

## OBSERVATION OF MESOSCALE STRUCTURES IN THE ALBORAN SEA WITH ERS-1 SAR IMAGES AND DATA FROM ACOUSTIC DOPPLER CURRENT PROFILER (ADCP) AND CTD

Bernardo SHIRASAGO, Elisa G. GORRIZ and Jordi FONT

Institut de Ciències del Mar CSIC, P. Joan de Borbo s/n, 08039 Barcelona, Spain

The observation of surface mesoscale structures in the Alboran Sea has been addressed by analyzing Synthetic Aperture Radar (SAR) images from the ERS-1 satellite and ship data. The latter include Acoustic Doppler Current Profiler (ADCP) and Temperature Conductivity and Depth (CTD) data.

The Alboran Sea is the first Mediterranean basin encountered by the Atlantic Water (AW) which flows inward through the Strait of Gibraltar. Many experiments have shown a high variability of the AW circulation, both in space and time (GASCARD and RICHEZ, 1985). One of the most important features formed in the western basin of this sea is a big quasi-permanent anticyclonic gyre (DONDE VA? GROUP, 1984; LA VIOLETTE, 1986). Numerical studies have examined the existence of this gyre and indicate it might be related to the non-linear density advection off the Strait of Gibraltar (WANG, 1987).

At the eastern basin less information is available, although several studies have shown that a second anticyclonic gyre or an eastward current along the African coast is present (LA VIOLETTE, 1990; VIUDEZ *et al.*, 1994). Typical diameter of these two gyres is near 100 km.

The study was carried out with 26 SAR images SAR, FDC format that cover the Alboran sea from September 12th to October 14th, 1992. The ship data were obtained during an oceanographic cruise (FE92), performed on the Spanish R/V "García del Cid" from September 17th to October 10th, 1992 and that included 134 stations. CTD casts in each station and continuous ADCP and surface T-S (Temperature-Salinity) alongtrack measurements were recorded. SAR images were reduced to a 512 X 512 pixel format and geolocated using the points supplied by ESA in each tape by means of an image processing system GEOJARS. This procedure was done in order to overlay the ADCP vectors on the images. The ADCP data were averaged every thirty minutes and maximum current velocities near 100 cm/s were obtained in some places.

Results in the comparison between SAR, ADCP and CTD data have shown a high correlation in the detection of mesoscale structures, especially the Western Anticyclonic Gyre, the baroclinic jet associated to both gyres and the eastward Algerian Current exiting the Alboran Sea. It is important to mention that some other structures, smaller in dimension as eddies and internal waves packets, are present in the SAR images.

This study is part of EUROMODEL MAST II project No. MAS2-CT93-0066 and ESA/ERS-1 AO Project E1 "Evaluation of ERS-1 Microwave Sensors Capability in the Study of Oceanic Fronts".

### REFERENCES

- DONDE VA? GROUP, 1984. ¿Donde Va?, An oceanographic experiment in the Alboran Sea. The oceanographic report, Eos Trans. AGU. 65(36): 682-683
- GASCARD J.-C. and RICHEZ C., 1985. Water masses and circulation in the western Alboran Sea and in the strait of Gibraltar. *Prog. Oceanogr.*, 15: 157-217.
- LA VIOLETTE P. E., 1986. Short term measurements of surface currents associated with the Alboran Sea gyre during ¿Donde Va? *J. Phys. Oceanogr.*, 16: 262-279.
- LA VIOLETTE P. E., 1990. The Western Mediterranean Circulation Experiment (WMCE). Introduction. *J. Geophys. Res.*, 95, (C2): 1511-1514.
- VIUDEZ A., TINTORE J., HANEY R. L., 1994. Three-dimensional structure of the two anticyclonic gyres in the Alboran Sea. *J. Phys. Oceanogr.* (accepted).
- WANG D. P., 1987. The strait surface outflow. *J. Geophys. Res.*, 92: 10807-10825.

## SEA LEVEL VARIATIONS IN RESPONSE TO WATER BUDGETS AND BAROMETRIC PRESSURE EFFECTS IN THE BLACK SEA

Halil I. SUR<sup>1</sup>, Yuri GORYACHKIN<sup>2</sup>, Mohammed A. LATIF<sup>1</sup> and Emin ÖZSOY<sup>1</sup>

<sup>1</sup> Institute of Marine Sciences, Middle East Technical University, P.K. 28, Erdemli. İçel 33731 Turkey

<sup>2</sup> Ukrainian Academy of Sciences, Marine Hydrophysical Institute 2, Kapitanskaya Str., Sevastopol 33500 Crimea, Ukraine

Long-term sea-level records from various stations in the Black sea (47 stations along the northern coast, 4 along the western coast, 1 on the southern coast), 2 in the Bosphorus, 1 in the Marmara sea and 3 along the Aegean / Mediterranean coast are studied to determine the seasonal and interannual dependence of sea-level variations in the Black sea, and its relationship with the neighboring seas. The relationship between sea-level and barometric pressure effects are investigated. Similarly, freshwater influx from rivers, evaporation and precipitation data are used to assess the variability in water budgets, and these are linked to the Bosphorus exchange flows and sea-level variations.

Spectral analyses show the time-scales in the sea-level, barometric pressure and the elements of the water budget are linked from seasonal to interannual periods. Shorter period variability in sea-level is related to storm surges and dynamical processes.

The hydraulically controlled flow in the Bosphorus plays a determining role in the sea-level variations. Barometric pressure differences between the Black sea and the adjoining seas are also very important in driving the exchange flows and the sea-level response.

