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Fluctuating groundwater table enhances N_2O emission from incomplete denitrification in a floodplain fen

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Nitrous oxide, a major greenhouse gas, is found to be emitted largely from organic soils. We have investigated the effects of water table and soil oxygen (O_2) content on N_2O fluxes from a drained floodplain fen in Estonia. We also studied the effects on natural abundance of nitrogen isotopes ^{15}N & ^{14}N in the soil to understand how the isotopic nature changes during nitrification and denitrification as we raise the water table and decrease O_2 in the peat. During the field experiments in autumn 2018, we studied three soil environments under varying O_2 content which were: oxic, suboxic and anoxic. Opaque truncated conical manual chambers (65 l) were used to sample gas from each site during one-hour sessions. The suboxic environment was connected to variation in water table, both in time and depth. We created an anoxic environment by experimental flooding. We observed low N_2O emissions under oxic conditions. Under suboxic conditions (0.4–6 mg O_2/l) N_2O emissions peaked at 6 mg O_2/l and decreased gradually with decreasing O_2. In the anoxic soil ($<$0.4 mg O_2/l) N_2O emissions were found to be lowest. The isotopic analysis of peat showed high ^{15}N content in the top 10 cm layer which gradually decreased with depth to 30 cm for anoxic soil. In the suboxic soil, ^{15}N was found to be increasing with depth. In the soil fluctuating between suboxic and anoxic, ^{15}N was abundant ($\delta^{15}N$ = 7–9‰ air N_2) indicating intensive microbial processing of nitrogen. The results indicate incomplete denitrification in the suboxic soil as the source of N_2O. We will conduct the same experiments in laboratory by creating mesocosms in 12 columns containing peat samples from the same site.