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# Holocene climate change and solar forcing in the North Atlantic area: evidence of 2 500, 1500 and 1 000-years periodicity by wavelet analysis.

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Since the pioneering studies of G. Bond on IRD from North Atlantic (Bond et al., 1993; Bond et al., 1997; Bond et al., 2001), it was suggested a 1500 yr variability of the climate for both the late Glacial and the Holocene, possibly resulting from the solar activity.

This periodicity, initially associated with the so-called Dansgaard-Oeschger oscillations, is also found in a great variety of studies through the Holocene. The 1500-year period seems to occur independently of the general glacial – interglacial climate changes. According to these results, the millennial-scale variability was attributed to the same forcing, ruling out any direct link with the ice-sheet oscillations. So far the solar forcing appears to be the best candidate to explain the persistence of the 1500-year period through the Holocene. However, when processed through the spectral analysis methods described above, the original dataset of Bond (Bond et al., 2001) does not significantly evidenced this 1500-year period.

In this study, we use wavelets analysis to explore in details North Atlantic climate variations and solar activity (via $\delta^{14}$C résidual) during the Holocene. The objective is to establish a possible linkage between solar forcing and the North Atlantic cli-

mate during the Holocene as initially proposed by Bond et al. (1997, 2001). Results of time-series analyses reveal two dominant periodicities around 2 500 and 1 000 years respectively. The 1 500-year cycle appears only between 2 500 and 5 000 yrs cal BP (called the “Atlantic period”). Holocene Greenland ice-core isotopic record exhibits the same periods of 2500 and 1500 years whereas the 1000-year cycle is less evidenced, but present, during the Holocene.

The same wavelets analyses were also performed on residual $\delta^{14}$C in order (1) to test the relationship between North Atlantic climate (Bond et al., 2001) and sun activity (2) to understand the specificity of the 2500-5000 year cal. BP interval. Residual Delta$^{14}$C time-series analyses confirm Bond hypothesis: solar forcing appears to be the dominant forcing during Holocene with two persistent periods of 2 500 and 1 000 years respectively. The 1 500-year cycle is also present in the residual $^{14}$C signal but disappears during “Atlantic Time” (between 2500 and 5000 yrs cal. BP, in opposition with North Atlantic data) while a 625-year cycle appears over the same interval.

These results indicate that North Atlantic climate is probably mainly driven by sun activity with two dominant wavelengths of 1000 and 2 500 yr. These periodicities are disrupted during the Holocene between 2 500 and 5 000 yr cal. BP while the 1 500-years cycle rises in opposition with the residual $\delta^{14}$C. This suggests that two forcing influence the climate during this “Atlantic” period: the sun and an other to be further determined, like the ocean salt oscillator (Broecker et al, 1999).