Geophysical Research Abstracts
Vol. 14, EGU2012-543-1, 2012
EGU General Assembly 2012

Comparison of Two Automatic Signal Correlation Methods to Align Relative Paleointensity Data

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Sedimentary relative paleointensity (RPI) data are often believed to represent a global signal at $>10^3$ yr timescales. The development of chronologies independent of oxygen isotope data (and orbital tuning) has important implications in paleoclimate science. Age models derived from RPI data could ultimately be used to better understand the climate signal in oxygen/carbon isotope data, the true link between orbital cycles and climate variations, and test for leads and lags in the climate system. As a first step, a method of accurately and reliably correlating RPI data from different sites must be developed. Automated correlations using algorithms have great advantage over visual correlations as they are based on firm criteria and repeatable, although a comparison of how various methods perform when aligning RPI or δ^{18}O data (or both signals in tandem) has not been undertaken. Here we compare the performance of two automatic correlation techniques when used to align RPI or δ^{18}O data. One is the dynamic programming method developed by Lisiecki and Lisiecki (2002) to align δ^{18}O. records, the other is the simulated annealing method proposed by Huybers and Wunsch (2004). RPI and δ^{18}O data collected from the North Atlantic are used to examine the differences in how these algorithms cope with different levels of inter-site variation in both RPI and δ^{18}O data, and fluctuations in sedimentation rate. The algorithms are also evaluated using synthetic datasets obtained using Monte Carlo simulations of RPI and δ^{18}O data. Multiple simulations are used to test the accuracy of the algorithms when handling different levels of signal to noise, variations in sedimentation rate, and differences in RPI resolution that are encountered when aligning RPI data collected from sediments with variable or differing sedimentation rates. Once data from the North Atlantic have been fully aligned using both methods, stacking techniques are employed to develop stacks of RPI and δ^{18}O data for each signal correlation method. Finally, North Atlantic Quaternary age models, developed using both standard insolation-forced ice-volume models, and "depth derived" methods, are applied to the stacks.