



## **Productivity of Russian forests during recent decades (1960-2010s)**

Anatoly Shvidenko (1,2), Dmitry Schepaschenko (1,3), and Ian McCallum (1)

(1) International Institute for Applied Systems Analysis, Laxenburg, A-2361 Austria, (2) V.N. Sukachev Institute of Forest, Siberian Branch of the Russian Academy of Science, 660036 Krasnoyarsk Russia, (3) Moscow State Forest University, Mytischki-5, 141005, Moscow reg., Russia

Knowledge of long term indicators of forest productivity is very important for reliable assessment of interaction of forests with major global biogeochemical cycles. We present a systematic analysis of indicators of productivity of Russian forests (live and dead biomass, net primary production, net ecosystem production, net ecosystem exchange; net and gross growth) for the last 50 years (1960-2010) using the diversity of available information sources and methods (forest inventories; different empirical and semi-empirical models; eddy-covariance; remote sensing products; dynamic vegetation models). Based on as comprehensive as possible adherence to the principles of applied systems analysis, we made an attempt to provide a time series analysis of indicators of forest productivity in Russia aiming at (1) obtaining the most reliable results, and (2) comprehensively assessing the variability and biases of the indicators. Practically all methods used resulted in biased estimates, sometimes significant. Taking into account the fuzzy character of assessment of forest productivity for large areas, any of the existing methods (used individually) are not able to recognize structural uncertainties. In order to get the most probable results and related uncertainties, a special statistical procedure for harmonizing along with multiple constraints of the estimates obtained by independent methods is suggested. Application of the above methodology resulted in a rather consistent assessment of the major indicators of productivity. For instance, we showed that forest live biomass at the country level could be estimated with uncertainty of 4-6% and net primary production – 7-10% (confidence interval 0.9) for individual years. These uncertainties decrease for about one-third in long-period time series. This allows us to observe the trend of increasing productivity of Russian forests during the last five decades at levels of  $0.5 \pm 0.2\% \text{ year}^{-1}$ . However, the above results should be used with caution because the entire procedure inevitably includes expert estimates and judgments.