



Weather regimes as recorded by a northern Red Sea coral record

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The variability of a coral $\delta^{18}\text{O}$ record from the northern Red Sea and its relationship with atmospheric circulation anomalies is investigated based on the weather regime paradigm. The Red Sea coral record has seasonal resolution and covers the last three centuries. A running correlation analysis reveals strong decadal variations in the correlation between winter mean coral $\delta^{18}\text{O}$ and winter NAO index with positive and highly significant correlation during 1975-1995, 1930-1950 and most part of the 19th century. Analysis of daily data during NCEP/NCAR reanalysis period (i.e. after 1948) reveals that the significant correlation between the coral record and the NAO index during 1975-1995 period is related to enhanced frequency of occurrence of persistent (time scale longer than 5-6 days) NAO+ daily circulation anomalies. This suggests that the frequency of occurrence of persistent NAO+ daily circulation anomalies was enhanced also during 1930-1950 and most part of the 19th century. The correlation between NAO index and our coral record is nonsignificant during the periods when the North Atlantic atmospheric circulation was dominated by other weather regimes.

During the summer season, coral $\delta^{18}\text{O}$ anomalies are related to a wave train that connects the North Atlantic and Middle East region. This wave train is the regional manifestation of the Northern Hemisphere circumglobal teleconnection (CGT) pattern recently identified through statistical analysis of observational data. Analysis of daily data reveals strong decadal variations in the frequency of occurrence of CGT events as well as relatively low persistency. The correlation between summer coral $\delta^{18}\text{O}$ and CGT index during observational period is modulated by the frequency of occurrence of daily CGT events. We detect significant correlation between our coral record and a reconstructed CGT index during 1820-1850 which may be an indication of enhanced frequency of occurrence of CGT events during this period.

We suggest that the coral records from the northern Red Sea can be used to obtain relevant information about the frequency of occurrence of winter and summer weather regimes during the pre-instrumental period.