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Biogeosciences Discussions

Interactive comment on "Assessment of soil *n*-alkane δD and branched tetraether membrane lipid distributions as tools for paleoelevation reconstruction" *by* F. Peterse et al.

Anonymous Referee #1

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This work evaluates the utility of the hydrogen isotopic composition of soil n-alkanes as a proxy for the isotopic composition of precipitation, as well as the accuracy of a recently developed soil temperature proxy in recording changes in temperature with elevation. Determining uplift histories of the major orogens is a rapidly growing field and a necessary component in climate research and tectonic models of mountain uplift. This work makes a necessary attempt to understand the accuracy of new organic proxies that are now emerging as possible tools in paleo-altimitry, and focuses on the application of these climate proxies across an elevational transect on Mt. Kilimanjaro in Tanzania. The authors determine that the D/H composition of soil n-alkanes are a poor recorder of the D/H of precipitation and thus are likely poor paleo-elevational tools. MBT/CBT soil temperature proxies correlates better with changes in elevational temperatures and is argued to better represent elevation in the ancient record. While this line of research is critical to advance the use of compound-specific hydrogen isotope analysis in paleoelevation and paleoclimate studies, I believe this work is fatally flawed and their conclusions overreach. I argue against publication at this time.

Mt. Kilimanjaro is an isolated volcano in a seasonally dry region. Knowledge of precipitation dD and/or soil water dD across this transect is critical to interpretations. This information is lacking. Instead, the authors apply model simulations of precipitation D/H from Bowen and Revenaugh, 2003. There are several reasons to doubt that this model accurately captures the character of isotopic patterns across an elevational transect up Mt. Kilimanjaro. First, Bowen's model is a global model that captures large-scale isotope patterns, but is far from accurate on the regional scale and especially across sharp elevational transects. There are practically no water stations in the area of study (see figure for data site locations) and certainly no stations on Mt. Kilimanjaro used in Bowen's model.

As the authors state, Mt. Kilimanjaro experiences two distinct rainy seasons, characterized by seasonal heavy and "long" precipitation patterns, but a detailed exploration on how precipitation occurs in this region is lacking. Comparisons are possible. For example, Rietti-Shati et al. 2000 (Stable isotope composition of tropical high-altitude fresh-waters on Mt. Kenya, Equatorial East Africa, Chemical Geology, 166, 341-350, 2000) found that a lack of a significant altitude effect on the d18O and dD of precipitation on Mt. Kenya and stated that this "lack of a significant altitude effect...is even more pronounced on another East African mountain, Mt. Kilimanjaro", citing Moser and Stichler,1970. Apparently, isotope work has been performed on Mt. Kilimanjaro and this work demonstrates that a simple isotope-elevation relationship does not exist! Taking this evidence, and the results of this study, one could argue that n-alkanes are indeed accurately capturing the nature of precipitation in the region. Both of these mountains are isolated, high-elevation volcanoes in the middle of a relatively dry or seasonally dry region with precipitation controlled by convective storms. The region studied in this work, as well as Mt. Kenya (Rietti-Shati et al.2000) represent a single peak in a broad, in a broad region at lower elevation. The pattern of precipitation across this feature is distinct from a long mountain range and there is not, nor would one necessarily expect there to be, predictable elevation-isotope relationships. Testing the veracity of precipitation proxies requires a clear and accurate knowledge of precipitation dD and its relationship with elevation. Both of these conditions are not met for this portion of the study. Further, Bowen's model results cannot be expected to reproduce adequate or accurate results for a study of this kind and as such the conclusions of this work are flawed and likely inaccurate. Clearly, changes in vegetation type, water-use efficiency, and apparent isotope fractionation could be playing a role, but the control on precipitation dD is so poor that any interpretations of this kind are pure speculation.

In contrast, temperature should reliably change with elevation. In the absence of local temperature inversion, temperature responds to the free air temperature lapse rate due to adiabatic cooling and the match of MBT/CBT temperatures with elevation is encouraging.

Interactive comment on Biogeosciences Discuss., 6, 8609, 2009.

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Interactive Comment

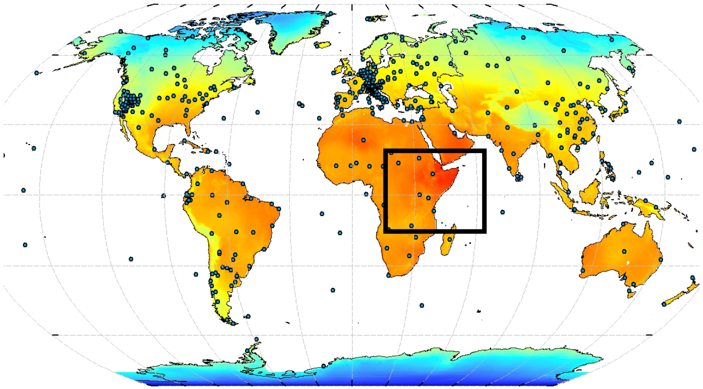

Fig. 1.

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Interactive Discussion

Discussion Paper