

Relationships of tree rings cellulose oxygen isotope ratio with Pacific climate factors in southwestern japan

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Tree ring cellulose isotope ratios are a useful proxy for paleoclimate studies as well as stalagmite, coral, and ice cores. In particular, oxygen isotope ratios in tree rings have been found to strongly correlate with relative humidity.

In recent years, there has been an increasing interest in examining with the relationship local climate factors, but also with the synoptic interaction the atmosphere-ocean. The atmosphere-ocean interaction includes ENSO (El Nino-Southern Oscillation), PDO (Pacific Decadal Oscillation), and NPGO (North Pacific Gyre Oscillation). It is clear that these fluctuations are not independent of each other, but affect each other.

In this study, we measure cellulose oxygen isotope ratio of annual tree ring and compare them with climatic factors to investigate the link between oceanic change and climate. One of the features of this study is that we can examine seasonal events by dividing the annual rings.

We collected disk samples from three Ryukyu pine (*pinus luchuensis*) trees (namely, "Sennen", "Santera", "Untera") in Amami Island (28°22' N 129°29' E). The disk samples were cut into transverse thin plates with a thickness of 2 mm using a diamond wheel saw to extract cellulose. The prepared cellulose specimen was divided into 12 segments for each ring along the growth direction using a binocular stereomicroscope and an ophthalmic knife. We used an online system of a pyrolysis elemental analyzer and an isotope ratio mass spectrometer (TCEA-Delta V Advantage) installed at the Graduate School of Environmental Studies, Nagoya University for isotope measurement.

Oxygen isotope ratio measurement data from 1788 to 2014, when the annual rings were divided into annual 2-24 subsamples, are shown in Fig1.

By comparing with the SST data around Amami Island, a positive correlation ($r = 0.36$, $N = 45$) between tree-ring oxygen isotope and the mean summer SST was obtained. This may be due to the fact that higher (lower) SST than normal causes an increase (decrease) in water vapor supply and an increase (decrease) in humidity compared to normal.

Using NPGO data on atmosphere-ocean interaction factors and comparing them with oxygen isotope ratios, a positive correlation ($r=0.58$, $N=21$) was obtained between NPGO and oxygen isotope ratios (lag+4 years) for early stage of tree-ring formation.

It is thought that the Kuroshio Current and atmospheric pressure will propagate the changes and affect the summer climate around the Amami Islands, but the exact mechanism needs to be studied.

Keywords: tree-rings, oxgen isotope ratio, atmosphere-ocean interaction, South-West Islands in japan, Ryukyu pines

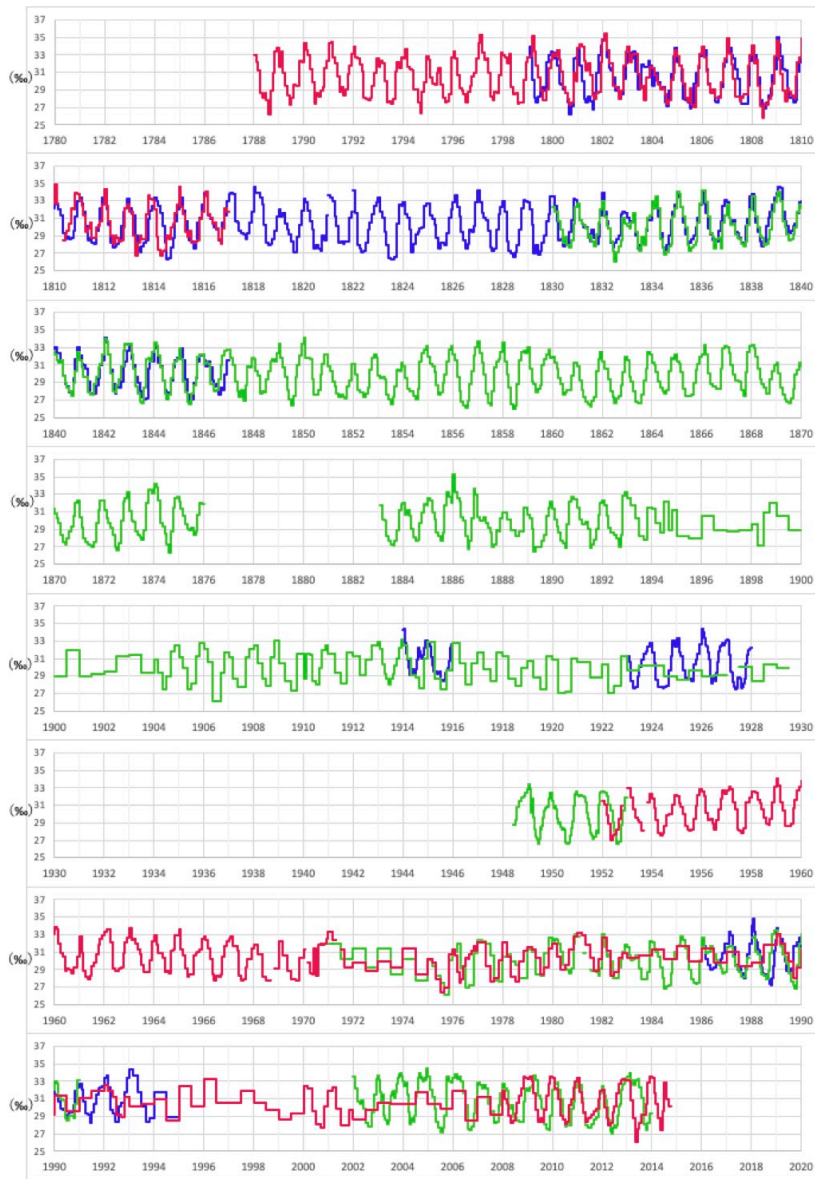


Fig1. Oxygen isotope ratio measurement data

Vertical axis: oxygen isotope ratio (‰), horizontal axis: year (AD)

Senna(Red), Santera(Blue), Untera(Green)