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Carbon dynamics after forest harvest in Central Siberia: the ZOTTO footprint area

Alexey Panov (1), Galina Zrazhevskaya (1), Olga Shibistova (1), Alexander Onuchin (1), and Martin Heimann (2)

(1) V.N. Sukachev Institute of Forest SB RAS, Krasnoyarsk, Russian Federation (alexey.v.panov@gmail.com), (2) Max Planck Institute for Biogeochemistry, Jena, Germany

Temperate and boreal forests of the Northern Hemisphere have been recognized as important carbon sinks. Accurate calculation of forest carbon budget and estimation of the temporal variations of forest net carbon fluxes are important topics to elucidate the "missing sink" question and follow up the changing carbon dynamics in forests.

In the frame of the ongoing Russian-German partner project the Zotino Tall Tower Observatory (ZOTTO; www.zottoproject.org) a unique international research platform for large-scale climatic observations is operational about 20 km west of the Yenisei river (60.8°N; 89.35°E). The data of the ongoing greenhouse gas and aerosol measurements at the tall tower are used in atmospheric inversions studies to infer the distribution of carbon sinks and sources over the whole Northern Eurasia. The tall tower footprint area estimates of carbon stocks and fluxes are highly demanded for bottom-up validation of inversion estimates. The ZOTTO site lies in a vast region of forests and wetlands, still relatively undisturbed by anthropogenic influences, but a moderate human impact on vegetation, represented mainly by logging activities, becomes essential. Therefore, accurate estimates of carbon pools in vegetation and soil following harvesting are essential to inversion studies for ZOTTO and critical to predictions of both local ecosystem sustainability and global C exchange with the atmosphere.

We present our investigation of carbon dynamics after forest harvest in the tall tower footprint area (∼1000 km2). The changes in C pools and annual sequestration were quantified among several clear-cut lichen pine (Pinus sylvestris Lamb.) stands representing various stages of secondary succession with a "space-for-time substitution" technique. When viewed as a chronosequence, these stands represent snapshots showing how the effects of logging may propagate through time. The study concluded that ecosystems during the first 15 yrs after forest harvest become C sources to the atmosphere which is attributed to increases in decomposition rates and decreases in litter inputs due to the ecosystem disturbed. Pine stands nearly 15-20-year-old after harvesting have been recognized as weak carbon sinks, and the ecosystem of 25-40-year-old represents a relatively strong C uptake.

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