Determination of past and present seasonal temperature in Arctic Siberia using high-resolution intra-ring oxygen isotope measurements across tree rings

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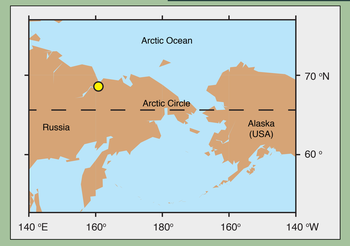
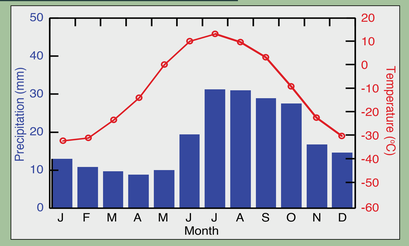
1. Background





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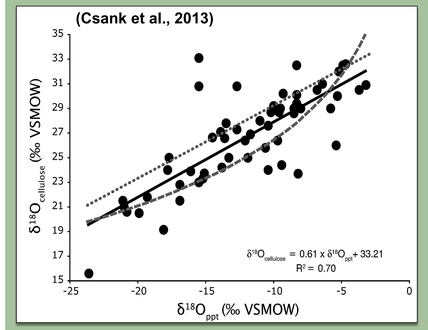
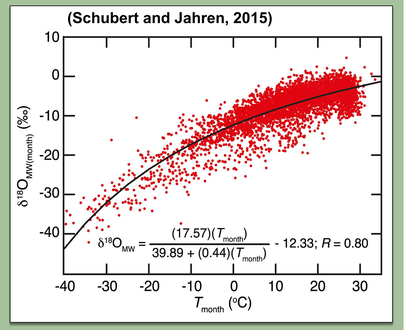
Siberia experiences temperature swings from summer to winter greater than any other location on the planet. Temperature seasonality is important for assessing changes to ecosystems and hydrology with warming temperatures.

2. Quantifying Temperature

Relationship between $\delta^{18}O$ value of cellulose ($\delta^{18}O_{cell}$) and $\delta^{18}O$ value of precipitation ($\delta^{18}O_{MW}$)

Effect of temperature on $\delta^{18}O_{MW}$

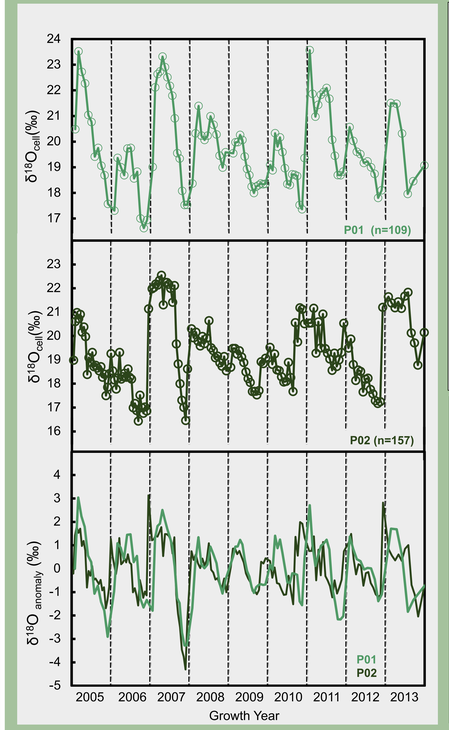




3. Model Verification

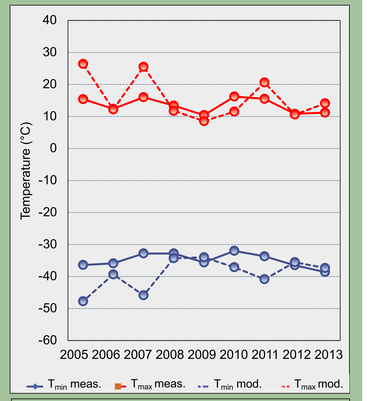
High-resolution intra-ring $\delta^{18}O_{cell}$ profiles

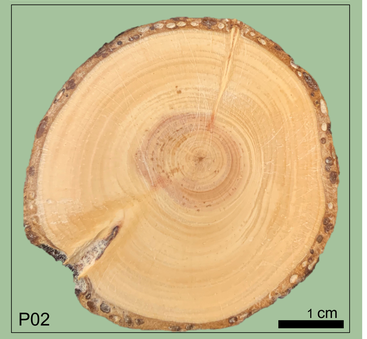
We determined a total of 266 oxygen isotope measurements on cellulose extracted from two *Pinus pumila* trees (PINE01 and PINE02) growing in Cherskiy, Russia.



Modern Temperature Quantification

We then used the change in the oxygen isotope value to quantify seasonal temperatures for the period 2005-2012.





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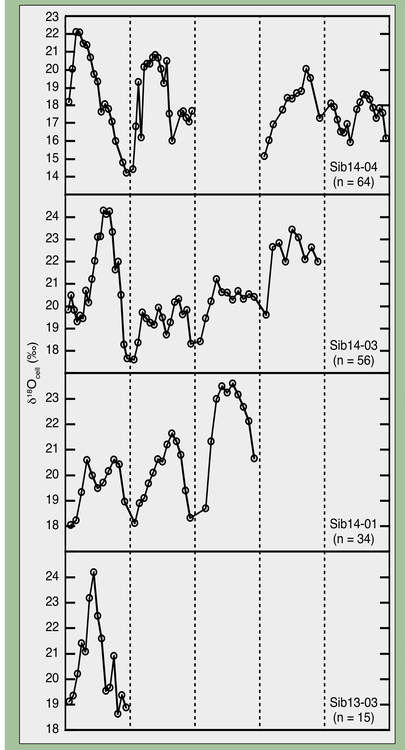
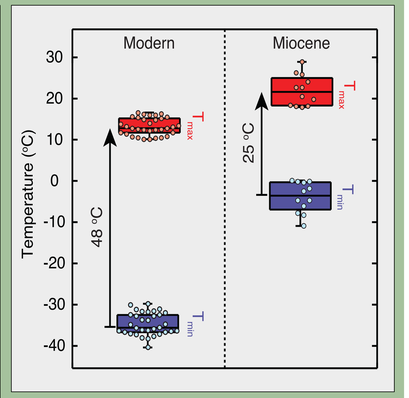
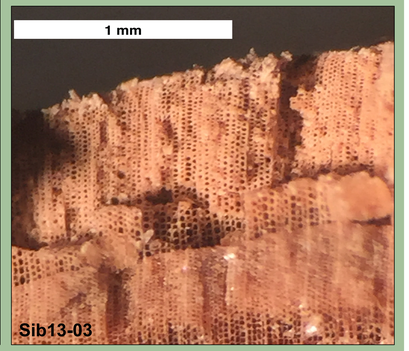
4. Fossil Application







Miocene Temperature Reconstruction

By applying the model to the oxygen isotope values of the fossil wood, we found that:

- There was a lower temperature seasonality during the Miocene (25 °C vs 48 °C)
- Temperature reconstructions for the Miocene resulted in winter temperatures much warmer than today. Miocene T_{min} (-4 °C) Modern T_{min} (-36 °C)
- Summer temperatures during the Miocene were warmer than the present day. Miocene T_{max} (21 °C) Modern T_{max} (12 °C)