EFFECTS OF CLIMATE CHANGE OVER THE NW AFRICAN COAST

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1. INTRODUCTION

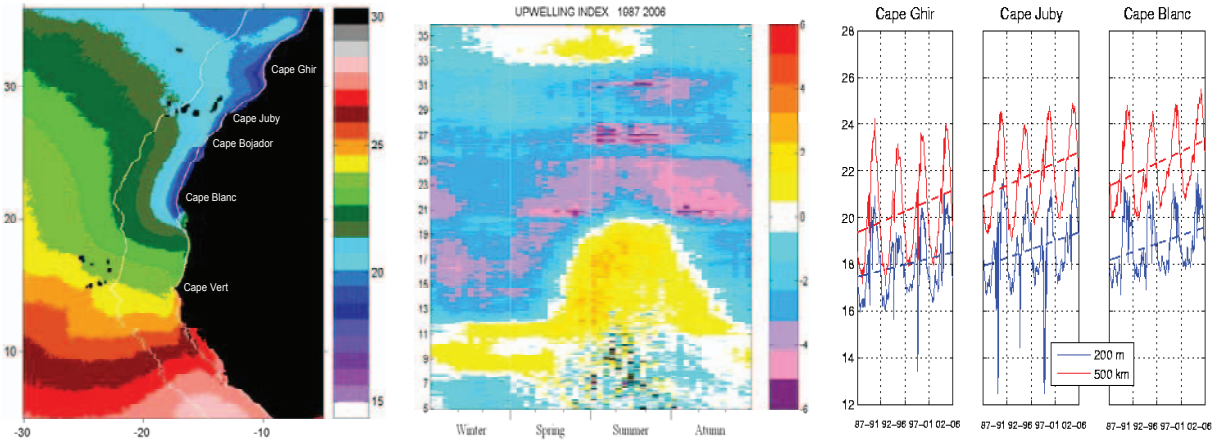
Climate change is one of the major factors affecting the Earth's ecosystems in the present and coming decades. Changes in the coastal upwelling ecosystems need to be accounted for as these structures are responsible for an important percentage of the global fish catch, for the primary and secondary productivity and for the atmosphere-ocean exchange. In this sense, our work aims to assess its impact in the coastal upwelling regions located in the northwest African coast (latitudes 5º to 36ºN and longitudes 5º to 30ºW). This area is one of the major upwelling regions in the world, so, it is important its study to predict the variability that measured parameters may have in the future.

2. METHODOLOGY

To that respect, this upwelling system has been thoroughly analysed using remote sensing weekly Sea Surface Temperature (SST) from NOAA-AVHRR 4 km GAC data [1] for the period 1987-2006 and wind stress data [2] from 1992 to 2006 provided by ERS and Quikscat platforms. The study has been carried out defining a SST upwelling index [3] as the zonal temperature difference between the shore and offshore. The alongshore component of the wind stress near the coast has also been computed to support and complement the results achieved. A detailed zonal, seasonal and long-term variability study has been conducted after extracting the relevant information from the 2080 SST weekly images (figure 1) and the corresponding wind stress data. In addition, a new methodology to compute the upwelling front distance to the coast has been implemented based on the automatic segmentation of upwellings features in SST images [4]. It is composed by 3 modules. *Pre-processing,* that performs the geometric selection, quality checks, land masking, filtering and image enhancement. *Feature Extraction,* which generates a region of interest (due to the well known distribution of the upwellings along the coast) and segments the structure, based on automatic thresholding techniques [5]. *Post-processing,* that uses morphological operators and spatial coherency tests to eliminate isolated components not belonging to the oceanic structure, relying on its connectivity.

3. RESULTS

With regard to the zonal and seasonal distribution of coastal upwelling, results demonstrate that upwelling is persistent throughout the year in the latitude range 20-33ºN. Two zones can be identified according to the intensity of the upwelling. From about 20 to 25ºN (Cape Blanc to south of Cape Bojador), the upwelling is intense throughout the year specially from spring to autumn (up to -8ºC) and between 25 to 33ºN, the upwelling is stronger in summer and autumn with the highest value (about -6.5ºC) around 27ºN (Cape Juby) and 31ºN (Cape Ghir). In latitudes between 12ºN and 20ºN upwelling shows a clear seasonal behaviour appearing from late autumn to early spring. South to 12ºN upwelling practically doesn't exist all around the year. All this zonal and seasonal behaviour is related to the seasonal variation of the Trade Winds which is coupled with the meridional shift of the Azores High.



(a) (b) (c)

Figure 1. Example of results for the period 1987 to 2006: (a) Mean SST (ºC), (b) Upwelling index (ºC) and coastal and offshore temperatures variation for 3 regions.

Concerning the long-term variability, four 5-years period have been considered (1987-1991, 1992-1996, 1997-2001 and 2002-206). An interannual study was not possible to perform when working with high quality of data as many data gaps appear. In summary, an upwelling intensification has been measured from 1987 to 2006 along the whole northwest African coast. The accumulated 20 years change in the upwelling index ranges from -0.5ºC in Cape Juby to -0.8ºC in Cape Ghir. This intensification is the consequence of a larger increase in the temperature of offshore waters with respect to coastal waters. For the complete period of time, the increase in SST coastal/offshore waters spans from 1.0/1.8ºC to 1.4/2.0ºC in Cape Ghir and Cape Blanc, respectively. However, this change is not correlated with an increase in the alongshore wind stress, which remains mainly stable for the period 1992 to 2006.

4. CONCLUSIONS

Certainly, climate change has been affecting the northwest African upwelling ecosystem in the last two decades, raising coastal and off-shore SST temperatures between 1º to 2ºC and increasing the magnitude of the upwelling index in more than 0.5ºC. Frontal distances to the coast have also been analysed and a moderate increase has also been computed.

5. REFERENCES

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