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Investigating the sensitivity of forest management on surface energy and water fluxes in a land surface model

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In a grid box of a land surface model, surface mass and energy fluxes are calculated based on key vegetation structural parameters of a particular plant functional type, such as leaf area index (LAI), canopy top and bottom heights etc. Forest management greatly influences the species composition and age class structure of a forest and hence these key structural parameters. In most climate models, differences in structural parameters within an individual forest type (PFT) – such as, for example, the difference in leaf area index (LAI) between a young and a mature evergreen needleleaved forest – are often unaccounted for.

Here, focusing on Fennoscandia (Norway, Sweden, and Finland) as a case region, we employ a novel forest classification scheme that differentiates between dominant tree genera and development stage to quantify the sensitivity of regional surface water and energy fluxes to differences in forest structure as shaped by forest management. The forest classification – recently integrated into the European Space Agency Climate Change Initiative's land cover map (Majasalmi et al. 2017) – is used to prepare surface datasets for a "Control" forest management case in CLM4.5. CLM4.5 is then run off-line, forced with CRU-NCEP atmosphere data, and sensitivity is quantified by comparing outcomes of simulations run with six alternate forest states to that of the control, where the six alternate states are developed to explore the full range in structural permutations in forests potentially shaped by forest management activities.

A secondary research objective is to quantify the sensitivity of competition (e.g. water) among forest PFTs on surface energy and water fluxes by allocating separate soil columns for forest PFTs in land surface models like CLM4.5.

Preliminary results suggest that a more detailed representation of forest structure in a land surface model is important for being able to more accurately quantify biogeophysical impacts of forest management.