# Greenhouse gas exchange in a northern Swedish managed boreal forest landscape estimated by biometric and chamber-based methods

Eduardo Martínez-García[1*], Mats B. Nilsson[1], Jörgen Wallerman[2], Johan E.S. Fransson[2], Hjalmar Laudon[1], Tomas Lundmark[1], Jinshu Chi[1], Matthias Peichl[1]

[1] Department of Forest Ecology and Management, Swedish University of Agricultural Sciences (SLU), Umeå, Sweden

[2] Department of Forest Resource Management, Swedish University of Agricultural Sciences (SLU), Umeå, Sweden

[*] Correspondence to: eduardo.martinez@slu.se

A managed boreal forest landscape comprises various potential net sinks and sources of carbon dioxide ($CO_2$) and methane ($CH_4$) across forest ecosystems with stands of varying species composition and developmental stages, but also includes a considerable fraction of mire and lake ecosystems. Due to this large heterogeneity and complexity, the quantification of the landscape-level (i.e., several tens of $km^2$) greenhouse gas (GHG) exchange in these boreal areas is currently highly uncertain.

Here we present results from a current study, in which we provide a 3-year (2016-2018) data set of $CO_2$ and $CH_4$ exchange fluxes over a managed boreal forest landscape (68 $km^2$) located within the Krycklan watershed catchment in northern Sweden. This study also takes advantage of the ICOS-Svartberget (Integrated Carbon Observation System) station (64°15'N, 19°46'E, 270 m a.s.l.) located within the catchment, which provides continuous data for all relevant meteorological and soil environmental variables.

In this study, the intra- and interannual variability of the landscape-level GHG exchange was estimated by a plot-based bottom-up approach, which uses biometric and chamber-based flux measurements carried out in 50 forest plots (10 m radius). These sampling plots were selected from a regular grid of 556 inventory plots across the catchment spanning various soil types, tree species and stand age classes. In each of the selected plots, monthly manual samplings using a custom-made closed chamber system were conducted to measure the forest floor $CO_2$ and $CH_4$ exchange across natural (both light/dark measurements) and trenching/vegetation removal plots (0.45 × 0.45 m). In addition, $CO_2$ and $CH_4$ chamber-based flux measurements were collected from mire and lake ecosystems. Additional plot-level measurements included tree and understorey above- and belowground biomass pools and production, litterfall rate, soil properties (humus depth, C and N, moisture and temperature) as well as leaf area index. Using high-resolution airborne Light Detection and Ranging (LiDAR) data, plot-level estimates will be up-scaled to obtain the GHG budget of the entire forest landscape. Finally, these estimates will be compared with those obtained from an eddy covariance system installed (70 m height) on the tall tower of the ICOS-Svartberget station.

This comprehensive study will add a key piece of information to the understanding of the spatial and temporal variability of the GHG budget over a heterogeneous regional landscape in northern Sweden and its potential as a tool for supporting the efforts in mitigating global climate change.