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Climate-induced mortality of “dark needle conifer” in Siberian taiga

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Within Siberia fir (Abies sibirica) and Siberian pine (Pinus sibirica) (so called “dark needle conifers”, DNC) mortality increased in the southern part of the DNC range. Siberian pine and fir showed decreased radial growth increment within southern Siberia since the 1980s with increasing mortality recorded since the year 2000. Tree ring width was strongly correlated with vapor pressure deficit, aridity and root zone moisture. Water stress from droughts made trees more susceptible to insect attacks causing mortality in about 10% of DNC stands in southern Siberia.
Biogeographically, tree mortality was located within the DNC - forest-steppes transition. Tree mortality was significantly correlated with drought and soil moisture anomalies. Within the interior of the DNC range mortality occurred within relief features with high water stress risk (i.e. steep convex south facing slopes with shallow well-drained soils). In general, DNC mortality in Siberia was induced by increased aridity and severe drought (inciting factors) in synergy with biotic attacks (contributing factor). In particular, bark beetle Polygraphus proximus made a strong input on the fir mortality. In future climate scenarios with predicted increase in aridity DNC could be eliminated from the southern part of its current range and will be replaced by drought-resistant conifers and broadleaf species (e.g., Larix sibirica, Pinus sylvestris, and Betula pubescence).