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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 8216;RC S377 : 'Reach of 8.2 k event' , Anonymous Referee 18217;

The study presents a highly valuable investigation to improve our understanding of induced climate changes by using proxy data series together with climate model simulations. The authors present a detailed analysis of a lake sediment core in the central South Atlantic spanning the entire Holocene. The focus is on the early Holocene and, in particular, on a climate anomaly in the time interval between 8275 and 8025 cal. yrs BP, which coincides with the 8.2 ka cold event. The 8.2 ka cold event is most pronounced in Greenland ice core records and the connection with distant climate anomalies is subject of still many investigations and is subject here. The present study uses the ECBilt-CLIO model which was forced in accord with a likely driver of the 8.2 ka event, i.e., by an abrupt meltwater pulse released from Lake Agassiz, which involves a

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reduction in meridional overturning circulation in the North Atlantic. However, the conclusions drawn on a potential physical relationship between the 8.2 ky cold event and the observed climate anomaly in the South Atlantic appear not to be fully convincing as discussed below.

Specific conclusions The multi-proxy record of the South Atlantic lake sediment is carefully and convincingly analysed and leads to the conclusion that during the time interval of the 8.2 ka cold event more precipitation occurred in the South Atlantic together with higher temperatures. The ECBilt-CLIO simulations also show a positive anomaly in precipitation and temperature in the southern Atlantic which is suggested to be an indication of the so-called bipolar seesaw.

The existence of a bipolar seesaw is widely discussed in literature but the processes involved and their temporal behaviors are still not conclusive as pointed out by the different papers listed by the authors. To obtain a better insight into the mechanisms related to the so-called bipolar seesaw the 8.2 ka event seems to represents a sub-optimal case study. This is because the 8.2 ka event has a relative short duration in comparison with the time scale of the interhemispheric Atlantic ocean circulation and a very high dating precision is required to resolve leads and lacks. Also as mentioned by the authors, a more extreme freshwater forcing experiment (1 Sverdrup over 100 years in Stouffer at al., 2006) leads to a modestly increased precipitation in the South Atlantic between 35-40 S.

It is true that the short duration of the 8.2 ka event makes it difficult to resolve and confidently correlate with other paleoclimate records. However, in our record the 8.2 ka event is well resolved and very well dated, and in our opinion there can be no doubt that the observed anomaly coincides with the 8.2 ka event in the North Atlantic region. The 8.2 ka event is unique in that the forcing of the event is known, even though the exact magnitude, i.e. the amount of water released to the North Atlantic, is less confidently known. This allows for precise modelling of the event, which can be tested against real paleoclimate data. In that respect the 8.2 ka event rather presents an optimal case for this study.

It is difficult to imagine that the climate anomaly derived from lake sediment data in the South Atlantic can happen with no time delay as displayed in Fig. 3.

Our climate model clearly shows that the South Atlantic reacts immediately to the freshwater release in the North Atlantic. In the model sea surface temperature and precipitation in the South Atlantic start to increase immediately after the freshwater release to the North Atlantic and there is no reason to assume that there would be a significant time lag between the sea surface warming and precipitation, and our proxy records.

A further difficulty to identify the effect of the 8.2 a cold event in the Southern hemisphere is evident from Fig. 3 where the EPICA deuterium curve shows a progressive cooling from the beginning of the Holocene until about 8100 cal. yrs BP.

It is true that the EPICA deuterium curve shows variation and progressive cooling until around 8100 cal. yrs BP. However, most of the cooling took place before the 8.2 ka event and it is unlikely that it caused the precipitation increase at 8200 cal. yrs BP. The progressive cooling did however cause a general increase in precipitation around 9000-8600 cal. yrs BP, which is seen in the record as the transition from peat to gyttja.

Another point of concern is the presentation of the simulated temperature and precipitation changes in the Southeast Atlantic enclosing the measurement site. It is hard to understand why the temperature and precipitation start already to grow before the freshwater pulse is released to the North Atlantic (Fig 6). This needs further clarification.

The apparent temperature increase before the freshwater pulse is due to the natural variability in the model and is merely coincidental.

It could be helpful, to further analyse the model output by comparing the simulated temperature anomalies in the North Atlantic with temperature and precipitation anomalies in the South Atlantic to describe space-time relationships between a climate anomaly *in the North Atlantic and a climate anomaly in the South Atlantic.*

Yes, this is certainly an interesting idea. However, this has already been done by Wiersma et al. (Wiersma, A.P., D.M. Roche, H. Renssen, 8220;Fingerprinting the 8.2 ka BP event climate response in a coupled climate model8221;, manuscript under review for The Holocene) and is outside the scope of this paper.

In summary, the analysis presents new information of climate changes, mainly precipitation changes, in the central South Atlantic at 37 S over the Holocene. The attempt to link the measured climate anomalies around 8.2 ky BP to the 8.2 ka cold event recorded in Greenland is not fully convincing. This also follows from the many abrupt changes in the magnetic susceptibility occurring over the Holocene (Fig. 2) for which the importance of an asymmetric North/South relation is questionable.

The Atlantic meridional overturning circulation has been variable throughout the Holocene as can be seen for example in marine cores from the North Atlantic (e.g. Oppo et al. 2003). The observed anomalies on Nightingale Island can therefore be part of a recurring pattern of South Atlantic surface water warming throughout the Holocene. In fact many of the observed precipitation events correlate with cool conditions and weaker circulation in the North Atlantic.

Interactive comment on Clim. Past Discuss., 3, 729, 2007.