SATELLITE SEA SURFACE TEMPERATURES AND NEAR SURFACE VERTICAL STRUCTURES IN THE ALBORAN SEA DURING THE SUMMER, AND COMMENTS ON SURFACE CIRCULATION MONITORING

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Project Huelva[1] was a limited experiment conducted in 1977 to (1) verify the reported Alboran Sea gyre reported by Lanoix[2] using satellite data, and (2) evaluate satellite infrared imagery data as a tool to detect 3-dimensional ocean structures in the Mediterranean Sea. Satellite imagery and concurrent in situ measurements were used to verify the presence of a strong anticyclonic gyre in the western Alboran Sea, during the month of July. Towed sea surface temperature (SST) measurements and XBT surface values were compared with enhanced NOAA infrared imagery; satellite data were provided by the Centre de Meteorologie Spatiale, Lannion, France. The towed thermometer was a quartz - crystal thermometer, shielded from incoming solar radiation, that remained in the upper 0.3 m of the water column. In general, differences in SST of up to 4oC were noted in the cold water zones between the high resolution towed SST values and the XBT surface values; differences of up to $\pm$1oC were noted elsewhere. The sea surface temperature distributions were then compared with XBT and STD vertical profile data to relate surface features to sub-surface structures. A total of 472 XBT casts were made; the spacing between XBT casts on some transects across the gyre boundaries was 1.6 km. The central warm zone of the gyre revealed an isothermal layer to about 20 meters depth, and a characteristic structure extending to depths of 150-200 meters. The cold water ring was characterized as extending to about the 50 meters depth, and as having negative near-surface vertical temperature gradients. The transition region between the two zones was characterized by strong interfingering in the vertical temperature profiles. The high frequency time variations of the gyre boundaries (< one day) created problems in analysis of the temperature data. Salinity data from 16 STD casts, in conjunction with the temperature distributions, permitted classification of water masses in the Alboran Sea gyre. It was determined that the source of the cool ring water in the gyre was North Atlatic water from about the 125m depth, just west of the Strait of Gibraltar; the characteristic salinity of < 36.5 could be traced in the cool ring water and in the warm central core water.

A satellite tracked MARISONDE surface drifter buoy was launched just east of the Strait of Gibraltar; in the axis of the cold water intrusion. The buoy drift followed the axis of the cold water ring,

and completed a full circle before continuing eastward. The eastward track depicted a meandering pattern similar to that commonly observed in the satellite imagery. The hardcopy satellite imagery from CMS has been monitored regularly since 1977, and frequent examination of selected available XBT data have been made. The data reveal that while the gyre is highly dynamic, it is a well developed permanent feature; maximum surface thermal contrasts occur in summer and fall. The structural and circulation data verified the gyre description reported by Lanoix; for which no satellite data were used. We conclude therefore that, in the summer at least, one can reasonably estimate the relative distributions of the temperature and salinity structures of the Alboran Sea gyre using only enhanced satellite IR imagery.

It is suggested that these results, and those of other subsequent satellite related investigations in the Alboran Sea, be used as a reference base from which to study much of the Mediterranean Sea.[3] A coordinated network of stations should be established to monitor in situ surface and near-surface thermal and salinity structures in selected areas throughout the Mediterranean, and comparisons made with satellite IR derived SST patterns, to construct a necessary data base upon which to evaluate satellite IR data as a useful ocean tool for three-dimensional thermal monitoring and analyses. Such a network should not focus only on ocean frontal areas, but should also include apparent uniform SST areas and upwelling zones. Similarly, with the development of a technology base constructed from a network of in situ circulation measurement stations or drift buoy zones, periodically updated, and corresponding analyses of appropriate satellite data, major surface circulation patterns throughout the Mediterranean Sea could be determined; frequent observations of enhanced satellite IR, visible and Synthetic Aperature Radar (SAR) imagery and microwave altimeter data would be required.

REFERENCES

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3. Gallagher, J., M. Philippe and B. Wannamaker "Satellite Monitoring of Ocean Surface Temperature Variability in the Mediterranean Sea," in Oceanography From Space, Plenum Publ. Corp. 1981, pp. 175-182.