

EGU2020-20567

<https://doi.org/10.5194/egusphere-egu2020-20567>

EGU General Assembly 2020

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## Space Observatory for carbon budget monitoring in Russian forests using Earth observations and modelling

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Russian forest is a factor of global importance for implementation of international conventions on climate considering its potential for absorption and accumulation of the atmospheric carbon at an impressive scale. Considering recently adopted Paris agreement on climate the comprehensive and accurate estimation of Russian forests' carbon budget became a top priority research and development issue on national agenda. However existing quantitative estimates of Russian forests' carbon budget are of significant level of uncertainty. One of the most obvious reasons for such uncertainty is not sufficiently reliable and up-to-date information on characteristics of forests and their dynamics.

The Russian Science Foundation has supported an ambitious research megaproject titled "Space Observatory for Forest Carbon" (SOFC) started in year 2019 and aimed at the development of a new concept and comprehensive methods for forest carbon budget monitoring using Earth observation data and forest growth and dynamics models. The main SOFC project objectives are as follows:

- Development of a new concept and methodology for Russian forests and their carbon budget monitoring based on the integration of remote sensing and ground data along with improved models of forest structure and dynamics;
- Development of new annually updated GIS databases on the characteristics and multi-annual dynamics of Russian forests;
- Development of an informational system and technology for the continuous monitoring of Russian forests' carbon budget.

Information necessary for carbon budget estimation includes data on various land cover types, forest characteristics (growing stock volume, species composition, age, site-index) and ecological parameters (Net Primary Production, heterotrophic respiration). Data on natural (fires, diseases and pests, windstorm, droughts) and anthropogenic (felling, pollution) forest disturbances causing deforestation, as well as information on subsequent reforestation processes are also vital.

The existing remote sensing methods can provide significant part of missing country-wide information about the land cover types and forest characteristics for the national-scale carbon

budget estimation and monitoring. Multi-year time series of this data since the beginning of the century allow modelling the forest dynamics and its biophysical characteristics. The Earth observation data derived information on forest fires' impact includes burnt area mapping over various land cover types as well as forest fire severity assessment allowing characterisation of fire induced carbon emissions. Furthermore, developed methods for processing and analysis of multi-year satellite data time series enable detection of forest cover changes caused by various destructive factors making it possible to substantially improve the accuracy of carbon budget estimation.

Obtained information on forest ecosystems' parameters is used to improve existing and develop new approaches to forest carbon budget estimation, as well as to simulate various scenarios of Russian economy development depending on forest management practices and climate change trajectories.

This work was supported by the Russian Science Foundation [grant number 19-77-30015].