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Effects of small-scale water table level fluctuations on carbon dynamics and redox processes in mesocosms of an alpine and a temperate wetland

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Methane and CO_2 emissions from wetlands depend on soil water content and the presence of alternative electron acceptors such as ferric Fe and sulfate. We investigated the impact of small-scale water table level fluctuations on redox processes, C fluxes and methanogenesis comparing soils of Mer Bleue (MB), a continental bog (Quebec, Canada) and Niwot Ridge (NR), an alpine fen (Colorado, USA). In mesocosm experiments, water table levels were altered in intact peat cores, simulating heavy precipitation of about 30 mm and short drought events as they occur during summer. Water table level in control cores was held constant. The chemical composition of soil solution as well as C fluxes were analyzed. Daily water addition of 2 mm*d^{-1} resulted in water table level fluctuations of about 1 cm in Mer Bleue and 5 cm in Niwot Ridge peat. Three simulated drought and two rain events caused a drawdown of 2.5 cm (MB) and 9 cm (NR) and an increase of approx. 3 cm in both MB and NR cores respectively. Ferrous iron concentrations in NR reached 300-400 μmol*l^{-1} in the saturated zone and were much higher than in MB cores with levels of about 30 μmol*l^{-1}. Reducing conditions prevailed up to 5 cm above average water table level. Drought events induced iron oxidation up to 2 cm below average water table level. Rewetting led to a peak in sulfide concentration followed by nearly complete depletion of H_2S. Methane production in NR cores was much higher than in MB cores (up to 350 and 100 μmol*l^{-1}, respectively). Drought events interrupt the increase in CH_4 concen-

tration in both NR and MB cores. Measured CO_2 fluxes were fairly similar among treatment and control cores and averaged 1.3 g C *m^{-2}*d^{-1}in MB cores and 6.8 and 6.2 g C *m^{-2}*d^{-1}in NR cores. Differences in fluxes were consistent with concentration profiles. There were no noticeable effects of water table level changes on CO_2 emissions. Methane emissions were mostly below detection limit in MB cores and highly variable in NR cores. While there was a clear increase in CH_4 emission in the control core from 30 to 150 mg C*m^{-2}*d^{-1}(R^2=0.83) within 50 days, fluxes in the manipulated core showed no significant trend. Repeated water table fluctuations reduced methane production in both MB and NR cores. Sulfate reduction seems to be the competing process in MB whereas in NR iron reduction was predominant. The results show that water table level fluctuations in the range of a few cm and days drive redox processes that differ depending on available redox sensitive species and suffice to decrease CH_4 emissions from different wetland soils.