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Rapid 20th century cooling in a northwest African alkenone-SST record

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Coastal upwelling areas are important for biological productivity and are of economic significance due to the large commercial fisheries in these regions. There is some evidence that upwelling is being impacted by rising greenhouse gas levels through changes in land-sea temperature gradients increasing the strength of upwelling-favorable, alongshore winds. However, with most evidence based on short instrumental records and very few long, high-resolution records from upwelling regions it is difficult to assess the extent of this trend, and the likely impact of further increases in atmospheric CO_2.

We investigated the late Holocene history of (alkenone) sea surface temperature (SST) in two cores from the center of the Cape Ghir upwelling system off northwest Africa. The most recent part of the two records overlap with the instrumental period for the last 100 years, and show a steady cooling trend of approximately 1.2˚C over this time. This result is consistent with wind-speed observations for the latter part of the 20th century that show pronounced upwelling intensification in the Canary Current region. In addition, the alkenone SST records are anti-phased compared to Northern Hemisphere temperature reconstructions for the last 2000 years and show a relatively warm Little Ice Age and cool Medieval Warm Period.

We propose that hemispheric-scale temperature variations could manifest themselves in a greater change in land surface-air temperature (SAT) as compared to SAT changes

over the ocean, affecting land-sea pressure gradients, alongshore winds and therefore upwelling. In a first analysis of a global climate projection to the year 2100, which follows the Intergovernmental Panel on Climate Change emission scenario A1B, we indeed find an increase in the Ekman pumping rate from October to January off northwest Africa and a nearly year-round increase off southwest Africa. Together, these results suggest that coastal upwelling off northwest Africa may continue to intensify as global warming and atmospheric CO_2 levels increase.