Ödsmål, Kville sn, Bohuslän

Hällristning Fiskare från bronsåldern	**Rock carving Bronze age fishermen**

MEDDELANDE från HAVSFISKELABORATORIET · LYSEKIL

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Hydrografiska avdelningen, Göteborg

Eel Problems in the Hanö Bight: Water Transports in 1975

(Svenskt sammandrag)

by

J.-O. Bladh, J. Johansson and A. Svansson

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Margareta Renström (1977) shows that there is a rather significant relation between catches of migrating eel in the Hanö Bight and wind direction. The conclusions could be made thanks to notes of daily catches made by fishermen at 9 fishing sites (Fig. 1, names numbered from 1 to 9). Most fishing sites had larger catches at winds from E-SE-S-SW and smaller from W-NW-N-NE. During the last 10-15 years the catches have decresed. In 1962 a pulp mill in Nymölla (Fig. 1) started its production and the question has been raised if the industrial outlet has influenced the catches.

It is possible that the effect of wind on the eel catches is transmitted through variable water movements, currents. One may think that eels prefer to move against the stream (Westerberg 1976). Or we may imagine upwelling, highly dependent on wind conditions, to be the important mechanism for changing the eel migration.

When inspecting their gears the fishermen also noted the surface current direction estimated by eye. Renström (loc. cit) made sign tests between catch data and these current observations. At fishing sites 6 and 7, current towards morth was connected with greater catches than current toward south.

Renström (loc. cit.) also investigated possible changes during 15 years of the connection between catch and wind, and catch and current. The material was grouped into 4 periods: 1960-63 with none or very small pulp production at Nymölla, 1964-67 and 1968-72 both with moderate production and 1973-75 with doubled production. The investigation showed that at N-wind the catches were somewhat smaller and at S-wind somewhat larger at the end of the period than in the beginning. In relation to currents, at least at fishing site 7, currents towards south were somewhat more disadvantageous at the end of the period than at the beginning.

Coastal measurements made 1972-73 every second day (Bladh and Björn-Rasumssen 1977) also contained a similar subjective observation of surface current direction as made at the fishing sites.

In order to derive data of higher precision, automatically recording instruments, type Aanderaa, were anchored during 1975 at two sites, one near Yngsjö 200 m from the beach and one at Taggen (Fig. 1).

Investigated Time Periods.

The silver eel fishery takes place during late summer and autumn. As Institut für Meereskunde in Kiel planned extensive mearuremnts in April 1975, however, it was thought appropriate to start the recording already then. Fig. 2 shows the positions of the German instruments.

The original idea was to deploy meters at 2 positions, one near Yngsjö right outside an eel pound net and the other more in the open sea (Fig. 1). Unfortunately the meter deployed at Taggen in April could not be retrieved and a new one was not laid out until October 1975. The measuring periods are therefore

Yngsjö 75 04 04 - 75 06 01
06 03 - 07 07
08 23 - 11 10

Taggen 75 10 03 - 75 11 10

The period in the autumn from which there is data both from Yngsjö and Taggen (75 10 03 - 75 11 10) is especially discussed below.

Measuring Technique

Aanderaa's automatically recording instrument stores not only data of velocity and direction of the current but also temperature, conductivity and depth. From temperature and conductivity the salinity can be computed.

The instrument is suspended under a subsurface buoy, normally at a depth where disturbance from sea surface waves is small. In this case the instrument at Yngsjö was placed at 8 m depth (2 m above bottom) and the subsurface buoy at 7.5 m depth. At Taggen the instrument was suspended at 6 m depth (11 m above bottom) and subsurface buoy at only 2 m depth. In the latter case the depths of instrument and buoy were less than intended. The consequences will be discussed below.

Recording was made every 20th minute, momentarily of every parameter except current speed. The latter is recorded as a mean of a 20 minute period, a necessary arrangment to achieve high precision. If the current direction varies significantly during the 20 minute interval, the result will be less satisfactory. The instrument manufacturer specifies the precision of direction to ± 7.5° for low speeds and ± 5° for speeds higher than 5 cm/s. The instrument has a threshold for speed of about 2 cm/s. If speed zero is recorded the half of the threshold value is used.

Data Management

The original recording is made on a simple magnetic tape. Transfer is made to a papertape and the information can thereafter be transferred to a computer, where the digital information is changed into data of temperature, salinity, depth, current direction and current velocity. These data as well as computed North and East Components of the current was transferred to a disk memory. In a second round, 2 hour, 3 hour, 24 hour and 14 day means were computed.

A comprehensive treatment was made for the connection between current and wind, particularly wind direction. Winds measured every third hour at Hanö lighthouse (Fig. 1) were used. Temperature and salinity data recorded in the Aanderaa instrument were not correlated, however, with winds as there are long term trends in the data, for temperature of natural reasons, for salinity due to fouling. See (however) the discussion on Fig. 5A below.

Daily Means of Current and Salinity

Fig. 3 shows the development during the common period in October-November. The currents at Taggen are much greater than those at Yngsjö but part of this is probably due to the fact that the suspension buoy at Taggen was too near the sea surface. High frequency movements are then added bythe rotor without the vane having time to follow the swift variations of the water direction. A comparison of the N-components measured at Yngsjö and the German station 15 (Fig. 2) does not show such a large difference in current amplitude (Fig. 4).

Fig. 5A shows the N-component of current and the salinity S ‰ at Yngsjö during 75 04 13 - 75 05 16. There is indication of positiv correlation, i.e. upwelling of more saline deep water when the current is towards north. Fig. 5B shows the even higher correlation between component of the wind (W-wind) and N-component of current at Yngsjö.

Bladh and Björn-Rasmussen (1977) also investigated the relation between wind direction and surface salinity, measured at the coast. Near Nymölla the salinity was higher than the mean value for winds from W, NW and N and lower for winds from NE, E and SE. For an observation site near Åhus, W-wind gave maximum in salinity but so did also NE-winds. Comparing the results in Fig. 5A both series of observation point to strong upwelling at W-winds and opposite at E-winds. Johansson (1977) finds that wind from WSW is the most effective to induce upwelling in an area called Hanö Bight with a NE-SW coast. But also winds from SW are nearly as effective in this respect.

Wind-Current Relations

This connection is displayed in Fig:s 6-8 for Yngsjö and 9-12 for Taggen. As the data periods are different a special comparison of the shorter period 75 10 03 - 75 11 10 with the total Yngsjö period was made (Table 1). There is no significant difference between the two. The results will be discussed below.

Theoretical Considerations

One important aim with the German experiment Baltic -75 was to check mathematical models with real current measurements. Simons (1976) makes such comparison of (approximately) daily means of 6 different periods in the beginning of May 1975. Fig. 13 shows such a comparison with rather bad result, Fig. 14, however, is quite satisfactory. The Yngsjö-arrow has been inserted and it is seen to coincide with the computed direction an all six periods. Simons (loc. cit.) writes that the flow reversal from clockwise circulation in nature occurs slower than in the model. At our station Yngsjö, however, the response seems to be in accordance with the model.

Current related to, wind, eel catches, salinity etc.

Simons (loc. cit.) has used his (and Kielmanns, 1976) model to compute steady state currents created by a constantly blowing wind, and differed between winds from N, E, S and W. As the model is linear, S-wind gives opposite currents to N-wind; W-wind has the corresponding relation to E-wind.

N- and E-winds produce rather similar current patterns (see Fig:s 15 and 16) with e.g. currents towards W at Taggen and S at Yngsjö. This is also what we approximately find in our material.

S- and W-winds show similar (opposite) directions except for currents measured at Yngsjö in S-wind occassions where most currents are nearly counterwindy.

There were no model computations for the directions NE, SE, SW and NW. NE situtation ought to be similar to the already similar N and E situtation. According to our current measurements SE is similar to E as well as SW and NW seem to be similar to W.

The results presented by Bladh and Rasmussen (loc. cit., site Snickarhaken near Åhus) are even more in accordance with the steady state transport picture of Simons (loc. cit.) as they also agreed for southwinds.

A relation between eel catches and current direction is not easy to find. The best wind for eel catches is S-wind, but here our results are very contradictory. Both SE and SW situations are like S, better than normal for eel, but these winds give opposite currents, one towards south and the other towards north (at Yngsjö).

Looking for a relation between upwelling of deeper water and catches of eel we find (see above) that the extreme situations are W-wind (upwelling) and E-wind (downwelling), none of them beeing extreme in relation to catches.

Table 2 has been constructed to summarize what has been discussed in this paragraph.

Conclusion

Most relations wind-current found in the present study are confirmed with earlier findings and German model computations. Only for the best "eel wind", from South, the present results are contradictory. Comparison with German measurements show that the current response to a new wind is much quicker near the coast than off-shore.

Also relations wind-upwelling found before are confirmed: W-wind is the wind direction most effective to bring up bottom water to the surface along the coast North and South of Åhus.

The relation eel catch-current is not that clear as the relation catch-wind or wind-current. As pointed out in the Introduction there is an indication of currents towards north in the Åhus area being more favourable for catch than currents towards south. Some changes from 1960-63 to 1973-75 of catches may be interpreted in terms of water transports bringing polluted water southward in cases of decreasing catches. But other effects, as well,must have been contributing in causing the long term catch decrease, such as changed wind directions (Renström l.c.), changed immigration of eel larvae, decreases on yellow eel, etc (Anon. 1975).

Finally reference should be made to spectral analysis of German current meter data published by Kielmann et al. (1976).

Vattentransporter i Hanöbukten 1975

Svensk sammanfattning.

Margareta Renström (1977) som fann ett signifikant samband mellan vindriktning och ålfångst i Hanöbukten, tittade också på sambandet mellan ålfångst och de strömobservationer, som fiskarena gjort varje gång de vittjat sina redskap. Det fanns en svag antydan att åtminstone vid Mästers och Yngsjö (Fig. 1) ström mot norr är förenligt med högre fångster än ström mot söder.

Renström undersökte också huruvida sambandet vind-fångst ändrats sedan tillkomsten av Nymölla pappersmassefabrik. Så har skett så att nordlig vind blivit något oförmånligare än förut och sydlig vind blivit något förmånligare än tidigare. Man kan tänka sig detta bero på att vid nordlig vind förorenat vatten sätter sydvart mot de viktiga fiskeplatserna.

Som det är sannolikt att länken vind-fångst går via vattnets rörelser, ansågs det motiverat att göra en del noggrannare strömmätningar. Två Aanderaas automatiskt registrerande strömmätare lades därför ut, en vid Yngsjö och en vid Taggen (Fig.1), 8 respektive 6 m djup. Som Institut für Meereskunde planerade sin stora undersökning "Baltic 75" att äga rum under april - maj 1975 (se Fig. 2) började vi också då. Tyvärr fungerade strömmätaren vid Taggen bara under hösten 1975.

Fig. 3 visar ström och vind under oktober-november då både Taggen och Yngsjö var i funktion. Det är troligt att de höga värdena vid Taggen delvis får förklaras med olämplig förankring. En jämförelse mellan Yngsjö och den tyska stationen nr 15 (Fig. 2) visar inte en så stor amplitudskillnad.

Som det finns anledning att misstänka att uppvällande saltare bottenvatten kan ha betydlse för fångsterna, är det intressant att även se på sambandet ström(vind)-salinitet. Fig. 5A visar att ström mot nord är förenligt med högre salinitet.

Fig. 6-12 visar så kallade strömrosor för 8 olika vindriktningar. I exempelvis Fig. 6, vindriktning E är strömmen mestadels mot S och SW, ungefär lika ofta 6-13 cm/s som mer än 13. cm/s.

Fig. 13 och 14 visar jämförelser mellan tyska modellberäkningar och strömmätningar under vissa perioder i maj 1975. Vinden har varit den uppmätta i olika delar av Hanöbukten. Fig. 13 visar dålig överensstämmelse utom nära land. Fig. 14 är mycket bättre och tycks bero på att vinden blåst från en viss riktning ett par dar. Det tar några dar för vattnet (men tyvärr ej modellen) att ställa in sig ute till sjöss men nära land svarar strömmen snabbt på vindändringar.

Fig. 15 och 16 visar modellberäkningar, där N-vind och E-vind blåst några dagar. För S-vind och W-vind ändrar man pilarnas riktning 180°. Resultaten må jämföras med våra mätningar. Tabell 2 har konstruerats för att man skall få en bättre överblick över dessa.

Resultatet av våra mätningar är en bättre förståelse av relationen vind-ström, en förståelse som vi har nått, inte minst med hjälp av de tyska resultaten. Någon bättre förståelse hur relationen ålfångst-vind fungerar har vi inte fått. Däremot har de nya mätningarna endast i ett fall (Yngsjö för S-vind) motsagt vad vi tidigare uppmätt.

References

Bladh, J.O. and S. Björn-Rasmussen, 1977: Hydrographical and Phytoplanktological studies in the Hanö Bight. To be published as a Meddelande från Havsfiskelaboratoriet.

Johansson, L., 1977: Uppvälling i svenska kustvatten - en undersökning utifrån tre års ytvattentemperaturkartor. SMHI, PM Ui/77.

Kielmann, J., 1976: Numerical modelling in connection with Baltic 75. 10th Conference of Baltic Oceanographers, Paper no. 24.

Kielmann, J., Holtorff, J. and U. Reimer, 1976: Data Report Baltic 75. Berichte aus dem IFM, Kiel, Nr. 26.

Renström, M., 1977: Wind and current in comparison with catches of silver eel in the Hanö Bight. ICES/EIFAC Symposium on eel research and management, paper no. 51. To be published by ICES.

Simons, T.J., 1976: Topographic and Baroclinic Circulations in the Southwest Baltic. Berichte aus dem Institut für Meereskunde, Kiel, Nr. 25.

Westerberg, H., 1976: Counter-current orientation in the migration of the European eel. ICES/EIFAC Symposium etc. paper no. 52.

Anon. 1975: Fiskeristyrelsens Åldagar , 11-12 mars 1975. Meddelande fr. Havsfiskelab. nr 190.

Table 1a.

YNGSJÖ 75 10 03 - 75 11 10

wind from cur-rent to	N	NE	E	SE	S	SW	W	NW	no wind	∑
N	5 20.8	11 28.9	4 6.3	0 0	0 0	11 39.3	36 31.3	3 16.7	0 0	70 22.4
NE	4 16.7	14 36.8	5 7.9	0 0	7 53.8	4 14.3	46 40.0	10 55.6	1 20.0	91 29.2
E	2 8.3	2 5.3	3 4.8	0 0	1 7.7	0 0	2 1.7	2 11.1	0 0	12 3.8
SE	1 4.2	1 2.6	2 3.2	0 0	0 0	0 0	0 0	2 11.1	0 0	6 1.9
S	8 33.3	8 21.1	35 55.6	5 62.5	0 0	1 3.6	3 2.6	0 0	2 40.0	59 18.9
SW	4 16.7	2 5.3	13 20.6	3 37.5	5 38.5	4 14.3	18 15.7	0 0	2 40.0	51 16.3
W	0 0	0 0	1 1.6	0 0	0 0	4 14.3	4 3.5	0 0	0 0	9 2.9
NW	0 0	0 0	0 0	0 0	0 0	4 14.3	6 5.2	1 5.6	0 0	11 3.5
100%	24	38	63	8	13	28	115	18	5	312

number %

Table 1b.

YNGSJÖ 75 04 04 - 75 07 07, 75 08 23 - 75 11 10

wind from current to	N	NE	E	SE	S	SW	W	NW	no wind	∑
N	18 15,9	23 21,3	15 6,3	4 7,5	8 6,7	57 26,9	174 41,4	32 40,5	15 32,6	346 24.9
NE	18 15,9	24 22,2	15 6,3	6 11,3	22 18,3	45 21,2	104 24,8	22 27,8	12 26,1	268 19.3
E	4 3,5	7 6,5	6 2,5	2 3,8	3 2,5	4 1,9	6 1,4	5 6,3	2 4,3	39 2.8
SE	4 3,5	3 2,8	8 3,4	1 1,9	3 2,5	4 1,9	10 2,4	3 3,8	0 0	36 2.6
S	30 26,5	32 29,6	131 55,3	23 43,4	17 14,2	19 9,0	22 5,2	6 7,6	5 10,9	285 20.5
SW	30 26,5	18 16,7	59 24,9	15 28,3	51 42,5	58 27,4	70 16,6	6 7,6	7 15,2	314 22.6
W	4 3,5	1 0,9	1 0,4	1 1,9	14 11,7	17 8,0	19 4,5	3 3,8	3 6,5	63 4.5
NW	5 4,4	0 0	2 0,8	1 1,9	2 1,7	8 3,8	15 3,6	2 2,5	2 4,3	37 2.7
100%	113	108	237	53	120	212	420	79	46	1388

number
%

Table 2

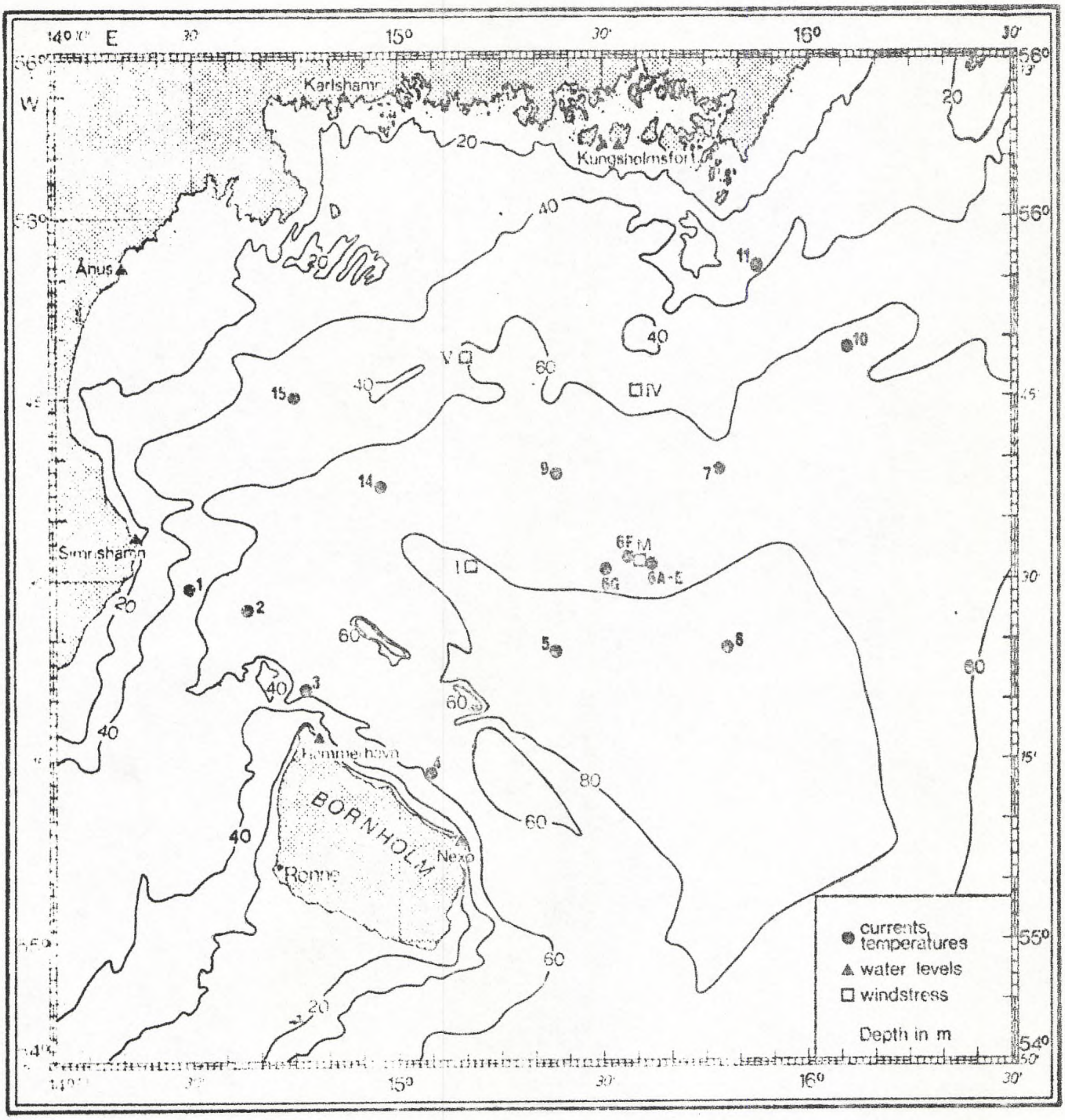
Current toward

Wind from	Yngsjö	Snickarhaken (near site 6)	Taggen	Eel Catches at site 6	Salinity near Nymölla $\bar{S}$ = mean salinity
N		S	SW	Small	$>\bar{S}$
NE	(S)	S	W	Small	$<\bar{S}$
E	S	S		Rather large	$<\bar{S}$
SE	SSW	S		Large	$<\bar{S}$
S	SW	N	E	Large	$\approx\bar{S}$
SW		N	E	Large	$\approx\bar{S}$
W	N	N	ENE	Small	$>\bar{S}$
NW	NNE	N		Small	$>\bar{S}$

FIG. 1

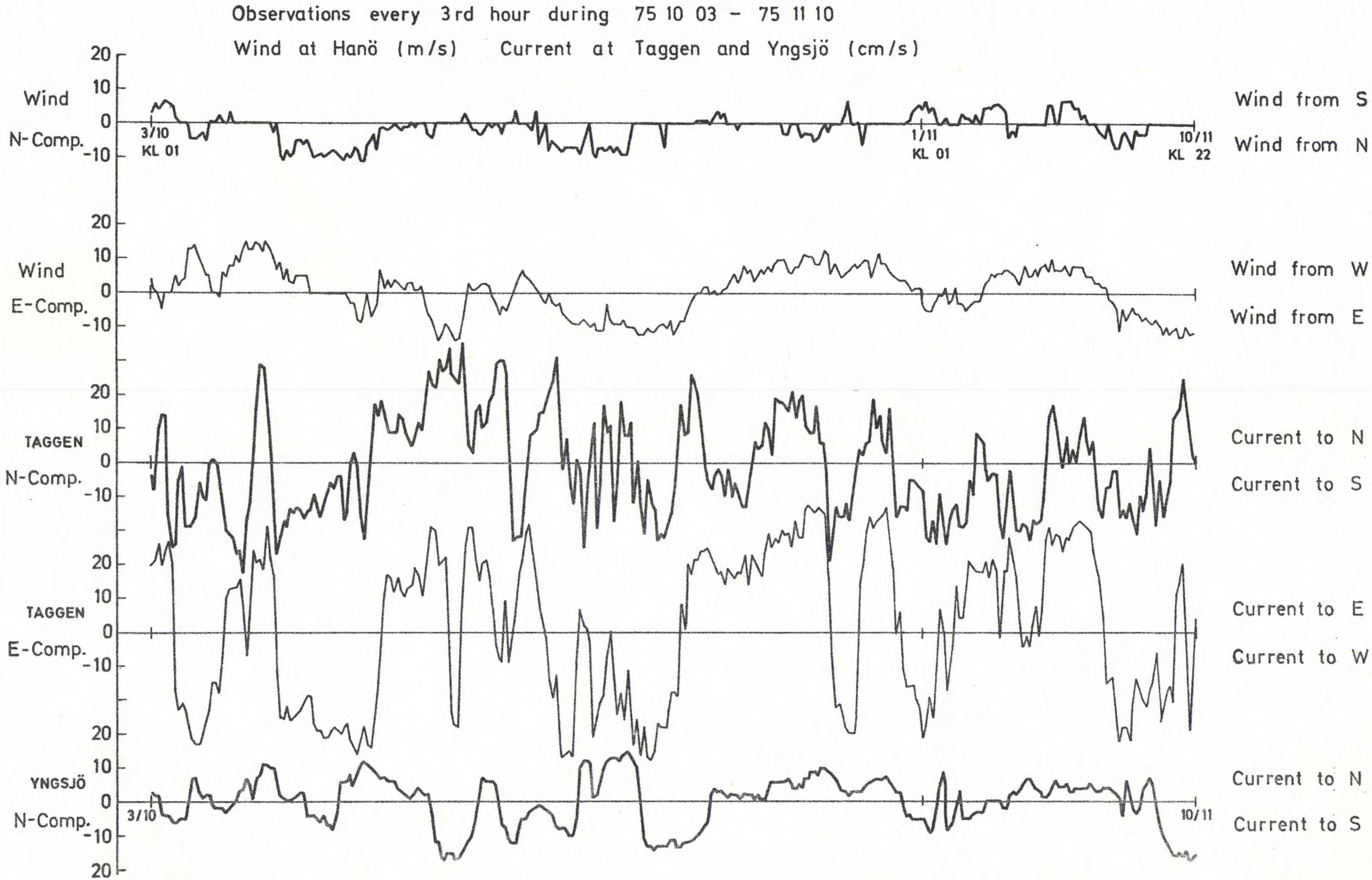
HANÖ BIGHT

FIG. 2



Reproduced from Kielmann et.al. 1976

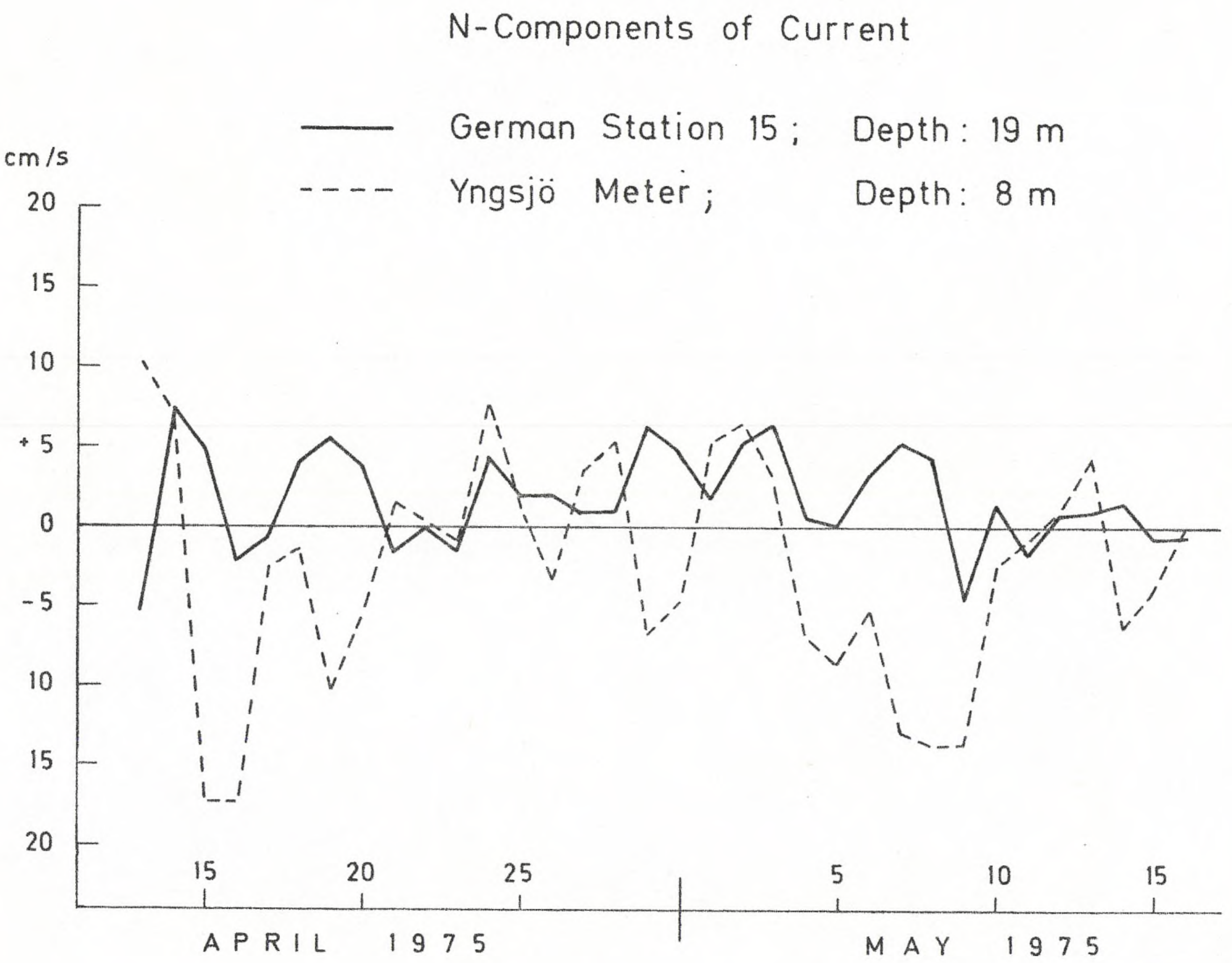
FIG. 3



Observations every 3rd hour during 75 10 03 - 75 11 10

Wind at Hanö (m/s) Current at Taggen and Yngsjö (cm/s)

FIG. 4


N-Components of Current
German Station 15 ; Depth : 19 m
Yngsjö Meter ; Depth : 8 m
cm/s
20
15
10
+ 5
0
- 5
10
15
20
15
20
25
5
10
15
APRIL 1975
MAY 1975

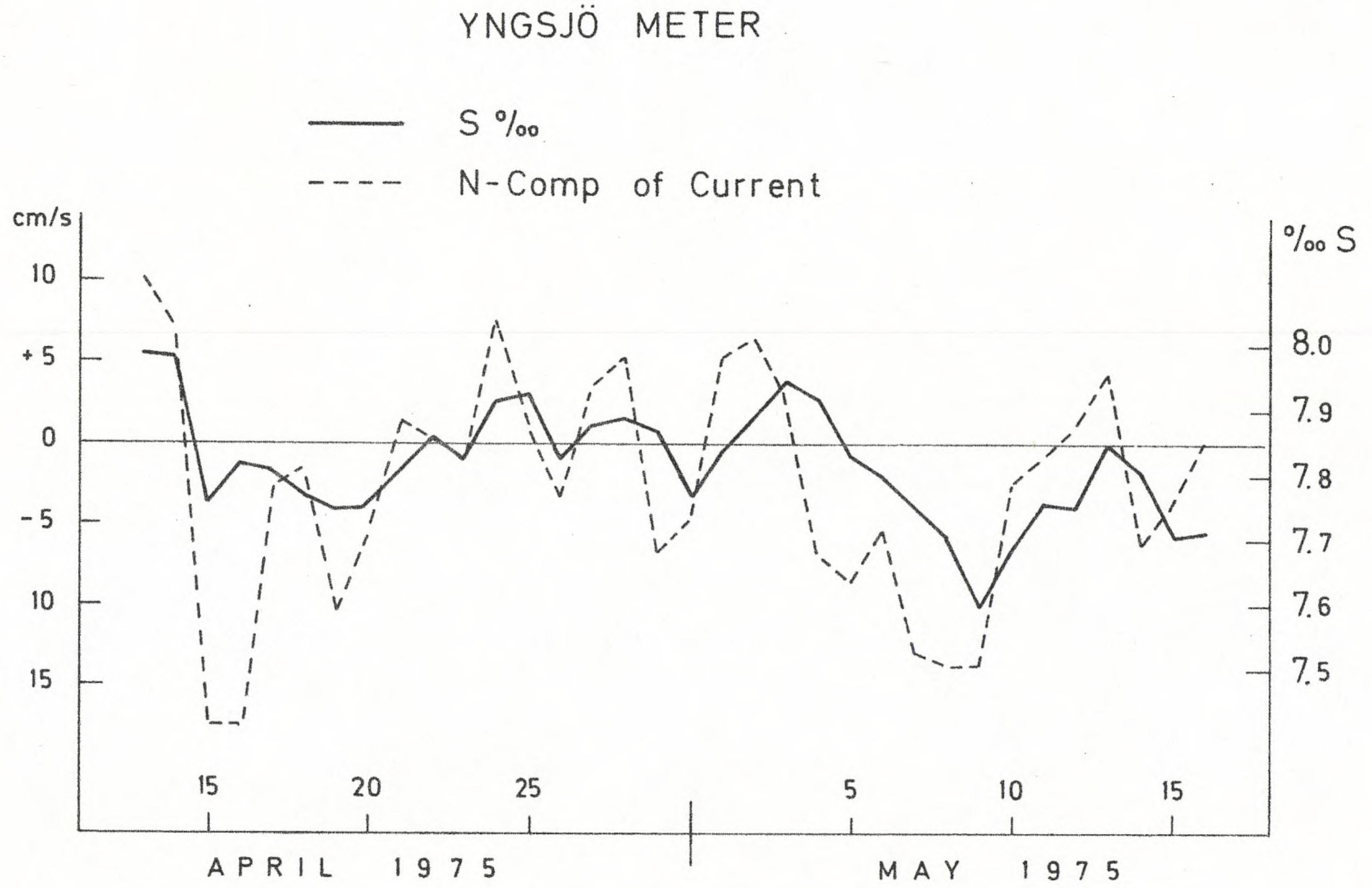

YNGSJÖ METER
S ‰
N-Comp of Current
cm/s
10
+ 5
0
- 5
10
15
‰ S
8.0
7.9
7.8
7.7
7.6
7.5
15
20
25
5
10
15
APRIL 1975
MAY 1975

FIG. 5A

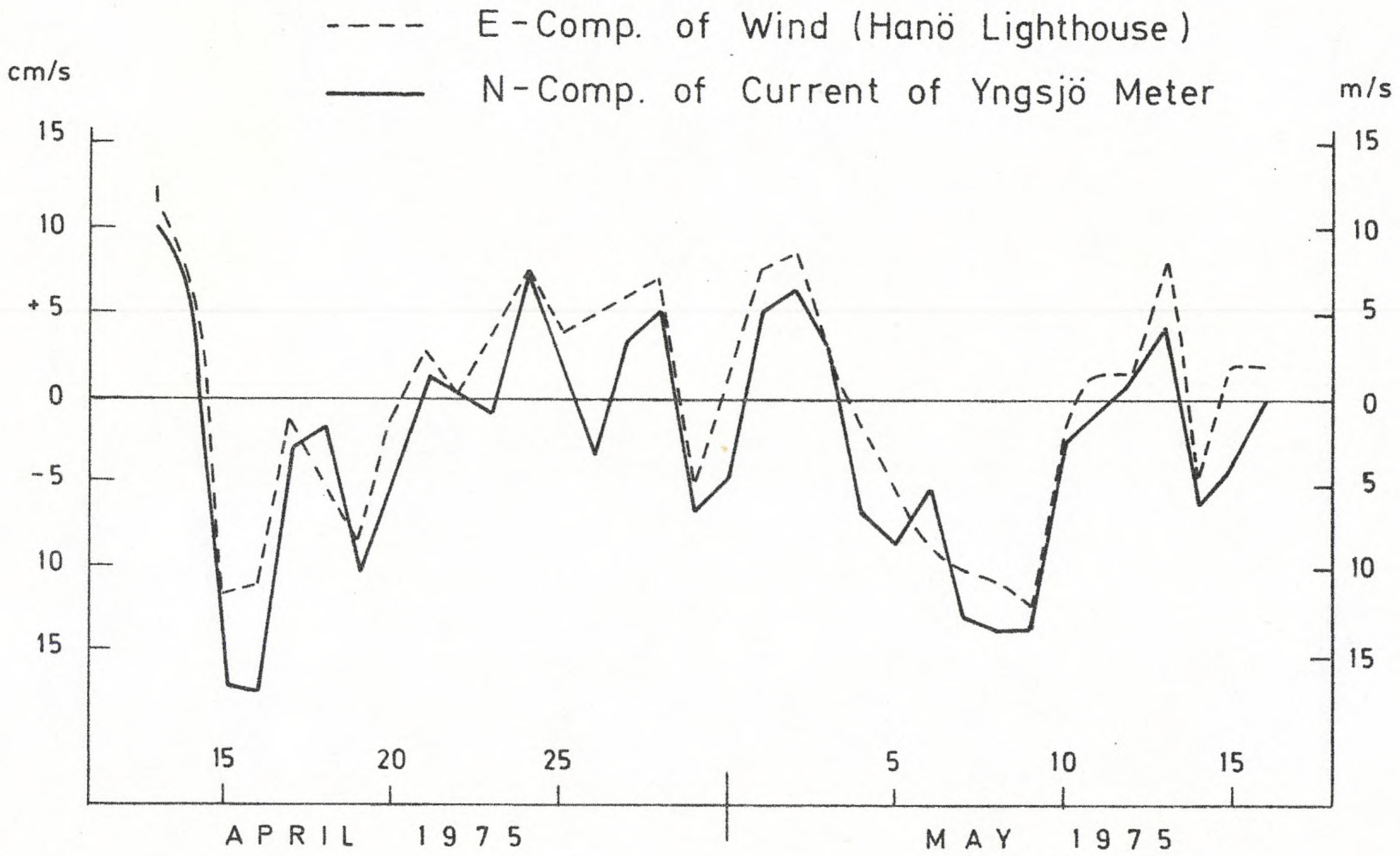
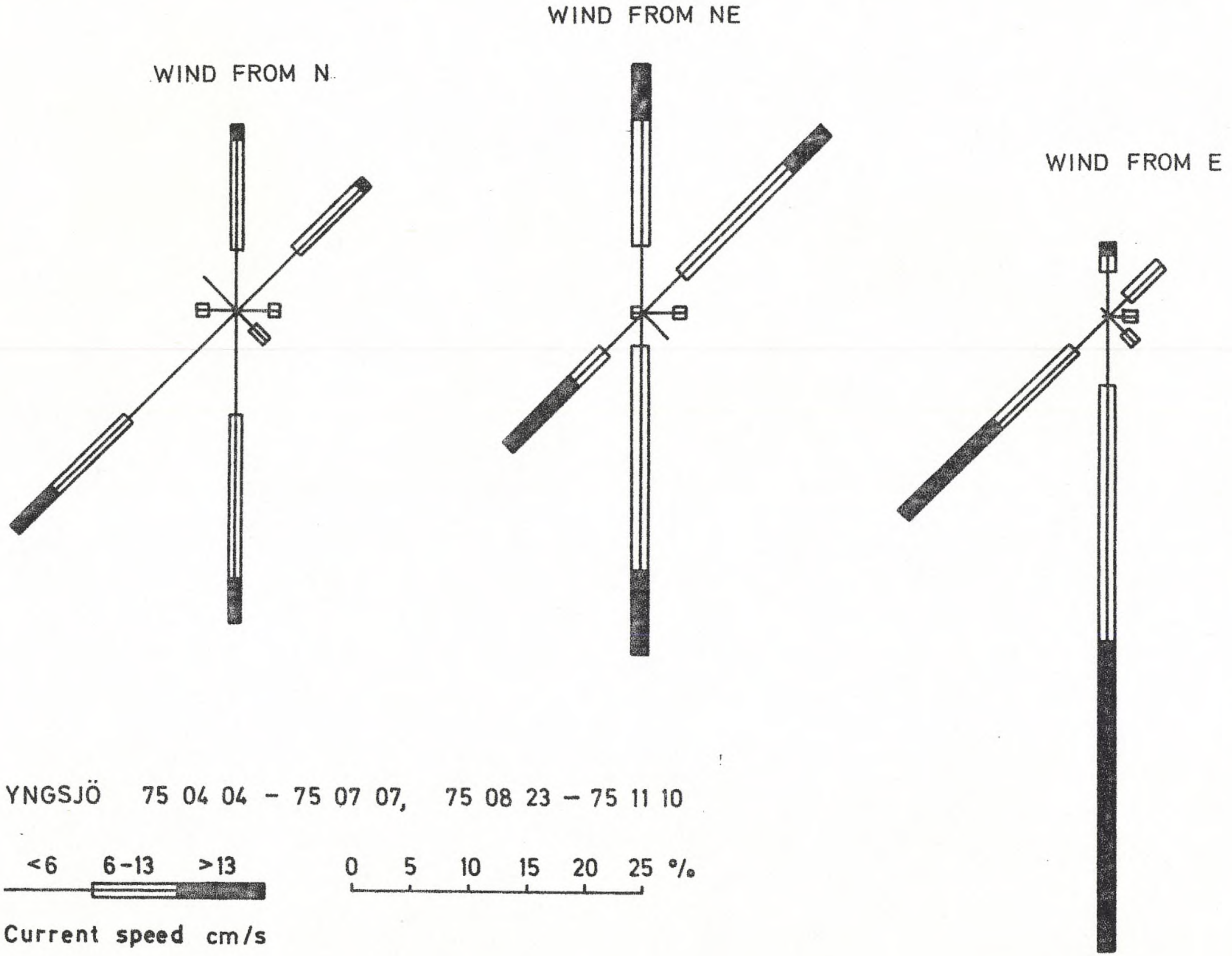

---- E-Comp. of Wind (Hanö Lighthouse)
—— N-Comp. of Current of Yngsjö Meter
cm/s
15
10
+5
0
-5
10
15
m/s
15
10
5
0
5
10
15
15
20
25
5
10
15
APRIL 1975
MAY 1975

FIG. 5B

FIG. 6

Current Directions, %, at 8 Wind Directions :



Current Directions, %, at 8 Wind Directions:

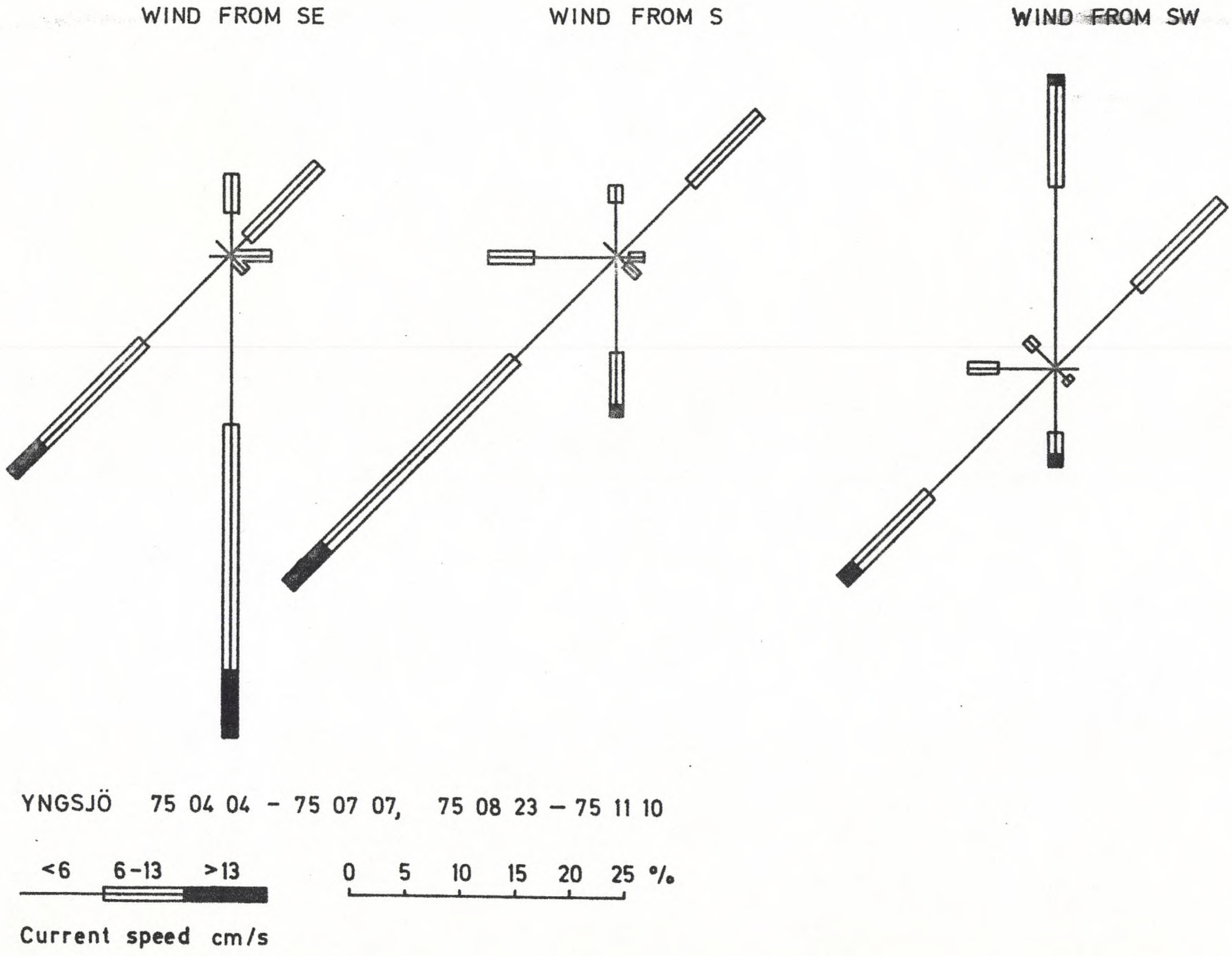
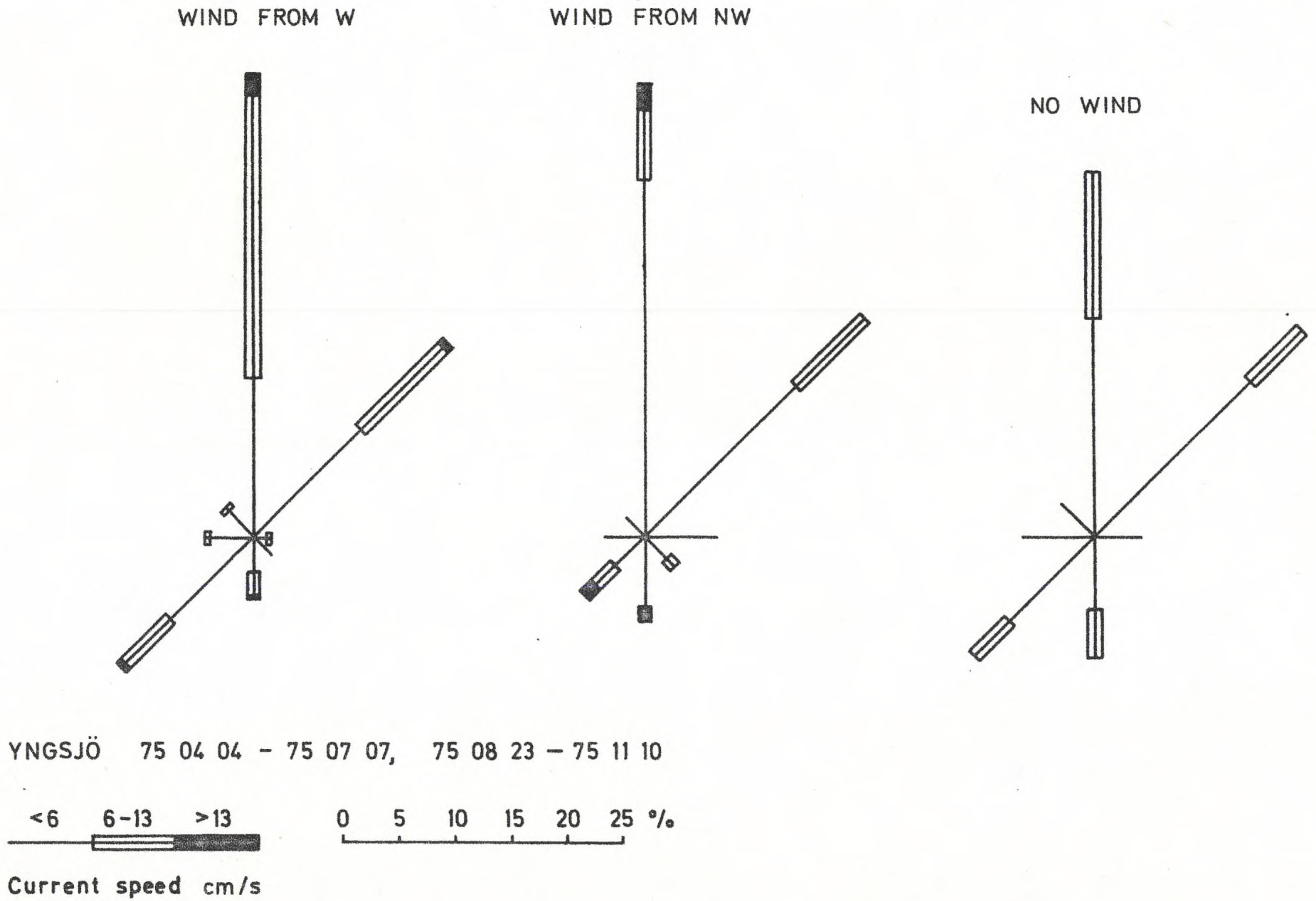


FIG. 7

Current Directions, %, at 8 Wind Directions:



YNGSJÖ 75 04 04 - 75 07 07, 75 08 23 - 75 11 10

FIG. 8

Current Directions, %, at 8 Wind Directions :

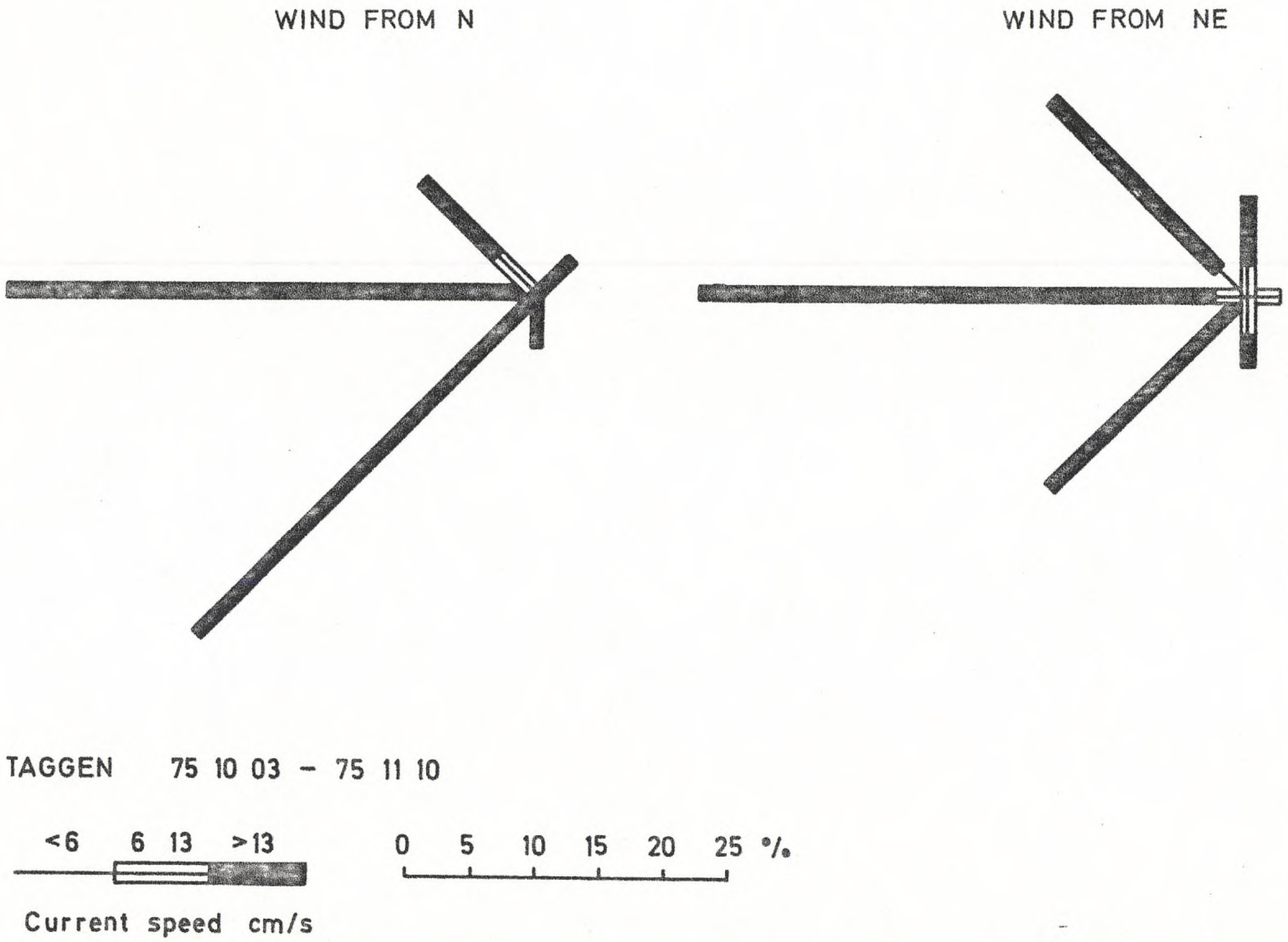


FIG. 9

Current Directions, %, at 8 Wind Directions :

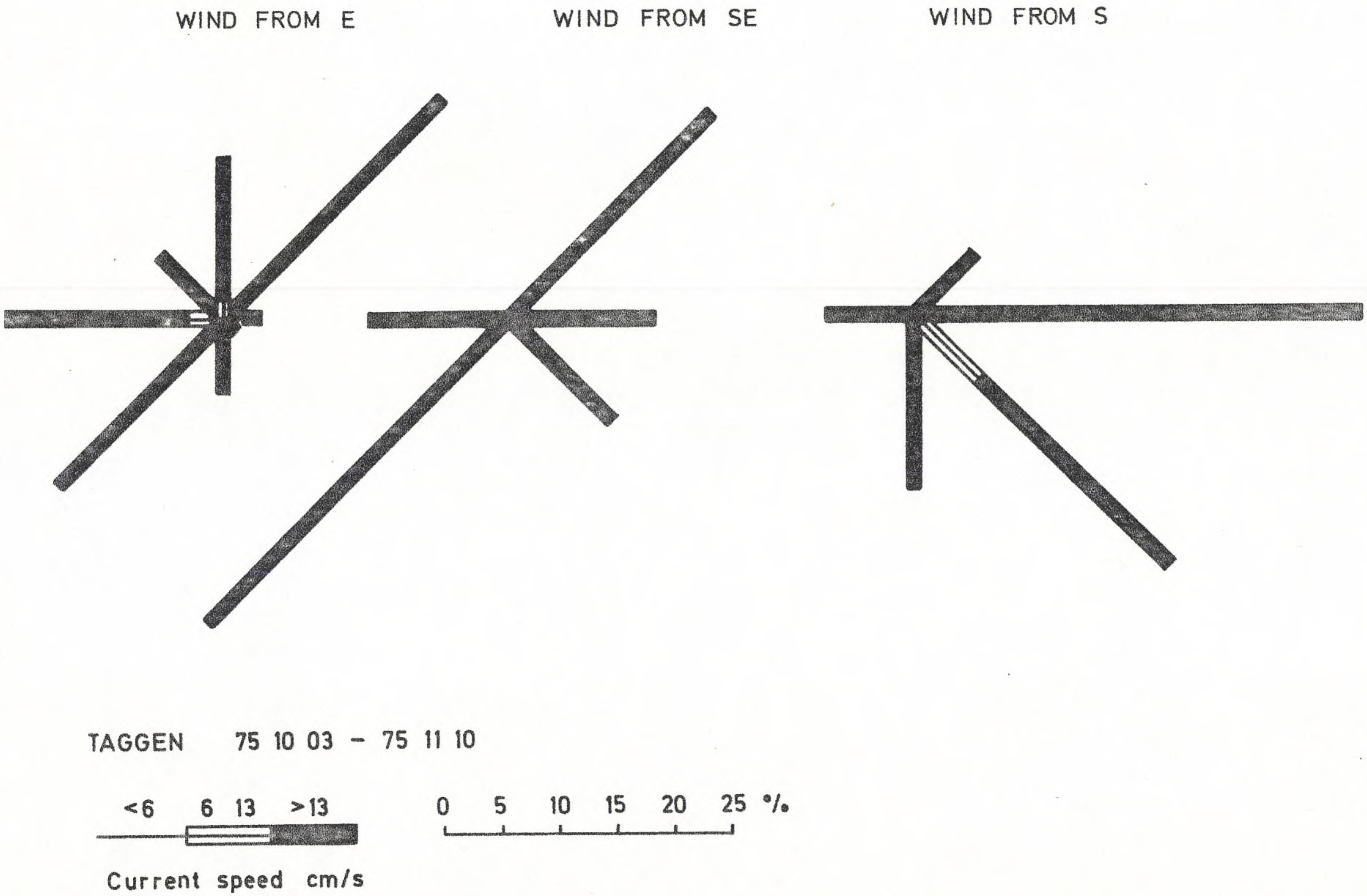


FIG. 10

Current Directions, %, at 8 Wind Directions:

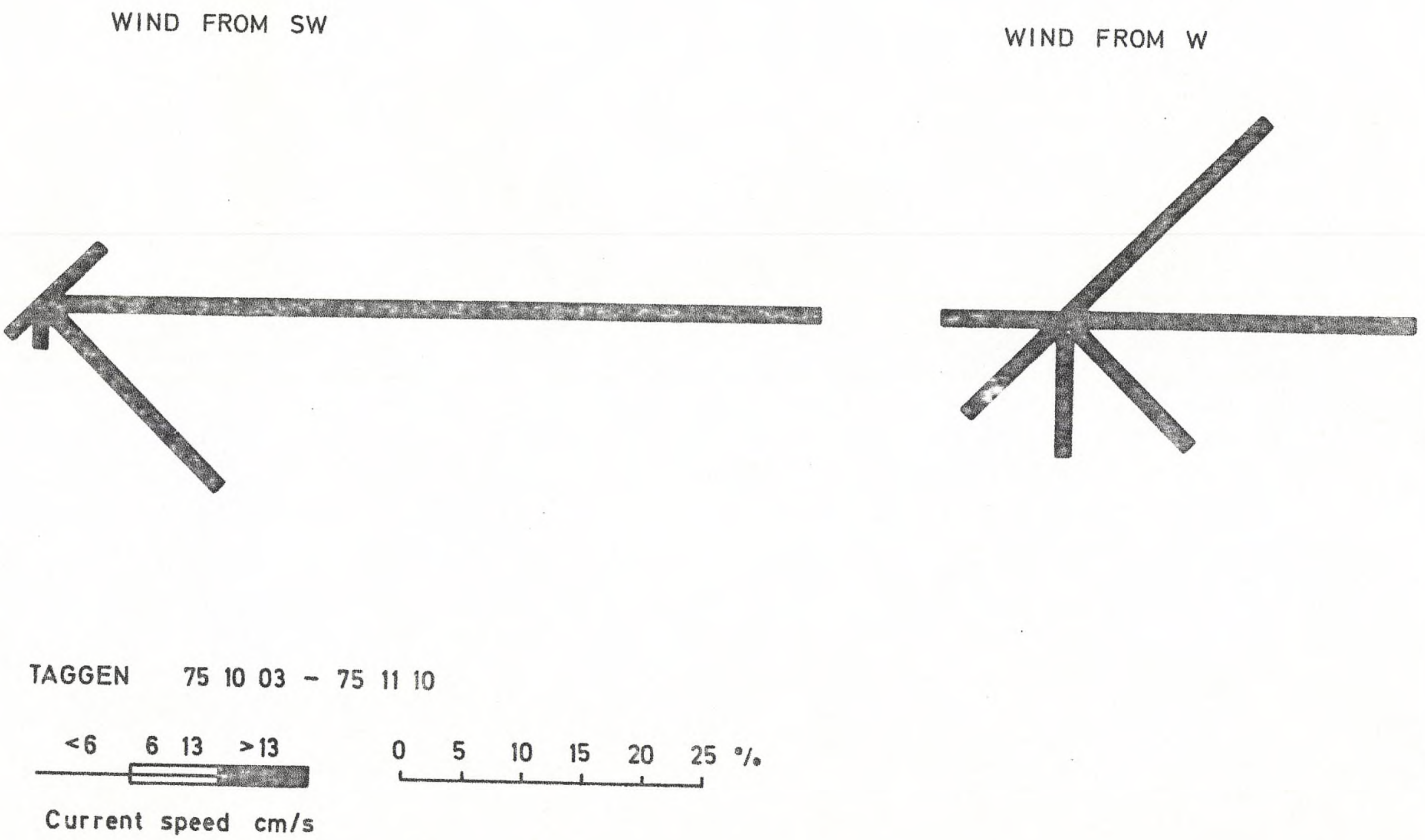


FIG. 11

Current Directions, %, at 8 Wind Directions:

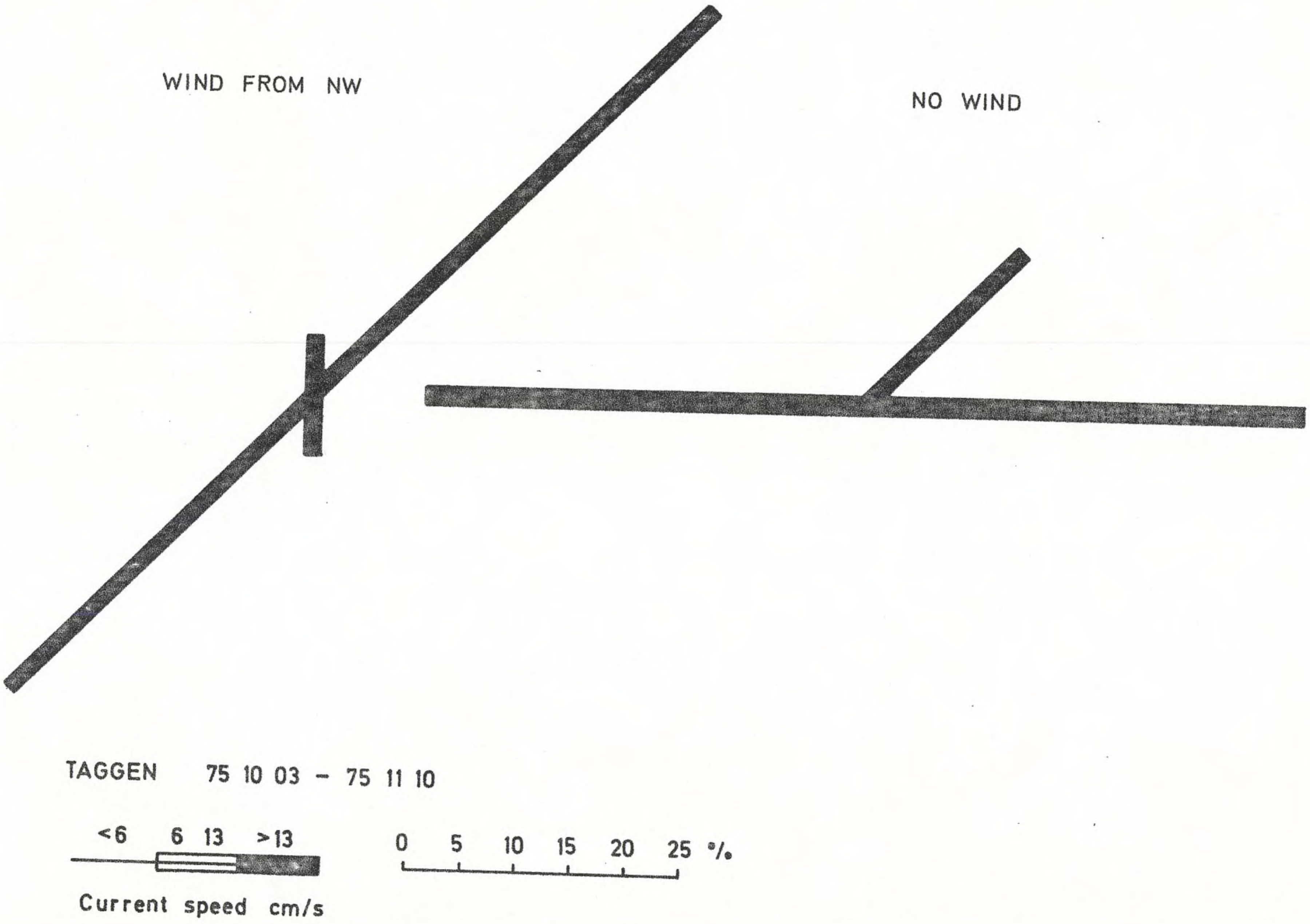
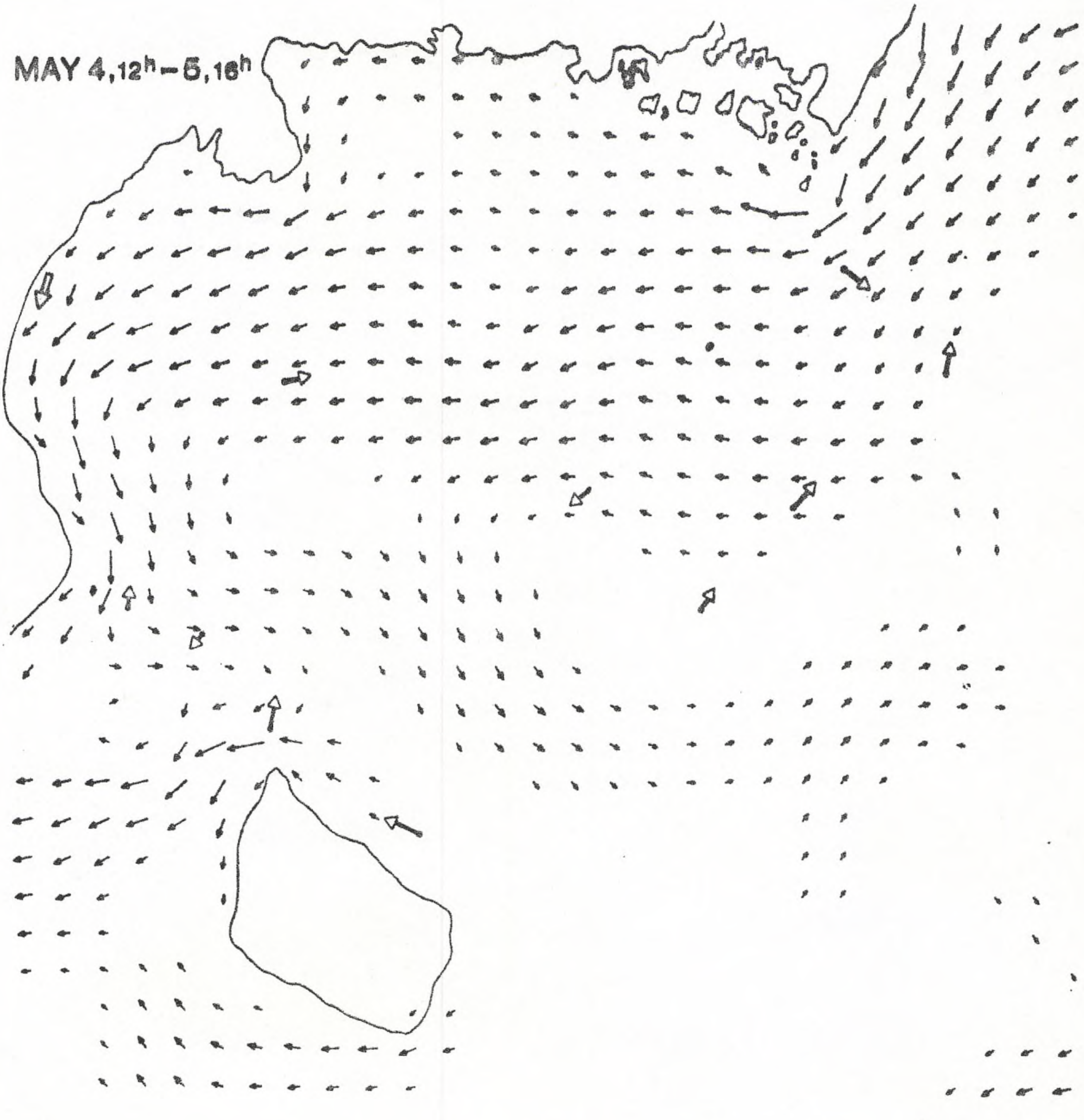


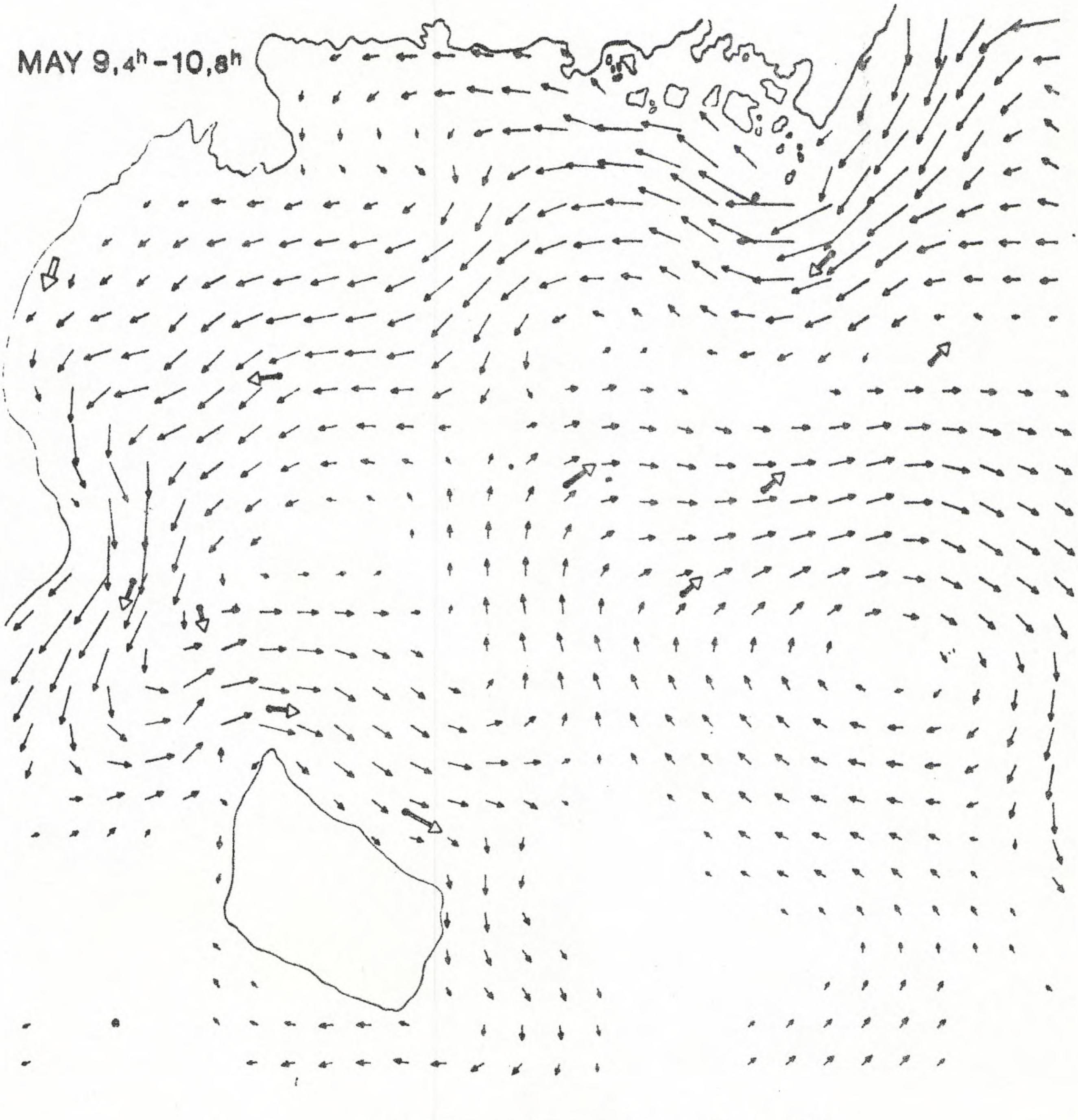
FIG. 12

FIG. 13



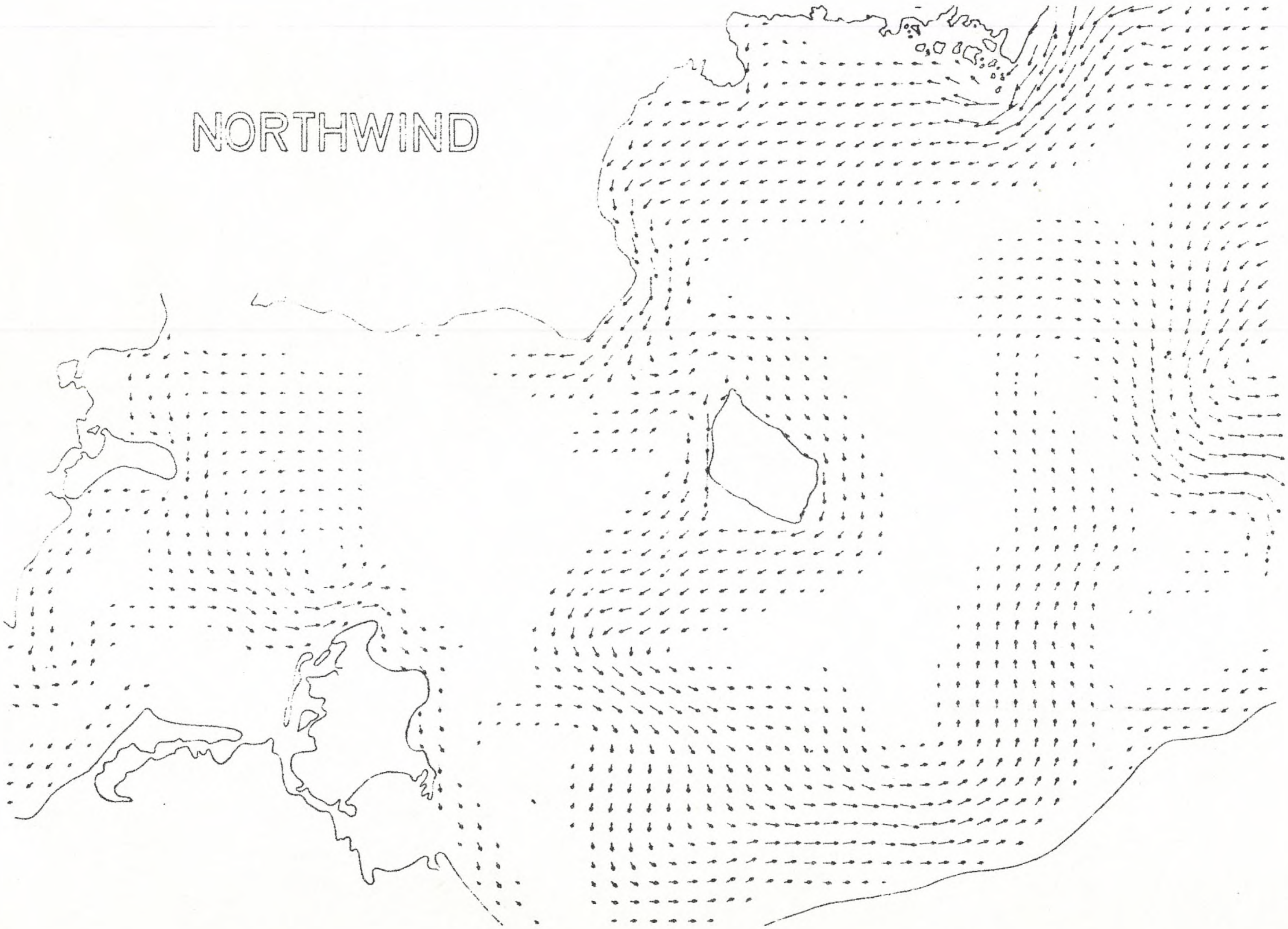
Reproduced from Simons 1976 with
Yngsjö current arrow inserted

FIG. 14



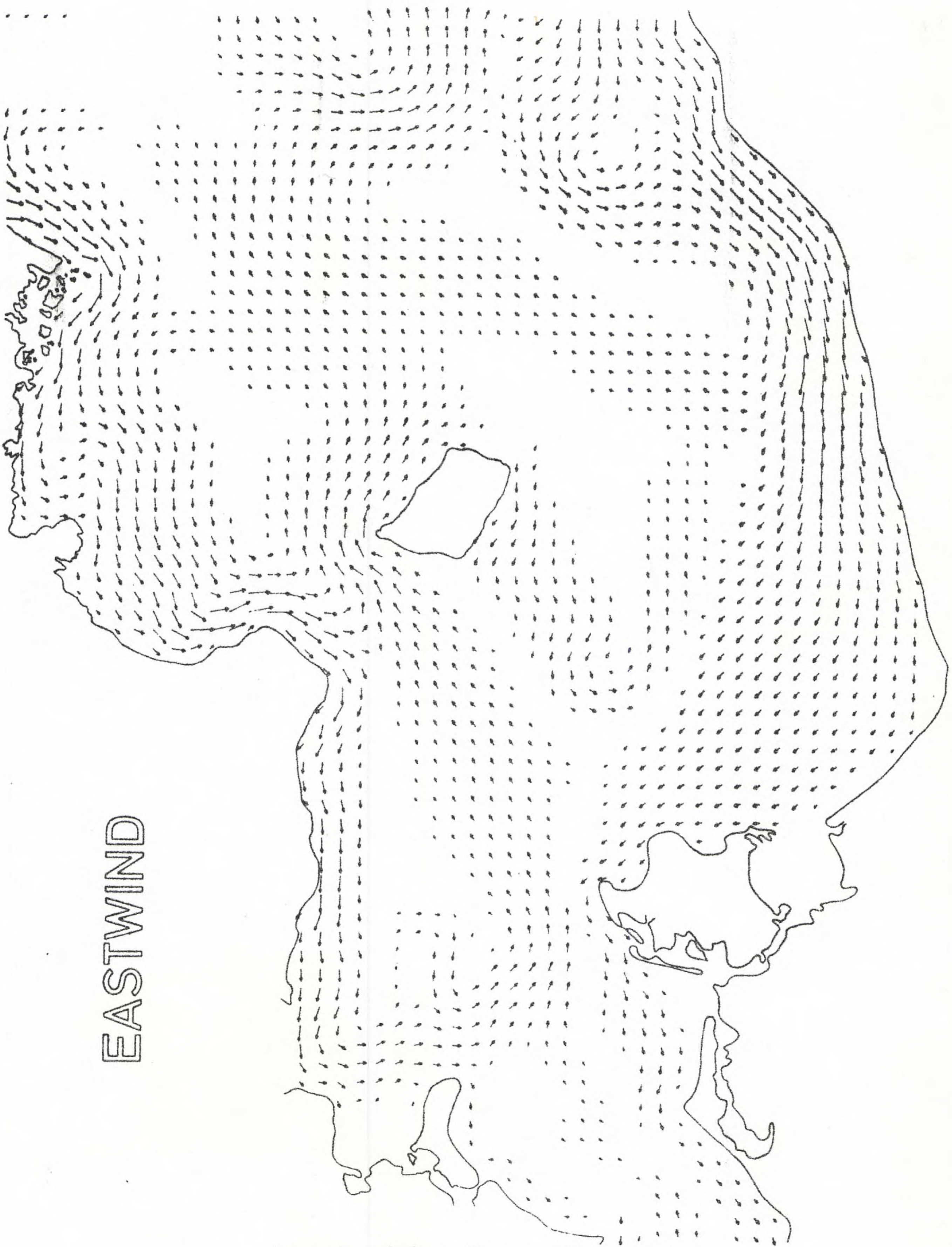
Reproduced from Simons 1976 with
Yngsjö current arrow inserted

FIG. 15



Reproduced from Simons 1976

FIG. 16



Reproduced from Simons 1976