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Using high-resolution intra-ring oxygen isotope measurements across fossil wood to reconstruct seasonal temperature in northeastern Siberia during the late Miocene

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Siberia experiences some of the greatest temperature seasonality of any region of the planet. A lack of long-term instrumental records inhibits interpretations of changes in seasonal temperature in response to rising CO_2. Here we demonstrate a new proxy for seasonal temperature based on high-resolution, intra-ring isotope analyses across tree rings. We first test the reliability of the proxy using modern tree rings collected from far northeastern Siberia and compare these data to a local climate station. We then apply these methods to well-reserved mummified fossil wood collected from a nearby site, dated to the late Miocene. Previous work on these wood fossils using carbon isotopes revealed high interannual variability in precipitation patterns, which was attributed to an inconsistent moisture source related to the onset of intermittent sea ice cover during the late Miocene. Quantitative information on seasonal temperature, however, is lacking. We hypothesized a lower temperature seasonality at the site during the late Miocene due to higher CO_2 levels, and lower sea ice coverage. This is consistent with models that suggest lower temperature seasonality during the warmer climate state of the late Miocene. Our data represent the first quantitative estimates of summer and wintertime temperatures for the region during the late Miocene, and provide a basis for understanding present-day changes in temperature seasonality in Siberia in response to rising CO_2 and diminishing sea ice coverage.