O-VII3

AVHRR/2 observations of the Tyrrhenian eddy during TEMPO

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The large scale circulation in the Tyrrhenian Sea is mainly cyclonic. Superimposed on this large scale circulation is a pair of eddies rotating in opposite direction and separated by a zonal front (henceforth called front) running at approximately 40° N. The northern eddy (henceforth called Tyrrhenian Eddy) is cold core and cyclonic while the southern is anticyclonic and relatively warmer.

The Tyrrhenian Eddy Multi-Platform Observations (TEMPO) experiment, whose intensive phase was carried in September 26th - October 9th, 1989, was devoted to both improving the understanding of the air-sea interaction dynamics of the North Tyrrhenian Sea and testing a methodology based on simultaneous observations collected from different platforms in view of the ERS-1 launch.

The utilization of AVHRR/2 data for TEMPO reflected the two phases into which TEMPO was divided: 1) an extended phase involving analysis of a long time series of images to select the most appropriate period for the execution of the oceanographic campaign and 2) an intensive phase, during the two-week campaign to support ship and aircraft operations by indicating frontal position and strength and to provide a source of synoptic data for the subsequent analysis.

One year worth of satellite imagery was examined in order to construct the statistics of persistence, intensity and evolution of the front and the Tyrrhenian Eddy. The edges of the SST front and the Tyrrhenian Eddy were digitized for each AVHRR/2 image. Analysis of the digitized frontal time series indicates the presence during fall and winter of a zonal SST front between Sardinia and the Italian Peninsula which is only visible in some of the spring and summer images. During the transition period between summer and fall the front evolves into a well organized cyclonic eddy which persists for the entire winter. An occasional cyclonic eddy, visible in some of the summer images, appears to be related to periods of intense wind in the Strait of Bonifacio. These observations support Moen's (1984) hypothesis which relates the presence of the North Tyrrhenian Eddy to baroclinic adjustment to the forcing by the wind stress curl. The radius of the Tyrrhenian Eddy varies from 50 to 75 km while the temperature difference between the eddy core and the surrounding waters ranges from 1 °C (in winter) to 2.5 °C (in fall).

On the basis of the AVHRR/2 observations from the extended phase the period September-October appeared to offer the best compromise between the need for cloud-free imagery and the likelihood of sampling the formation stages of the Tyrrhenian Eddy.

During the intensive phase, NOAA-11 passes received by the Italian Meteorological Service were processed by Telespazio in Rome. From each acquired pass a SST image of the Northern Tyrrhenian Sea was atmospherically corrected, remapped to Mercator projection, compressed (down to 20% of the original size) to save on transmission time and cost and relayed via Inmarsat to the ship approximately two hours after the satellite pass. On the ship the image was decompressed and presented on a PC screen. On the basis of the looks at this imagery the scientists on board the ship directed the ship to the area of strong SST fronts to perform multi-platform observations. The analysis of the images collected during the intensive phase indicates that a transition between a summer and a winter condition occurred. Namely, the imagery of 19-20 September displays a meridionally banded SST structure that progressively disappears, as well as a zonal SST front. From 21 September onwards the zonal front appears to evolve into a cyclonic cold core eddy which can be observed starting 30 September. This transition process may have indeed been accelerated by the passage of an atmospheric perturbation which lasted the 28 and 29 September.

REFERENCES

MOEN J., 1984. Variability and Mixing of the surface layer in the Tyrrhenian sea: Milex-80, Final Report. SACLANTCEN Report SR-75, 128p.