THE EAST AUSTRALIAN CURRENT

REVIEW OF WORK 1972-1977

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This review covers the period 1972-1977. Earlier work is covered in two previous reviews (Hamon 1970, 1973).

The period 1972-1977 has seen an expansion of field work in the area, mainly by the Royal Australian Naval Research Laboratory. CSIRO work has been on the use of satellite-tracked buoys, on near-coastal currents in relation to sea level, and an XBT section east from Sydney. This review will attempt to highlight the main results.

## Sub-surface Isothermal Layers

Lens-shaped isothermal core layers have been found by close-spaced XBT observations across a number of eddies (Nilsson, Andrews and Scully-Power in press). As an example, an eddy near 37°S, 151°E in late February 1975 was isothermal (16.5°±0.1°C) from 220 to 320 m at the centre. This layer was about 150 km in diameter, with thickness reducing toward its edges. Such features are most unusual, and are presently unexplained. They appear to form only south of 34°S, since careful inspection of the extensive series of XBT's obtained along 34°S by M.V. "Maheno" did not reveal any evidence of sub-surface mixed layers.

## The East Australien Current - Continuous, or a Series of Eddies ?

Current atlases show an "East Australian Current" as a series of south-oriented vectors from north of Brisbane to about Sydney (say 22° - 34°S). Is this a continuous current at any one time, or merely the near-shore flow due to a succession of anti-cyclonic eddies, or some mixture of the two ?

Early cruises seldom extended far enough north to throw useful light on this question. Few cruises have examined the near-shore circulation north of 27-29°S. Even south of these latitudes, no generalisation appears possible on the data presently available.

The track of the second EOLE satellite-tracked buoy (Cresswell 1976) gives evidence of a continuous current from 28°S to 36°S, although the lack of fixes during most of the southward passage along the coast means that the actual track taken is not known. (The buoy moved from 27°40'S, 154°50'E to 35°10'S, 151°00'E in 12 days, so its mean speed was at least 80 cm sec $^{-1}$).

Figure 2 of Hamon, Godfrey and Greig (1975) shows the variability in current at the shelf edge 27°S-32°30'S over a period of years, obtained from navigation logs of merchant ships.

The current was found to vary from zero to more than 4 knots, but it is not clear if the lower values are due to a genuine weakening of the current, a gap between eddies, or temporary shifts of the current away from the shelf edge.

The most recent satellite-tracked buoy results, for the period Janurary-July 1977 (Cresswell, unpublished data), support the idea of a string of eddies, at least between 29°S and 43°S. These eddies have shown remarkably little movement; one of Eden having been virtually stationary for about 4 months.

## "Summer" and "Winter" Eddies

Scully-Power et al. (1975) claim that the near-surface thermal structure of summer eddies differs from that of winter eddies. In summer, a shallow ( 40 m) layer of warmer water overlies the main thermal structure of the eddy, while in winter this shallow layer is absent. If this is generally true, we might expect to "see" eddies in thermal infra-red (or scanning microwave) satellite imagery in winter, but not in summer. However, other features in satellite imagery, e.g. cloud patterns, might reveal the presence of eddies (Scully-Power et al. 1975, Scully-Power and Twitchell 1975).

## Remote Sensing

Andews and Scully-Power (1976) reported location of an eddy off Jervis Bay in early September 1974, using an airborne radiation thermometer. Satellite observations of cloud patterns over eddies have also been reported (Scully-Power and Twitchell 1975). Attempts have been made to get satellite thermal infra-red imagery for the area, especially in real time, but these attempts have not been successful. Further attemps are being made.

Fully-processed sea surface temperature maps (GOSSTCOMP) of the whole area are being obtained regularly from NOAA/NESS, U.S.A., and some comparison has been made with SST from merchant ships. The GOSSTCOMP maps are on too small a scale for application to the East Australian Current area.

## Comparison with Numerical Model

Godfrey (1973a, b) examined the physical significance of processes in a numerical model of Bryan and Cox, especially processes associated with formation and movement of anticyclonic eddies near the model's western boundary. Longshore pressure gradients, and non-linear effects, were found to be important. The similarities between the model results and the observed East Australian Current system were stressed, and it was suggested that the underlying dynamics of the EAC might resemble those found in the numerical model.

Godfrey (1973b) also pointed out that upwelling, (defined as average upward vertical motion at depths of about 100-500 m) should occur within 90 km of the coast in the EAC region, but would not necessarily result in enrichment of the euphotic layer. The upwelling would consist mainly of warm, nutrient-poor water rising up over colder water. The mechanism is quite different from the classical wind-driven upwelling.

## The "Maheno" XBT Section

This section - at fortnightly intervals, along 34°S, to about 160°E - was started in July 1969. It was discontinued on 1975 so there are about 6 years of data. Boland (1973) reported on the first two years of observations. A more detailed report on the whole series is in Ms form.

The series confirms earlier estimates of space and time scales in the area. There is, however, evidence of longer time scales ( 120 days) in the latter half of the data, compared to 70 days in the first 2 years.

"Disturbances" (isotherm depressions or elevations) continually appear and disappear on the sections. With only one section, it is not possible to say if these disturbances are eddies or not. The seasonal behaviour in temperature at 240 m depth ($T_{240}$), averaged over the six years, shows three maxima, the most marked being in winter (May-July), and at longitudes between 154°E and 155°E. This marked winter maximum was unexpected. The other two maxima, in February and October-November, are nearer shore, and appear to be consistent with nutrient maxima below 30 m at the Port Hacking 50 m station (Hahn, Rochford and Godfrey 1977). Boland suggests the connection might be a bottom Ekman layer associated with the near-shore currents implied by the $T_{240}$ maxima.

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