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# Wildfire dynamics in mid-Siberian larch dominated forests

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Models predict climate-driven changes of wildfires frequency with air temperature increase. The most significant climate-induced air temperature increase is observing in Siberia. Hire we examined the long-term wildfire dynamics, including fire return interval (FRI), in the zone of larch dominance and "larch-mixed taiga" ecotone. A wildfire chronology encompassing the $15^{th}$ through the $20^{th}$ centuries was developed by analyzing tree stem fire scars.

Average FRI was found $82\pm7$ years for the zone of larch dominance, and $77\pm20$ for the "larch-mixed taiga" ecotone.

FRI depends on the relief features: on north-east facing slopes it was $86\pm11$ years, for south–west facing slopes at $61\pm8$ years, for flat terrain at $68\pm14$ years, and for bogs $139\pm17$ years.

The topography affects fire recurrence through different fuel loading, temperature conditions on the different slope and aspects, even frequency of lightning strikes.

FRI decreased from 101 years in the $19^{th}$ century to 65 years in the $20^{th}$ century, for the zone of larch dominance, and from 97 years to 50 years for the "larch-mixed taiga" ecotone. For the zone of larch dominance the leading factor was climate change, since about 90% of fires were caused by lightning. Whereas for the "larch-mixed taiga ecotone" the effect was caused by both, climate and anthropogenic, factors.

Extreme fire events correlates with summer air temperature deviations at the regional

and sub-continental levels ($R^2$= 0.46-0.62).

Wildfires cause increase of seasonal thawing depth by factor of 3 to 5. Post-fire permafrost depth is decreasing with rate $\sim$ 0.3 cm/yr, whereas moss and lichen cover depths is increasing ($\sim$0.1 cm/yr). Fire-induced active layer depth increase lead to growth acceleration of surviving trees and regeneration which lasts $\sim$30 yr.

Fires are inherent to larch forests and are necessary fore its maintenance. Larch is a "pyrophyte" (i.e., "likes fire") species: light larch seeds need a mineralized surface of fresh burns for germination. Larch is also protected by thick bark, whereas competitive species (e.g., Siberian pine) are not. The main cause of larch mortality is damage of the root system which is restricted to the narrow ($<$30 cm) strata above the permafrost. With a climate-induced increase of active layer overall increase of larch resistance to fires may be expected. The decrease of FRI may interfere with climate-driven migration of competitor species into zone of larch dominance, affecting biodiversity at high latitudes.