DISTINGUISHING GLOBAL WARMING FROM NATURAL VARIABILITY IN THE NORTH ATLANTIC SEA SURFACE TEMPERATURE RECORD

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The increase in heat content of the World's Oceans between 1961 and 2003 equates to approximately 90 % of the estimated increase in heat content of the entire Earth system over this period. Knowledge of trends and variability in oceanic heat content is thus vital to monitor and interpret global warming. Sea temperature time series typically exhibit considerable low frequency variability, associated with internal oscillations of the ocean-atmosphere system. Whilst upper-ocean warming has been observed in each of the ocean basins since 1850, year to year differences are typically larger than underlying warming trends. We resolve the dominant modes of variability in the in the North Atlantic sea surface temperature (SST) record in order to extract the underlying warming signal, which is then related to the trend in atmospheric CO_2 concentrations. The dominant modes of low frequency variability in North Atlantic SST records, determined through EOF analysis, correspond to the Atlantic Multi-decadal Oscillation (a 50-88 year cycle of North Atlantic heating and cooling), the East Atlantic Pattern, and the North Atlantic Oscillation, respectively accounting for 23 %, 16 % and 9 % of variance in the data set. The latter two modes correspond to the dominant modes of variability in the North Atlantic seal level pressure record. Resolved modes of natural variability in the North Atlantic SST record explain nearly 50 % of the observed warming trend, with the remainder attributed to anthropogenic activity. The anthropogenic contribution to the current warm anomaly in the North Atlantic SST record has been estimated at 0.42 °C.

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