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The Recognition of Multi-Decadal Scale Climate Variability in the Paleo-record over the Past 1000 Years

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Proxy reconstructions of climate from tree rings, corals, stalagmites, sclerosponges, and deep-sea sediments show multi-decadal climate variability preserved in records extending back at least 1000 years. Most of these records appear to show a strong correlation with indices such as the North Atlantic Oscillation (NAO) and the Atlantic Multi-decadal Oscillation (AMO) over the period of the instrumental record ($\sim$1850-present). The repeated recognition of these signals in a number of different archives and geographical locations throughout the Atlantic (Cape Verde Islands, Gulf of Guinea, Puerto Rico, Cariaco Basin , South Florida, and the Bahamas) strongly suggests that these signals are real and have climatic significance. The AMO and NAO climate signals are manifested in these indices through (i) the direct effect of water temperature and salinity on the growth rate of trees and corals and (ii) temperature and salinity influences on the incorporation of geochemical proxies, such as the Mg/Ca, Sr/Ca, and oxygen isotopic ratios, into the skeletons of different carbonate producing organisms. In many areas these relationships are complex and there is often considerable local variability in the response of corals and trees, particularly in the growth rate related parameters. Prior to the instrumental period, the tree-ring index compiled by (Gray et al., 2004, GRL,31) has been taken as the principal reconstruction of the AMO. While most of the marine records examined appear to correlate with the tree-ring record during the instrumental period, there are significant discrepancies prior to 1850. This raises many questions about the stationarity and persistence of the AMO and the suitability of individual archives such as tree rings for these modes.