

## Impact of anomalous high temperature in the 2020 spring-summer season on terrestrial carbon cycle across Siberia

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Siberia has been experienced one of the most rapid warming trends in recent decades, and this tendency will continue in the future. Furthermore, extreme climate anomalies have been reported across Siberia. Anomalous high temperature in 2020 spring to summer is reported as a record-breaking one, and the impact of the high temperature on the terrestrial environment is concerned. In this study, we analyzed bottom-up and top-down estimations, including satellite remote sensing datasets/products, in-situ observation, and atmospheric inverse analysis outputs to quantify the response of the terrestrial environment to the warming. We detected an apparent positive anomaly in land surface temperature, and it exceeds over five degrees above the long-term (20 years) mean based on MODIS products. Snow cover duration also shows much earlier snowmelt (e.g., one month) than the normal, and earlier increases in river discharge were observed. NDVI and LAI also consistently show positive anomalies in March to June seasons. Gross primary productivity (GPP) also shows 10-20% larger than normal years. We also detected large CO<sub>2</sub> uptake anomalies in the spring and early summer by atmospheric inversion, probably due to earlier vegetation green-up. Although this analysis did not include the CH<sub>4</sub> budget assessment, a large anomalous CO<sub>2</sub> budget was estimated caused by anomalous temperature anomaly. Further analysis requires comprehensive greenhouse gas assessment by including CH<sub>4</sub>.

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