INSTITUT ZA OCEANOGRAFIJU I RIBARSTVO — SPLIT
SFR JUGOSLAVIJA

No. 50 BILJEŠKE - NOTES 1983.

MEDALPEX in the North Adriatic

Preliminary report

MEDALPEX u sjevernom Jadranu - Preliminarni Izvještaj

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INTRODUCTION

Coverage of the North Adriatic by intensive meteorological observations in the frame of the ALPEX programe was used as the basis to study the influence of atmospheric disturbances on current field variations and conditions for deep water formation. This was the main objective of MEDALPEX for this region.

Temperature-salinity data were collected at an experimental polygon of 43 stations (Fig. 1). The whole experiment was undertaken twice: 16—25 March and 5—16 May 1982. In addition to temperature-salinity and turbidity data, samples for determination of suspended matter, species composition and phytoplancton density were collected at 11 stations in March and at 17 stations in May. Current data from three moorings with two or three »Aanderaa« RCM4 current meters were collected throughout the entire two months period (i. e. from March 16 — May 15). Data were recorded every 10 minutes. Current measurements with three »Aanderaa« RCM4 current meters were also performed at the oil-drilling platform »Panon« from February 22 through April 12 1982.

The objective of this paper is to describe some oceanographic features without analysis of simultaneous meteorological data as they are still unavailable.

DATA ANALYSIS AND DISCUSSION

The experimental polygon was designed to examine in detail the frontal zone vhich appears between the water of the northernmost part of the Adriatic and the water of the open North Adriatic. The first water is under the impact of freshwater runoff from the river Po and other North Italian rivers. The water of the open North Adriatic is influenced by advection from the south. The approximate position of this frontal zone was detected earlier as marked in Fig. 2 (Zore-Armanda, in press).

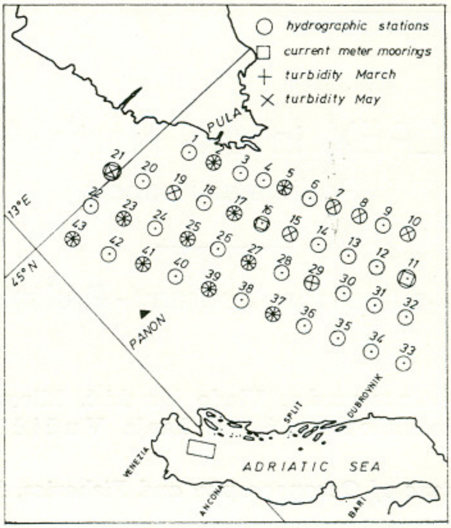

Fig. 1. Station map.

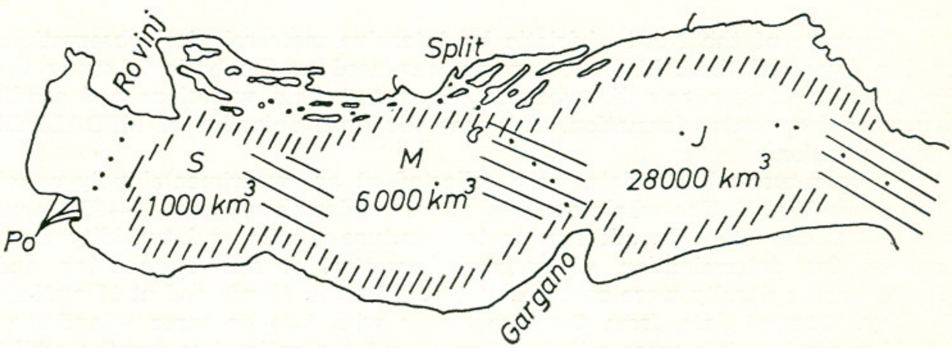

Fig. 2. Schematic presentation of the frontal zones (hatched) and zones of formation of the Adriatic water types (after Zore-Armanda, in press). Stations at the transect delta Po — Rovinj refer to Fig. 7.

Data collected during both cruises (March and May 1982) showed clearly the existence of the frontal zone between the colder and lower salinity water on the north and warmer and saltier water on the south (open North Adriatic). Between the two cruises the front moved only slightly north (Figs. 3 and 4). In the surface layer in May horizontal salinity gradient due to maximum river runoff was very large and frontal zone was not visible; in deeper layers however the front was still very pronounced.

The angle between frontal and horizontal surface was about 0.3°. Saltier water penetrates towards the north in the bottom layer (Figs. 5 and 6). In March north of the front temperature decreased with depth while south of the front it increased with depth. i. e. there was change of sign of the vertical temperature gradient across the front.

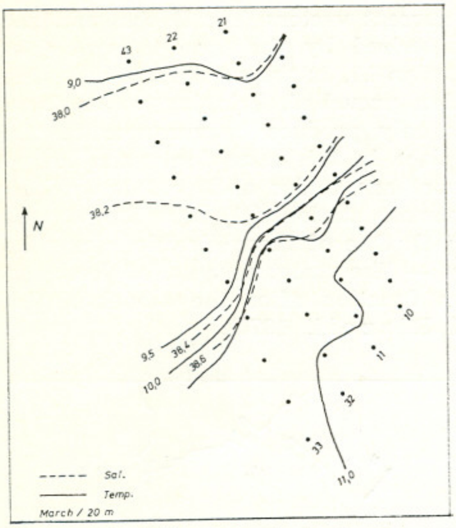

Fig. 3. Isohalines and isotherms at depth of 20 m in March show chearly the position of the frontal zone.

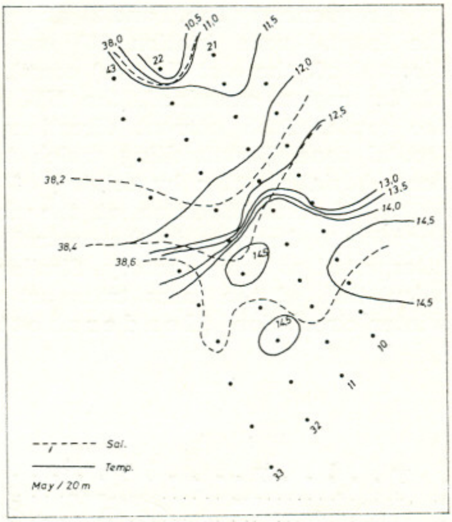

Fig. 4. Isohalines and isotherms at depth of 20 m in May show also the position of the frontal zone.

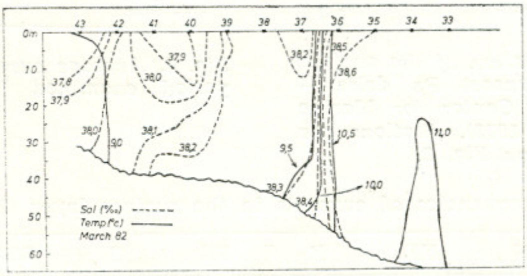

Fig. 5. Vertical distribution of temperature and salinity in March at one longitudinal transect.

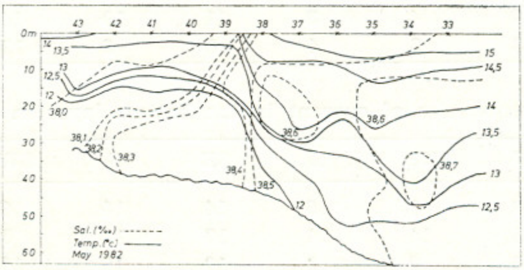

Fig. 6. Vertical dsitribution of temperature and salinity in May at one longitudinal transect.

The position of this front could be connected to the discharge of North Italian rivers. The spreading of this freshwater in the northernmost part of the Adriatic prevented the formation of the coastal front in this region which appears elsewhere in the Adriatic at the distance of several kilometers from the coast (Fig. 2) .Fig. 7 shows clearly the influence of the river Po on the salinity from the west (Italian coast) all along the eastern (Istrian) coast.

Frequencies (Tab. 1 and 2) and mean current vectors (Fig. 8) showed, that the frontal zone (station 16) was characterized by the west current (i. e. directed off the east (Istrian) coast). At station 11, at the most southern point of the region examined, the NW direction prevailed, bringing water from the south. Such current directions may only produce convergence in the frontal zone. Downwelling which takes place in this zone forms the heavy deep Adriatic water by mixing of the northern colder and southern saltier water. Current direction at the northernmost station (21) and Panon was opposite to direction in the central part (16). One of these directions may be interpreted as compensatory. Similar eddy — like structure resulted from the calculation of the mass transport stream function after the model of the winter circulation (H e n d e r s h o t t and R i z z o l i, 1976).

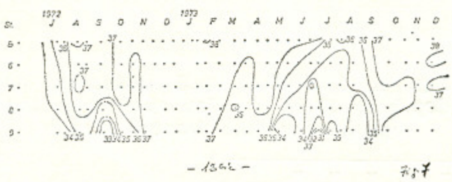

Fig. 7. Annual variation of the surface salinity on the transect Po delta — Rovinj (data after Center for Marine Recearch, 1972 & 1973). Stations are marked on Fig. 2.

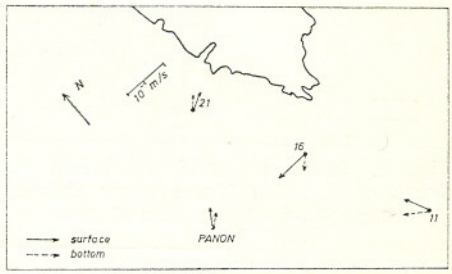

Fig. 8. Average current vectors for the period examined (cca two months).

Tab. 1. Direction frequencies of currents in the surface layer (8 m) in percentage

Station	N	NE	E	SE	S	SW	W	NW
21	15	16	12	13	15	8	8	13
Panon	23	13	16	15	7	5	5	15
16	9	4	8	11	10	14	21	21
11	13	3	4	6	6	13	24	29

Tab. 2. Direction frequencies of current in the bottom layer in percentage

Station		N	NE	E	SE	S	SW	W	NW
21	(30 m)	32	11	6	14	14	6	5	12
Panon	(35 m)	25	14	14	16	11	5	4	11
16	(40 m)	5	2	2	19	16	16	22	18
11	(54 m)	10	2	3	8	7	11	27	32

The influence of the wind will be described very briefly as ALPEX wind data were not available. Information on the wind speed and direction were taken from the Daily weather reports from seamen. In Figs 9 and 10 mean daily current vectors are shown for one situation with the strong NE-wind and for one situation without wind. The horizontal distribution of the mean daily current vectors in the meteorological situation with the strong wind showed on the southern side of the front current directed northwestward (i. e. parallel to the coast) probably as a consequence of the Ekman transport.

In the region where the front was situated, according to the temperature data, current vas directed westward (i. e. parallel to the front and in the direction of the wind). North of the front the mean current vector had the northeastward direction. On the other hand, according to results obtained by Stravisi (1973) in the northernmost part of the Adriatic (i .e. Gulf of Trieste) the transport under the influence of NE-wind (bora-wind) is mostly in the windward direction. This suggests that the circulation north of the front is characterized by the cyclonic gyre which is strengthened by the influence of bora-wind.

In quiescent meteorological situations the mean daily current was very weak in the whole region (Fig. 10) and variable in space.

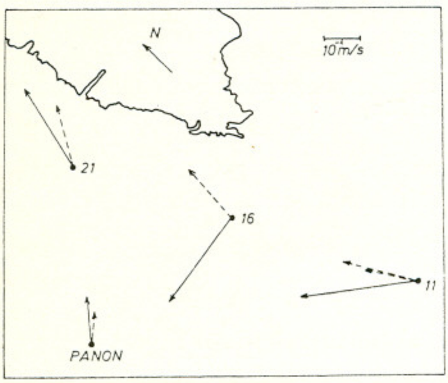

Fig. 9. Mean daily current vectors for the meteorological situation with the strong NE-wind (March 23, 1982). Solid line represents surface current vectors and dashed line represents deeper layer current.

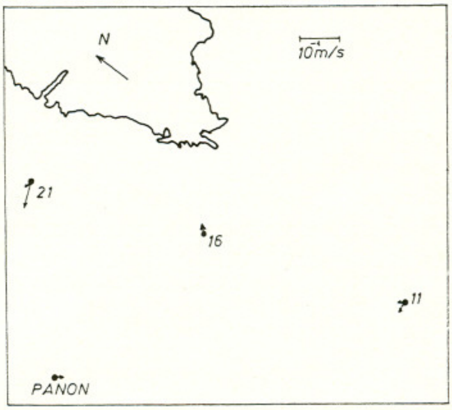

Fig. 10. Mean daily current vectors for the meteorological situation with no wind (April, 9 1982). Solid line represents surface current vectors and dashed line represents deeper layer current.

Turbidity was measured in three spectral regions (red, green and blue) as well as without filter. Extinction in the red part of the spectrum is almost entirely caused by suspended matter with diameter bigger than 1 micron; in the studied region these particles originate from the Po and other North Italian rivers. Distribution of suspended matter, as obtained from the extinction in the red part of the spectrum, showed similar shape during both cruises. Concentration of suspended matter decreased towards the south and extinction isolines followed frontal lines (Figs. 11 and 12). The river Po inflow has maximum in May and consequently the turbidity in May was greater

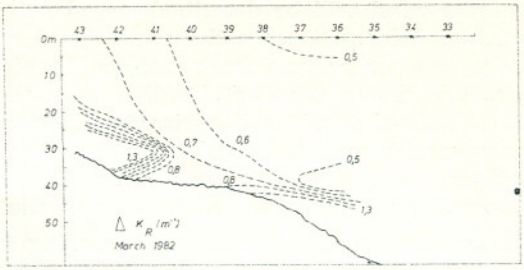

Fig. 11. Vertical distribution of suspended matter (extinction coefficient anomaly for red light —Δk_R) in March

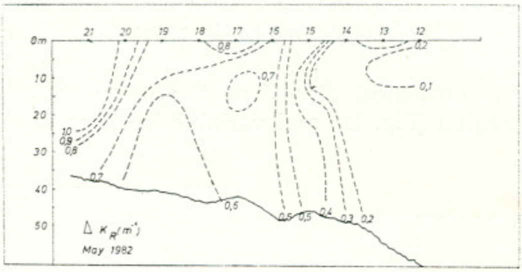

Fig. 12. Vertical distribution of suspended matter (Δk_R) in May.

than in March in the entire area. The turbidity increase from March to May followed also from Secchi disc readings (Tab. 2). Transparency was lower north than south of the front.

Differences of Secchi depth averages across the front were greater in March than in May (Tab. 3).

Tab. 3. Secchi depth averages (H_{SD}) in meters and standard deviations (σ)

	North of the front		South of the front	
	H_{SD}	σ	H_{SD}	σ
March 1982	12.40	1.50	16.29	1.75
May 1982	12.92	2.16	15.19	1.29

Current meter data at stations 16 and 11 were in agreement with the transparency pattern. The least turbid water were found south from the frontal zone where the current came from SE direction carrying clearer waters.

Extinction in blue and green is caused by yellow substances and phytoplankton. It increased with depth and it was greater at stations north of the front while it had maximum in the frontal zone (Fig. 13). Exctinction averages in blue and green part of the spectrum were greater in May than in March.

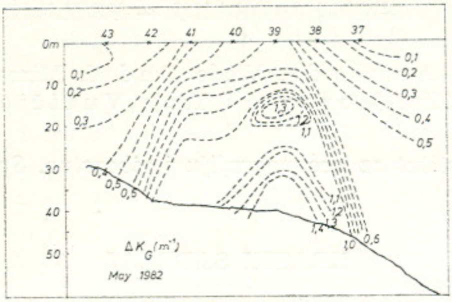

Fig. 13. Vertical distribution of the extincition coefficient anomaly for green light (Δ k_G) at one longitudinal transect.

CONCLUSIONS

Preliminary analysis of the MEDALPEX data collected in the North Adriatic showed clearly the presence of the frontal zone. It appeared between the water of the northernmost part of the Adriatic (under the impact of river runoff) and the water of the open North Adriatic influenced by the advection from the south. Frontal zone was also seen from the distribution of current vectors and turbidity data.

ACKNOWLEDGEMENT

Authors wish to express their thanks to all participants of the MEDALPEX Yugoslavia and especially to those from Institute of Oceanography and Fisheries, Split, Hydrographic Institute of Yugoslav Navy, Split, and Center for Marine Research Rovinj — Zagreb of the »Ruđer Bošković« Institute.

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MEDALPEX U SJEVERNOM JADRANU — PRELIMINARNI IZVJEŠTAJ

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KRATKI SADRŽAJ

Izvršena je preliminarna analiza MEDALPEX podataka prikupljenih u sjevernom Jadranu u razdoblju od marta do maja 1982. godine. Podaci o temperaturi i slanosti, prikupljeni na poligonu od 43 postaje, jasno pokazuju prisustvo frontalne zone između hladnije i slađe sjevernije vode i toplije i slanije južnije vode. Prisustvo fronte potvrđuju i strujomjerni podaci, kao i podaci o turbiditetu. Dinamički je frontalna zona izrazitija uz jači vjetar. Konvergencija na liniji fronte ukazuje na mogućnost tonjenja vode i formiranja teške pridnene vode u frontalnoj zoni.