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TITLE: Atlantic Multidecadal Oscillation (AMO) and sea surface temperature in the Bay of Biscay and adjacent regions

AUTHOR: ['Carlos García-Soto', 'R. D. Pingree']

ABSTRACT:

The sea surface temperature (SST) variability of the Bay of Biscay and adjacent regions (1854?2010) has been examined in relation to the evolution of the Atlantic Multidecadal Oscillation (AMO), a major climate mode. The AMO index explains ~25% of the interannual variability of the annual SST during the last 150 years, while different indices of the North Atlantic Oscillation (NAO) explain ?1% of the long-term record. NAO is a high frequency climate mode while AMO can modulate low frequency changes. Sixty per cent of the AMO variability is contained in periods longer than a decade. The basin-scale influence of NAO on SST over specific years (1995 to 1998) is presented and the SST anomalies explained. The period analysed represents an abrupt change in NAO and the North Atlantic circulation state as shown with altimetry and SST data. Additional atmospheric climate data over a shorter ~60 year period (1950?2008) show the influence on the Bay of Biscay SST of the East Atlantic (EA) pattern and the Scandinavia (SCA) pattern. These atmospheric teleconnections explain respectively ~25% and ~20% of the SST variability. The winter SST in the shelf-break/slope or poleward current region is analysed in relation to AMO. The poleward current shows a trend towards increasing SSTs during the last three decades as a result of the combined positive phase of AMO and global warming. The seasonality of this winter warm flow in the Iberian region is related to the autumn/winter seasonality of south-westerly (SW) winds. The SW winds are strengthened along the European shelf-break by the development of low pressure conditions in the region to the north of the Azores and therefore a negative NAO. AMO overall modulates multidecadal changes (~60% of the AMO variance). The long-term time-series of SST and SST anomalies in the Bay of Biscay show AMO-like cycles with maxima near 1870 and 1950 and minima near 1900 and 1980 indicating a period of 60?80 years during the last century and a half. Similar AMO-like variability is found in the Russell cycle of the Western English Channel (1924?1972). AMO relates at least to four mesozooplankton components of the Russell cycle: the abundance of the chaetognaths Parasagitta elegans and Parasagitta setosa (AMO ?), the amount of the species Calanus helgolandicus (AMO ?), the amount of the larvae of decapod crustaceans (AMO ?) and the number of pilchard eggs (Sardine pilchardus ; AMO +). In addition to AMO, the decadal to multidecadal (D2M) variability in the number of sunspots is analysed for the last 300 years. Several periodicities and a multi-secular linear increase are presented. There are secular minima near 1710, 1810, 1910 and 2010. The long term variability (>11 years) of the solar sunspot activity explains ~50% of the variance of the SST of the Bay of Biscay with periods longer than 11 years. AMO is finally compared with the Pacific Decadal Oscillation, the leading principal component of North Pacific SST anomalies.

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