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A chain of processes - from past climate variations to paleoclimate reconstructions

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Paleoclimate proxy data cover large sections of the Earth's past dynamics and hold information that is crucial to improve climate models on timescales from decades to millennia. The attribution of proxy variability to different physical climate parameters and seasons, such as, e.g., summer temperature or winter precipitation, is necessary for most model-data intercomparisons. This is, however, complicated by time-scale dependence, underdeterminacy and short overlapping periods in the calibration to modern-day data. Non-climatic and potentially archive-specific and local effects further decrease the signal-to-noise-ratio and increase the uncertainty of a paleoclimate reconstruction.

The proxy data have heterogeneous origins, e.g. from marine or terrestrial archives, which grew biologically or resulted from sedimentation processes. This amplifies reconstruction uncertainty due to proxy- and archive-specific technical challenges like record sparsity, age uncertainty and sampling time irregularity. Despite these obstacles, paleoclimate reconstructions are essential to test how adequately climate models simulate long-term climate variability, and to identify potentially lacking mechanisms that propagate internal climate variability on annual to millennial timescales.

Improving our understanding of paleoclimate archives and proxies will therefore enable us to obtain better climate reconstructions that are more suitable to be compared to modeled data or modern-day observations. In this contribution we aim to identify and survey the chain of processes that occurred from the moment when past environmental variations were recorded in natural paleoclimate proxies, through the human sampling, calibration and attribution process to the final reconstruction.

We distinguish paleoclimate archive classes for example according to their origin, such as terrestrial, marine or biogenic, and geographical occurrence, such as alpine, tropical or polar. We are further interested in the dependence of the proxy interpretation on the archive type, location and recording seasonality. We identify common challenges such as bioturbation in marine or lacustrine sediments, and isotopic diffusion in ice-cores which both lead to a smoothing of the resulting signal. Where proxy communities have developed successful solutions or coping strategies, these could be useful for other types of paleoclimate data. Besides our goal to recognize cross-pollination potential we determine archive-proxy combinations that provide complementing climate information.

Ultimately, the emerging proxy panorama will improve the potential of paleoclimate reconstructions and will contribute to a better understanding and reduction of uncertainties and caveats in paleoclimate data analysis. In order to populate and cross-reference the proxy network further we explicitly welcome and rely on the opportunity for feedback and discussion with experts at the EGU General Assembly 2014.