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The importance of water level drawdown on greenhouse gas emissions from a temperate UK reservoir.

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Aquatic systems experience natural fluctuations in water level, but this is often more extreme in reservoir environments due to seasonal water demands or operational maintenance. Water level fluctuations cause changes in hydrostatic pressure and temporarily alter the biogeochemical processes in previously submerged sediments as they dry out. During drawdown events, ebullition becomes more intense and bubbles bypass methane consumption in the sediment and water column leading to a larger atmospheric methane flux. Vegetation which re-colonises this zone may also provide a significant labile carbon input on rewetting.

We report on a year of weekly-to-fortnightly measurements from a temperate Scottish reservoir, focusing on the three-month drawdown period. During drawdown and rewetting, fluxes at the sediment-atmosphere interface were measured using static and soil respiration chambers, with water chemistry and sediment nutrient concentrations analysed to investigate the drivers of measured fluxes.

Results highlighted that pulses of aquatic CO_2 and CH_4 flux occurred during rewetting, with sediment fluxes linked to moisture and pH. Using an estimate of the areal extent of exposed sediment from a UAV survey during maximum drawdown, we calculated that the three month drawdown period contributed 53% (11200 kg) of CO_2, 77% (69 kg) of CH_4, and 98% (27 kg) of N_2O total annual emissions. Drawdown contributed a total of 66% of CO_2eq-weighted emissions for the year. This study adds to the growing body of evidence that suggests reservoir drawdown zones are active areas of biogeochemical cycling, and that drawdown can stimulate CH_4, CO_2 and N_2O release. This has implications for the management of reservoir systems, and for GHG inventories in the face of increasing water demands and more extreme drought conditions.