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Is there a break in scaling on centennial time scale in Holocene temperature records?

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A variety of paleoclimatic records have been used to study scaling properties of past climate, including ice core paleotemperature records and multi-proxy reconstructions. Records extending further back in time than the Holocene are divided into glacial/interglacial segments before analysis. The methods used to infer the scaling include the power spectral density (Lomb-Scargle periodogram and standard periodogram), detrended fluctuation analysis, wavelet variance analysis and the Haar fluctuation function. All the methods have individual strengths, weaknesses, uncertainties and biases, and for this reason it is useful to compare results from different methods when possible. Proxy-based reconstructions have limited spatial and temporal coverage, and must be used and interpreted with great care due to uncertainties. By elaborating on physical mechanisms for the actual climate fluctuations seen in the paleoclimatic temperature records as well as uncertainties in both data and methods, we demonstrate the possible pitfalls that may lead to the conclusion that the variability in temperature time series can be separated into different scaling regimes. Categorizing the Earth's surface temperature variability into a «macroweather» and "climate" regime has little or no practical meaning since the different components in the climate system are connected and interact on all time scales. Our most important result is that a break between two different scaling regimes at time scales around one century cannot be identified in Holocene climate. We do, however, observe departures from scaling, which can be attributed to variability such as a single internal quasi-periodic oscillation, an externally forced trend, or a combination of factors. If two scaling regimes are claimed to be present in one single time series, both regimes must be persistent. We show that the limited temporal resolution/length of the records significantly lowers the confidence for such persistence.
A total of six Holocene ice core paleotemperature records were studied, (GRIP, GISP2 and NGRIP from Greenland, EPICA, Vostok and Taylor Dome from Antarctica). For all time series the estimated scaling exponent β is between 0.1 and 0.3 up to millennial time scales, where a deviation is observed and a seemingly higher value of β is inferred on longer time scales. The Holocene ice core records have by Lovejoy et al. (2012) been claimed to be exceptionally stable, compared to other proxy records such as marine sediment cores. Such a statement should be followed by a discussion about different types of proxy reconstructions and climate conditions. This presentation highlights that care should be taken when comparing the climate of continental land covered by ice, with a marine sediment record representing an oceanographically dynamic area. Different proxies are representative of different environmental variables, and the reconstructions are created to give a general paleoclimatic overview of a certain area, and are in that manner only blurred snapshots of the past climate.