

Assessment of Northeastern Japan Tree-Ring Oxygen Isotopes for Reconstructing Early Summer Hydroclimate and Spring Arctic Oscillation

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The spring Arctic Oscillation (AO) significantly affects the subsequent summer rainfall in the East Asian Summer Monsoon (EASM) region, and analysis of meteorological data indicates this teleconnection strength varied on interdecadal timescales during the late 20th century. Tree-ring records may be able to extend the relatively short observational record, but the extent to which these proxy reconstructions correspond to AO variability has yet to be explored in this region. Therefore, we present new tree-ring cellulose oxygen isotope ($\delta^{18}\text{O}$) records from northeastern Japan (Akita, northern limit of EASM), spanning AD 1950 to 2003 which overlaps with the instrumental record. Tree-ring $\delta^{18}\text{O}$ is used for reconstructing the past hydroclimate variability and allows us to consider whether tree-ring $\delta^{18}\text{O}$ has the potential to clarify the longer-term interdecadal changes in the spring AO-EASM relationship. Measurements and analyses show that our tree-ring $\delta^{18}\text{O}$ datasets have a significant negative correlation with May-June-July relative humidity, and the tree-ring $\delta^{18}\text{O}$ in northeastern Japan also significantly correlates with the summer EASM index. Temporal comparisons between our record and observed monthly AO index indicate that reconstructed following early summer relative humidity significantly correlates to the previous March-April-May AO. This linkage changes on interdecadal timescales, and the linkage is relatively strong during early 1970s through early 1990s. Similar results are also obtained using a separate tree-ring $\delta^{18}\text{O}$ record from a separate location about 200 km to the southeast, suggesting that tree-ring cellulose $\delta^{18}\text{O}$ in northeastern Japan is indeed useful for better understanding the long-term teleconnection between the spring AO and EASM.

Keywords: Tree-ring, Oxygen isotopes, Northeastern Japan, Arctic Oscillation, East Asian summer monsoon