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Drought effect on methane, nitrous oxide and carbon dioxide dynamics along boreal forest-mire ecotone

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The effect of drought on CH_4, N_2O and CO_2 dynamics of boreal forest and mires has been seldom observed in a continuum between xeric and wet habitats. Such a continuum includes a transitional zone between forests and mires which is frequently exposed to large soil moisture differences, but generally overlooked due to a relatively narrow extent. Although, it's known that CH_4, N_2O and CO_2 dynamics are sensitive to soil moisture.
We evaluated spatiotemporal effects of drought on CH_4, N_2O and CO_2 dynamics in continuum of nine distinct forest/mire types. Soils changed from well-drained podzols to poorly-drained histosols and ground water raised downslope from the depth of 10 m in upland forests to 0.1 m in mires. Meteorological conditions, forest floor respiration, methane, and nitrous oxide flux data were collected during growing season of exceptionally wet (2004), intermediate (2005), and exceptionally dry (2006) year. The CH_4, N_2O and CO_2 fluxes were studied by chamber methods.
The seasonal median forest floor CH_4, N_2O, and CO_2 dark fluxes between forest/mire types and between rainy, intermediate, and dry years varied from -0.07 to 1.68 mgCH_4 m2 h-1, from 1.5 to 24.65 μgN_2O m^2 h^{-1}, and from 0.26 to 0.76 gCO_2 m^2 h^{-1}. The CH_4 oxidation in upland forest and transitional types was similar between wet and dry years, though the CH_4 production of mires was reduced in dry year. Probably due to low nitrification potential, larger soil water differences between years 2005 and 2006 did not seem to trigger corresponding changes in small N_2O fluxes. The forest floor dark CO_2 efflux during drought was in comparison to wetter periods significantly reduced in upland forest and transitional types, but stayed similar or even increased in mires.
In the carbon rich soil of forest/mire transitions mainly soil CO_2 efflux were sensitive to short term fluctuations between water level drawdown and water saturation, whereas CH_4 and N_2O fluxes changed minimally.