

Assessment of carbon budget of terrestrial ecosystems of Russia and comparison of bottom-up and top-down estimates

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We present a reanalysis of terrestrial ecosystems Full verified Carbon Account (FCA) for Russia for the period of 2000-2012. The methodology relies upon integration of multiple approaches of carbon cycling assessment with following harmonizing and mutual constraints of the results received by independent methods. The landscape-ecosystem approach (LEA) was used for a systemic design of the account and empirical assessment of the LEA based on a relevant combination of pool-based and flux-based methods. The information background of the LEA is presented in a form of an Integrated Land Information System which include the hybrid landcover (HLC) and relevant attributive databases. HLC was developed based on remote sensing multi-sensor concept (using 12 different satellite products), geographic weighted regression and Geo-wiki validation. Carbon fluxes which are based on long-term measurements were corrected based on seasonal climatic indicators of individual years. Uncertainties of intermediate and final results within LEA are calculated by sequential algorithms. Results of the LEA were compared with those obtained by eddy covariance, process-based models of different types, inverse modeling and GOSAT Level 4 Products. Uncertainty of the final results was calculated based on the Bayesian approach. It has been shown that terrestrial vegetation of Russia served as a net carbon sink at range of 0.48-0.65 Pg C yr⁻¹ during the studied period, mostly driven by forest sink, with interannual variation of around 10-20%. The regional variation was significantly higher that depends on specifics of seasonal weather and accompanying regimes of natural disturbances. The overall uncertainty of the Net Ecosystem Carbon Budget is estimated at ~22-25% ($\pm 1 \sigma$) at the annual basis and ~7-9% for the period' s average under an assumption that the methods and data used do not have uncontrolled biases.

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