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Greenhouse gas (CO_2, CH_4, and N_2O) dynamics and underlying processes in two of the world's major rivers: the Elbe and the Murray

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Global greenhouse gas (CO_2, CH_4 and N_2O) emissions from inland waters are significant yet estimates remain highly varied and are quoted with large uncertainty[1,2]. Recent CO_2 estimates range from 0.75 – 3.3 Pg C yr^{-1} and are comparable in magnitude to the global land or ocean anthropogenic CO_2 sink[1−5]. However, these estimates are not adequately constrained by small scale measurement data, particularly for CH_4 and N_2O, which have received far less attention than CO_2[6,7].

Here we present in-situ measurements of inland water-atmosphere greenhouse gas exchange obtained over several hundred kilometres on the Elbe (Germany/Czech Republic) and Murray (Australia) Rivers. Gases were analysed using a Fourier-Transform InfraRed (FTIR) Trace Gas Analyser, which allowed simultaneous and continuous measurement of CO_2, CH_4, N_2O, CO and δ13C in CO_2. This analyser was coupled to an equilibrator and a floating chamber to facilitate either continuous measurement of gas partial pressures within the waters or the overlying atmosphere, or the direct measurement of water-atmosphere gas exchange. Gas transfer velocities were derived from these measurements and also modelled from water and air turbulence parameters. A suite of biogeochemical parameters, such as dissolved organic carbon (DOC) and dissolved inorganic nitrogen (DIN), were measured to gain further insight into the broader mechanisms driving greenhouse gas exchange.

This presentation will reveal the high spatio-temporal variability of greenhouse gas partial pressures measured along the land to ocean aquatic continuum. Such variability is not commonly reported in the literature, as measurements are usually obtained through discrete sampling, at coarse spatio-temporal resolution. Furthermore, it will highlight significant natural and anthropogenic drivers of variability such as diurnal cycling, discharge from wastewater treatment facilities, water regulation, including weirs and altered flow regimes, and connectivity with floodplain wetlands. The relationships between greenhouse gases and routinely measured biogeochemical parameters will be discussed. Finally, this research will provide an estimate of the water-atmosphere greenhouse gas exchange from two globally significant inland water systems.

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