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Climate of the Past Discussions

Interactive comment on "South Atlantic island record reveals a South Atlantic response tothe 8.2 kyr event" *by* K. Ljung et al.

K. Ljung et al.

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Response to RC S447 : 'Comments on SAtlantic response...' , Anonymous Referee 2

General comments : This paper presents interesting new results of multiproxy analyses from a continental sediment core located on the South Atlantic Ocean, in the Tristan da Cunha islands. These data are interpreted in terms of paleoclimatic changes and compared with the results of coupled intermediate complexity model experiments. The aim of the authors is to demonstrate the widely distribution of the effect of the so-called 8,2 kyr event and to analyse the climatic mechanisms in the South Atlantic. The paper is interesting but lacks of precisions for several aspects and needs to be more precisely focused in the general discussion.

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Discussion Paper

Technical comments : - chronology of the core. The 14C measurements show several age reversals, and more strangely, the three data points dated both with bulk sediment and terrestrial macrofossils show systematically a bulk sediment older than the terrestrial macrorests. Even if the difference between the two ages is within the error bar, can the bulk sediment ages be contaminted with 8220; dead 8221; carbon which would explain this systematicity?

Bulk samples often yield older ages than terrestrial macrofossils because of incorporation of 8220;dead8221; or old carbon from various sources. Nightingale Island is not volcanically active and there is no carbonate bedrock present, thus incorporation of dead carbon is unlikely. The most probable cause for the older ages is reworking of older organic matter.

The cal ages are provided in table 1 with one digit which is not significant (7074,5 years : 7074 or even 7070 is well enough). The data should be presented in a more simple way.

This has been corrected

When reporting the depth interval of the silty gyttja identified as the 8,2 kyr event on a depth-age graph, the duration of the event is from 8050 to 8450 calendar years, with an age plateau during the interval. The duration is not 250 years as stated in the text (p740- line 23). Moreover, the duration of 250 years is not very different of the GRIP duration of 160-180 years, within error bars. What can be the cause of the age plateau recorded during the 8050-8450 year interval ? Is this a big increase in the sedimentation rate or a level of sediment deposited by a catastrophic surge (that can be linked to an increase of precipitation) ? I would favour the increase in the sedimentation rate because of the decrease of the C and N contents seen in figure 3. Indeed, this decrease is not what is expected from the increase of the tree taxa (that will favour the increase of C content).

Yes, there is probably an increase in sedimentation rate at around 8200 cal yrs BP. The

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radiocarbon dates imply this and the higher minerogenic and terrestrial organic matter content was probably caused by increased erosion and deposition. The increase of tree pollen might at first seem to contradict increased erosion, since more extensive tree cover in the catchment would limit erosion. However, in this case the increase of tree pollen in the sediment was probably not caused by more extensive tree cover but by increased pollen deposition as a result of increased catchment erosion and surface run-off. This is a pattern that has been recorded at other localities on Tristan da Cunha, and it also explains why tree pollen increase together with pollen types which are normally associated with open ground, such as Empetrum rubrum and Rumex sp.

- the explanation p739 lines 11 to 22 is not clear. What can be the causes of TS changes, except sea salt aerosols ? I would expect that, in a continental environment, the changes in organic matter content will have an impact on TS content and I am not convinced by the explanation given to show that the lower TS is linked to lower (or at least not increased) sea salt input to the area. If the silty gyttja interval is linked to a sediment surge as suggested by the 14C dates, the dilution will decrease the C, S and N contents without any other significations.

The dilution effect of the increased sedimentation rate and lower organic content can only partly explain the decrease of TS. The relative decrease of TS is larger than that of TC, as shown by the higher TC/TS ratios. This difference in relative decreases can be explained by lower deposition of sulphur, which is mainly deposited by sea salt aerosols.

- in figure 3, the S content records a big variation around 9100 years, while the C does not show any change and the C/S is also flat. What can be the explanation is such record

This is only one sample, which has yielded a zero reading for TS. Since the sample has a high content of organic matter there should be sulphur present and the sample is considered as a faulty measurement. This sample was erroneously included in the

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figure and since it is a measurement error it has been removed from the figure.

- p741, the authors describe extensively the other anomalies of their record and particularly the one at 7500-7300 years. In the 13C record of Oppo et al, 2003 (proxy of the deep water ventilation), this time period does not show any particular anomaly. Moreover, in the paper of Hall et al, the 7500-7300 time interval seems to be marked by a faster deep water mass (as seen by the sortable silt index). This last part of the paper is really not convincing and should be clarified and rewritten.

Our precipitation increase at 7500-7300 cal. yrs BP is correlated with one of the strongest Bond events (Bond, et al. 2001). It has been hypothesised that the Bond events were triggering weaker meridional overturning circulation. Contrary to this, the sortable silt curve of Hall et al. (2004) indicates stronger overturning circulation during many of the Bond events. We think it is difficult to explain why strong overturning circulation in the Atlantic would be accompanied by cool surface conditions and abundnat ice rafting in the North Atlantic. Our data support the hypothesis of weaker overturning circulation during the Bond event at 7500-7300 cal. yrs BP, but not with stronger overturning circulation as indicated by Hall et al. (2004). We therefore argue that this was indeed a period of weaker overturning circulation, increased SST in the South Atlantic and increased precipitation on Nightingale Island.

- what is the variability of the model during the 550 years of the experiment before the fresh water forcing ? It is difficult to see if the 0,3C increase after the fw pulse is significantly different of the variability of the Early Holocene experiment.

The standard deviation of the annual surface temperature for the first 100 years (i.e. before the perturbation, see Fig. 6) is 0.17°C. Note that Figure 6 shows the 30-year running mean, so the curves are somewhat smoothed to show clearly the signal. As a consequence of this relatively small inter-annual variability, the warming of 0.3°C after the perturbation is statistically significant at the 99

Technical correction: - one typo in the Alley et al reference in Geology (1997 and not

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This has been corrected

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