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The Skogaryd Research Site - Integration of terrestrial and freshwater greenhouse gas sources and sinks

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Forests play an important role in the global carbon (C) cycle, and management as well as climate can cause major effects on the balance of C between the atmosphere and the plant/soil system. With regard to our commitments to the Kyoto and post-Kyoto actions on climate change, we need reliable predictions on how this balance is affected by management and climate.
In 2006 the Skogaryd Research Forest was established in the southwest of Sweden (58°23'N, 12°09'E). The overall goal is to quantify net greenhouse gas (GHG) fluxes from drained spruce forest soils, by determining the individual fluxes and pools of C and nitrogen and elucidating their connection to site fertility, drainage status and abiotic parameters. The generated data will be used in GHG models, for model validations and ultimately emissions predictions. During 2006-2009 the research has focused on two sites, mineral and organic soils, both dominated by Norway spruce (Picea abies). Both sites are drained fertile soils but with different land-use history that have affected their physical properties. Measurements include: net ecosystem exchange of CO_2, shoot photosynthesis and respiration at different locations within the canopy, stem respiration, emissions of N2O and CH4 using manual chambers, soil respiration with automatic chambers including a trenching experiment where root, ectomycorrhizal, and heterotrophic respiration are separated, fine root production using minirhizotrons, and ectomycorrhizal mycelia production. The organic site also includes a wood ash fertilization experiment.
From 2010 the research has been expanded by the project Landscape Greenhouse Gas Exchange (LAGGE) to the whole watershed, from the pristine mire system via streams, riparian zones, forests, to lakes and the subsequent exchange between the atmosphere and surface waters. The current accounting of forests as carbon sinks has relied on measurements of vertical carbon dioxide (CO_2) exchange between vegetation and the atmosphere. The budgets have ignored dissolved carbon (C) and nitrogen (N) transport in water to streams and lakes and the subsequent exchange between the atmosphere and surface waters. Aquatic habitats can be significant net sources of CO_2 and methane (CH4) and potential hot spots for N2O release, all important for natural greenhouse gas (GHG) emissions. Inland waters need to be included in the C and GHG balances for terrestrial landscapes. This project aims to quantify GHG balances at the landscape scale in forested regions that include land-atmosphere, land-water, and water-atmosphere exchange of CO_2, CH4 and N2O. Different terrestrial and aquatic ecosystems will be linked holistically, using site specific techniques at different scales, from aircraft (km2) to chambers (m2) to develop integrated models that can be used to quantify net GHG flux for management strategies. The LAGGE project involves six Swedish universities and site is open for more cooperations.