CURRENTS OFF THE EAST COAST OF MALTA

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Abstract

The results of experiments to measure the surface and subsurface currents off the east coast of Malta are presented. These experiments were conducted as part of the IOC/UNEP pilot project on the coastal transport of pollutants. The subsurface currents were measured off the east coast of Malta at a depth of 25 m. The results from data recorded between April and December 1978 show a mean subsurface current flow of 0.07 $m s^{-1}$ along the coast towards the east southeast, with diurnal variations in the flow. The results from surface drift card experiments conducted in 1979 show wind induced surface currents.

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Introduction

In continuing the work previously reported to this committee, (HAVARD 1978), further measurements of subsurface and surface coastal currents have been made as part of the IOC/UNEP co-ordinated pilot project MED-VI. The measurements were conducted off the east coast of Malta.

Materials & Methods

The subsurface currents were measured using a recording current meter (Aanderaa RCM4). The current meter station was at the location of the submarine effluent outfall (35° 54.0'N, 14° 32.7'E) which is 800 m offshore. The current meter was moored 25 m below the surface in a total water depth of 35 m, using a subsurface taut mooring. The meters were installed and serviced by divers. The recorded tapes were translated into printout and graphic display by Aanderaa Instruments. Three tapes were sent to the Instituto de Investigaciones Pesqueras, Barcelona where the progressive vector diagrams and component plots were prepared. This computer processing of the data by Dr A. Crusado of I.I.P. is gratefully acknowledged.

Surface currents have been infered from drift card experiments. The cards used in the releases in September 1979 were horizontally floating cards made in the department. (Previous local experiments in 1973 and 1977 used vertically floating cards). The cards were released in batches of 100 from 3 stations (see Fig. 1) on two occasions (3rd and 13th September).

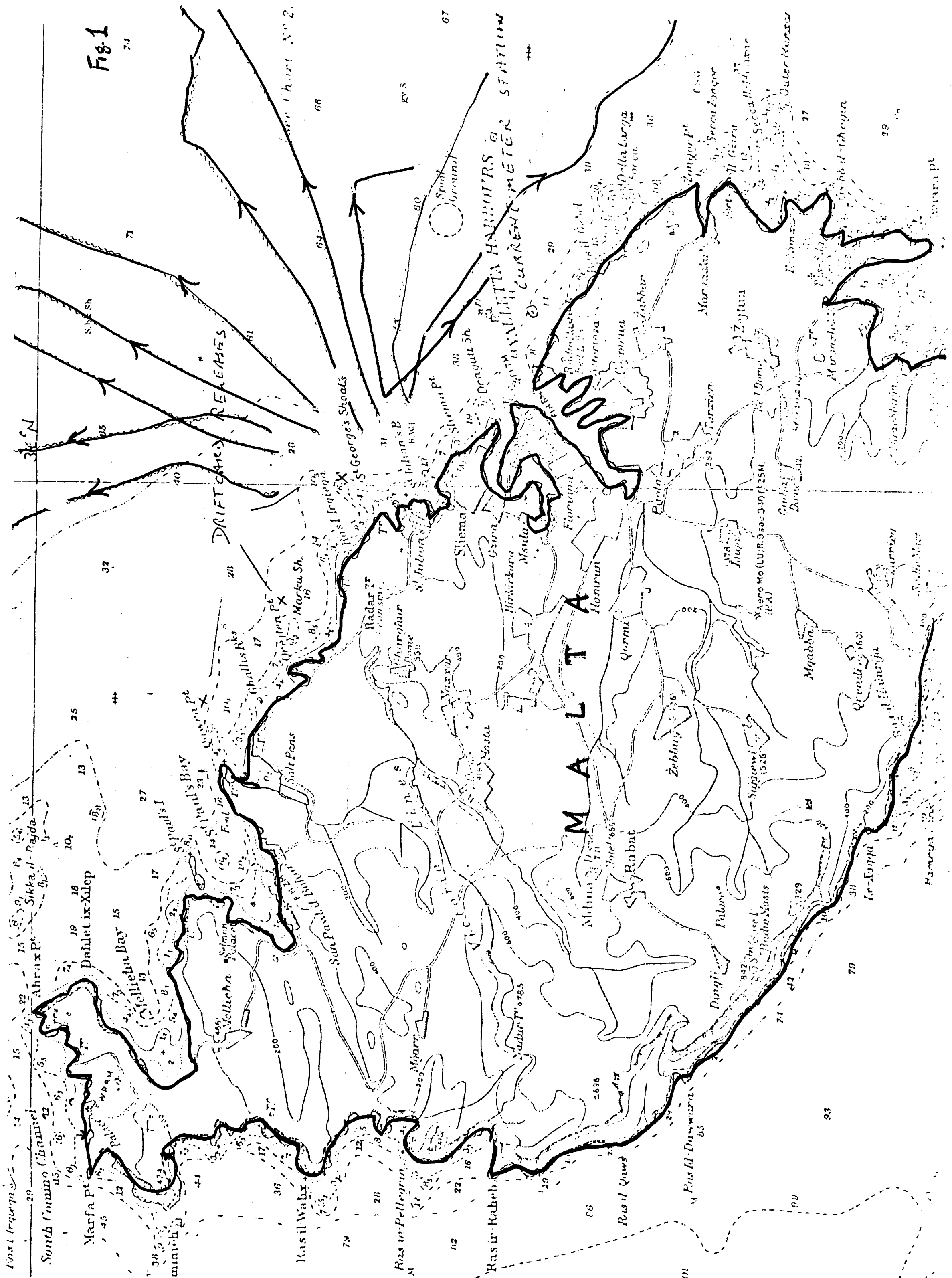


Fig 1
DRIFT CARD RELEASES
VALLETTA HARBOURS CURRENT METER STATION
MALTA
St Georges Shoals
St Pauls Bay
Mellieha Bay
Rabat
Qormi
Sliema

On each occasion the **last** batch of cards was tracked by the releasing vessel for about 1 hour after release. The cards released at the two previous stations were relocated as the vessel returned to port. This gave data on the initial path and velocity of the cards which were allowed to continue to drift. A drogue set at 1 m depth was also released with the first batch of cards and recovered as the vessel returned to port, in order to compare surface currents with those just beneath the surface. Precise positioning was attained using double horizontal sextant bearings.

Results

i) Subsurface currents

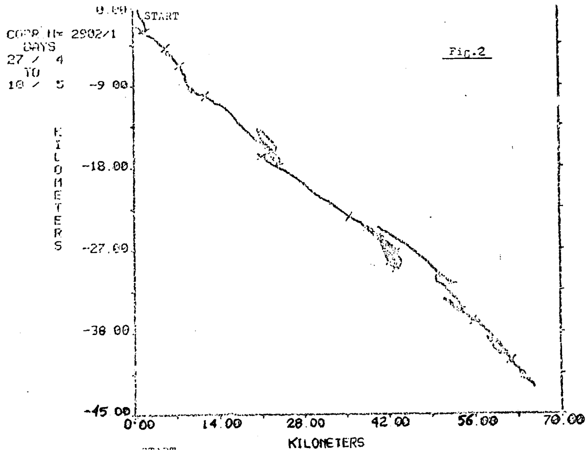
The progressive vector diagrams for the data recorded from April to September 1978 are shown in Figs. 2, 3 and 4. The mean transport of the water mass at this depth (25 m) is to the eastsoutheast with a velocity of the order of 0.07 m s^{-1}. The variations in the current are more easily seen on the component plots. An example of these component plots is shown in Figs 5 and 6 which are the east and north component respectively for the first 20 days of the data shown in Fig. 4. (i.e. from 29th July to 18th August 1978). During this period of 20 days the winds were relatively light and the mean velocity of water transport was less than the overall figure quoted above. The component plots show clearly diurnal variations in the current with higher frequency components superimposed. The maximum current recorded during this period is 0.45 m s^{-1} to the eastsoutheast.

(ii) Drift card results

As stated above the cards released in 1979 were initially tracked. On both occasions the surface wind happened to be from the southeast (this is not the prevailing direction). The cards initially drifted along the coast in an approximately northwesterly direction with a speed of about ¼ m s^{-1}. The drogue also moved in the same direction but with a lower speed. On the second occasion, cards recovered in the first 24 hours showed that this initial flow was continued. Some cards were stranded on the northeast coast of Gozo having been transported 13 miles in less than 24 hours. A change in wind direction to the northeast on subsequent days brought the cards back down the coast, with cards being recovered several days later from the southeastern end of Malta. These results emphasise the strong dependance of surface coastal currents on wind strength and direction in the Malta area.

Discussion

Malta lies in the region of water exchange between the western and eastern basins. The water is fairly well stratified. The upper water is transported from the western to eastern basins and can be expected


START
Fig.2
KILOMETERS
KILOMETERS
0.00
14.00
28.00
42.00
56.00
70.00
-9.00
-18.00
-27.00
-38.00
-45.00

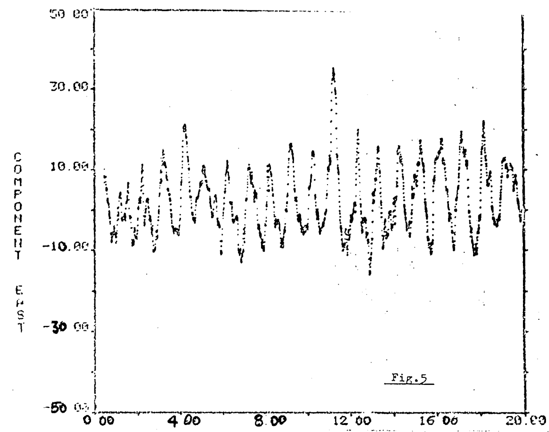
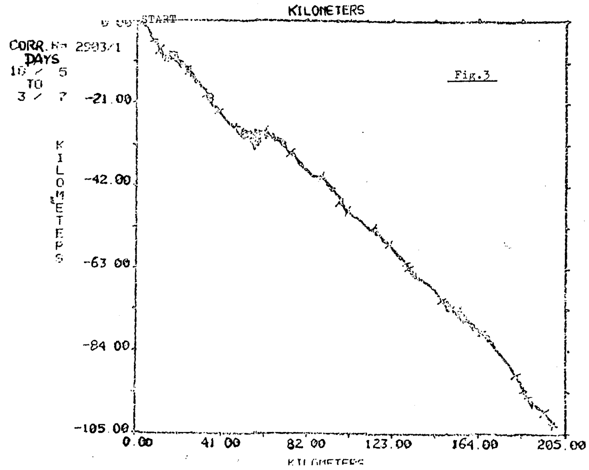


Fig.5
COMPONENT EAST
50.00
30.00
10.00
-10.00
-30.00
-50.00
0.00
4.00
8.00
12.00
16.00
20.00


START
Fig.3
KILOMETERS
0.00
41.00
82.00
123.00
164.00
205.00
-21.00
-42.00
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-84.00
-105.00

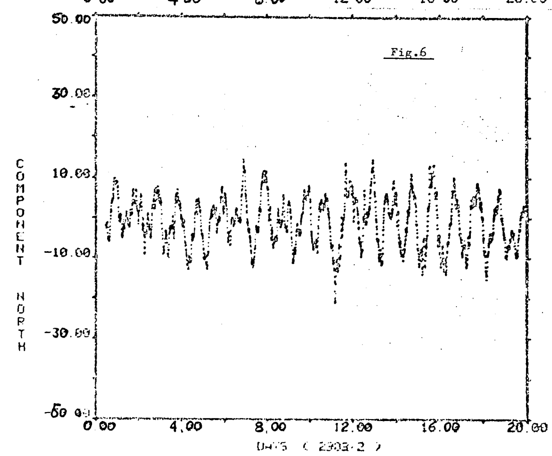
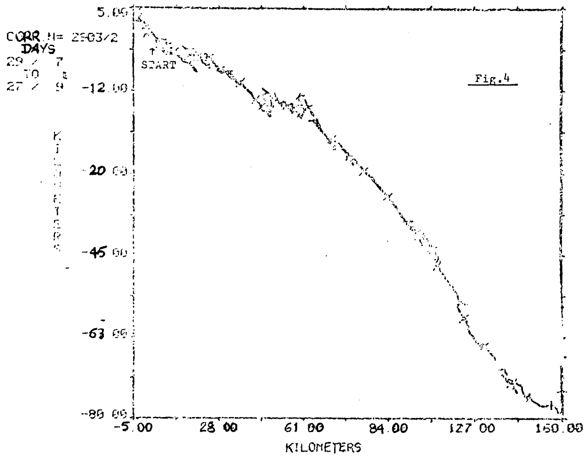


Fig.6
COMPONENT NORTH
50.00
30.00
10.00
-10.00
-30.00
-50.00
0.00
4.00
8.00
12.00
16.00
20.00


START
Fig.4
KILOMETERS
5.00
-12.00
-20.00
-45.00
-63.00
-80.00
-5.00
28.00
61.00
84.00
127.00
160.00

to flow past Malta in a southeasterly direction. As the sill depth of the Malta Channel between Malta and Sicily is only about 100 m, the return flow of intermediate water will be south of Malta over the sill with a depth of about 500 m between Malta and the Medena bank.

As was expected from the bathymetry, the coastal currents measured have strong longshore components, with a mean transport to the southeast. The relatively strong diurnal variation in the subsurface current was not expected as there is no significant vertical tide at Malta. It is not certain that the diurnal and higher frequency variations are tidal in origin but the long period over which they have been observed would indicate a tidal origin. Unfortunately no tide gauge exists at Malta so no correlation with vertical tide has yet been possible.

This observed diurnal variation in subsurface current means that the data from drift cards must be carefully interpreted. Unfortunately no method other than drift cards was available locally to study surface currents. The major conclusion that can be drawn from drift card experiments is the strong dependance on surface wind. The initial paths of the cards released in 1979 was opposite to those of the 1973 and 1977 experiments. Since surface wind is highly variable around Malta, the resulting surface current will also be highly variable.

Previous current data for the area around Malta is available from ships drift measurements. The major feature of this data is the high variability in the estimated current especially in winter.

References

HAVARD D.A. - The Study of the Problems of the Coastal Transport of Pollutants in Maltese Coastal Waters. IV[es] Journess Etud. Pollutions, pp 555-557, Antalya, C.I.E.S.M. (1978).