RS02 Biogeochemical processes and greenhouse gas emissions in inland waters

Poster: Assessment of "Carbopeaking" in a hydropeaking-impacted river in the Italian Alpine area.

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Hydropeaking (i.e., rapid and frequent artificial flow fluctuations caused by reservoir-operated hydropower production) is a much-investigated river stressor, and has been associated, among others, to sudden changes in temperature ("thermopeaking"), underwater soundscape ("soundpeaking"), total dissolved gas saturation ("saturopeaking"). We have recently started investigating the "carbopeaking", i.e., variations of greenhouse gas (mainly CO_2) concentrations and evasion fluxes through the water-air interface associated with hydropeaks. Here we report on the methodology and preliminary results from a field-measurement campaign conducted in a single-thread Alpine river (River Noce, Italy) during multiple hydropeaking events. The analysis of water samples collected in the upstream reservoir showed CO_2 oversaturation in the hypolimnion, around the depth of the hydropower intake system. In the Noce reach upstream of the hydropower plant outlet (i.e., in a residual flow stretch), the CO_2 concentrations displayed diel fluctuations around the atmospheric equilibrium concentration, likely driven by diurnal primary production. Conversely, water released at the hydropower outlet during hydropeaking were consistently oversaturated in CO_2 relative to the atmosphere, in agreement with the concentrations in the reservoir's hypolimnetic water. As a result, hydropeaking events were associated with an alteration of the sub-daily patterns of CO_2 concentration downstream of the hydropower outlet which, combined with higher gas exchange velocities occurring during higher flow rates, can cause periods of enhanced CO_2 emissions. The results highlight the potential impact of hydropeaking on greenhouse gas emissions, demonstrating the need to account for sub-daily variations of flow and gas concentration to accurately quantify carbon balances in rivers impacted by hydropower.