

Hydrology controls methane and nitrous oxide fluxes in swamp and bog forests

Ülo Mander (1,2), Jaan Pärn (1), Martin Maddison (1), Kaido Soosaar (1), Jüri-Ott Salm (3), Kristina Sohar (1), and Alar Teemusk (1)

(1) University of Tartu, Institute of Ecology and Earth Sciences, Estonia (ulo.mander@ut.ee), (2) Irstea, Hydrosystems and Bioprocesses Research Unit, Antony, France (ulo.mander@irstea.fr), (3) Estonian Fund for Nature, Tartu, Estonia

We used data from a global soil, and N2O and CH4 gas sampling campaign. The objective was to analyse N2O and CH4 emissions related to peat conditions in swamp and bog forests. Altogether, we studied 21 swamp and bog forest sites under various climates: 3 alder swamps and 3 artificially drained bog pine forests in Estonia (Jan.-Dec. 2009), 2 bog forests in Transylvania/Romania (Apr. 2012 & June 2014), 3 cypress swamps in the Everglades (Apr. & Dec. 2013), 2 bog forests in West Siberia (July 2013) and a bog forest in Tasmania (Jan.-Feb. 2014). The N2O and CH4 effluxes were measured during 5-6 days with 8-10 opaque static chambers per site. Soil samples were taken for further analysis of pHKCl, NO₃-N, NH₄-N, soluble P, K, Ca and Mg, totN and C. Groundwater was measured from sampling wells.

The most significant independent factor for site average CH4 fluxes was groundwater depth – an exponential relationship; R²=0.42; p=0.0007; n=21. The N2O fluxes showed a decreasing (power) relationship with the C/N ratio – R²=0.53; p<0.0001; n=21. Related to groundwater level, the N2O fluxes peak at around -40cm. Variation in greenhouse gas fluxes was largest at the more favourable conditions - at optimal water table (+5 to -20cm) for CH4 and at low C/N for N2O. The results agree with previous literature but they are the first to draw such conclusions from a global campaign following a uniform protocol.