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Detecting the Spectrum of the Atlantic's Thermo-haline Circulation: Deconvolved Climate Proxies Show How Polar Climates Communicate

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Deconvolution is widely used in a wide variety of scientific fields, including its significant use in seismology, as a tool to recover real input from a system's impulse response and output. Our research uses spectral division deconvolution in the context of studying the impulse response of the possible relationship between the nonlinear climates of the Polar Regions by using select δ18O ice cores from both poles. This is feasible in spite of the fact that the records may be the result of nonlinear processes because the two polar climates are synchronized for the period studied, forming a Hilbert transform pair. In order to perform this analysis, the age models of three Greenland and four Antarctica records have been matched using a Monte Carlo method with the methane-matched pair GRIP and BYRD as a basis of calculations. For all of the twelve resulting pairs, various deconvolutions schemes (Weiner, Damped Least Squares, Tikhonov, Truncated Singular Value Decomposition) give consistent, quasi-periodic, impulse responses of the system. Multitaper analysis then demonstrates strong, millennia scale, quasi-periodic oscillations in these system responses with a range of 2,500 to 1,000 years. However, these results are directionally dependent, with the transfer function from north to south differing from that of south north. High amplitude power peaks at 5,000 to 1,7000 years characterize the former, while the latter contains peaks at 2,500 to 1,700 years. These predominant periodicities are also found in the data, some of which have been identified as solar forcing, but others of which may indicate internal oscillations of the climate system (1.6-1.4ky). The approximately 1,500 year period transfer function, which does not have a corresponding solar forcing, may indicate one of these internal periodicities of the system, perhaps even indicating the long-term presence of the Deep Water circulation, also known as the thermo-haline circulation (THC). Simplified models of the polar climate fluctuations are shown to support these findings.