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Multicentennial shell-based δ18O records for the North Sea indicate a link between tropical volcanic eruptions, North Atlantic modes of atmospheric variability and bottom water temperatures

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Here we present an annually resolved and absolutely dated marine δ18O series using shell material based on a 460-year (AD1543-2003) crossdated A. islandica shell chronology for the Fladen Ground in the northern North Sea. The shell δ18O record (interpreted here as a proxy for bottom water temperatures) has been analysed in relation to indices of atmospheric pressure across the North Atlantic, specifically the North Atlantic Oscillation (NAO) and the Scandinavian Pattern (SCAND). The correlation between the δ18O record and these atmospheric indices has also been analysed in relation to strong tropical northern hemisphere volcanic eruptions. Initial results suggest that there is a non-stationary coupling of the extended winter NAO (December to March) and the shell δ18O with an approximate periodicity of 30 years, including an uninterrupted 36-year period starting in AD 1826 that shows a mean 11-year running correlation of -0.58. The coupling between the SCAND and the δ18O is similarly non-stationary but with significant frequencies at periods of 40, 20, 18 and 8 years indicated by spectral analysis. Periods of strong negative correlation between the SCAND and the δ18O series are near-synchronous with periods of high sulphate fluxes in the northern hemisphere caused by tropical volcanic eruptions. We suggest that strong volcanic eruptions force the SCAND into a negative phase which then dominates the water column density in the northern North Sea.