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Interactive comment on "High resolution ^{14}C bomb-peak dating and climate response analyses of subseasonal stable isotope signals in wood of the African baobab – A case study from Oman" *by* Franziska Slotta et al.

Supriyo Chakraborty (Referee)

supriyo@tropmet.res.in

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Radiocarbon analysis of the annual rings of trees has been carried out by several investigators to study a variety of natural processes. Such kinds of records, especially in the extra-tropical region of the northern hemisphere are widely available. The tropical region, however, is not well represented. To fill this gap Slotta et al. attempted to reconstruct atmospheric 14C records from southern Oman based on the radiocarbon analysis of tree rings. The atmospheric radiocarbon activity showed anomalous enrichment during the early to mid-1960s, which is well documented in various atmospheric

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measurements as well as observed in several tree ring-based proxy records. The authors have made a high-frequency sampling of a baobab tree during the bomb peak interval in order to study the nature of the 14C variability and the underlying mechanism that caused the observed variability. One of the main observations of their analysis is that the 14C variability in this region is characterized by a significantly low value (ca 9%) compared to the expected value across the similar latitudinal belt. The authors opine that the internal cause, such as plant physiological processes are primarily responsible for this depletion. Apparently, they ignore the external factors, such as the fossil fuel dilution of atmospheric 14C variability, which may also produce such kind of anomalous signal. I would suggest the authors discuss this aspect as well to systematically rule out this possibility before coming to a definitive conclusion. My concerns are given below.

Section 4.1 The authors observed 14C activity in their tree ring that was noticeably lower than the NH3 and SH3 around the bomb peak (1964-1967). The authors explain that the anomalously low values were driven by plant physiological activities, the carbohydrate turn over time. But this hypothesis suffers from some limitations because such kind of low tree ring 14C activities has been reported by some investigators in the Asian region without invoking the tree physiological process. For example, Kikata et al. observed a bomb peak around D14C = 692‰ in Vietnam. Hua et al. (2000) found 694‰ in northern Thailand. Chakraborty et al. (1994) found 630‰ in an urban area in west India. Murphy et al. observed a slightly higher value of 705‰ in central India, which was also supported by Chakraborty et al (2008)'s observation of 708‰ in another site in central India.

Some of these authors have attributed the lower value of atmospheric 14C activity in a specific region in terms of fossil fuel dilution. For example, Chakraborty et al. (1994) analyzed a teak sample from a western Indian urban area and found a somewhat low value of 630‰ but the same species of another teak sample obtained from a central Indian but forested environment showed a bomb peak of 708%. The lowering

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of bomb peak (approx. 11%) in the urban area was attributed to fossil fuel dilution of atmospheric 14C. Chakraborty et al. (2008) did not invoke the idea of tree physiological process in this case, though the possibility, in principle, may not be ruled out. But, the occurrence of two different 14C values in the same tree species at two different places seem to be driven by an external factor(s) rather than the tree physiological processes.

There may be other reasons to doubt the tree physiological process affecting the tree ring 14C activity. The mechanism explained by the authors involves the incorporation of previous year's carbon that significantly affects the average age of the current year wood. If that be the case, then a similar effect should have been observed by other investigators. Hua et al. (2003) analyzed a Pinus Radiata tree sample collected at Armidale in New South Wells, Australia and found excellent agreement with the atmospheric observation for the period of 1952 to 1967. But these authors observed higher 14C values in their Armidale tree ring samples for the period of 1968-1975. Obviously, an increase in radiocarbon activity cannot be explained by tree physiological processes. So either an increase or a decrease in 14C activity is likely to be driven by external factors.

Using a numerical exercise and auto-correlation analysis of d13C data Slotta et al. estimate that approx 85% of fast cycling carbon pools and 15% of slow-cycling carbon pools are contributing to the lower values of the bomb peak. If this explanation is true, then this effect should have been manifested in the entire record the authors have reported, which is not apparent from their results. Rather, the authors admit that the baobab F14C values for 1945, 1952-1954, 1956 and 1957 are indeed higher than the calculated range. This observation casts doubt in their explanation of the old carbon turn over mechanism in explaining the negative excursion of 14C activity during the bomb peak period. There may be another explanation of lower 14C activity in this region. Cember (1989) analyzed coral 14C from across the Red Sea to estimate the gas exchange rate. Cember observed a very high air-sea exchange process over the Red Sea region. If this process is also operative in this region which is not very far from

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the Red Sea, then a viable explanation of anomalous 14C activity in the atmosphere may be provided.

2.4 Radiocarbon dating The analytical description provided by the authors is not up to the mark. For example, radiocarbon dating requires 13C correction and age correction; there is no mention of whether such kind of corrections has been done. The reporting of 14C activity, especially in the case of sequential samples (tree ring, corals) is typically done in cap delta notation (D14C), but the authors have preferred normalized activity. For comparison purposes with the published records, the authors are suggested to report the 14C activity in cap delta notation. Finally, the error in 14C measurement should be mentioned in terms of cap delta as well as the corresponding temporal value.

Minor issues: Line 92: The rainfall amount and its isotopes usually show a weak inverse correlation. Pls, provide reference for evidence of “strong” correlation.

Line 141: very heavy rainfall in a single day producing high negative d18O “due to amount effect” is not technically right. Many studies (Lawrence and Gedzelman, 1996; Gedzelman et al., 2003; Lawrence et al. 1998; Chakraborty et al., 2016; Xu et al., 2019), showed that extreme precipitation events such as cyclonic activities produced very low values of precipitation d18O.

Line 181: pls provide a zoomed figure for the 1962-63 record of bomb 14C.

Line 199: What are the reference materials used?

Line 202: Please provide the permil sign after 0.15 and 0.25.

Line 217: ‘weakening’ should be “weaken”.

Line 251-252: How the interpretation of the F14C data was confirmed by visual and statistical comparison of the TRW chronology with precipitation data should be explained in detail.

Line 255: ’shallow’ should be replaced by "gentle".

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Line 268: ’radiocarbon’ should be followed by "analysis".

Line 275: ‘considerably declining’ meaning is not clear.

Line 280: What is the physical basis of getting a strong correlation between d18O and RWI? Also mentioned in Line 334. Please provide the value of correlation and state the sample number.

Line 309: the lag between cyclonic events and the corresponding d18Omin should be provided on a monthly time scale.

Line 355: ’extend’ should be replaced by "extent".

Line 494: "evaporative enrichment in 18O...".Please provide supportive evidence of enhanced soil evaporation, say by means of observed or reanalysis data in support of this speculation.

Line 505: "Vapor pressure deficit ...18O enrichment in leaf water", and "lower stomatal conductance...13C discrimination to decline" require supporting literature.

Line 514: the authors argue that the decline in d18O...might be due to the previous year’s October precipitation. If so, then d18O is also expected to be auto-correlated.

Line 524: likely in ’would have likely..." should be deleted.

References:

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Lawrence, J. L. & Gedzelman, S. D. Low stable isotope ratios of tropical cyclone rains. Geophys. Res. Lett. 23, 527–530 (1996). Gedzelman, S., Lawrence, J., Gamache, J., Black, M., Hindman, E., Black, R., Dunion, J., Willoughby, H., Zhang, X., 2003. Probing hurricanes with stable isotopes of rain and water vapor. Mon. Weather. Rev. 131 (6), 1112–1127.

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