LONG TERM TEMPORAL EVOLUTION OF THE SURFACE LAYER CIRCULATION IN THE ALBORAN SEAOBSERVED FROM THE ERS-1 ALTIMETER

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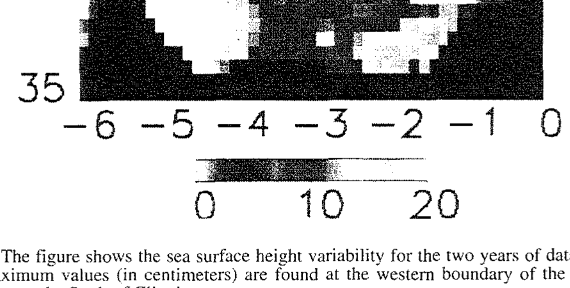
EUROMODEL is one of the MAST II/MTP Core Sub-projects. Its main objective is to describe, understand and simulate the circulation in the western Mediterranean sea with particular emphasis on the seasonal and mesoscale variability. One key region is the Alboran sea, where the incoming jet of Atlantic water forms a meandering current with one or two gyres. The Alboran Sea dynamics has been the object of several EUROMODEL studies, from both the numerical and experimental aspects (e.g. SPEICH, 1992; VIUDEZ *et al.*, 1994). "Evaluation of ERS-1 microwave sensors capability in the study of oceanic fronts" is a project selected by the European Space Agency (ERS-1 AO E1) that aims at identifying surface mesoscale structures in the western Mediterranean by ERS-1 altimeter and SAR. In this context altimeter data have been used to study the long-term variability of the sea surface topography in the Alboran sea. This variability provides information on the temporal evolution of the regional circulation, that appears to be complex with occasional disappearance of one of the gyres (mainly the eastern) and intense mesoscale motion along the meandering jet.

Data from ERS-1 altimeter have been extracted in the region 35°N to 38°N and 6°W to 0°. Atmospheric corrections, such as the wet and dry troposphere, were applied to the data extracted in the area along with the removal of the Rapp geoid, and the orbit error by means of removing a linear tilt and biass in the along-track direction over the Mediterranean. Tides were also removed using the CANCEIL *et al.* (1994) tide model for the Mediterranean. The along-track data were interpolated to a regular grid in space-time using a successive correction scheme whereby the space-time scales for each successive iteration converge. Maps of residual sea level were then created at regularly spaced intervals of 10 days with a 35-day e-folding time scale applied in the spatial domain to include an entire repeat. The obtained values, with maxima of 20-30 cm, are on the order of oceanographic variability. To extract the spatially coherent signal a set of Complex Empirical Orthogonal Functions (CEOF) were derived from the 75 10-day maps from Feb. 1992 - Jan. 1994. Unlike real EOFs the complex CEOFs give both amplitude and phase information since the eigenvectors of the spatial covariance matrix are now complex. The slope of the temporal phase versus time is then the instantaneous frequency of the propagating wave (VAZQUEZ, 1993). The first 3 CEOF modes explain 71% of the total variance. CEOF 1 accounts for 45% of the variance and is likely associated with changes in the incoming jet in Gibraltar or even the western anticyclonic gyre. It has two maxima out of phase between 5° and 4° W, indicating that if the circulation associated with the southern maximum is anticyclonic (gyre), the circulation of the northern maximum is cyclonic. This scenario is consistent with model results and with observations of cyclonic eddies north of the main anticyclonic gyre (LA VIOLETTE, 1984; TINTORÉ *et al.*, 1991). The second CEOF (17 % of the variance) appears to be associated with the western anticyclonic gyre, and in addition highs can be seen in areas of the Almeria-Oran front and the formation of the Algerian Current. There is a 180° phase difference across the front indicative of the possible slope in sea level. The spatial structure of CEOF 3 (9% of the variance) is more complex and seems clearly associated with changes in the structure of both gyres. The spatial phase of the western anticyclonic gyre indicates little or no propagation but its formation represents a quasi-stationary pattern. However the phase contours for the maximum located at the position of the eastern gyre change across the maximum, indicating a propagation along the African coast.



The figure shows the sea surface height variability for the two years of data. The maximum values (in centimeters) are found at the western boundary of the basin, close to the Strait of Gibraltar.

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