Path and Volume Transport of the Kuroshio Current in Sagami Bay and their Relationship to Cold Water Masses near Izu Peninsula*

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Abstract: The path of the Kuroshio in Sagami Bay was surveyed through drifter tracking from Oshima-West Channel to Oshima-East Channel. A subsurface drifter with a drogue at 300 m depth flowed around Oshima from Oshima-West Channel to Oshima-East Channel. A difference in flow directions between the upper and lower layers was apparent in the northwest of Oshima. Flow directions there were shown to change from north in the surface layer to east in the bottom layer, and this was confirmed with moored current meters.

A profile of northward current velocity was estimated from measurements in six layers with current meters deployed in the Oshima-West Channel. The profile shows a core of northward flow along the eastern bottom slope and a weak southward flow along the western bottom slope. Volume transport of the Kuroshio into Sagami Bay was estimated to be $1.8 \times 10^6 \text{m}^3\text{sec}^{-1}$ from the profile.

Long-term current measurement showed that southward flows were observed in Oshima-West Channel in July 1977, May 1978 and April 1979. Cold or warm water masses appearing south of the Izu Peninsula are suggested to have caused the changes.

Displacement of the cold water mass in July 1977 is discussed on the basis of current measurements and offshore oceanographic conditions.

1. Introduction

Sagami Bay opens southwards to the Pacific Ocean through Oshima-West Channel between Izu Peninsula and Oshima, and through Oshima-East Channel between Oshima and Boso Peninsula (Fig. 1). Water depth exceeds 1,500 m from Oshima-East Channel to the central part of Sagami Bay. Sagami Trough extends from Oshima-East Channel into the bay. On the other hand, water depth of the Oshima-West Channel is only 500 m. The Izu Ridge extends southeastward from the Izu Peninsula, and the mean water depth south to Hachijojima Island is several hundreds meters. The deepest channel on the ridge about 1,100 m depth is located south of Mikurajima Island. The 500-m depth contour in Fig. 1 shows a triangular submarine plateau with apexes at Oshima, Zenisu Shallow and Miyakejima. The Oshima-West Channel is

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Fig. 1. Bottom topography of the Izu Ridge from Izu Peninsula to Hachijojima Island. Contours are for the 500 m and 1,000 isobaths.
the northernmost passage from west to east in the Izu Ridge.

The Kuroshio flows eastward west of the Izu Ridge. Uda (1937) observed the surface flow in Sagami Bay by using drifting boards. He found that the Kuroshio from Oshima-West Channel flowed out through Oshima-East Channel. From a compiled set of Geomagneto-Electric Kinetograph (GEK) data, Nitani et al. (1979) showed that the flow through the Oshima-West Channel increased when the path of the Kuroshio formed a large meander south of Honshu. It has been confirmed that the Kuroshio current in the surface layer flows clockwise around Oshima to pass over the Izu Ridge from Oshima-West Channel to Oshima-East Channel. Although water to a depth slightly less than 500 m can pass through the Oshima-West Channel, subsurface currents around Oshima have not been observed. Taira et al. (1978) determined the trajectory of a drifter with a window-shade drogue in the 300 m layer. The subsurface drifter went northward at a speed of 6 cm sec\(^{-1}\) from the point of release in the middle of Oshima-West Channel. A sluggish current in the 300 m layer was revealed by the subsurface drifter, and it was not clear whether the deep flow of the Kuroshio was passing through Sagami Bay. In this study, two subsurface drifters were tracked to determine the current path at 300 m in Sagami Bay.

Barochoic transport of the Kuroshio passing over the Izu Ridge was estimated to be 33 × 10\(^{6}\) m\(^3\) sec\(^{-1}\) at a reference level of 1,000 db from oceanographic observations on 19–21 March 1977 (Hydrographic Office, 1977). Teramoto (1965) estimated the volume transport through Oshima-West Channel to be 2 × 10\(^{6}\) m\(^3\) sec\(^{-1}\) from the measurement of telluric electric-potential difference between Oshima and Izu Peninsula in 1959–1961. The volume transport of the Kuroshio through Sagami Bay is estimated to be about 6% as large as the total. In this study, the volume transport was estimated from records of six current meters moored in a cross section of Oshima-West Channel on 18–23 March 1977.

Taira and Teramoto (1981) described the long-term measurement of currents in the 250-m layer in the central portion of the Oshima-West Channel from February 1977 to May 1979. They observed that the mean flow was northeastward with a speed of 54 cm sec\(^{-1}\) and that the magnitude of the flow was dependent on the longitude of the Kuroshio axis west of Hachijojima. They found that the flow in the Oshima-West Channel was southward for several days in July 1977 and in May 1978 and that the flow was decreased remarkably in April 1979. Oceanographic conditions during these periods are examined in Section 4 of this paper. In Section 5, disappearance of a cold water mass in July 1977 west of the Izu Ridge is discussed on the basis of recorded temperature and current speeds in the Oshima-West Channel, and estimated volume transport through the channel.

2. Tracking of drifters around Oshima

For the purpose of finding current paths as well as velocity, tracking of one surface drifter and two subsurface drifters was carried out from release points in Oshima-West Channel from 20 to 22 March 1977. Window-shade drogues 3 m wide and 15 m long were placed at 1 m depth for the surface drifter, and at 300 m depth.

![Fig. 2. Paths of surface drifter (S), and subsurface drifters (D1 and D2). Tracking periods: S 13:00 20 March–7:00 21 March 1977; D1 10:00 20 March–14:00 22 March 1977; and D2 11:00 20 March–7:00 21 March 1977. Time marks on trajectories S and D2 indicate one hour. Numerals on bottom contours show depth in meters. Mooring stations (B1, A1, A2 and B2 in March 1977, and C in September 1977) are also indicated.](image-url)
for the subsurface drifters. The method adopted is the same as described by Taira et al. (1978).

Figure 2 shows trajectories of the three drifters. The subsurface drifter-D1 moved steadily in a northeast direction with an average speed of 8.5 cm sec\(^{-1}\) during 52 hr. The release point of drifter-D1 was almost identical to that of the subsurface drifter tracked by Taira et al. (1978). Both of them showed sluggish northward flows. On the other hand, the subsurface drifter-D2 moved clockwise around Oshima with an averaged speed of 74.7 cm sec\(^{-1}\). The drifter-D2 is the first to reveal that the Kuroshio current in the deep layers flows directly from Oshima-West Channel to Oshima-East Channel.

The surface drifter-S moved along a path almost coincident with that of drifter-D2 at in the initial stages of tracking. The paths seem to lie along the isobath of 500 m. After passing northwest of Oshima, the surface drifter-S followed a different circular path of larger radius. The averaged drift speed was 117.1 cm sec\(^{-1}\).

The trajectories of the surface and subsurface drifters separate at a point located at 34°50'N and 139°16'E. The drifter-S went northwards after passing the point, while the drifter-D2 went northeastwards. A large difference in current direction was indicated in the upper and lower layers at the point of separation. The current meters were moored at 200 m and 400 m at the point (34°50'N, 139°16'E; water depth 600 m, Station C in Fig. 2) where separation was observed. The results of current measurements in these two layers from 2 September to 30 November 1977 are shown in Fig. 3 in progressive vector diagrams. The vector diagram for the 200 m layer is directed towards 55° T(true) with an almost constant speed of 29 cm sec\(^{-1}\). The current in the 400 m layer is variable but is directed towards 85° T on average with a mean speed of 3.4 cm sec\(^{-1}\). The direction of the current in the 400 m layer is coincident with that of the bottom contours at the mooring station. This difference in flow direction cor-

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**Fig. 3.** Progressive vector diagrams for the currentmeters moored at 200 m (upper layer) and at 400 m (lower layer) at the station C (34°50'N 139°16'E; water depth 600 m). The time marks indicate every five days in the diagrams. The diagram for the lower layer is enlarged five times. The station is shown in Fig. 2.

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**Table 1. Currentmeter moorings across Oshima-West Channel in March 1977.**

<table>
<thead>
<tr>
<th>Station</th>
<th>B1</th>
<th>A1</th>
<th>A2</th>
<th>B2</th>
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<tr>
<td>Latitude</td>
<td>34°43'N</td>
<td>34°44'N</td>
<td>34°43'N</td>
<td>34°43'N</td>
</tr>
<tr>
<td>Longitude</td>
<td>139°03'E</td>
<td>139°08'E</td>
<td>139°13'E</td>
<td>139°18'E</td>
</tr>
<tr>
<td>Water depth</td>
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<td>550 m</td>
<td>533 m</td>
<td>180 m</td>
</tr>
<tr>
<td>Meter depth</td>
<td>150 m</td>
<td>130 m</td>
<td>330 m</td>
<td>330 m</td>
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</table>

<table>
<thead>
<tr>
<th>Daily mean north component (cm sec(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 March</td>
</tr>
<tr>
<td>19 March</td>
</tr>
<tr>
<td>20 March</td>
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<tr>
<td>21 March</td>
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<tr>
<td>23 March</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>S. D.</td>
</tr>
</tbody>
</table>
resides with the path separation of the surface and subsurface drifters at the point. These measurements show that the flow direction changes from $0^\circ$ T in the surface layer to about $90^\circ$ T in the bottom layer.

Average north components of velocity were estimated from the trajectories along 34°45'N in Oshima-West Channel. They were 7.0 cm sec$^{-1}$ for drifter--D1, 88.7 cm sec$^{-1}$ for drifter--D2, and 102.9 cm sec$^{-1}$ for drifter--S, respectively. These will be compared with those measured with currentmeters in Section 3.

3. Volume transport of the Kuroshio through Oshima-West Channel

With an aim of clarifying the structure of the velocity field, we made current measurements for one week in March 1977 by mooring six currentmeters in an east-west section of the Oshima-West Channel. The mooring stations are shown in Fig. 2 and Table 1. The channel is about 33 km wide there. We diminished tidal currents by averaging hourly velocities over 25 hr. Daily values of the north component of velocity centered at 15:00 on each day of 18-23 March 1977 are shown in Table 1 together with the 6-day average and the root mean square deviation.

The northward velocity was stronger in the eastern half of the section and this was also confirmed by tracking of drifters. A week southward flow is observed in the western corner of the section. Uda (1937) also pointed out a narrow southward flow along Izu Peninsula. In addition, it is clear from Table 1 that fluctuations in speed were slight in the strong northward flow around Station A2.

Distribution of the northward velocity component in the whole channel section was estimated from the daily velocities measured at six points. A two-dimensional profile was assumed to be governed by the following equation:

$$V(x, z) = V_0(x) [a(\alpha z/H(x))^2 + b z/H(x) + c]$$

and

$$V_0(x) = ax^2 + \beta x + \gamma$$

where $x$ and $z$ coordinates are selected to be horizontally eastwards across the channel and vertically upwards, respectively. $V_0(x)$ is the surface velocity, $H(x)$ the water depth and $a$, $b$, $c$, $\alpha$, $\beta$ and $\gamma$ constants to be determined observationally.

The quadratic assumption for the vertical profile is derived from the velocity profile of the offshore Kuroshio by Teramoto (1972). The quadratic assumption for the horizontal profile of surface velocity is derived from the approxi-

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**NORTHWARD VELOCITY** cm sec$^{-1}$

Fig. 4. Northward current component in the cross section of the Oshima-West Channel estimated from six-day average of currentmeter records. Layers in which measurements were made are shown with circles.
Fig. 5. Daily means of east component, north component of the current in Oshima-West Channel, and water levels at Hachijo-jima and Oshima for two years from 1 June 1977 to 31 May 1979. Dates of extreme values are noted on the curve.

Fig. 6. Hourly means of currentmeter record from 15 June 1977 to 2 September 1977. Sub-panels show water temperature, east and north components of velocity, and current speed.
mate profiles of the Kuroshio in the open sea measured with GEK. We also assumed that the velocity was zero along the channel bottom.

Figure 4 shows 6-day averaged northward velocities in the cross section of the Oshima-West Channel. A core of weak southward flow is located along the western slope of the channel bottom. Velocity in the 300-m layer in the core of the southward flow is about 5 cm sec$^{-1}$, which is nearly the same as that obtained from drifter-D1. A core of strong northward flow is located along eastern slope of the channel bottom. The velocity in the surface layer in the core of northward flow is about 60 cm sec$^{-1}$, which is 55% as large as the speed of drifter-S. Since the drifters moved northwards against a north wind of 7 m sec$^{-1}$, the speed of the drifters was not accelerated by the wind. The Kuroshio current in the surface layer is shown to be stronger than that estimated from the assumed quadratic profile of the current. The velocity in the 300 m layer in the northward flow core is also only 45% as large as the speed of drifter-D2. Drag of the surface current is suggested to increase the speed of the subsurface drifter.

The velocity profile obtained for each day was integrated numerically over the northward flowing portion, southward flowing portion and the whole channel section. The estimates of volume transports are shown in Table 2. The mean value of net transport is $(1.8 \pm 0.2) \times 10^{6} \text{m}^{3} \text{sec}^{-1}$. This is comparable to that of $2 \times 10^{6} \text{m}^{3} \text{sec}^{-1}$ obtained by Teramoto (1965) through electric potential measurements from 1959 to 1961. The geostrophic transport of the Kuroshio flowing through the whole Izu-Ridge on 19-21 March 1977 is estimated to be $33 \times 10^{6} \text{m} \text{sec}^{-1}$ for a reference level at 1,000 db (Hydrographic Office, 1977). Our estimate shows that 6% of the total is flowing through the Oshima-West Channel.

4. Events of southward flow in the Oshima-West Channel

Long-term measurements of current have been carried out since February 1977 to date at a station (34°43'N, 139°15'E; water depth 485 m and meter depth 250 m) in Oshima-West Channel. The daily variations of north and east components of velocity are shown in Fig. 5 for two years from June 1977 to May 1979. Data gaps are caused by malfunctions of the current meters. Figure 5 also shows daily records of water level at Hachijojima (Kaminato, Hydrographic Office) and Oshima (Okada, Japan Meteorological Agency). In this section, we describe the marked short-period phenomena in July 1977, May 1978 and April 1979.

4.1 The event in July 1977

The north component of the velocity in Oshima-West Channel decreased in July 1977. Figure
6 shows hourly records of east and north components of velocity as well as water temperature measured with the current meter. Variations with tidal frequencies are dominant in both records of temperature and current velocity. The amplitude of temperature variations is about 1°C, and that of current speed is about 15 cm sec⁻¹.

We must examine the temperature change recorded by a moored instrument carefully because the instrument depth is changed by inclination of the mooring line due to current drag. Taira and Teramoto (1981) reported that the mooring line made an inclination angle of 30° from the vertical in a current with a mean speed of 72.4 cm sec⁻¹. Lowering of the current-meter is estimated to be 30 m for an inclination angle of 30°. If we take a vertical temperature gradient of 1/100°C m⁻¹ in Kuroshio water at 200 m (e.g., Taira and Teramoto, 1981), the depth increase by 30 m may cause temperature lowering by 0.3°C. The recorded variation of temperature in Fig. 6 is much greater than that caused by the motion of mooring line. A relation between temperature and current speed also shows that the temperature change was not caused by depth changes of the current meter. The current speed was increasing rapidly on 27-31 July 1977 after the start of the northward flow. This would cause a lowering of recorded temperature due to the depth increase of the current meter. However, Fig. 6 shows that the recorded temperature was increasing linearly in the ten days from 27 July to 5 August 1977.

Figure 6 shows that the flow turned southward on 13 July 1977 and that the southward flow lasted until 26 July 1977. Recorded temperature was around 12°C while the flow was southward, and it rapidly decreased to 8°C when the strong northward flow started. The event occurred in a period of abnormal flow of the Kuroshio. The cold water mass accompanied with the meander was cut off from the Kuroshio in mid-May 1977. The cut-off cold water mass behaved as an isolated cold ring until it was joined to a cold water mass newly formed.

![Graph showing temperature and current speed changes](image_url)

Fig. 8. Hourly means of current meter records from 12 May 1978 to 30 July 1978. Subpanels show water temperature, east and north components of velocity, and current speed.
east of Kyushu, and then a well-developed cold water mass was re-established in early-August 1977 (Kamihira et al., 1978a; Solomon, 1978).

Figure 7 shows bimonthly variations of isotherms in the 200-m layer from early-July to mid-August 1977 (Prompt Report of the Sea Conditions, Hydrographic Office). The Kuroshio axis is indicated by the 15°C isotherm in the 200-m layer (Kawai, 1969). Figure 7 (a) and (b) shows three cold water masses in the sea area: one south of the Kuroshio axis, and two north of the axis. The former is the cut-off cold ring. The cold water mass east of Kyushu was formed in June 1977.

The southward flow in Oshima-West Channel was observed for the sea conditions shown in Fig. 7(b). The cold water mass southwest of the Izu Ridge, delineated by the isotherms of 9°C and 10°C, is considered to prevent the Kuroshio from flowing into Sagami Bay. The process of disappearance of the cold water mass is discussed in Section 5.

4.2 The event in May 1978

The current in Oshima-West Channel decreased in mid-May 1978. Figure 8 shows hourly records of the current meter. The measurements started on 12 May 1978 when the current had weakened. A southward flow was recorded on several days centered around 23 May. The northeastward current increased gradually on 6 June, and water temperature lowered by 1°C.

Figure 9 shows isotherms in the 200 m layer from early-May to mid-June 1978. The path of the Kuroshio was unstable in the period. Figure 9a shows that the isotherm of 15°C indicative of the Kuroshio axis was meandering around three cold water masses located east of Kyushu, south of the Kii Peninsula, and southwest of Izu Peninsula. The cold water mass southwest of Izu Peninsula occupied a large area in early-May (depicted by 14°C in Fig. 9a), and it was replaced by a warm water mass in the next half month (depicted by 17°C in Fig. 9b). Figure 9c shows that the warm water mass disappeared southwest of the Izu Peninsula in early-June.

A southward flow was observed in the Oshima-West Channel for the sea conditions shown in Fig. 9b. The warm water mass southwest of the Izu Peninsula is considered to prevent the Kuroshio from flowing into Sagami Bay.

Fig. 9. Isotherms at 200 m observed in early-May(a), late-May(b), and early-June(c) in 1978 (from Prompt Report of Sea Conditions, Hydrographic Office).

Figure 5 shows that the water level at Hachijo-jima decreased remarkably around 25 May 1978. The water level at Hachijo-jima Island is indicative of the Kuroshio axis: high water level indicates that the axis lies north of the island, and low water level that it lies to the south. Kamihira et al. (1978b) surveyed the surface Kuroshio by the GEK and observed an eastward current of 2.6 knot at a station 90 km south of Hachijo-jima on 18–19 May 1978. The
Fig. 10. Hourly means of currentmeter record from 25 March 1979 to 12 July 1979. Sub-panels show water temperature, east and north components of velocity, and current speed.

4.3 The event in April 1979

The current in Oshima-West Channel decreased in late-April 1979, and the water level at Hachijo-jima lowered during this period (Fig. 5). Figure 10 shows hourly records of the currentmeter. The current speed decreased gradually from 26 to 29 April 1979. The current increased abruptly by 60 cm sec$^{-1}$ on 30 April 1979. Water temperature decreased by about 3$^\circ$C when the current speed increased.

Figure 11 shows isotherms in the 200 m layer in April 1979. The path of the Kuroshio was unstable during this month. A decrease of flow in the Oshima-West Channel was observed for the sea conditions shown in Fig. 11b. Figure 11b shows that the Kuroshio was meandering around a cold water mass southeast of Izu Peninsula. The cold water mass was observed to have disappeared in May 1979. The cold water mass is considered to prevent the Kuroshio from flowing into Sagami Bay. Some part of the Kuroshio might be flowing south of Hachijo-jima as suggested by the lowering of water level at the island.

5. Disappearance of a cold water mass in July 1977 from west of the Izu Ridge

A cold water mass was observed to be located southwest of Izu Peninsula from 15 July to 4 August 1977 (Fig. 7b). Its diameter was about 55 km for the 9$^\circ$C isotherm in Fig. 7b, and the volume of the water mass is estimated to be $1.1 \times 10^{8}$ m$^3$ for an assumed thickness of 500 m.

The origin and displacement of the water mass was not fully observed hydrographically. Figure 7a shows a cold water mass west of Kii Peninsula, which might be a part of the large cold water mass before separation of the isolated cold ring in mid-May 1977 (Kamihira, et al.,
The cold water mass appeared to move westward from the west of the Kii Peninsula to the southwest of Izu Peninsula. Figure 7c shows that the cold water mass had disappeared from southwest of Izu Peninsula and that a 9°C isotherm was located east of Honshu. The distance from the southwest of Izu Peninsula to the east of Honshu is 250 km.

Figure 1 shows three deep passages over the Izu Ridge: Oshima-West Channel, a channel south of Mikura Island, and a channel south of Hachijojima Island. Water level at Hachijojima remained high and no remarkable change was recorded in July 1977 (Fig. 5). This may show that the cold water mass did not pass through the channel south of the island and that it passed through one of the northern channels.

In the channel south of Mikurajima Island, Hasunuma (1978) measured the current at a station located at 33°54′N, 139°49′E (a water depth 1,200 m and meter depth 1,050 m). He showed that northeastward flow decreased remarkably from 12 July to 30 July 1977. The current speed increased suddenly from 10 cm sec⁻¹ to 30 cm sec⁻¹ on 31 July, four days after the start of the northward flow in Oshima-West Channel. If we consider that the northward flow in the channel south of Mikurajima started after the disappearance of the cold water mass, this indicates that the cold water mass passed through the Oshima-West Channel.

Current measurements during the event were made in Oshima-West Channel at 250 m near Station A2 in Fig. 2. The mean north component of velocity over ten days from 27 July 1977 was 38 cm sec⁻¹. We estimated the volume transport in the channel from its linear relation to the north component velocity at 330 m at station A2. The correlation coefficient of the inflow transport to the north component of the 330-m layer at A2 is 0.5, and the following relation is obtained from Table 2: (Inflow transport, in 10⁶ m³ sec⁻¹) = (V₃₃₀ m A₂, in cm sec⁻¹) × 0.052. The estimated transport is 1.8×10⁶ m³ sec⁻¹ for the north component of 34 cm sec⁻¹ (estimated from 38 cm⁻¹ at 250 m depth). When the volume of the water mass is divided by the volume transport, it is estimated that it would take seven days for the water mass to pass through the channel. A travel distance of 230 km in seven days is obtained for a current of 38 cm sec⁻¹. The distance is almost equal to the observed displacement of the cold water mass from the southwest of Izu Peninsula to the east of Honshu. These and the relation between the recorded temperature and current speed may show that the cold water mass passed through the channel.

### Table 2. Estimated volume transport through Oshima-West Channel from measurements in six layers from 18 May to 23 May 1977.

<table>
<thead>
<tr>
<th>Date</th>
<th>Inflow</th>
<th>Outflow</th>
<th>Net</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 March</td>
<td>2.0</td>
<td>0.1</td>
<td>2.0</td>
</tr>
<tr>
<td>19 March</td>
<td>2.1</td>
<td>0.0</td>
<td>2.1</td>
</tr>
<tr>
<td>20 March</td>
<td>1.9</td>
<td>0.1</td>
<td>1.8</td>
</tr>
<tr>
<td>21 March</td>
<td>1.5</td>
<td>0.1</td>
<td>1.5</td>
</tr>
<tr>
<td>22 March</td>
<td>1.6</td>
<td>0.1</td>
<td>1.5</td>
</tr>
<tr>
<td>23 March</td>
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<td>0.0</td>
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<tr>
<td>Mean</td>
<td>1.81</td>
<td>0.06</td>
<td>1.76</td>
</tr>
<tr>
<td>S.D.</td>
<td>0.21</td>
<td>0.04</td>
<td>0.23</td>
</tr>
</tbody>
</table>

(Unit: ×10⁶ m³ sec⁻¹)
through Sagami Bay from the southwest of the Izu Peninsula to the east of Honshu.

6. Conclusions

(1) Tracking of surface and subsurface drifters showed that the Kuroshio current flowed from Oshima-West Channel to Oshima-East Channel around Oshima. The turning radius of the subsurface drifter was smaller than that of the surface drifter. The flow directions northwest of Oshima determined by drifter tracking and moored current meters was confirmed to change from northward at the surface to eastward at the bottom.

(2) Net transport of the Kuroshio through Oshima-West Channel was estimated to be $1.8 \times 10^8$ m$^3$ sec$^{-1}$ from current measurements in six layers. The derived current profile revealed a northward flow core along the eastern bottom slope and a weak southward flow along the western slope.

(3) Southward flows were observed in the Oshima-West Channel under abnormal conditions when cold water masses (in July 1977 and April 1979) and a warm water mass (in May 1978) were located south of the Izu Peninsula. The Kuroshio current is thought to be prevented from flowing into Sagami Bay by these water masses. Recorded temperature remained 1–4°C higher in the southward flow than in the northward flow. The temperature decreased when the northward flows began.

(4) The current measurements and hydrographic observations showed that the cold water mass appearing southwest of the Izu Peninsula in July 1977 may have passed through Sagami Bay to the east of Honshu.

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相模湾の黒潮の流路・流量と伊豆半島附近的冷水塊との関係

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要旨：大島西水道から放流した漂流ブイを大島東水道まで追跡して、相模湾の黒潮の流路を調べた。水深500mの大島西水道は伊豆海嶺を西から東へ通過する黒潮の最北の通路になっており、漂流ブイを用いてその流量を評価した。300m層にドローチをとりつけた漂流ブイは大島をまわって、大島西水道から大島東水道へ流れ出た。大島の北東部で表層流と下層流の流向が異なることが漂流ブイによって示されたので、流速計を用いて、表層では北向きであるが深層とともに流向が変化し、底層では東向きになっていることを確かめた。大島西水道の6層の漂流結果から断面流速の分布を調べ、北向きの強い流れの核が水道の東側の斜面上にあること、そして、西側の斜面上では弱い南向きの流れがあることを示した。また、相模湾に流入する黒潮の流量の評価値として1.8×10^6m^3/sec^-1を得た。大島水道の長期観測によって、通常は北流であるが、1977年7月、1978年8月、1979年4月の3回にわたって、南流になったことを観測した。これらの変化は伊豆半島の南方に出現した冷水塊や暖水塊によって引き起こされたことが示唆された。漂流観測と海洋観測の結果に基づいて、1977年7月の冷水塊の消減について論じた。

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