Basic Study of Paleoclimate Reconstruction Using Width of Teak Annual Rings in Java, Indonesia

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Tree ring has been regarded as one of the useful paleoclimate record media and measuring tree-ring width, among several proxies such as $\delta^{18}O$ and $\delta^{13}C$, is one of the approaches to reconstruct and interpret the history of precipitation at high and mid latitude. At low latitude, teak has been widely used for paleoclimate reconstruction because teak is the one of few trees that can make tree rings. The tree ring of teak is, however, not growing in a concentric fashion and the width on the disk might have bias from place to place. Although some previous researches (e.g., D'Arrigo et al., 1994; Schollaen et al., 2013) showed positive relationship between teak's tree-ring width and precipitation at Indonesia, the measuring methods of these researches do not take the bias of tree-ring width into account.
Here, we developed new measuring methods to improve the issues above and to reconsider if teak's tree-ring width can reconstruct paleoclimate such as precipitation. Two different measuring approaches were developed: "method of approximation as circle or sector (method 1)" and "method of approximation as trapezium (method 2)". Four teak samples were used: one of them is from Dungus area and the others are from Cepu, Indonesia.
As a consequence, method 1 was larger than method 2, and this might be because the boundaries of tree rings have curved and the length of boundaries were long. With method 1 and method 2, we developed tree-ring index as D'Arrigo et al. (1994) and Schollaen et al. (2013) have done and the tree ring index was made by two ways: three-year and five-year running average. The result showed that both method 1 and method 2 showed the mostly the same in all the samples by each running average, indicating that both method 1 and method 2 can be applied as the tree-ring index. Besides, $\delta^{18}O$ of all samples also showed mostly the same values between individual samples, showing the possibility that not only tree-ring width but also $\delta^{18}O$ can be used for determining the date of tree-ring.
Moreover, the tree-ring index showed the following correlation with the following climate factors; positive correlation between two samples and precipitation in early rainfall season, which is consistent with Schollaen et al. (2013); positive correlation between all four samples and dry season Southern Oscillation Index (SOI) and between three samples and rain season SOI, which is consistent with Murphy and Whetton (1989); negative correlation between three samples and one-year average (August to July) SOI; and negative correlation between two samples and dry season DMI.
As describe above, teak seems to be useful for paleoclimate reconstruction. It is necessary to be further verified by additional data from other teak samples in other area.

Keywords: tree ring, tree-ring width, dendroclimatology, dendrochronology

