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Moored Current Meter Measurements Across Davis Strait

by

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INTRODUCTION

Davis Strait is the connection between the Labrador Sea and the Arctic waters to the north. The sill depth in Davis Strait is approximately 650m and limits the exchange to the upper waters. The northward flowing, warm, salty water from the Labrador Sea is found on the eastern side, following the continental slope of Greenland. The cold, fresh water flowing southward extends across much of the strait and is most notable in the upper part of the water column.

Starting in the fall of 1987, an array of 5 current meter moorings was deployed (figure 1) across Davis Strait at 66° 15'N. The moorings were equipped with Aanderaa RCM5 current meters. Each instrument was set up to measure at hourly intervals the current velocity, temperature and most instruments measured the conductivity ratio (salinity) and pressure. Instruments were nominally located at 150m, 300m and 500m. The arrays were recovered each fall and new ones deployed until the fall of 1990 giving three years of measurements at fourteen instruments.

We were fortunate to have a complete return of all instruments but unfortunately there was considerably more data loss than we expected. Some of the loss was due to a couple of instances of water getting into the pressure cases and rotors being dislodged during the mooring operation. Most of the data loss was due to failure of the mechanical encoders during operation.

RECORD MEANS

The hourly values available were averaged over the entire record to give an overall impression of the conditions encountered over the three years. The temperature (figure 2) and salinity (figure 3) means show the same distribution as the 'snapshots' observed with a CTD during the cruises in the fall of each year. The eastern half of the strait shows the moored data giving a higher average than the instantaneous.

The northward component of velocity (figure 4) indicates averages of several cm/s (up to 8) southward. The eastern half of the section has the highest values, both southward and northward. The instrument indicating the greatest average is 150m at D_2. The minimum average is at 500m on mooring C.

MONTHLY MEANS

Temperature: At 150m (figure 5a) there is very little variability in the records at moorings A, B and generally at C. This is probably due to the large core of cold water at these locations giving no temperature gradients. Moorings D and E exhibit fluctuations of approximately 4°C, presumably due to east/west excursions in the front between cold arctic water and warm Labrador Sea water. On the eastern side there appears to be an annual signal with maximum temperature occurring in November. At 300m (figure 5b) the variability extends completely across Davis Strait. There is no obvious annual signal. At 500m (figure 5c) the

variability is reduced but significant changes are observed at moorings D and E.

Salinity: At 150m (figure 6a) at moorings A and B there is maximum variability with an annual signal of a minimum in January and a maximum in July. To a lesser degree the annual signal is observable at mooring C. There is no detectable annual signal at mooring E. At 300m (figure 6b) at moorings A and B the annual signal leads that at 150m by two or three months. At 500m (figure 6c) there is very little variability observed in salinity.

Currents: There is very little monthly variability in the east/west component of velocity (figures 7d, 7e and 7f) at any mooring or depth. The slight, non-zero values of mean component represent local variations in bathymetry. The dominant currents are north/south with only the eastern mooring showing dominantly northward currents. At 150m (figure 7a) at mooring A there is a strong annual signal with a strong reversal in direction. In December/January the maximum northward current is observed with the maximum southward in September/October. Mooring D at 150m may show an annual signal with maximum southward current in the fall. Moorings B, C and D show generally southward currents at 150m. Mooring E shows a generally northward flow at 150m with an annual signal - maximum in November and sometimes even southward in the spring. At 300m (figure 7b) all moorings indicate reduced currents with less indication of an annual signal. At 500m (figure 7c), the only significant currents are found at D_2 (south) and E (north).

TRANSPORT

A simple approach to computing volume transport through Davis Strait is to attribute a cross-sectional area to each of the fourteen instruments. This was done to compute the volume transport from the surface to 500m. Using the record mean values of north/south currents one gets an average southward volume transport at moorings A, B, C, D_1, and D_2 of 0.3, 0.7, 0.5, 0.5 and 1.1 x $10^6 m^3 s^{-1}$ respectively. The northward transport of mooring E is 0.7 x $10^6 m^3 s^{-1}$ giving a net southward transport through Davis Strait of 2.4 x $10^6 m^3 s^{-1}$.

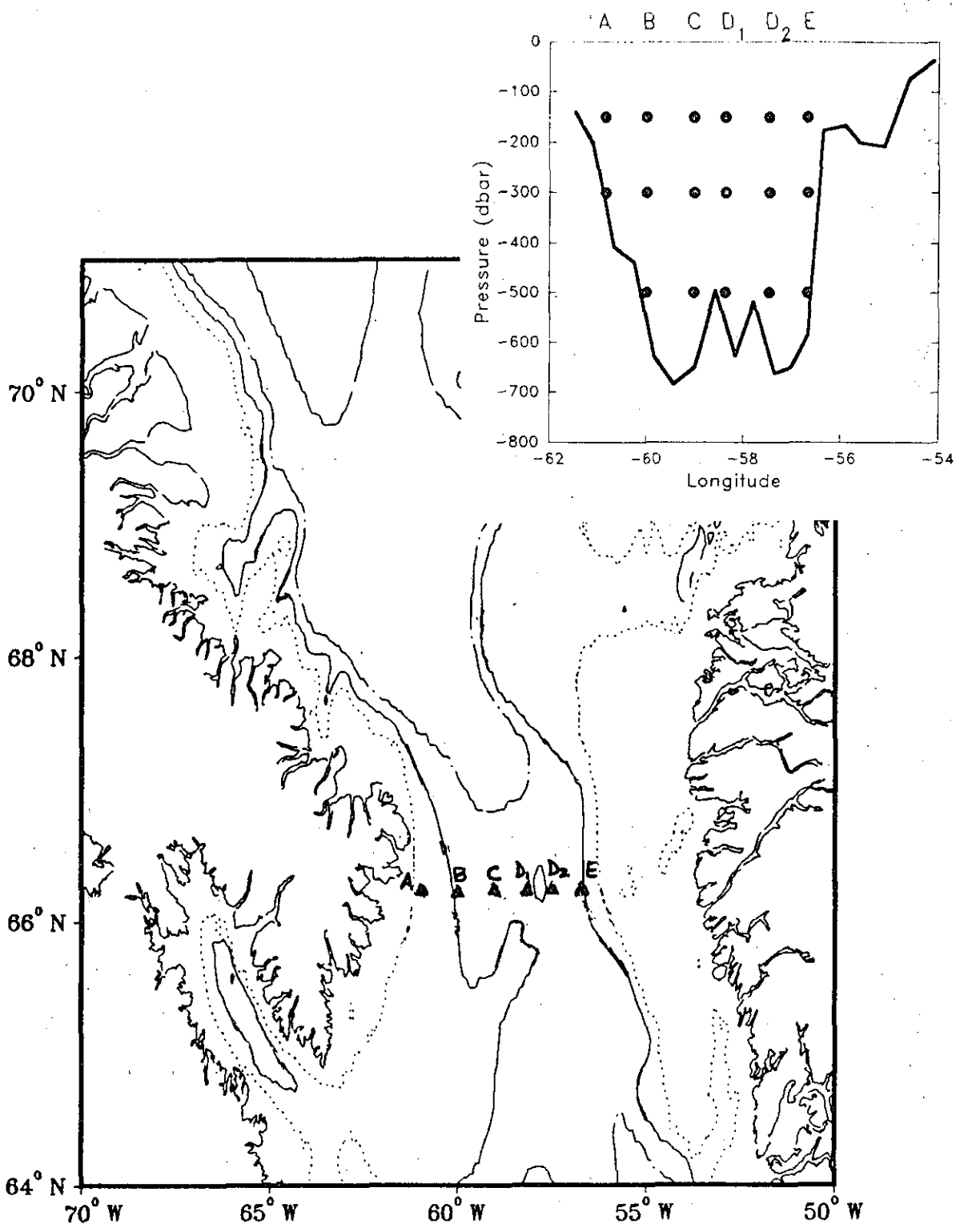

Figure 1: Location of moorings in Davis Strait and distribution of instruments across the line.

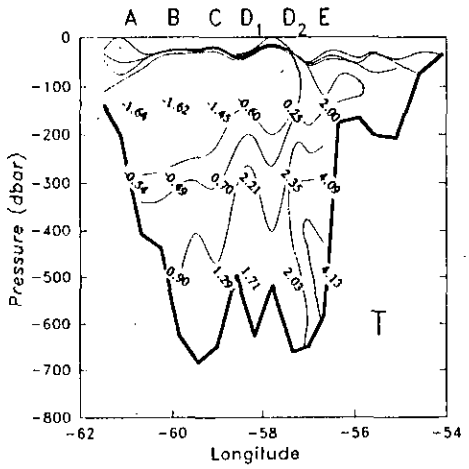

Figure 2: The record mean of temperature as measured by the current meters with a background of the temperature field as measured by a CTD in September, 1990.

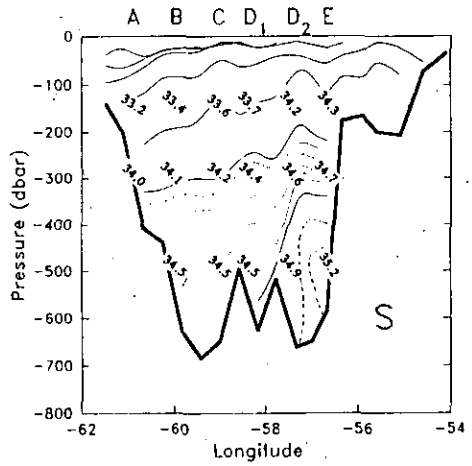

Figure 3: The record mean of salinity as measured by the current meters with a background of the salinity field as measured by a CTD in September, 1990.

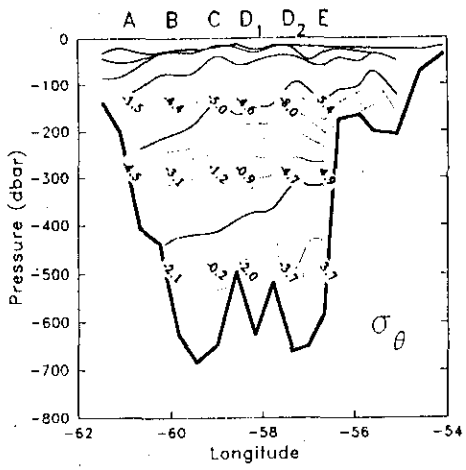

Figure 4: The record mean of the north component of velocity (cm/s) as measured by the current meters with a background of the density anomaly (σ_θ) field as measured by a CTD in September, 1990.

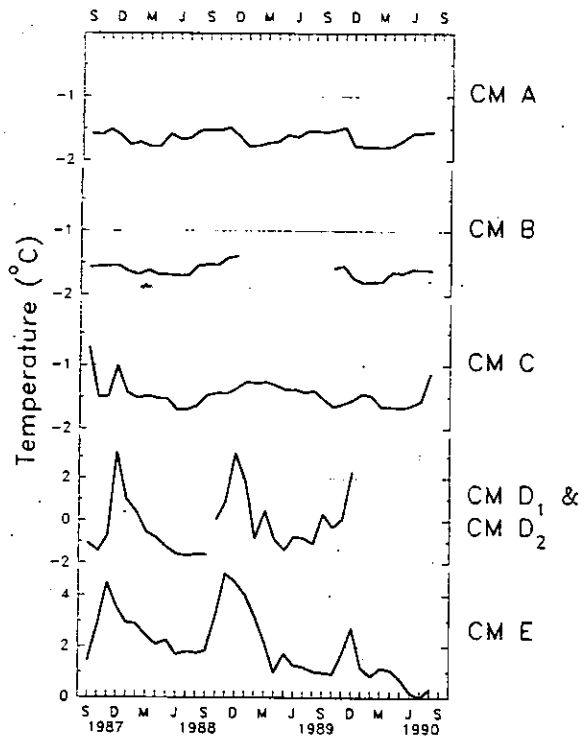

Figure 5a: Time series of monthly mean temperature at 150m.

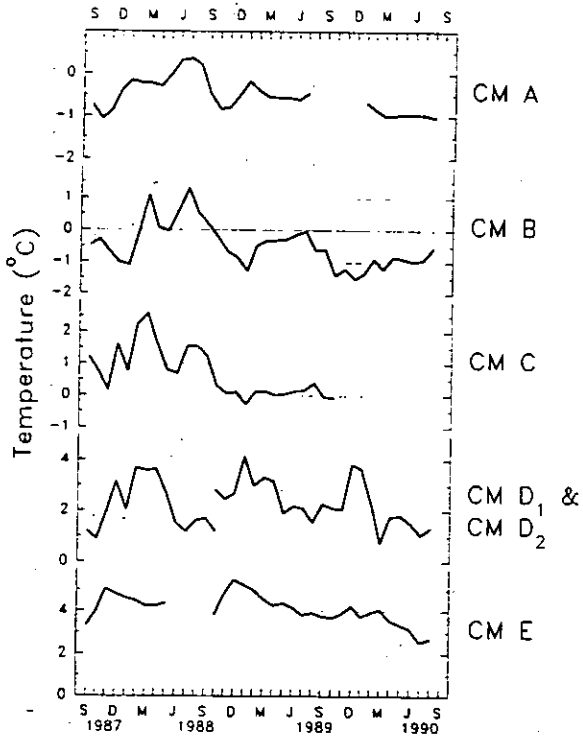

Figure 5b: Time series of monthly mean temperature at 300m.

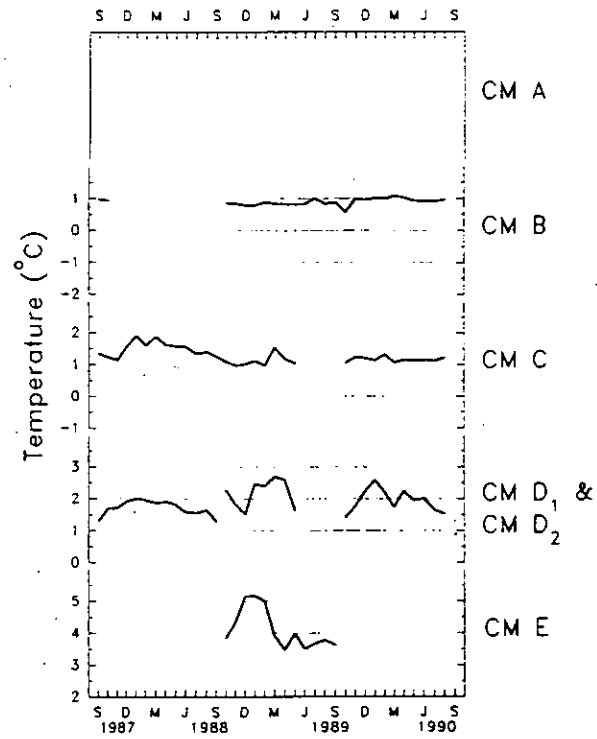

Figure 5c: Time series of monthly mean temperature at 500m.

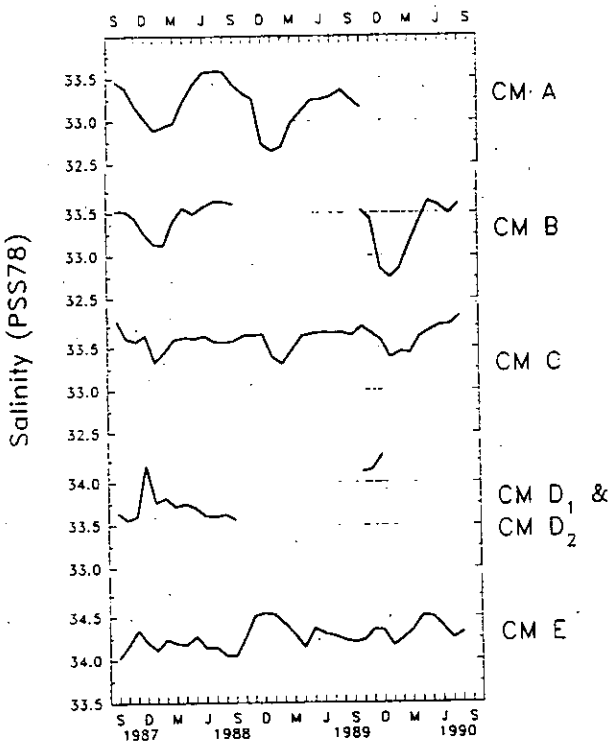

Figure 6a: Time series of monthly mean salinity at 150m.

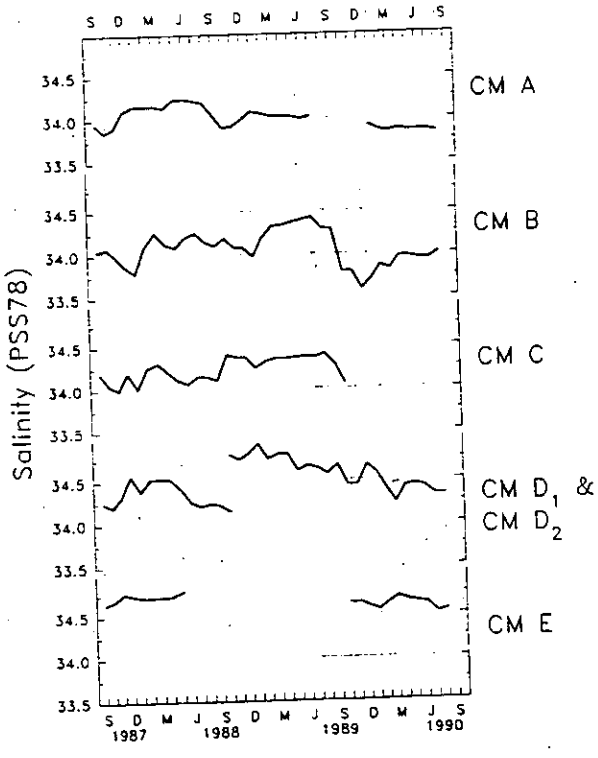

Figure 6b: Time series of monthly mean salinity at 300m.

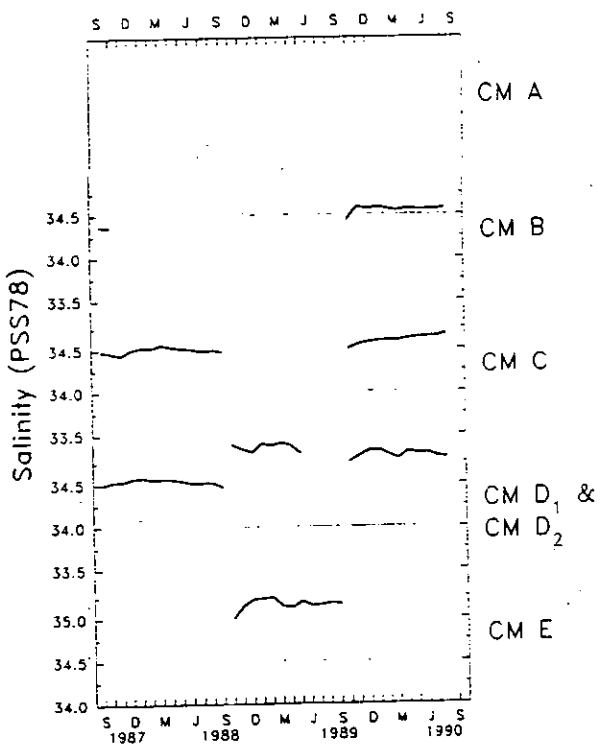

Figure 6c: Time series of monthly mean salinity at 500m.

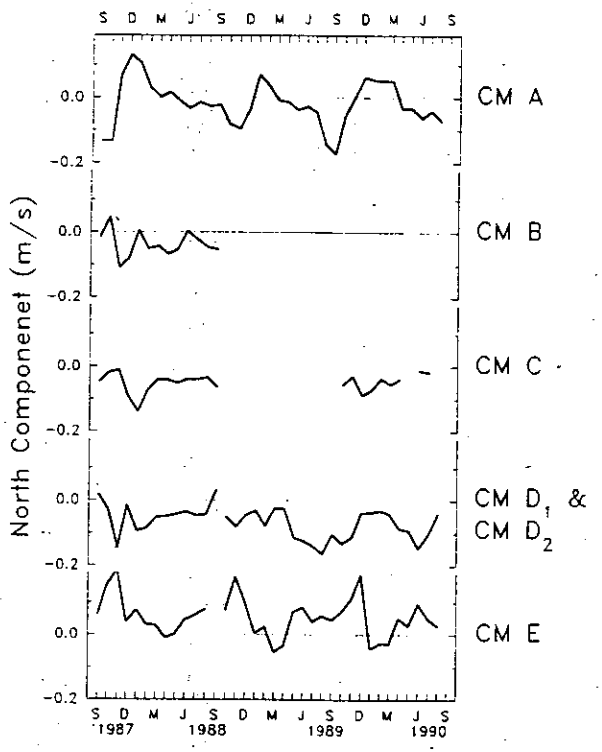

Figure 7a: Time series of monthly mean northward component of velocity at 150m.

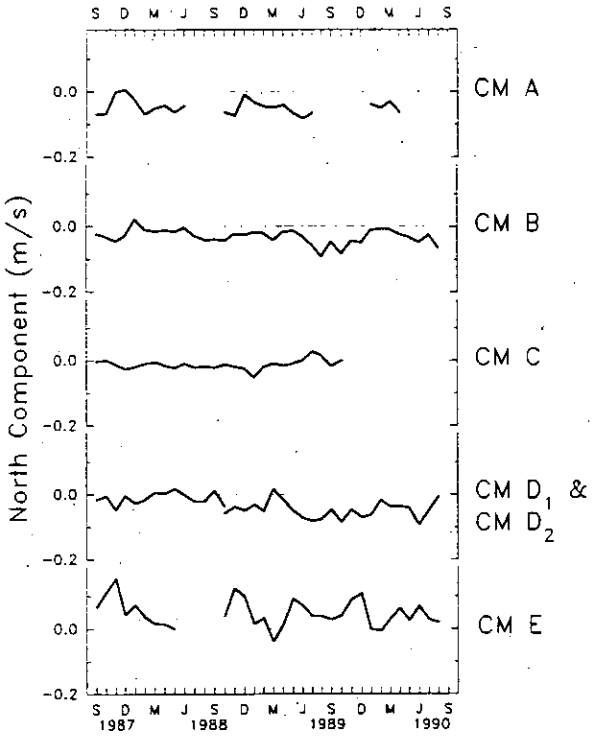

Figure 7b: Time series of monthly mean northward component of velocity at 300m.

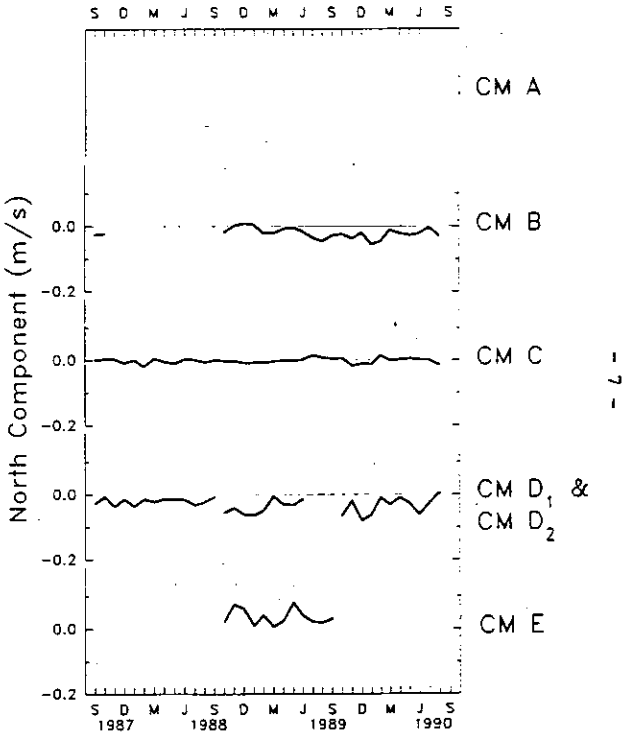

Figure 7c: Time series of monthly mean northward component of velocity at 500m.

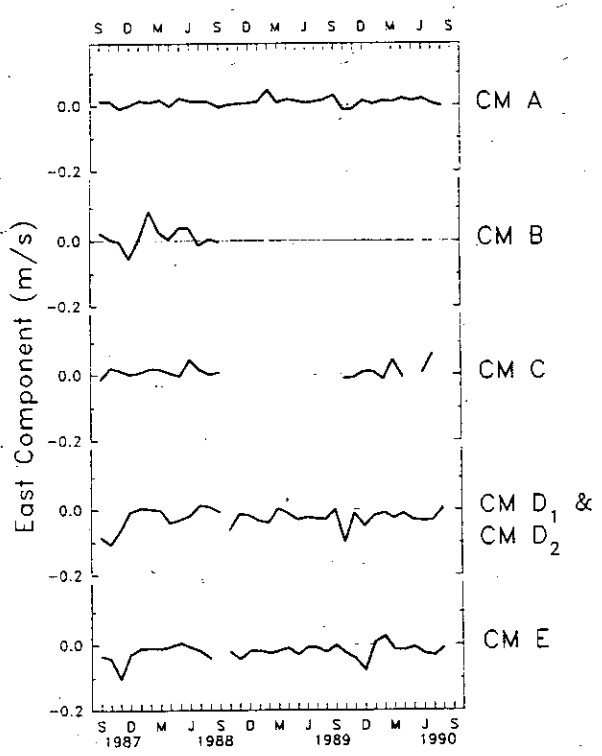

Figure 7d: Time series of monthly mean eastward component of velocity at 150m.

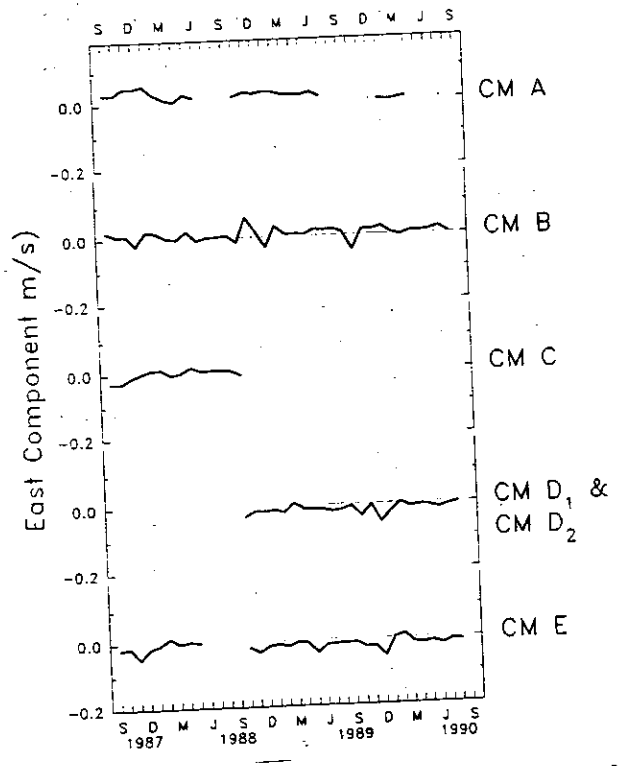

Figure 7e: Time series of monthly mean eastward component of velocity at 300m.

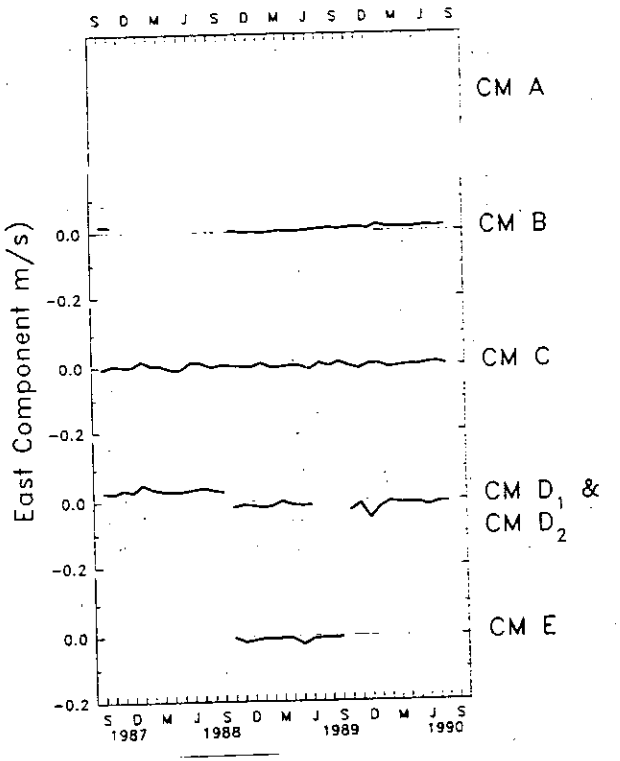

Figure 7f: Time series of monthly mean eastward component of velocity at 500m.