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The role of fires for tundra-forest transition in northwest Siberia

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Transition of arctic vegetation from tundra to shrubs and forest is an important process influencing global carbon budget. Transition is predicted due to warming and prolongation of the growing season but observations show that it is slower than expected. Fires are disturbances that could trigger a shift of biomes.

We studied the transition of dry tundra to forest and woodland in northwest Siberia for burned and background sites within the time interval of 60 years. We used meteorological data to estimate potential shifts in vegetation based on a bioclimatic model. To investigate fire and vegetation dynamics, we used historical and modern satellite imagery (Corona KH-4b, Landsat-5,7,8, Resurs-P, SPOT-6,7). We performed comparative analysis of vegetation using high-resolution satellite data from different years.

The growing season length increased by 20 days and the mean temperature of the growing season increased by 1°C making climatic conditions suitable for trees. We showed that ca 40% of the total study area experienced fires at least once during the last 60 years. Within this period, shift from dry tundra to tree-dominated vegetation occurred in 6-15% of the area in the non-disturbed sites compared to 40-85% of the area in the burned sites.