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Satellite-derived spatiotemporal patterns of environmental changes caused by 2018-2019 wildfires in Arctic-Boreal Russia

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Forest fires affect environmental changes both directly, changing the type of land cover, causing local and regional air pollution through emissions of greenhouse gases and aerosols, and indirectly through a secondary effect on atmospheric, soil and hydrological processes. The increase in the number and area of uncontrolled wildfires, the degradation of permafrost in high latitude areas leads to a change in the balance of greenhouse gases in the atmosphere, and it results in the negative impact on the Earth's climatic system.

This study examined the Arctic-Boreal territories of the Russian Federation, where huge forest fires were observed in 2018-2019. In most of these areas, forest fire detection is carried out only by means of the satellite monitoring without aviation support. The sparsely populated and inaccessible territories are a major factor of the rapid spread of fires over large areas. Most of the forest areas in the region are so-called control zones, where the authorities may decide not to extinguish the fires if they do not threaten settlements and economic facilities, and consider the salvation of forests economically unprofitable. However, there is no reliable data on the environmental consequences of large forest fires in the Arctic-Boreal territories.

Satellite monitoring of wildfires provides the detection of fire locations, an assessment of their area and burning time. In our study, we used various indices calculated from remote sensing data for the pre-fire and post-fire periods to identify the spatiotemporal patterns of environmental change caused by large wildfires. The Sentinel 5 TROPOMI time series have been analyzed for the short-term and long-term atmospheric composition anomalies detection caused by forest fires in the region. In the process of comparing the methane concentrations time series for the 2018-2019 fire seasons the constantly high values anomaly zones were found. We believe that these anomalies are resulting from Sentinel-5 CH₄ algorithm constrains, which requires additional work on data validation with relation to the local conditions.

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