WIND INDUCED VARIABILITY IN THE WESTERN ADRIATIC CURRENT

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Abstract

During the winters of 2000/2001 and 2002/2003, current-meter moorings were used to observe the West Adriatic Current (WAC). In the former deployment, the southeastward current of the WAC was enhanced during four bursts of current following large bora wind events. Correlation strength between along-shore currents and model wind stress formed a pattern similar to the bora wind strength pattern, thus suggesting the current enhancement was not locally induced. In the latter deployment, a nine mooring section was maintained across the Adriatic. The WAC transport variability was dominated by events of strong transport, associated with strong bora and sirocco wind events.

Key words : wind-driven currents, West Adriatic Current, bora, sirocco

The Adriatic Circulation Experiment (ACE) is a project to study the circulation response and the transfer of heat and momentum when strong winds impact a marginal sea. The Adriatic Sea was chosen for the setting of this work because of the numerous strong wind events that occur there during every winter. The two types of wind events that are the most common are the bora winds that blow from the northeast with complex shear patterns induced by orography and the sirocco winds that blow from the southeast along the axis of the Adriatic. The general ocean current circulation is cyclonic with a northwestward-flowing East Adriatic Current (EAC) on the east side of the sea and a southeastward-flowing West Adriatic Current (WAC) on the west side. Cushman-Roisin *et al.* (1) provide a general review of the Adriatic winds and currents.

The U.S. Naval Research Laboratory in collaboration with the NATO SACLANT Undersea Research Centre and with Consiglio Nazionale delle Ricerche - Istituto di Scienze Marine – Ancona deployed a single Acoustic Doppler Current Profiler (ADCP) mooring during the winter of 2000/2001 in 57 meters of water near Senigallia, Italy in the pathway of the WAC. Book et al. (2) present the results of this pilot study and show that the non-tidal variability around the mean depth-average current of 10.4 cm/s toward 140∞ was dominated by bursts of currents that exceeded 30 cm/s during four events, and reached 45 cm/s during one event. These burst all followed bora wind events. Correlations between along-shore currents and simulated wind stress from the COAMPS™ model were calculated over the whole north Adriatic. The cross-covariance between currents and wind stress had a spatial pattern similar to the bora wind itself, reaching maxima along the northern Adriatic coast, off the southern tip of Istria, and near Ilovik Island. Wind stress in these regions had stronger correlation with currents at the mooring than did wind stress near the mooring, thus suggesting the bora current enhancement was not locally induced.

During the winter of 2002/2003, the ACE project combined with many other projects from Europe and the U.S. to focus on the physical oceanography of the northern Adriatic using current meter moorings, surface drifters, WERA radar, hydrographic cruises, towed vehicles, remote sensing, wind measurements, and numerical models. The group deployed three sections of current meter moorings from Italy to Croatia over the period of September 2002 to May 2003. One of these sections had nine moorings along a line between Senigallia, Italy and the Croatian island of Susak, across the location of the earlier pilot mooring deployment. Four of the ADCP moorings from this section crossed the path of the WAC along the Italian slope. The mean outward-directed volume transport of this sub-section was 0.15 Sv. The non-tidal transport of the sub-section is punctuated by numerous bursts of strong transport, each associated with a bora or sirocco wind event as modeled by the LAMI wind model. Events that produced non-tidal transports exceeding 0.3 Sv were the bora of September 23-24, December 7-10, January 6-12, January 25-26, February 1, February 12-19, and April 3-5, and the sirocco of November 16-19, and November 25-26. The highest observed non-tidal transport of 0.51 Sv occurred during the sirocco of November 16. Figure 1 shows the transport time series. The current-meter data from all the moorings show that strong bora and strong sirocco both strongly enhance the mean cyclonic circulation that crosses the Senigallia/Susak line.

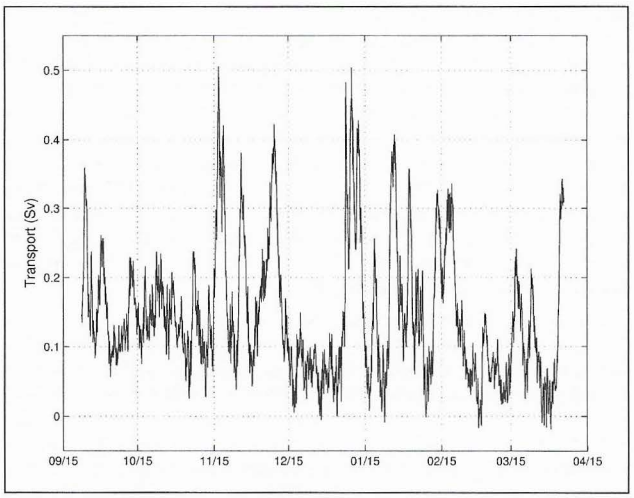

Fig. 1. Net transport directed out of the northern Adriatic (toward 138ºT) calculated from data measured by four ADCPs along a 25 km portion of the Italian slope off Senigallia. The measurements span the range of bottom depths from 25 to 66 m.

References

1 - Cushman-Roisin B., Gačić M., Poulain P.-M., and Artegiani A., 2001. Physical Oceanography of the Adriatic Sea: Past, Present and Future. Kluwer Academic Publ.

2 - Book J. W., Perkins H. T., Cavaleri L., Doyle J. D., Pullen J. D., in press. ADCP observations of the western Adriatic slope current during winter of 2001. *Prog. Oceanog.*