Geophysical Research Abstracts
Vol. 13, EGU2011-3239, 2011
EGU General Assembly 2011

Detection of trend changes in the Plio-Pleistocene climate of Northern Africa using linear mixed modeling

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Climate variability of Northern Africa is of high interest due to its spatial diversity (e.g. East African Rift System) and climate-evolutionary linkages under investigation. In our preliminary work we analyze published data sets of terrigenous dust flux from the ODP sites 659, 721 and 967 spanning the time of the Plio-Pleistocene transition events (< 4 Ma).

In general, the detection of transition events in time series is of fundamental interest for the understanding of the system's internal dynamics. Therefore we have elaborated a method based on a linear mixed modeling approach to compute a probability density characterizing the existence and confidence of change points in a time series.
Our main interest is in challenging the available data with advanced statistical methods to detect significant trend changes and to compare different model assumptions for different proxy data sets. For that purpose, we avoid any preprocessing of the data (e.g. to obtain equidistant time steps for filtering methods). Additionally we demand a plausible description of the errors for the estimated parameters, in form of confidence intervals. Finally, depending on what model we restrict on, we achieve an insight in the probabilistic structure of the assumed model in the full parameter space to estimate the most likely underlying model's parameters. To gain this information, we focus on Bayesian inference by formulating the data as a linear mixed model, such that the change points are perceived as isolated singularities in a regular background of a given palaeo-climate signal.

We will present our preliminary results of the ongoing development of the described investigation technique and compare the detected trend changes with already published analysis approaches on these data sets. Furthermore we will discuss our results in the context of palaeo-climate interpretations revealed on different proxy data sets. Finally we will elaborate the range of promising application possibilities on palaeo-climate proxy data sets in general.