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Using Radar and Optical remote sensing to estimate boreal forests NEP (carbon sources and sinks).

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Estimating the sources and sinks of carbon at continental scale is still an issue. On the one hand, atmospheric CO2 inversion studies give access to large-scale sinks and sources, but do not give information on spatial distribution and processes. On the other hand, forest inventory data help identifying the processes, but they severely sample forested areas and they are not ideal in terms of temporal sampling and homogeneity between institutions, countries etc. Ecosystem modelling is a third approach. However, complex mechanistic biosphere models are difficult to calibrate and initialise at large scales, and then give access to 'statistical' carbon sinks and sources, without detailed spatial accuracy. Good temporal sampling and spatial accuracy as well as algorithm homogeneity are natural 'strengths' of remote sensing approaches. So far, remote sensing applications have been mostly successful i) to provide land use/land cover mapping and ii) to estimate large scale net primary productivity (NPP), by using the light-use-efficiency concept (LUE) and optical satellite data (NDVI vegetation index). Few attempts have been made to estimate net ecosystem productivity (NEP), which requires an estimation of soil respiration and litter decomposition (Rh) in addition to NPP. In boreal forests, the balance between the two terms (NEP = NPP-Rh) is primarily dependent on the forest perturbations, like fires and clear-cuts, and on the resulting stand age and stand history.

- The first problem is to simulate such forest cycles. Here we present a methodology, based on a classical LUE model, which accounts for forest stand age to estimate NPP and NEP. A simple approach is used to parameterise Rh and NPP as a function of stand age and forest type, using relationships established from recently published chronosequence studies. These studies clearly show that young boreal forest stands are sources of carbon in the first 10 to 30 years, because decomposition exceeds NPP, before they turn to carbon sinks.

- The second problem is to access information on stand age at large scales. In this purpose, we propose to take advantage of Radar data. We use the Siberia-1 biomass map (Schmullius et al. 2001), which is based on ERS and JERS imagery, to derive stand age using biomass/age relationship for Siberian tree species. These data allow to run the model at high to moderate resolution (100 to 1000 m) over large areas. We show model simulations for Central Siberia and details on areas where ground data are available. Model sensitivity is commented, and the potential of such remote-sensing approaches of NEP is discussed.

Schmullius, C. et al., 2001, SIBERIA - SAR Imaging for Boreal Ecology and Radar Interferometry Applications,European Commission ENV4-CT98-0743.