MIDWESTERN CLIMATE RECORDS FROM TREE RING $\delta^{13}C$ AND $\delta^{18}O$ VALUES

Scott Lepley

Dr. Kenneth MacLeod, Dissertation Supervisor

ABSTRACT

Current climate change is the subject of intense scientific, public and political debate. These discussions center upon whether the rising global average temperatures are the result of natural climatic cycles or feedbacks from global anthropogenic input into the climate system. Notably, 13 of the 14 globally hottest years have been recorded since 1995. Unraveling detailed connections and, equally important, estimating potential economic and societal consequences of global warming or other climatic events require examining regional scale data. In particular, there is an urgent need to quantify recent climatic changes in regions where human activities are most vulnerable.

The Midwest of the United States is an agricultural center of the world, with an economy intimately tied to crop growth and, thus, climate. This region (unlike other North American regions) exhibits a strong continental seasonality and, as a result, has also experienced some of the most extreme events over the 20th century including the Dust Bowl Drought and the 1993 Flood. Unfortunately, high-resolution climate records prior to instrumental data are lacking in this region of the US. A potential archive of climate variability pre-instrumental records is long continuous tree ring chronologies. By utilizing tree ring stable carbon isotopes from white oak

in northern Missouri, we may be able to better constrain and understand climate dynamics of the central Midwest

This project is possible due to the existence of the American Long Oak Chronology (ALOC) project developed at the University of Missouri Tree Ring Laboratory. The ALOC record is the only northern hemisphere continuous millennial-scale (912-2004 AD) tree ring chronology within the American Great Plains. It is, thus, a unique archive that permits the direct construction of a $\delta^{13}C$ tree ring time series to investigate the climatic history of America's agricultural heartland.

The results can be summarized as follows: 1) by selecting specific samples from the American Long Oak Chronology that have growth patterns according to the average regional growth patterns, a more robust climatic signal can be obtained, 2) $\delta^{13}C$ and $\delta^{18}O$ values from tree rings seem to track climate variability (mainly precipitation) in the Midwest, 3) compared to the 20th century, predicted average summer precipitation from tree ring $\delta^{13}C$ values during the last five centuries suggests that greater magnitude and longer duration extreme events have occurred, and 4) using $\delta^{18}O$ from these oaks appears to be the best climatic proxy.

This research has wide ranging implications. This research was the first tree ring isotopic study to utilize a large continuous chronology to select samples based on growth patterns to improve the isotopic signal. Also, this was the first isotopically estimated precipitation record in the central US that extends before instrumental records, which allowed for a better examination of climate variability in an attempt to understand what the future may hold. In addition, the results from the study suggest that climatic disasters (such as drought and flooding) can occur on even larger scales and over longer time periods than the worst 20th century events, which may aid in disaster planning. Lastly, this study has laid the groundwork for continued research in this field and at this University.