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Climate of the Past Discussions

Interactive comment on "The origin of the 1500-year climate cycles in Holocene North-Atlantic records" *by* M. Debret et al.

Anonymous Referee #1

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Review of "The origin of the 1500-year climate cycles in Holocene North-Atlantic records" by Debret et al.

Debret et al. investigate the millennial-scale (2500,1500,1000 yr) cycles in solar output and in climate records from the North-Atlantic region. They study non-stationary cycles with the wavelet method. By comparing presence or non-presence of cycles in records from key locations they conclude that circum-Atlantic records cannot be explained by solar forcing but require changes in ocean circulation (in the 1500yr band?).

General comments:

I think that Debret et al. show an interesting analysis which could eventually be published in Climate of the Past. However, I do not think that Debret et al. make an entirely

convincing case. Even if Debret et al. claim to do "a thorough study" they miss important aspects of the paper by Bond et al. (2001). Two examples: Bond et al. do not claim that there is a clear 1500-yr cycle in the Holocene IRD record and Debret et al. use a different (worse) record to check for the solar influence than Bond et al. (2001).

Specific comments:

I have a crucial question after reading this paper. How should we interpret the agreement between IRD and cosmogenic radionuclide records shown in figure 3 in Bond et al. (2001) if solar forcing is not the common cause? I agree that the agreement is not perfect but there seems to be reasonable agreement throughout the complete Holocene. Bond et al. obviously used a very broad spectral filter that seems to include the whole range of frequencies discussed by Debret et al. A simple example: The so-called little ice age represents a period of low solar activity and high IRD. However, if I understood Debret et al. correctly they do not see a solar influence on IRD during the late Holocene. Is this correct?

The main focus of this paper is the discussion of cycles. However, I think the discussion by Debret et al. is incorrect when they give the impression that the 1500yr cycle is "remarkably regular" or "mysteriously regular". For example, Bond et al. (2001) are aware that the 1500 year cycle during the Holocene is not a clear clock-like cycle. They clearly state: "Those drift-ice cycles compose part of an enigmatic, at best quasiperiodic, “1500-year” cycle ...". Based on the newest NGRIP dating Ditlevsen et al. (CP2007) conclude that "the recurrence times (of D/O events) are indistinguishable from a random occurrence". So, I am not convinced that there is a "mysteriously regular" 1500 year cycle.

In the cycle discussion (figure 3) I think an important aspect is missing. How much of the signal can be explained by the 1500 (1650) yr cycle and are the cycles statistically significant. For example, wavelet analysis suggest a dominant 2500-yr cycle in IRD. However this cycle does not convincingly show up in figure 2. Figure 3 suggests that

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this cycle is present throughout the complete Holocene which should lead to a significant cycle in all spectra, correct? In addition, the phase relationships between cycles in different records are not studied by Debret et al. I think it would be important to know if the cycles in the different records are in phase (or constant phase shift). To me this seems to be a crucial test to check if there is really a common cause behind these records. The 1450 yr cycle seems to have periodicities from 1450 to 1700 yr in different records. Over the Holocene, these cycle will run out of phase by more 1000 years. This cannot be explained by dating uncertainties and I don't see how one can infer a common cause behind the different cycles if there is indeed a variable phase shift.

Debret et al. state that circum-Atlantic records cannot be explained by solar forcing but require changes in ocean circulation. Does this include only the 1500 yr band as it is suggested by their analysis. This should be clearly written. There are other examples where Debret et al. could be more precise to avoid misunderstandings (e.g. "match perfectly" ... this implies 100% agreement).

Debret et al. use the residual D14C to check for the solar influence and they write that Bond et al. (2001) did the same. This is incorrect. Bond et al. used 10Be and the 14C production rate to check for the solar influence. D14C is influenced by the carbon cycle and the cycles in the residual D14C record depend very much on the applied detrending method (especially for the longer cycles as e.g. the 2500 yr cycle).

The 1500 yr cycle is present in the residual D14C during the early Holocene and in IRD during the late Holocene. What is the implication? Is there a solar 1500-yr cycle but it does not influence climate? Why is it present in the climate data when it is not present in 14C? coincidence?

Details:

page 680 line 22: wouldn't it be more accurate to say that "... climate records cannot exclusively be explained..."

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Page 681 line 7: Why does solar forcing rule out any direct link with the ice-sheet oscillations? Solar forcing could influence ice-sheet oscillations.

Page 681 line 23: Again, Bond et al. do not report a 1500-yr oscillation

Page 681 line 25: The calculation of the background noise spectrum is not well explained (at least for non-experts). It should be expanded or it needs a reference to where this method is discussed.

page 682 line 1: how does the 1000yr & 1500yr filter work. I guess it needs a certain bandwidth that is not explained in the text.

page 682 line 2: add that it is a correlation between filtered and raw data

page 682 line 3: "1000 yr filter not conclusive" during the last 5000 yr. To me it is very conclusive during the last 2000 years.

page 692 line 16: "first part of the Holocene". I understand "first part" as the period during the early Holocene which seems to be in contradiction to the interpretation by Debret et al.

page 683 line 12: There seems to be a mix up of references. Emiliania Huxleyi & Jackson et al.

page 686 line 2: there seems to be a typo in the formula: t-b/a ->(t-b)/a

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Interactive comment on Clim. Past Discuss., 3, 679, 2007.