Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09299, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09299
EGU General Assembly 2008

Detrending noisy and non-stationary climate time series with penalised least-squares splines

R. Holme, J. Marshall and D. Duckworth

University of Liverpool, 4 Brownlow St., Liverpool L69 3GP, UK. (holme@liv.ac.uk)

Application of conventional statistical techniques to climate records is hampered by many non-ideal features of the series: non-stationarity, long-tailed error distributions, and errors in both values and dating. Sophisticated statistical methods have been applied to such series, but perhaps sometimes these methods might even be too sophisticated. We apply a simpler method, drawn from optimisation theory. Specifically, we take a stable isotope series from Holocene lake sediments in Haweswater, a small hard-water lake in NW England and seek to fit the data with a smooth function, such that the square norm of the second derivative in time (a proxy for curvature) is minimised. We derive this function on a basis of cubic B-splines, although we emphasise that the basis is a matter of numerical convenience rather than mathematical significance. This method, called Penalised least-squares splines, previously applied in geomagnetism and palaeomagnetism, allows fitting of long-term quasiperiodic trends in the data without having to assume stationarity, and easy identification and treatment of outliers. Large discontinuities in the data series, associated with abrupt climatic events are identified from an initial fit and removed by hand; this procedure is strongly statistically supported a posterori.

The method provides a rigorous way of defining climate "events", and allows comparison of long-term trends and events in time series of climatic records from different archives. Interpretation of both the resulting smooth background variation and departures from it are discussed, as is the extension of the method to other climate signals, including Greenland ice-core records.

Reference: Marshall J. D., et al (2007) Geology vol 35 pp 639-642