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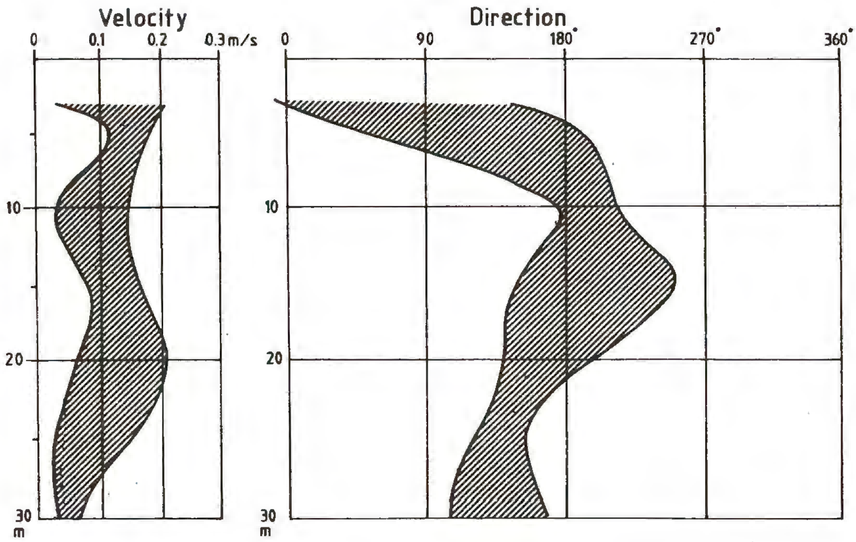

ON THE SPATIAL REPRESENTATIVITY OF OUR OCEANOGRAPHIC MEASUREMENTS

By Barry Broman

SMHI SWEDISH METEOROLOGICAL AND HYDROLOGICAL INSTITUTE

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Abstract

ABSTRACT

The oceanographic variables measured at and transmitted by the automatic stations are measured in principle at one point. The locations near the body of a lighthouse leeds to the question: "How far from the point are the values valid?" and "How do the variables vary in the surroundings of the station?"

A straight-forward study was made. At several locations along a section out from the lighthouse temperature, salinity and currents were measured. The results from this study are presented.

Key words

Current, Temperature, Salinity, Spatial Representativity

Supplementary notes

This paper was first presented at the COST 43 Seminar in Bergen, Norway, 8 - 9 September 1980.

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INTRODUCTION

When using measured data one often has to consider what the measurements mean and what they represent. Measurements are made at points in space, but one normally uses the data as representative for a larger surrounding space. By locating the automatic oceanographical stations at lighthouses off-shore - i.e., at places where the bottom depth in most cases is much smaller than that in the surrounding sea - an error especially in the current measurements is introduced. An interesting question is then: How large will the discrepancies in the measured variables be within reasonable distances - a kilometer or so - from the lighthouse? In order to estimate this, some rather simple field measurements were made at the two stations Trubaduren and Almagrundet shown in the map in figure 1.

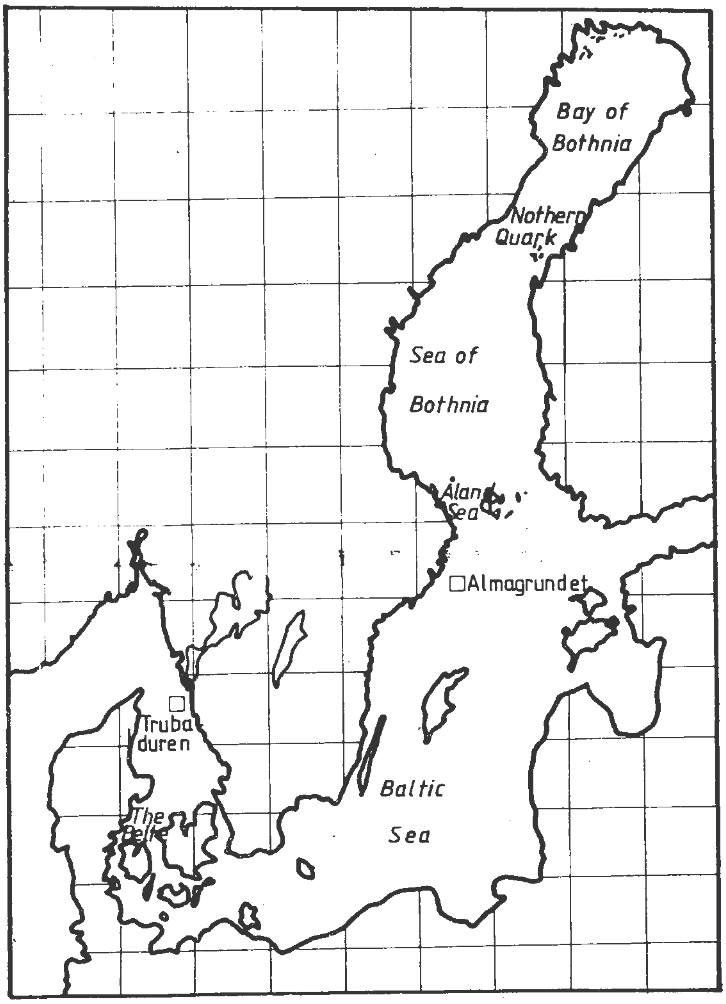

Figure 1. Map over the Baltic area.

FIELD PROGRAMS

Trubaduren

By using gelatie pendulums (Haamer, 1973) and a CTD-probe (Inter-Ocean), currents - directions and velocities - temperature and salinity were measured at 8 station along a section perpendicular to the main current direction in the area. The measurements were supposed to show how the current component in the main direction as well as both temperature and salinity varies with distance from the lighthouse. Together with some depth contours the 8 stations are shown in figure 2.

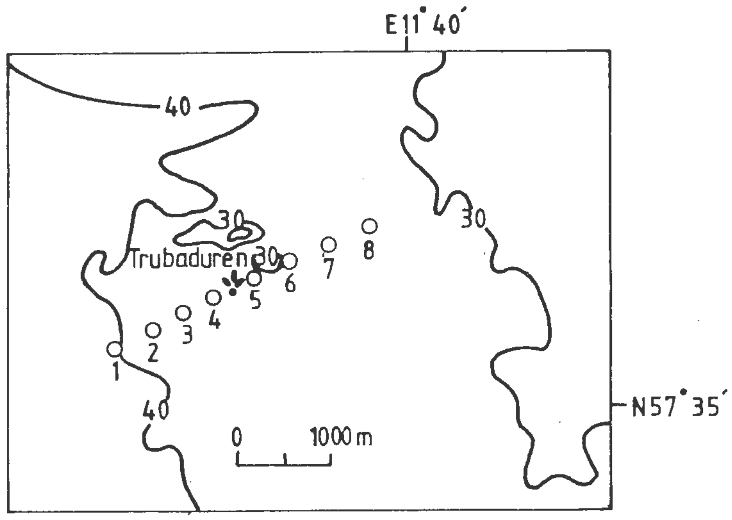

Figure 2. Field stations at Trubaduren.

Measurements were made on three occasions (1980-01-18, 1980-04-10 (I), 1980-04-10 (II)).

Almagrundet

Measurements of currents, temperature and salinity were performed at 3 stations close to the lighthouse of Almagrundet. So far there are observations from only one occasion (1979-11-22). Figure 3 shows depth contours and the three stations in the area close to the lighthouse.

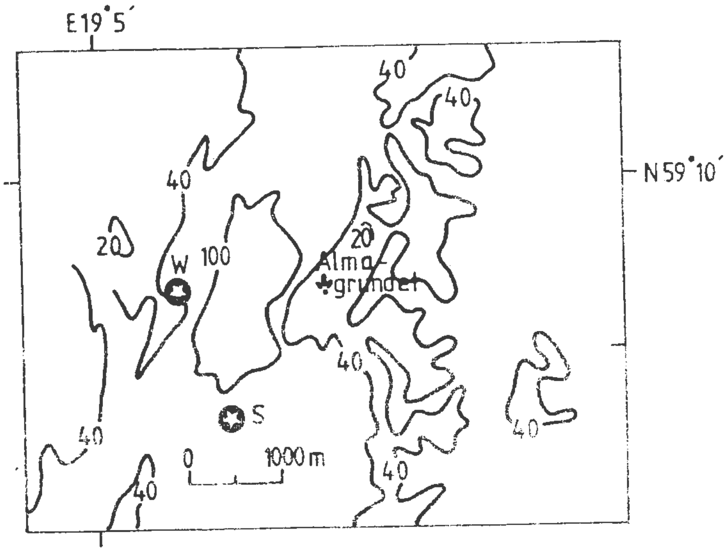

Figure 3. Field stations at Almagrundet.

The locations of these were more or less arbitrarily chosen. The current observations were made by following drifting drogues for a couple of hours.

RESULTS

The fields of current, temperature and salinity in the measured section close to Trubaduren from the three occasions were prepared. These fields are shown in a number of diagrams at the end of this paper. They all show that all the measured variables change along the section. This becomes clearer in diagrams showing the observed total variation span of the measured parameters (currents: figures 4, 5, and 6, shaded areas).

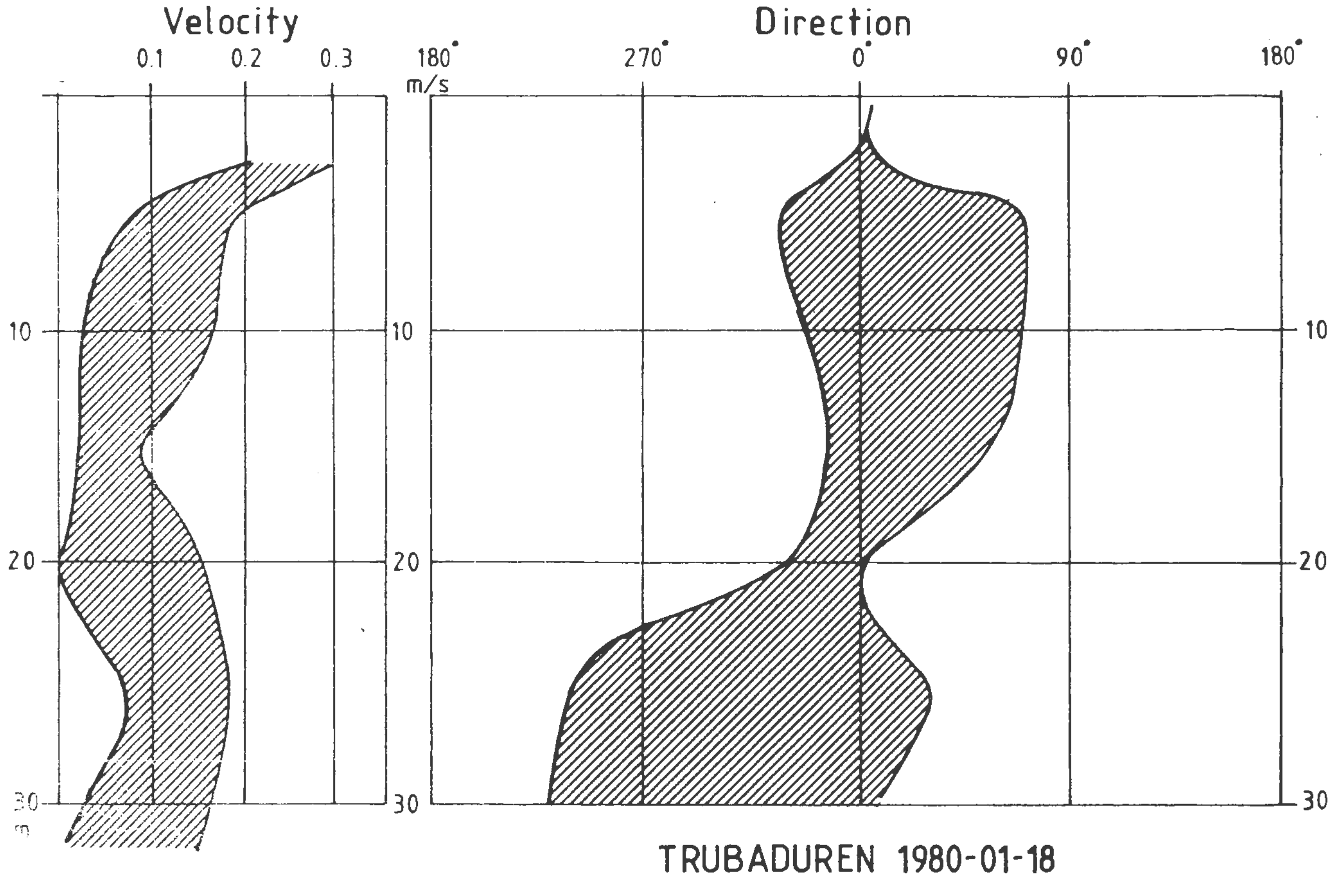

Figure 4. Trubaduren 1980-01-18.

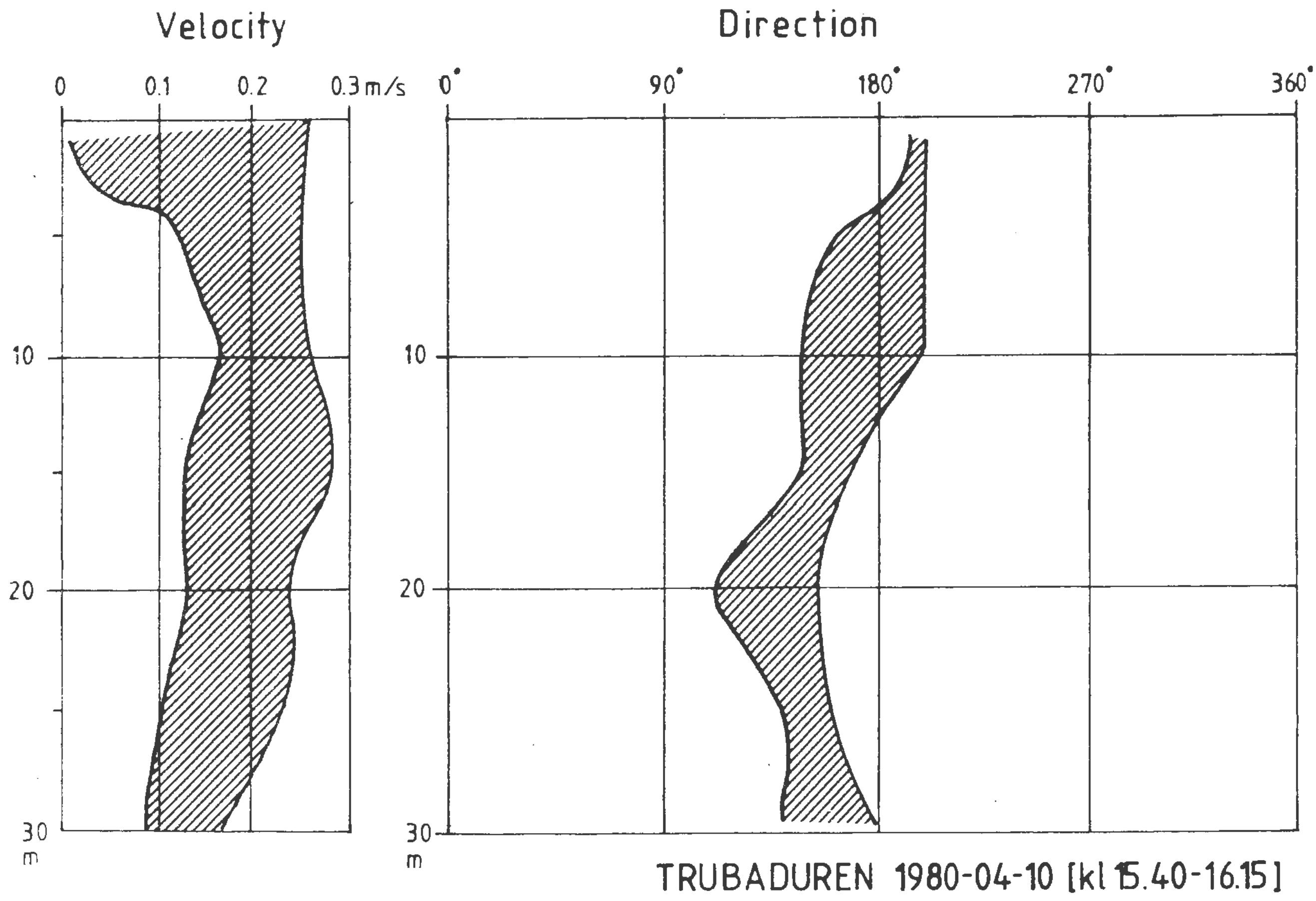

Figure 5. Trubaduren 1980-04-10 (1540-1615).

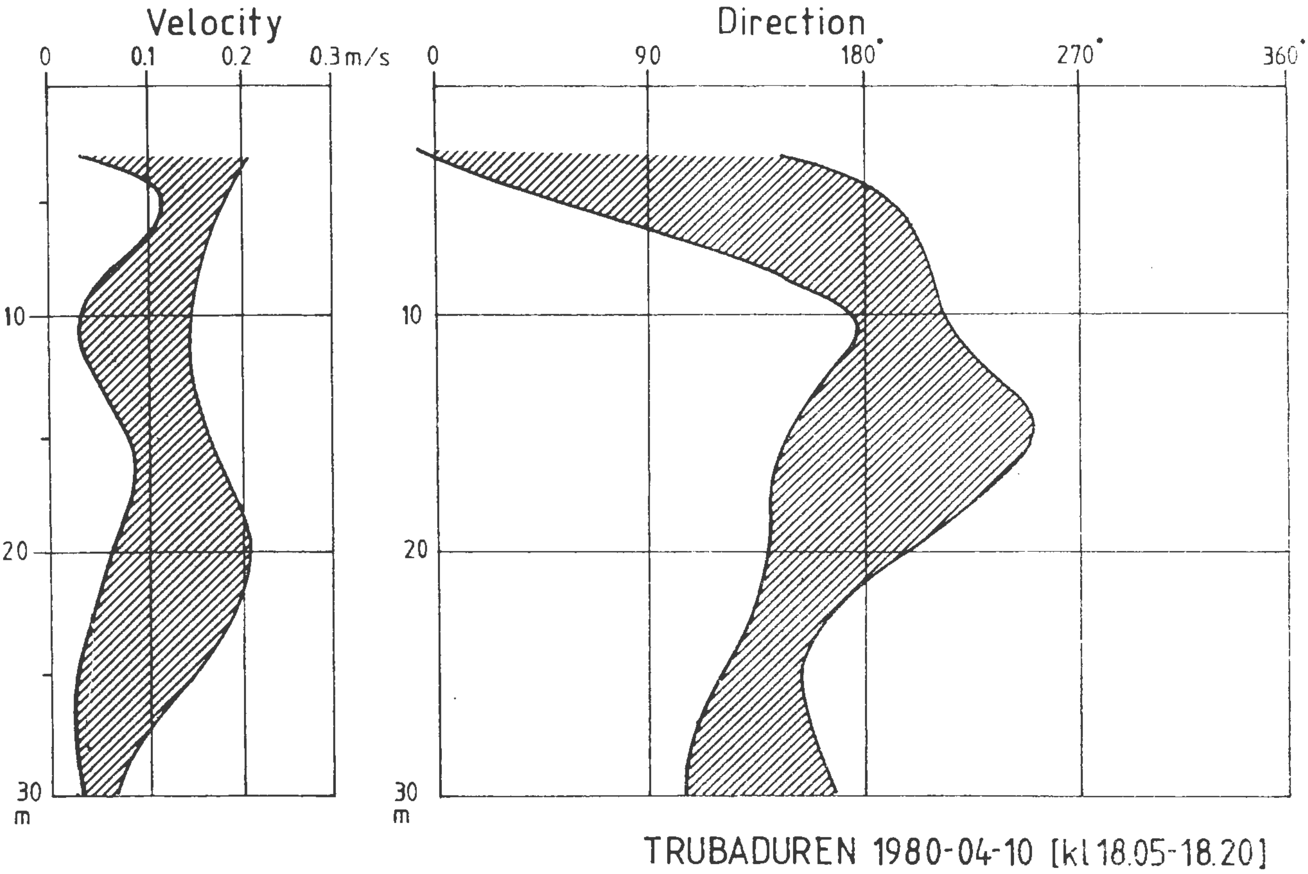

Figure 6. Trubaduren 1980-04-10 (1805-1820).

From the diagrams one can conclude that the velocity varies within about 0.1 m/s, and that the direction sometimes shows considerable variation. As expected, the variations of temperature and salinity are largest within the thermocline and the halocline, bur even above the halocline there is considerable variation (figures 7 and 8).

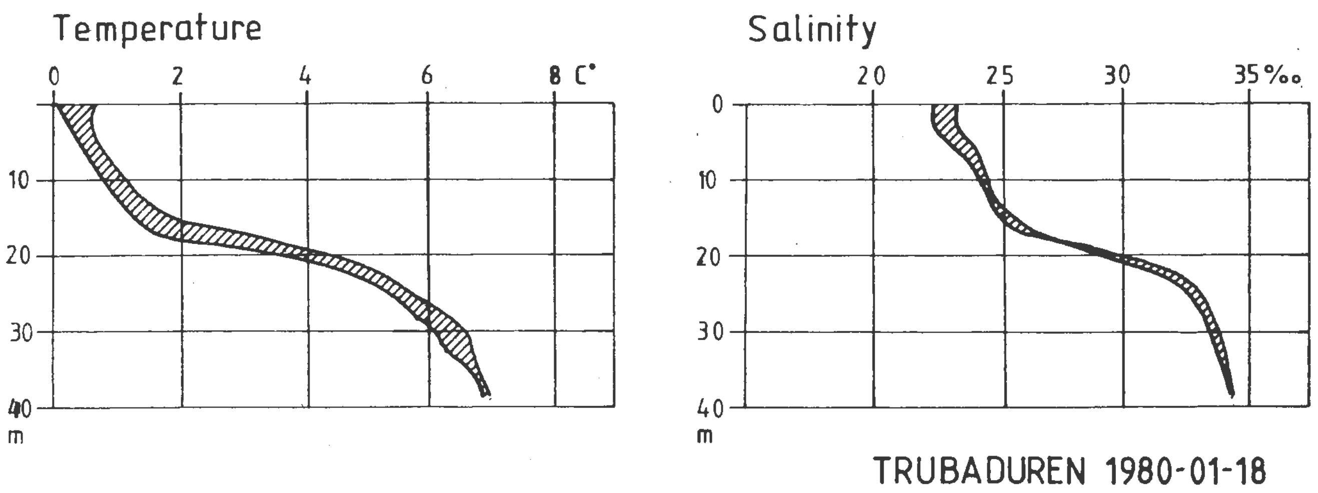

Figure 7. Trubaduren 1980-01-18.

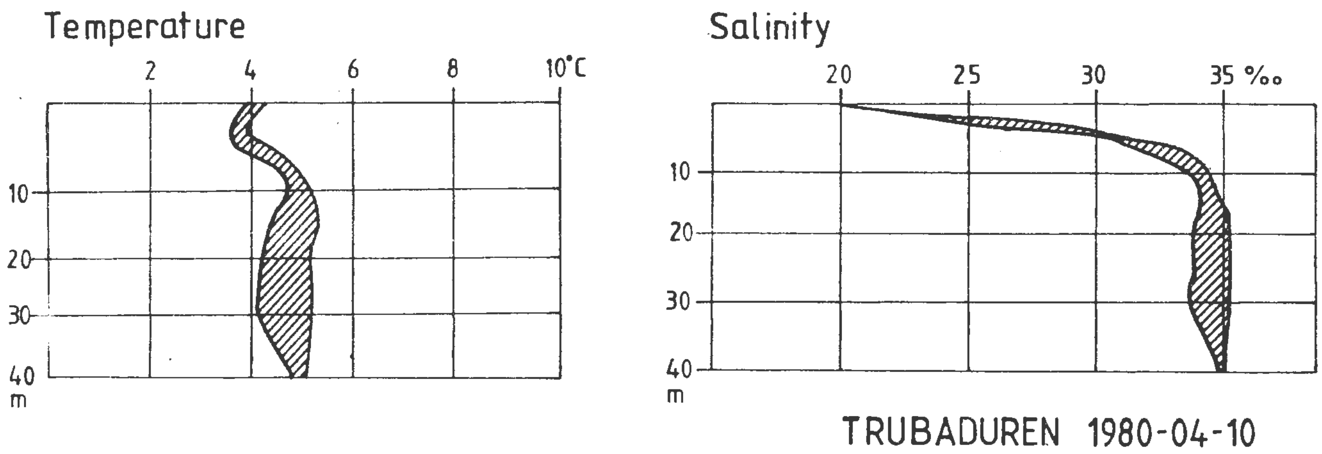

Figure 8. Trubaduren 1980-04-10.

The current measurements from Almagrundet are shown in figure 9, both as trajectories (top) and as variation diagrams (bottom) similar to figures 4, 5, and 6.

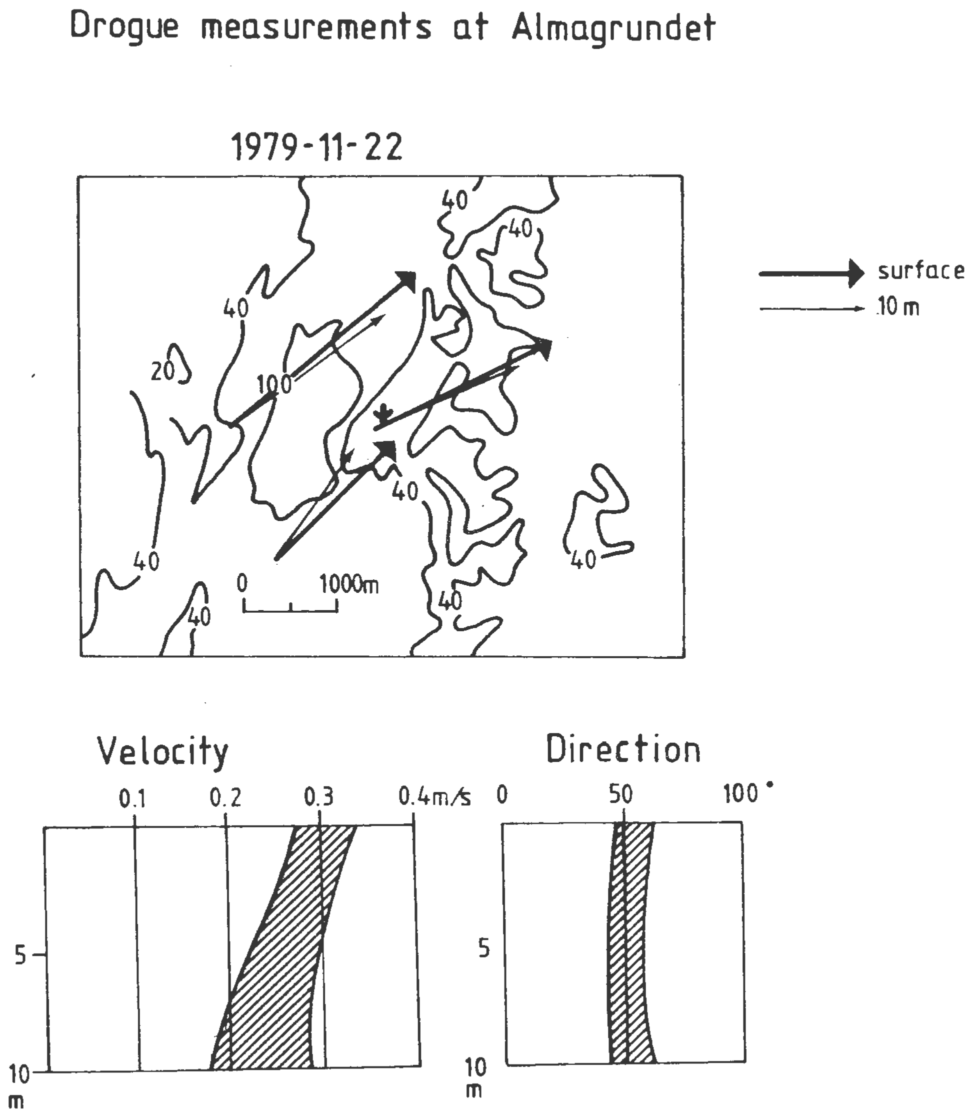

Figure 9. Measurements at Almagrundet.

These data show almost the same variation of velocity as the data from Trubaduren, but much less variation of direction, probably due to high wind velocity (SW 10 - 12 m/s) with fairly stable wind direction. In the surface layer the variations in both temperature and salinity were rather small, due to the time when the measurements were made. At this time of the year (November 1979) the conditions in the upper layer are rather homogenous. Within the thermocline and the halocline the variations are larger (figure 10).

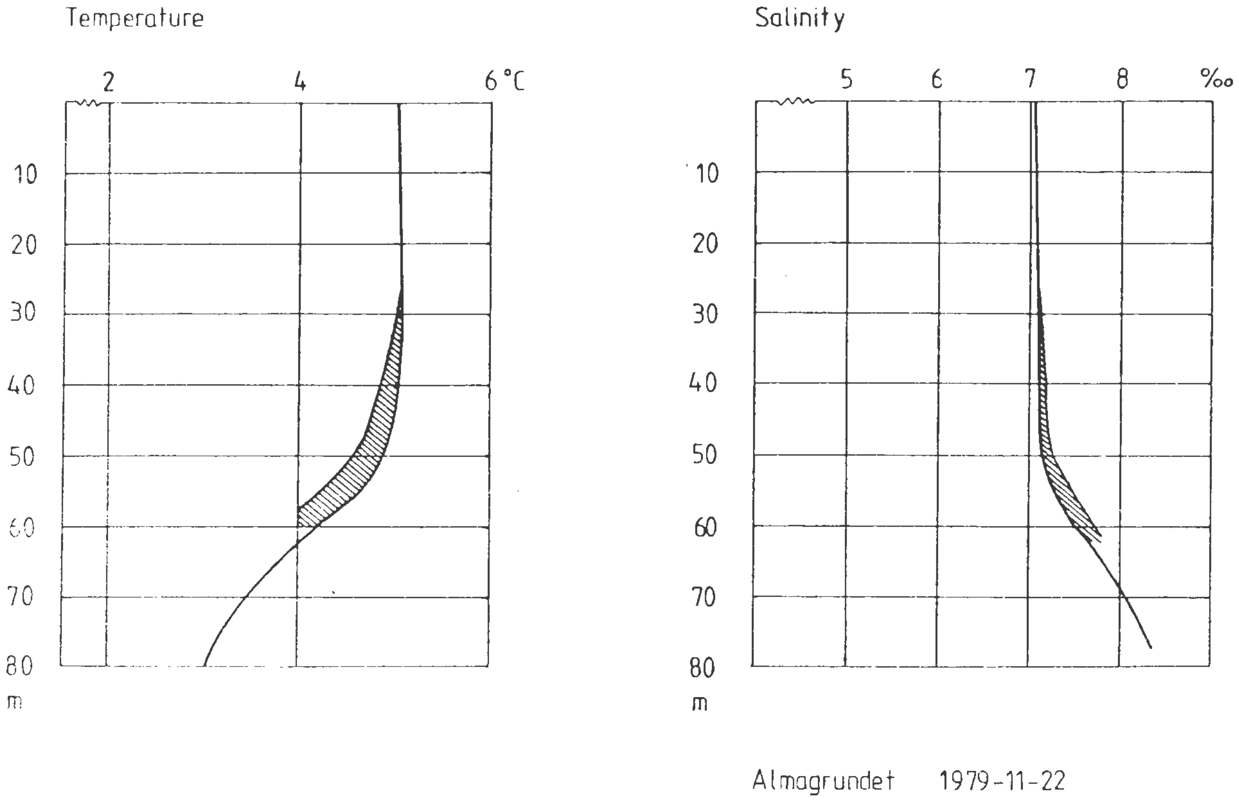

Figure 10. Almagrundet 1979-11-22.

Using only the maximum variation as parameter the following diagrams can be constructed (figure 11).

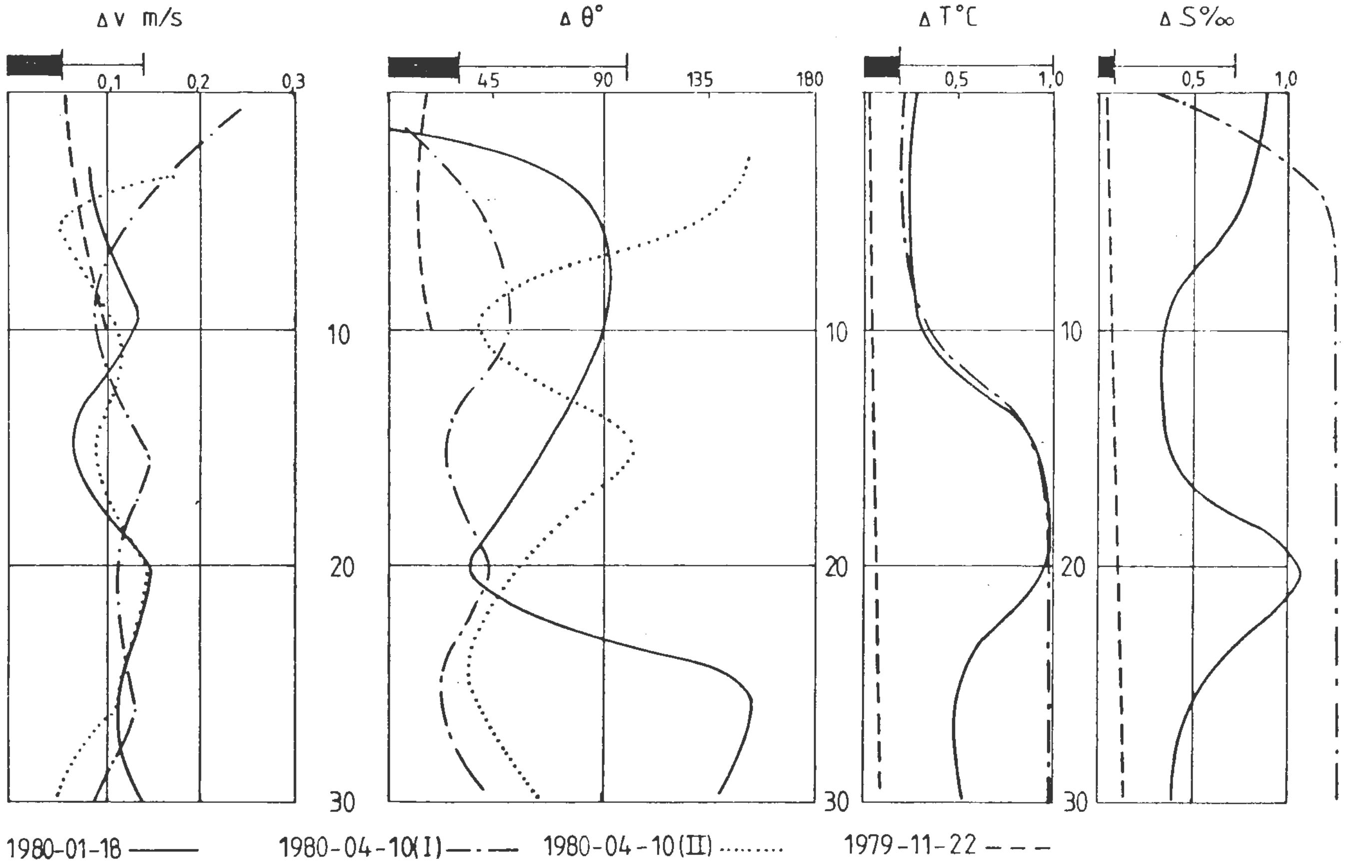

Figure 11. Spatial variation of velocity, direction, temperature and salinity at Trubaduren and Almagrundet.

Fig. 11 shows - at each measured level and from each measuring occasion (separate curves) - the maximum spatial deviation of current velocity (V), current direction (θ), temperature (T) and salinity (S). On top of the diagrams there are typical and rather large variations within a 3-hour interval as judged from a subjective study of hourly registrations from the automatic stations of Trubaduren and Almagrundet.

CONCLUSIONS

Although there are only a few observation occasions, the following conclusions seem to be justified. On a real time basis data from the automatic stations Trubaduren and Almagrundet (and probably other stations as well) can give velocities within 0.1 m/s, current directions within about 50^{o} or 60^{o}, temperatures within 0.3^{o} C in most cases and salinities probably within 0.3 or 0.4 $^{o}/oo$. These "errors" due to spatial variation are of the same order as the large variation within 3-hour intervals. See the marks at the top of the diagrams in figure 11.

As a consequense of these results one may perhaps lower the ambition of the instrumental accuracy. But before doing so, one has to take the mean values for quite a long period into account. How large is the spatial variation based on mean values over a week, a month and a year?

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Model 513D
Operating & Maintenance Manual
Inter Ocean systems, inc./3540 Aero Ct.
San Diego

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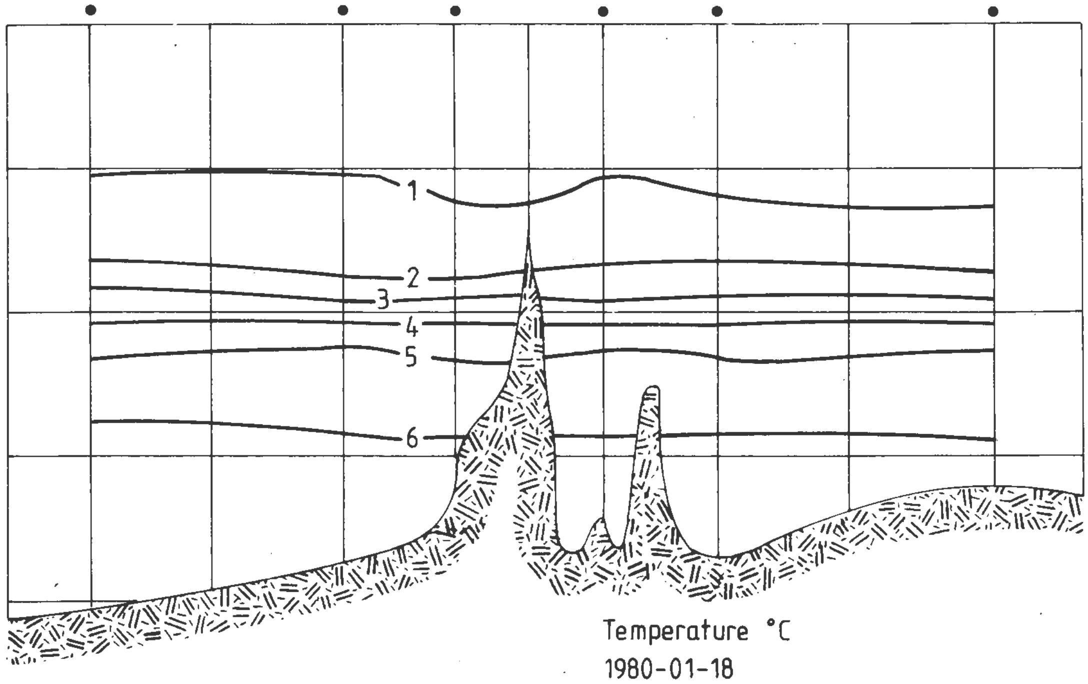
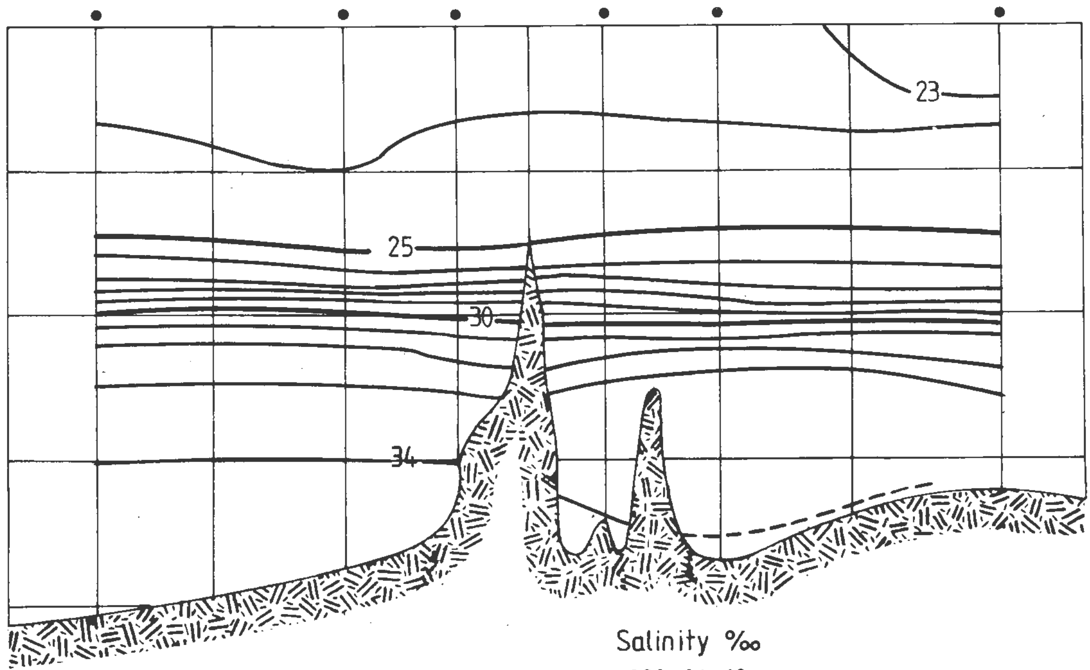
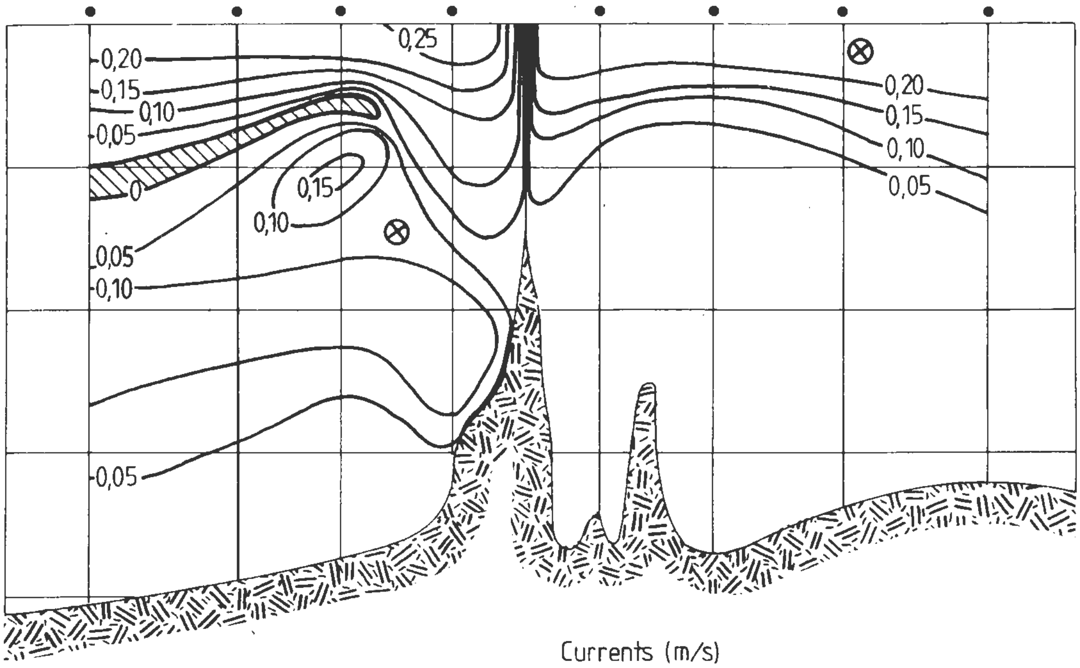
Temperature, salinity and current fields from the three occasions at Trubaduren are shown on the following pages.


1
2
3
4
5
6
Temperature °C
1980-01-18

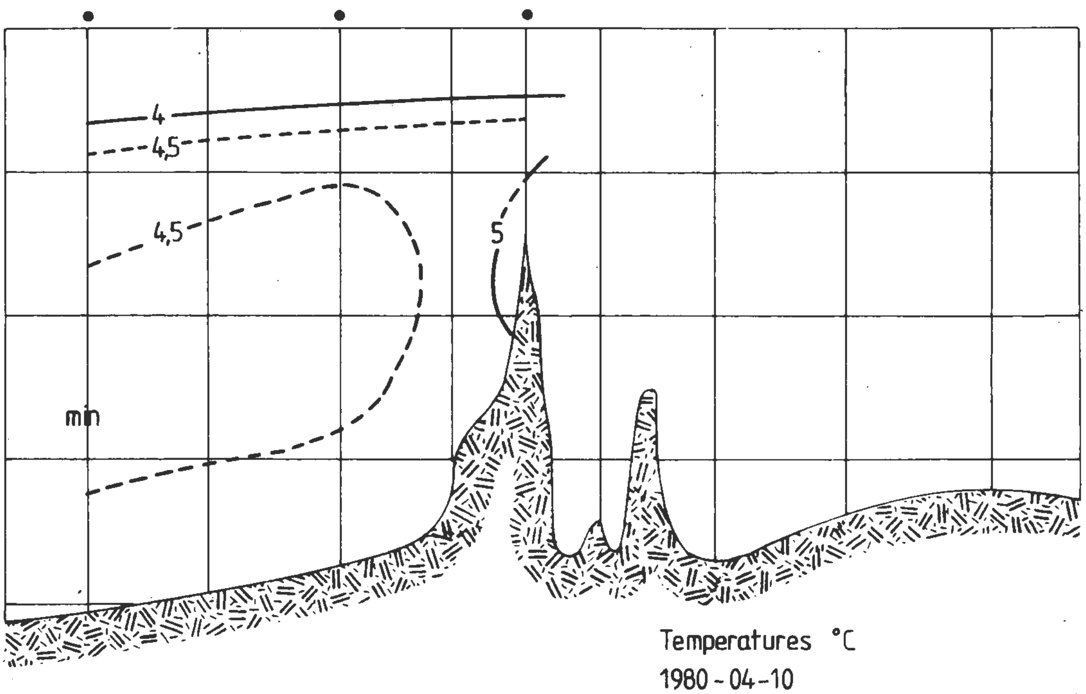

23
25
30
34
Salinity ‰
1980-01-18

• station

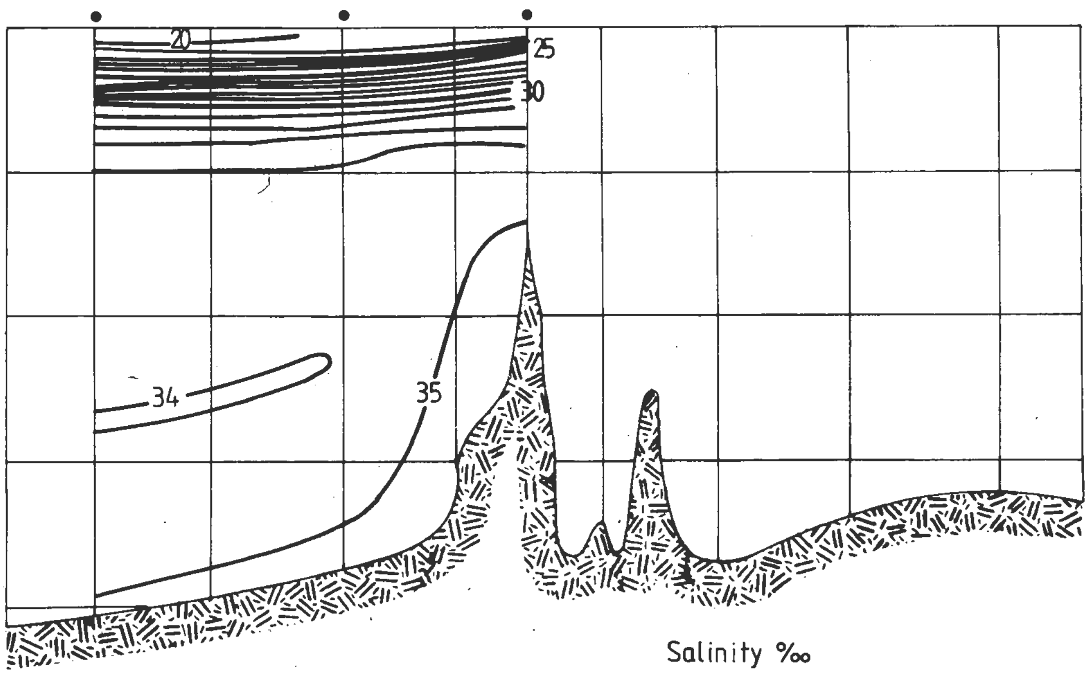


Currents (m/s)
component across the section
1980-01-18

• station

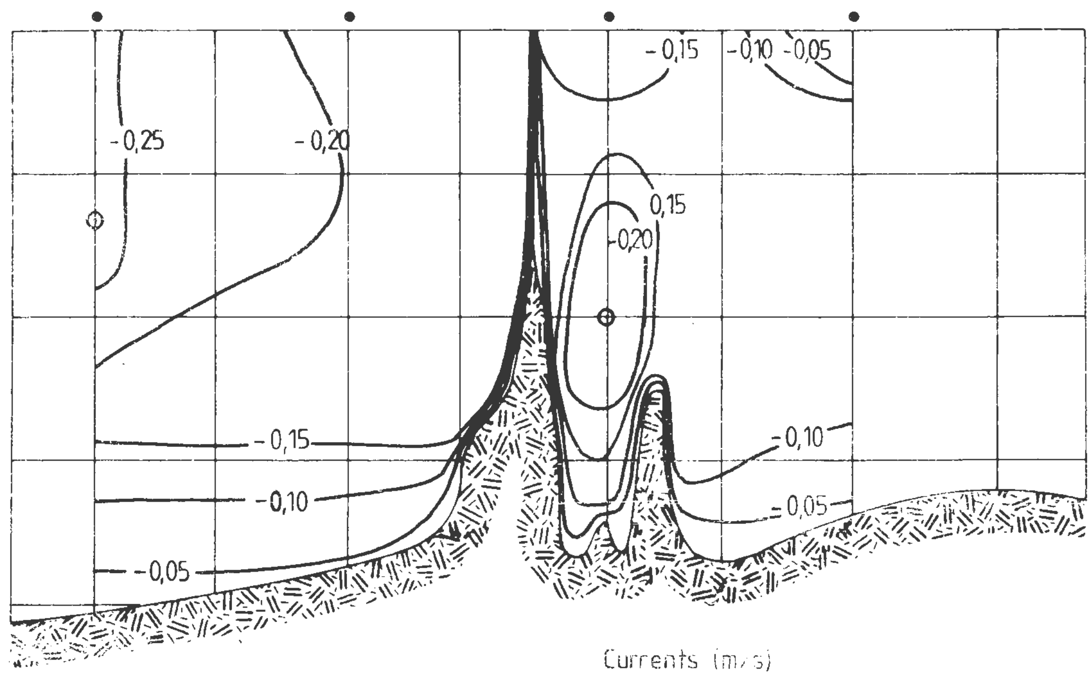


Temperatures °C
1980-04-10

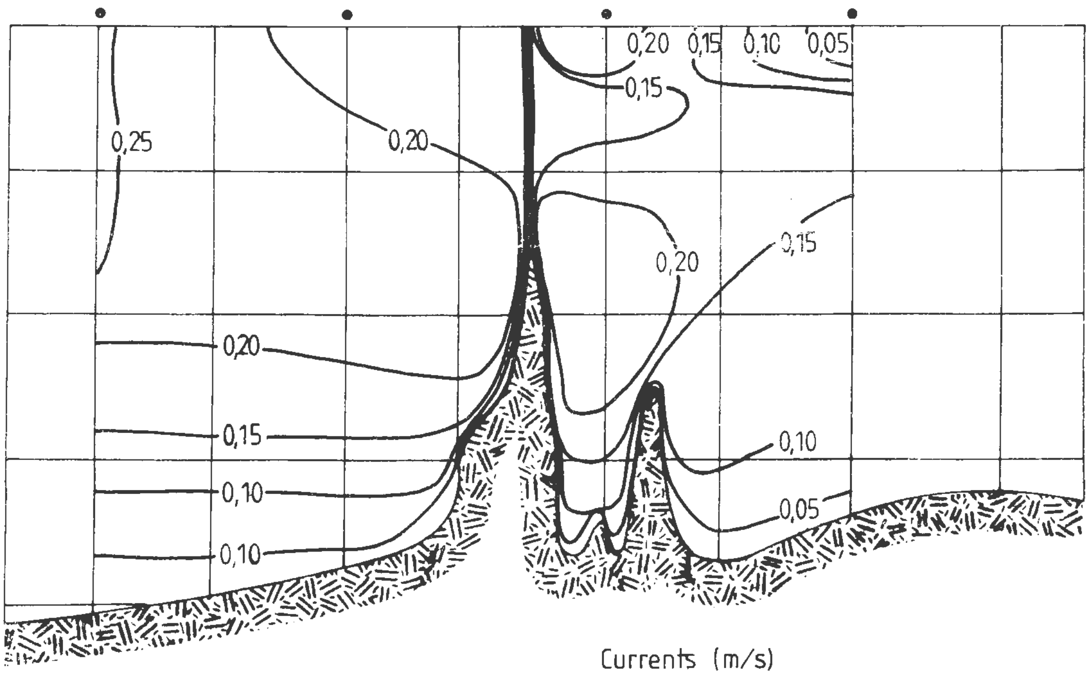


Salinity ‰
1980-04-10

• station

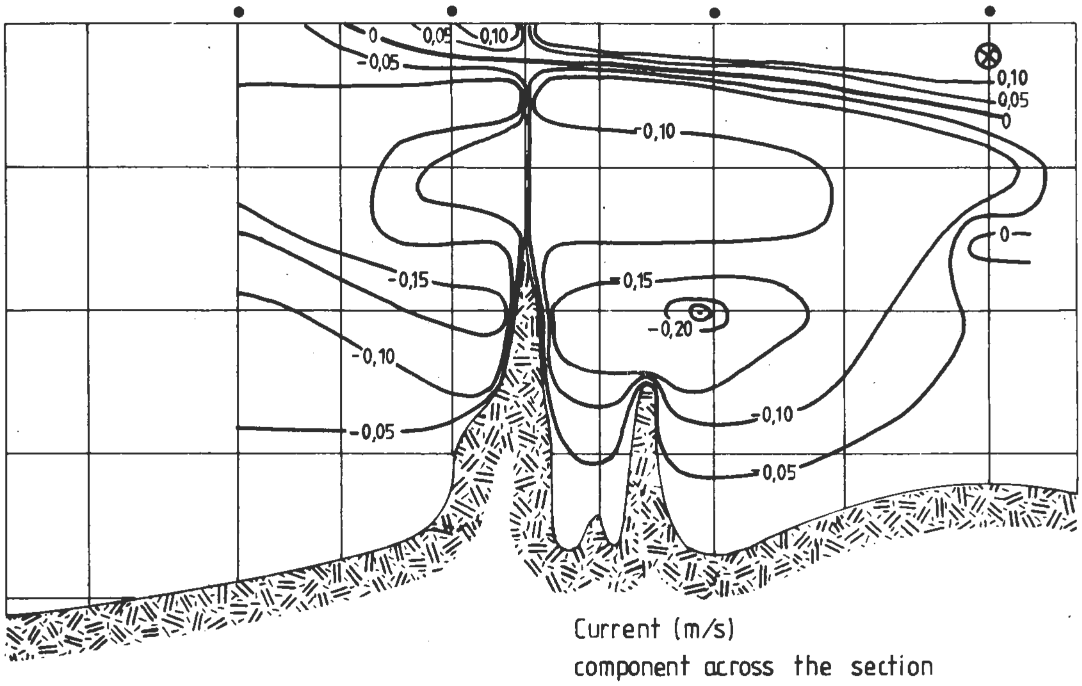


Currents (m/s)
component across the section
1980-04-10 (1540-1615)

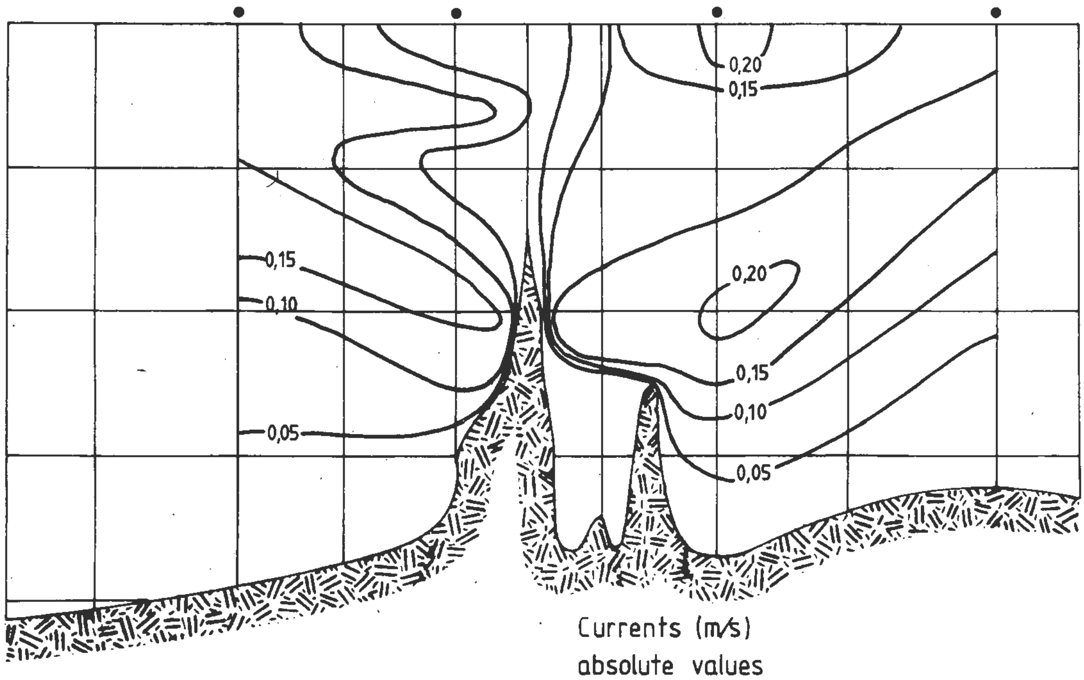


Currents (m/s)
absolute values
1980-04-10 (1540 1615)

• station



Current (m/s)
component across the section
1980-04-10 (1805-1820)



Currents (m/s)
absolute values
1980-04-10 (1805-1820)

• station

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