On thin ice: contrasting responses of woody NPP to permafrost thaw

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Boreal forests are located at latitudes that are predicted to experience some of the greatest warming on the planet. Forests growing on permafrost may be particularly vulnerable, with accelerated soil warming and permafrost degradation linked to changes in woody net primary productivity (NPP$_w$). Recent evidence suggests that the responses of NPP$_w$ to permafrost thaw are mixed, with both increases and decreases in productivity observed following the onset of permafrost degradation. What determines these contrasting responses is currently poorly understood. This leads to uncertainties in predicting the future vegetation and carbon dynamics in permafrost regions, which propagate to climate projections in Earth System Models. Here, we propose a framework, and a set of hypotheses to explain the observed differences in the response of NPP$_w$ to permafrost thaw. We argue that the relationship between permafrost thaw and NPP$_w$ is non-linear and determined by a set of climatic and environmental variables. On this basis, we partition ecosystems into classes, and describe their relationships between permafrost thaw and NPP$_w$. 