Effects of the extreme wet event on nitrogen availability and NDVI in larch forest of Eastern Siberia

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Under global climate change, in Eastern Siberia extreme wet events are expected to be frequent in the future, thereby affecting the productivity of the taiga, which is the dry and nitrogen-poor ecosystem on permafrost. This study aims to investigate the effects of the extreme wet event in 2006-2007 on the taiga forest at Spasskaya Pad forest station (62°25' N, 129°62' E) near Yakutsk, Russia. For this purpose, in the summer of 2018, a transect 60 m × 510 m with 30 m × 30 m plots, in total 34, was set including dry sites and wet sites distributed after the wet event, to obtain needle samples from 105 mature larch trees at a height of 5 – 6 m, for the investigation of spatial variations in the foliar $\delta^{13}C$, $\delta^{15}N$, and C/N ratio and also NDVI (Normalized Difference Vegetation Index) calculated from Landsat images. Besides, the temporal dataset of the mean annual maximum NDVI (Normalized Difference Vegetation Index) within the transect in 1992-2019 was compared to the ecosystem parameters, such as larch foliar parameters, tree-ring width index (RWI), soil moisture equivalent (SWE) at the upper layer, which have been observed for long time in the typical dry forest at the station, and the climatic parameters in order to understand how ecosystem conditions differ before and after the wet event.

Before the wet event, temporal variation of the mean annual maximum NDVI in the transect showed high positive relationships with SWE in the beginning of the summer season, RWI, and foliar $\delta^{15}N$ and negative relationship with foliar C/N. That means high aboveground productivity of the typical dry forest was controlled by high soil moisture and afterwards by high nitrogen availability. However, after the wet event, excessively high soil moisture played a negative role on nitrogen availability and NDVI because of high tree mortality, particularly in a depression where all trees died.

In the summer of 2018, the wet plots were mostly covered by grasses, which become more productive in August, than in June: therefore June NDVI was used for the analysis of spatial variations, in order to partly remove the contribution of grasses to NDVI. Lower June NDVI and lower C/N ratio, or higher N content, were observed at the wet sites than those at the dry sites, because a low forest density caused by the wet event may result in high soil N availability for one mature tree. High $\delta^{13}C$ values were observed at the wet sites that may be explained by higher solar availability because of low tree stand density. In both dry and wet sites, the $\delta^{15}N$ were various, which may be caused by various nitrogen sources for trees.