to be distinguished. We confirm the boundaries between channels and lakes are intertwined as much as they are with the wetlands, and how small extreme anomalies can only begin to be explained with such high-resolution data, even more so in combination with modelled data.