Climate feedbacks on the cycling of carbon dioxide, nitrous oxide, sulfur, and methane on a semi-arid floodplain

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Biochemical reactions in floodplain sediment-water system exchange carbon, nitrogen, sulfur and methane with the atmosphere and surface waters. Variations in temperature and precipitation connected to climate change can potentially impact biogeochemical fluxes between the floodplain, river and the atmosphere.

Here we report CO_2, N_2O, CH_4 greenhouse gases and O_2, N_2, SO_4, NO_3 concentrations following three years of monitoring a partially saturated sediment from a semi-arid floodplain. Moreover, we studied variations of C, O, N and S stable isotopes of CO_2, N_2O CH_4, and SO_4.

We sampled a cross-section of five wells characterized by increasing distance from the Colorado River and a vertical sampling increment of 0.5m from 0.5m to 3m depths. Sampling was done with a bi-monthly-monthly frequency. Maximum concentrations in CO_2 (~10%v) N_2O (~50ppmv) and SO_4 (~70ppmw) coincide with minimun oxygen concentrations (~4-14%v) and are associated with seasonal maximum water table elevation whereas minimum CO_2, N_2O, and SO_4 production is observed during cold season and low water table. CH_4 production was observed only in the two wells close to the river and indicate a chemically reduced zone during episodes of high water table elevation. N_2O, SO_4, and CH_4 production is associated with a variation of the redox potential at the unsaturated zone/groundwater interface.

Our data suggest that climate change has the potential to strongly impact hydrological-biogeochemical dynamics of the floodplain. A drier climate will decrease the amplitude of water table fluctuation and therefore, limit the sediment volume for seasonal production of CO_2 N_2O, SO_4 and CH_4. In the case of increased precipitation and greater snow accumulation, rapid thawing of the snowpack and precicipitation would increase CO_2 N_2O, SO_4 and CH_4 production.