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Long-term and millennial-scale climate variability in north-western France during the last 8850 years

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Vegetation and quantitative climate reconstructions from a north-western France shelf core (VK03-58Bis) show orbital and suborbital climate variability for the last 8850 years in this region. A long-term cooling trend in summer temperatures, marked by gradual temperate and humid forest decline, parallels cooling in Greenland and the decrease of mid-latitude summer insolation reduction until at least 2000 yr cal BP. At long-term scale, the lowering in seasonal contrast revealed by vegetation changes follows the increase of precession.

Corylus woodlands spread at the expense of deciduous *Quercus* forest, between 8740 and 8390 cal yr BP, linked with the high seasonality conditions which, counterbalancing the long-term astronomical forcing trend, were amplified by the north Atlantic high-latitudes winter sea-ice expansion. High seasonality conditions resulted from the Agassiz and Ojibway final outburst episodes and consequent gradual reduction of the MOC (Meridional Overturning Circulation).

Between 8390-8060 cal yr BP, a sudden *Corylus* woodland decline marks the 8.2 kyr

cold event in north-western France probably triggered by the severe MOC reduction, associated with slowest flow of the ISOW (Iceland-Scotland Overflow Water), leading to the additional drop in winter temperature over Europe and Greenland. Nonetheless, seasonality remains high during this interval.

The high seasonality conditions detected in “VK03-58Bis” between 8740-8060 cal yr BP reflects the multi-centennial-scale climate cooling 8.6-8.0 kyr episode of the North Atlantic. A complex pattern in annual precipitation within the multi-centennial-scale cooling (between c. 8740-8060 cal yr BP) has been detected in north-western France. This complex pattern is marked by a relatively dry period sandwiched by two episodes of increased moisture availability.

Following the Agassiz and Ojibway final outburst episodes, climate became more stable. However, millennial scale climate cooling episodes are recorded in “VK03-58Bis” and characterised by weak winter cooling and increases in precipitation.

Furthermore, dinocyst analysis and benthic gastropod *Turritella communis* occurrences indicate substantial regional changes such as the southward migration of the Boreal biogeographical zone between 8740-8480 cal yr BP and the subsequent opening of the English Channel at around 8480-8390 cal yr BP.