A note on the continuance of the Somali eddy after the cessation of the Southwest monsoon

Somali eddy
Geostrophic transport

Tourbillon des Somalis
Transport géostrophique

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ABSTRACT

Near synoptic observations off the Somali coast using expendable bathythermographs indicate that the large eddy located in the northern Somali Basin which developed during the SW monsoon, could still be identified during the following Northeast monsoon. The offshore (towards the East) geostrophic volume transport is decreasing from 26×10^6 m^3/sec. in October to 7×10^6 m^3/sec. in December.

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RÉSUMÉ

Note sur la continuité du tourbillon des Somalis après la fin de la mousson de Sud-Ouest.

Des observations presque synoptiques, effectuées au large de la côte des Somalis à l'aide de bathythermographes perdables, indiquent que le grand tourbillon situé au nord du bassin des Somalis qui se développe pendant la mousson de Sud-Ouest, peut encore être identifié pendant la mousson suivante de Nord-Est. Le volume du transport géostrophique vers le large (vers l'Est) décroît de 26.10 m^3/s en octobre à 7.10^6 m^3 en décembre.

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Near synoptic observations off the Somali coast during the beginning of the Northeast monsoon toward the end of 1978 from the French R/V "Jean Charcot" and Exxon tanker "Esso Wilhelmshaven", using expendable bathythermographs (XBTs), indicate that the large eddy (Bruce, 1979) located in the Northern Somali Basin which developed during the previous Southwest monsoon, could still be identified and mapped (Fig. 1).

Surveys during the Southwest monsoon within the last twenty years reveal that large eddies develop during June-September, but it is not certain after the cessation of the SW monsoon winds what decay rate can be attributed to the eddies. From a number of hydrographic observations and current measurements at the end of the NE monsoon in February-March 1965, Bruce and Volkmann (1969) found evidence for a large subsurface eddy (maximum velocities were at 400 m depth) located in the Northern Somali Basin. They suggested that this deeper circulation might have been associated with the eddy which had developed during the preceding Southwest monsoon in the upper layers and became increasingly deep as the season progressed. The velocity field in the upper 200 m by this time (February-March) was relatively weak, and there was no clearly discernable eddy structure, suggesting a downward transfer of momentum during the time since the end of the Southwest monsoon.

The temperature sections (Fig. 1) from "Jean Charcot" and "Esso Wilhelmshaven" using relatively closely spaced XBT stations (~20-30 km between stations) between 20 November-2 December 1978 show the eddy center to be located between about 9°N-10°N. The

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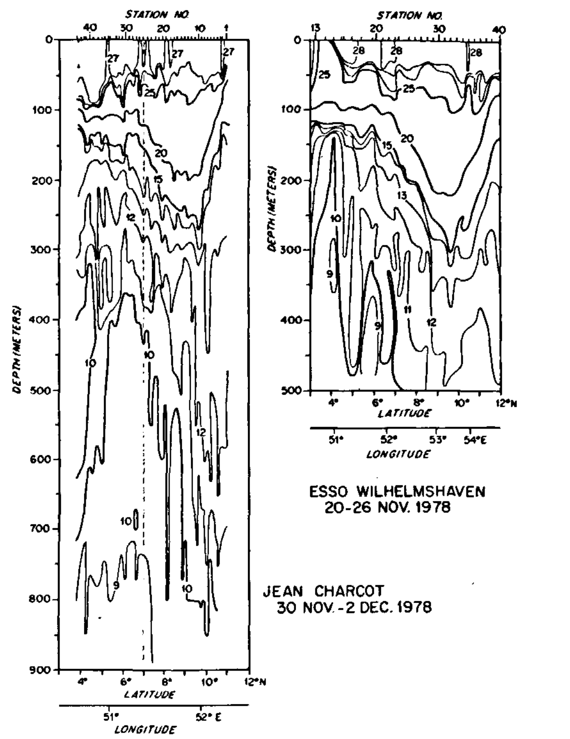

Figure 1

Temperature (°C) sections from XBT observations in the Somali Basin. Station positions are shown in Figure 2. The vertical dashed line represents the change of direction in the "Jean Charcot" XBT section.

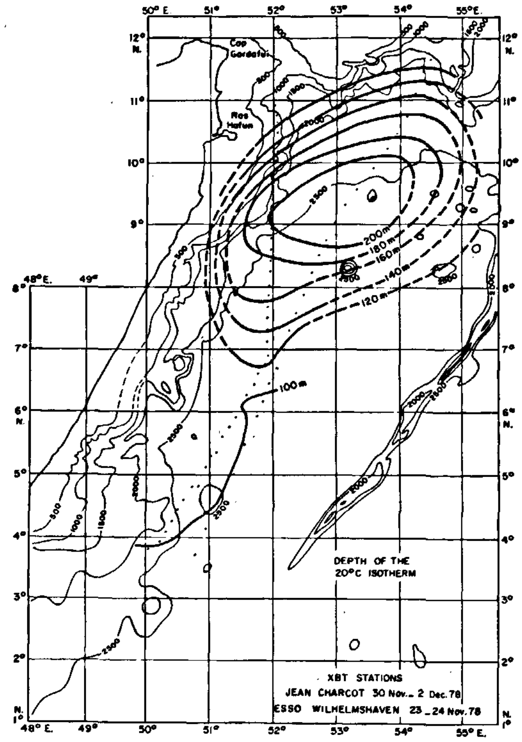

Figure 2

Depth, in meters, of 20°C isotherm in Northern Somali Basin between 23 November-2 December 1978. Depths of isobaths shown in fathoms. The contours are dashed outside of the XBT observations area.

outer edge of the eddy extends South to about 6°N and North to 12°N. Horizontal temperature gradients associated with the eddy are apparent to at least 600 m depth on the "Jean Charcot" section.

The mixed layer at this time extends to about 50 m depth, whereas within the eddy during the period of maximum wind strength of the Southwest monsoon (July, August, and early September) (Bruce, 1979), this nearly isothermal layer may be as deep as 200 m. The position of the eddy is shown by a map of the depth of the 20°C isotherm (Fig. 2).

The signal of the eddy in the surface dynamic topography is shown in Figure 3. The same salinity values have been assumed for all stations using a mean T-S curve, determined by data obtained from previous surveys during the Southwest monsoon period. The density gradients found in the Somali eddy field are largely a function of temperature. The deep trough to the north of the eddy (11°30'N), similar to that occurring during the Southwest monsoon (Bruce, 1979), is still evident, with a drop of 0.35 dy.m from the eddy center. The offshore (toward the East) geostrophic volume transport through the section amounts to 22×10^6 m^3/sec. (0-400 m relative to 400 dbar). During some years in mid-SW monsoon the offshore transport may reach 38 to 42×10^6 m^3/sec. (Bruce, 1979).

Two further XBT sections from data obtained previous to and after that of "Esso Wilhelmshaven", although along essentially the same sea lane ("Esso Tokyo", 11-12 October 1978 and "Esso Wilhelmshaven", 26-27 December 1978), allow us to estimate the decrease in offshore volume transport toward the end of the year (Table). In a similar manner to that in Figure 3, the offshore transport is calculated between the position of

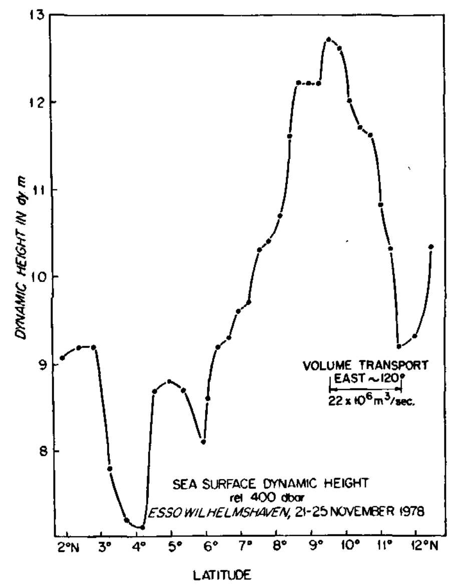

Figure 3

Surface dynamic height along "Esso Wilhelmshaven" section relative to 400 dbar.

Table

Volume transport, relative to 400 dbar (0-400 m) offshore through tanker section.

Date	Latitude Longitude	to	Latitude Longitude	Volume transport in 10^6 m^3/sec.
11-12 October 1978	8°30'N 53°30'E		11°05'N 54°47'E	26
24 November 1978	9°37'N 53°21'E		11°36'N 54°30'E	22
26-27 December 1978	10°12'N 54°16'E		12°03'N 55°07'E	7

the station with maximum dynamic height in the approximate center of the eddy and that with the lowest value in the trough of the Northern eddy boundary. However, as noted in the Table, these station positions vary because of apparent northward translation of the eddy relative to the tanker sea lane during the period 11 October-27 December. The transport decreased only from 26 to 22×10^6 m^3/sec^{-1} during approximately six weeks between 11-12 October and 24 November. However, the relatively rapid drop from 22 to 7×10^6 $m^3/sec.$ between 24 November and 26-27 December might have been caused in part by the opposing Northeast monsoon (duration normally December-March in the Somali Basin). Wind data from the tankers indicate that in 1978 the SW winds in the Somali Basin had stopped by mid-October, and had then commenced from the NE by late November.

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