

## ***Interactive comment on “Modern calibration of *Poa flabellata* (Tussac grass) as a new paleoclimate proxy in the South Atlantic” by Dulcinea V. Groff et al.***

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I believe this is an interesting piece of work, as indeed more reliable paleoclimatic proxies for the southern Atlantic are needed, to increase our understanding of past climate patterns. The author also collected a nice dataset. I do agree that *Poa flabellata* peat has promising potential to be the base of a good proxy, as it has a high accumulation rate in the peat, and is mainly present as the unique plant species. I do however not agree that the real proof of the power of the recorded isotopic signal as paleoclimate proxy has really been given in this manuscript. I have a couple of major concerns on the data treatment and interpretation and a large number of minor remarks. First, the

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observed correlation of  $^{13}\text{C}$  and  $^{18}\text{O}$  of the leaf cellulose with RH and T is used as an indication of the power of the proxy for paleo climatic studies. The leaf samples were young leaves growing during the sampled year. The leaves start to grow vertically in the summer and get broader during the winter. The summer samples are thus systematically younger samples than the winter samples. It can not be excluded that the observed difference in  $^{18}\text{O}$  and  $^{13}\text{C}$  is related to the change in leaf phenology rather than a climatic response. As the entire leaves are collected in winter, the recorded isotopic signal is a combination of the entire growing season. Further, it is important to note that this seasonal resolution will not be recorded in the peat record, as only mature leaves will contribute to the litter. A much better way of assessing the potential of the proxy for paleoclimatic reconstructions would of course be to sample a peat core, and correlate  $^{13}\text{C}$  and  $^{18}\text{O}$  signals of the core to recorded climate data. Therefore, it is needed to better frame the study, and rather use it as a background study on the physiological response of the Tussac grass and incorporation of atmospheric isotopic signal in the cellulose and only put it forward as a very first step toward the development of a paleo climatic proxy. Further comments: It is not always clear what is tested when statistical tests are performed. An example of this, is when the RH and T of the different locations are compared. It seems to me that the yearly average T and RH are compared using the individual days as replicates (i.e. SD computed on variation between days). This seems wrong to me as the variation in T and RH between individual days has no link with the uncertainty on the average T and RH of that location. To compare the RH and T of the measuring period for these locations only the measurement uncertainty (which is typically very small). Further to be able to say something on the difference in yearly average RH and T between sites in general, several years of observations are needed. The same problem occur when  $^{18}\text{O}$  and  $2\text{H}$  in precipitation between seasons is compared, the monthly variability is not related to the uncertainty of the mean. On top of this, it is not so meaningful to compare the numerical average when comparing seasons, i.e. the weighted average should be used. Again only the measurement uncertainty is relevant when comparing the seasons. Using the weighed

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averages the average of the locations could be used to compare the different seasons, however, to me it doesn't seem right to use these different locations as replicates. (as a final note on these seasons start and end the 21st of a month, while samples were taken per month, this should also be acknowledged.) When looking at the correlation of the  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  in leaf cellulose with RH and T, it is observed that they correlate with both. Beside the issue discussed above it is also important to note that RH and T are also strongly correlated (i.e. Drier (77 -85 %)/hotter (9-11°C) summers and wetter (90-98%)/colder (1-5.5°C) winters). For which, from the data it can not be concluded if the effect is a result of the RH or T or both. It would be interesting to give some insight on what effect might be prevailing here.

Smaller remarks: L75: it sounds quite contradictory to expect low WUE in water-limited environments. L80: It is a rather strange thing to say that  $\delta^{18}\text{O}$  of source water often correlate with temperature. Better to say (and this is also how it is described in the given reference) that the  $\delta^{18}\text{O}$  of precipitation correlates with temperature. (sure in the case of tussocks, source water is directly related to precipitation, but this cannot be claimed in general). L128: It is not clear what 'frozen for eight days' exactly means, what happened after these 8 days? In fact the entire section is not very clear, what is the point of freezing them for 8 days if some were already stored at RT for 6 months? Please rewrite and clarify. L144 and L150: When secondary reference material are used, the accepted value used for it should be given (this does sometimes change over time). L203: Paragraph is too long, too many irrelevant details are given for which the major lines get lost. I believe this paragraph should be shortened by c.a. 50% L204: Why is this correlation analysis done on averaged values? It should be done using the individual data points.

L13: replace 'investigate' by 'measured', delete 'plants' L14: I believe the author mean: '... explore relationships with seasonal temperature and air humidity variations across 4...' L16: Delete 'significantly' (if not you would not report it) L23: 'did not differ significantly' (there is no test to claim that 2 things do not differ, you can only claim

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that you could not see a significant difference. L32: '...resulted in an intensification and poleward...' L35: Sentence starting with 'The inconsistency of...' Is not totally clear, reformulate. L47: Should it not be '...generate substantial amounts of peat...'? L57: I believe it could be cited as. 'Smith and Prince (1985) established radiocarbon...' L62: '...of any peatland, globally, P. ....' L67: '...in this semi-arid habitat...' L69: a) I guess it is 'up to 39 cm' or 'c.a. 39 cm' b) '...year) while in winter an increase...' L70: '...tiller at the base of...' L70: Sentence starting with 'The climate signal...' Is not clear, please reformulate. L73: 'physiological responses such as changes in stomatal conductance and...' L77: '...information on...' L78: '...tissue was formed...' L79: '...humidity and plant physiology (...)' L80: '...often correlate...' L81: '...cellulose can also...' L82: '...plant water pools.' L86: rather use '‰' L97: If mean temperature is given, the time span of this mean should be given, same for L109: Why is the fact that they were first shipped to University of Maine mentioned? I don't think the reader is interested in the postal route... L113: It is '...were purified...' or 'Water was extracted out of precipitation sample...' L119: '...relative to VSMOW' No need to mention they are reported in ‰ (this is visible in the results, and can lead to inconsistency). L130: '...were used, fine roots...' L133: Just out of personal curiosity, did the grinding of leaf material using a ball mill work? my experience is that this does not work very well with fibrous material. L137: a) What is an undetectable amount? Should give a detection limit here, if not it is meaningless. b) it is nitrogen and carbon content, not ‰nitrogen and ‰carbon L140: 'varied by < 0.1 ‰ and 0.3 ‰ respectively' L143: '...relative to VSMOW (...)' L146 and 151: replace ranges by 'c.a. 0.25 mg' and 'c.a. 2 mg' L148: Delete '; units are expressed. ....mil)' L150: Reformulate last sentence L153: what is meant with 'analysing the average'? I think the author means that for every site 3 to 4 leaves were used as replicates in every month. L184: what is the 'n = 344', summer only counts 90 days... L189: Simply say that September 2015 sample was missing for surf bay (we all know that a year has 12 months). Was that sample missing or was it not sampled, meaning that October 2015 is in fact September + October? L192: '... $\delta\text{D}$  values (...)', 'monthly composite' is redundant with the first part of the

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sentence. L204: '...leaf  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$  values...' L206: add p value after segregation between winter and summer values. L206: How could measurement have a significant correlation? I believe the author meant to write that the  $\delta^{18}\text{O}$  value of precipitation did not correlate significantly. Further it would be more logical to write that  $\delta^{18}\text{O}$  of leaf and root did not correlate with  $\delta^{18}\text{O}$  of precipitation rather than the other way around (statistically it is the same thing, though it is not logical). L212: ' $28.9 \pm 1.3\%$  idem at L214 etc. ... (change everywhere) L213: I do not find it meaning full to add the range, as the distribution was normal, giving average  $\pm$  SD is enough (and really no reason to add also the range). L222: interaction is not an effect, what the author wanted to say is that 'no significant interaction could be observed'. L237: Not clear if this is an own observation (nothing is mentioned about VPD in the result section) or something from literature. L241: '...ratio of  $\text{CO}_2$  partial pressure in the leaf and that of the ambient air...' L241: what can be explained, the difference in partial pressure ratio or the effect of it on the  $^{13}\text{C}$ ? L257: what are 'cellulose isotopes'? L317: Quite strange to say 'at least 12,500  $^{14}\text{C}$  years, while on line 64 it says that peatlands initiated between  $\sim$  12,500 and 5,500  $^{14}\text{C}$  years.... Figure 3b: Why is not the individual data presented, rather than averages? Table S1: if the it is given that longitude is south, the negative sign should not be used (sensu stricto a negative south latitude is a northern latitude). So remove the '(S)' or the '-' idem for long (W). Figure S3: Link did not work, until I found that the '-' was not for a split for a line break (like my browser interpreted it when clicking on it), but a real hyphen. Probably better to use 'https://climatereanalyzer.org/' Figure S5: Add your data to this graph.

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