Reconstruction of October-May Precipitation Variations Based on Tree Rings in Kermanshah City over the 1705-2010 Periods

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Extended Abstract

Introduction
Long-term high-resolution climate proxies are essential for understanding climate variability in the region, where few long-term climate records are available. Due to cyclic variations of climate, long term climatic data for understanding of its fluctuations is necessary. One of the major problems of climatic studies in Iran is unavailability of longer useful instrumental data. Trees added annually a ring to their past annual rings in moderate climate. Annual tree rings can provide important information on long-term climate fluctuations. Trees are widespread and silent witnesses of climatic changes during their long life span which record them in their growth ring width and structure. Since annual tree rings are usually distinguishable in woody species grown in cold and temperate ecosystems, they can be used to reconstruct the past climate of different regions with annual or seasonal resolution. This paper presents a reconstruction of October-May precipitation variations in Kermanshah province using Quercus Infectoria tree rings over the last 305 (1705-2010) years.

Methodology
In this study 20 cores from 10 Quercus Infectoria Olive were extracted at breast height with an increment borer in Faryadras site. The cores were mounted on sample holders and after air drying, the surface of a core was prepared with razor blades and the surface contrast was enhanced with chalk. Ring widths were measured with a LINTAB5 measuring system with a resolution of 0.01 mm and all cores were cross-dated by statistical tests (sign-test and t-test) using the software package TSAP-Win. The raw ring-width series were standardized to remove biological growth trends as well as other low-frequency variations due to stand dynamics with the ARSTAN program. The residual chronology (RC) was selected to calibrate the ring-width-climate relationships. Mean monthly precipitation from prior October to current May was
provided by Kermanshah meteorological station (1951-2010) near to our sampling site. Based on a linear regression model, we reconstructed October–May precipitation for the region over the last 300 (1705-2010) years.

Results and Discussion
All *Quercus Infectoria* trees have a similar growth trend in Faryadras site. Similar growth patterns among the trees indicate that they are influenced by common environmental forcing factors. The length of the residual chronology is 305 (1705 – 2010) years. In fact this is the longest chronology for the west of Iran so far. Tree-ring widths positively respond to each month's precipitation from previous October to current May. Positive correlation between the residual chronology and previous October- March precipitation shows that monthly precipitation in this period has an important role for growing of tree rings in the next year. Correlation analysis between chronology and previous October to current May precipitation shows that the highest correlation is given to prior March and current May precipitation ($p < 0.001$). In addition, ring widths are significantly related to the total precipitation of October-May ($p < 0.001$). El Nino events have positive effect on tree-ring widths and La Nina events have negative effect on tree-ring widths. The results show that severe wet years coincided with historical El Niño events. Our reconstruction showed that last decade of 18th century and second decade of 19th century are the wettest and driest decades respectively. Wet periods occurred in 1710s, 1740s- 1890s, 1820s, 1850s, 1890s, 1930s, 1950s, 1970s and 1980s. Dry decades occurred in 1720s, 1730s, 1810s, 1830s, 1840s, 1860s-1880s, 1900s-1920s, 1940s, 1960s, 1990s and 2000s.

Conclusion
We extracted 20 cores from 10 *Quercus Infectoria* trees in Faryadras site, Kermanshah. Precipitation is the major factor affecting the radial growth of *Quercus Infectoria* trees in the site. After investigation of correlation coefficients between the residual chronology and climatic data from Kermanshah meteorological station during the period 1951-2010, a linear model was used to reconstruct October-May precipitation. The results show that precipitation from prior October to current May has positive effect on tree ring widths. Severe wet years coincided with historical El Niño events and many of sever dry years controls by La Nina events. The results indicate that there is a great potential to extend the tree-ring series in length in the study area, which could provide high resolution paleoclimatic records that span the last several centuries.

*Keywords:* Dendroclimatology, Chronology, October-May Precipitation, Tree-rings, Quercus Infectoria.