Role of Po River waters in the intense winter convection episode in the South Adriatic Pit

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Introduction: A very intense convection episode in the cyclonic South Adriatic Gyre (SAP) was documented on 18 February 2012, after an episode of extreme heat loss (21 Jan-15 Feb). The amount of newly produced organic matter became very large during the two subsequent cruises (Fig. 1; Tab. 1), much larger than in the other seasons. The enrichment of the SAP is held to be related to the upwelling of bottom nutrient rich waters, but here we investigate the new possibility that nutrient rich waters from the Po River flowing along the western Adriatic coast had spread towards east and induced a high organic production.

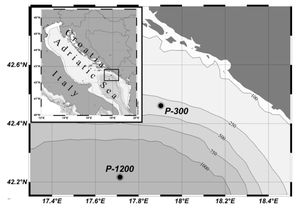

Figure 1 Position of sampling stations.

Table 1 Integral values of chlorophyll a (Chl *a*) and dissolved inoragic nitrogen (DIN).

Date	3 Oct 11	11-12 Jan 11	18 Feb 12	29 Mar 12	30 May 12	10 Sep 12
Stat	300	300	300	300	300	300
Chl *a* (mg; 0-bottom)	3	3	9	13	3	2
DIN (m mol; 0-bottom)	460	396	553	375	764	809
DIN (m mol; 0-200 m)	222	163	382	230	473	446
Stat	1200	1200	1200	1200	1200	1200
Chl *a* (mg; 0-bottom)	3	4	6	18	3	2
DIN (m mol; 0-bottom)	4280	2477	3466	3090	3385	2289
DIN (m mol; 0-200 m)	330	404	467	403	378	300

Result 1: The heat loss episode homogenized the water column while the overall density became higher in the coastal zone, contrary to the January case before the event (Fig. 2. Tab. 2). That induced a change in the direction of geostrophic currents. In March the upper layers became warmer and coastal zone was again lighter than open sea, but currents in deeper part of SAP remained of „negative", "anticyclonic" sense.

Table 2 Temperature (T), salinity (S) and σ_t at different layers of st. 300, st. 1000 (located between st. 300 and st. 1200) and st. 1200 with geostrophic currents relative to 100, 280 or 980 dbar surface (**V;** positive for NW direction) between them.

		st. 300			st. 1000			**st. 1200**			st.300/1000	st.1000/1200
		T(°C)	S	σ_t(kg/m^3)	T(°C)	S	σ_t(kg/m^3)	T(°C)	S	σ_t(kg/m^3)	V (cm/s)	V (cm/s)
12 Jan 11	**0-100 m**	**14,70**	**38,65**	**28,86**	**14,55**	**38,71**	**28,94**	**14,36**	**38,69**	**28,96**	**14**	**4**
	0-280 m	**14,51**	**38,66**	**28,90**	**14,20**	**38,66**	**28,98**	**14,13**	**38,66**	**28,99**	**14**	**2**
	0-980 m				**13,79**	**38,69**	**29,08**	**13,79**	**38,69**	**29,08**	**/**	**0**
18 Feb 12	**0-100 m**	**13,85**	**38,70**	**29,08**	**13,73**	**38,67**	**29,09**	**13,69**	**38,67**	**29,10**	**2**	**2**
	0-280 m	**13,60**	**38,65**	**29,10**	**13,72**	**38,67**	**29,09**	**13,70**	**38,67**	**29,09**	**-2**	**0**
	0-980 m				**13,65**	**38,69**	**29,12**	**13,66**	**38,69**	**29,11**	**/**	**-2**
29 Mar 12	**0-100 m**	**14,97**	**38,86**	**28,96**	**13,95**	**38,70**	**29,06**	**13,95**	**38,70**	**29,06**	**17**	**0**
	0-280 m	**14,64**	**38,84**	**29,02**	**13,77**	**38,69**	**29,09**	**13,77**	**38,69**	**29,09**	**12**	**0**
	0-980 m				**13,63**	**38,69**	**29,12**	**13,67**	**38,69**	**29,11**	**/**	**-2**

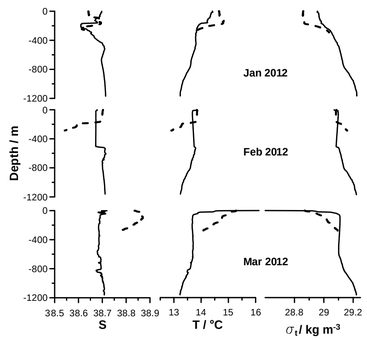

Figure 2 Distribution of T, S and σ_t values during winter cruises at st. 300 and 1200.

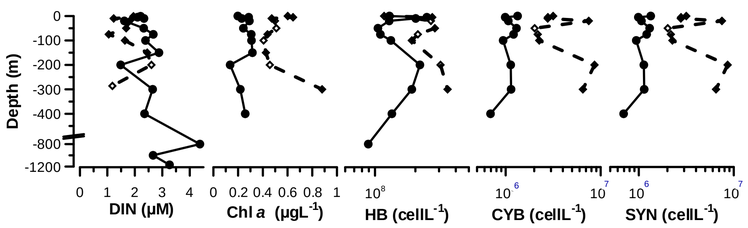

Figure 3 DIN, Chl *a*, heterothropic bacteria (HB), cyanobacteria (CYB) and *Synechococcus* (SYN) at st. 300 (dashed) and st.1200 (solid) in February.

Results 2: The integral DIN (Tab. 1) markedly increased between the January and February cruise at both st. 1200 and 300, implying large nutrient input. At st. 1200 Chl *a* was detected down to 600 m in February (Fig. 3) and down to 200 in March, while at st. 300 it reached bottom layers during both cruises. Chl a values found in March were below (st. 300) or in line (st. 1200) with expected values derived from DIN changes in the 0-200 m layers (Gro Fonnes Flaten et al., 2005).

Result 3: Could Po contribute to nutrient load and higher productivity? Salinity change, namely slight decrease in value between January and February cruise, does not give clear evidence on freshwater inflow. But, the change was presumably influeced in addition by evaporation which could have been extremely strong during 21 January-15 February episode and compensated the effect of fresh water inflow. One of the few satellite images available for the period of interest, taken on 24 February (Fig. 4) indicated spreading of chl a rich Po waters from the western Adriatic coast toward the east.

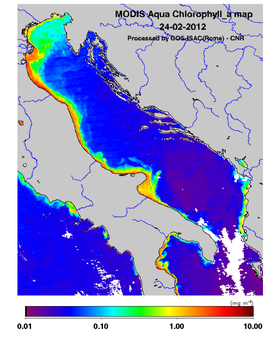

Figure 4 Satelite images (MODIS Aqua Chlorophyll *a* map processed by GOS-ISAC Rome – CNR) on two dates during the 2012 winter.

Result 4: Modelled surface currents document that during the 21 Jan-15 Feb heat loss episodes movements from western coast towards east at latitudes of SAP occurred on 23 Jan, on 28 Jan-3 Feb and 10 Feb, being occasionaly of very high intensity (Fig 5). Such eastward flow was also captured during 19-21 Feb and 29-30 Mar but was less intense. Corresponding to geostrophic currents estimates, the „anticyclonic" motions around the SAP are clearly visible in the surface layer 29-30 Mar.

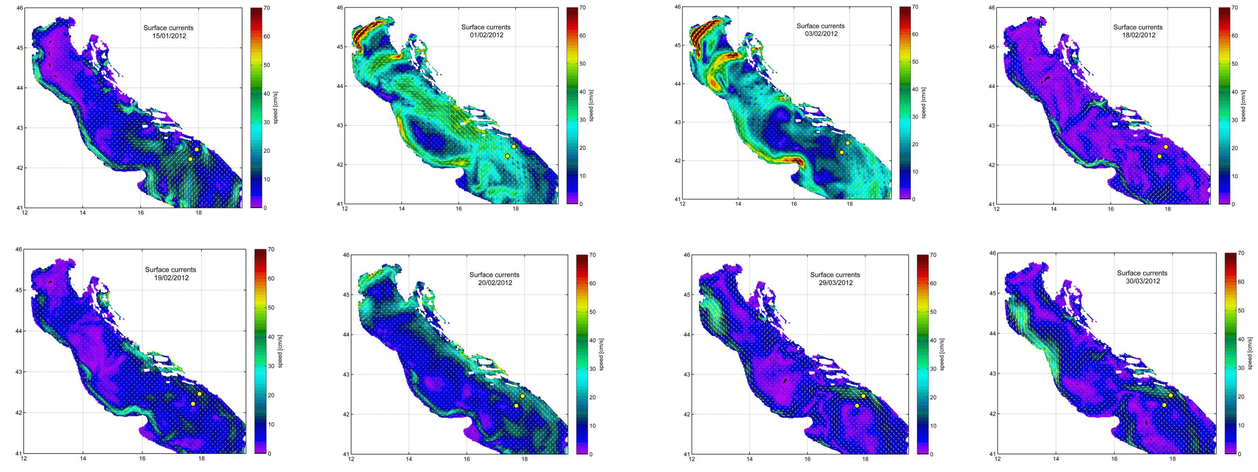

Figure 5 Daily averaged surface currents obtained by ROMS model on selected dates. Yellow dots denote stations 300 and 1200.

Conclusion: The results presented here support the idea that waters from Po contributed to a higher productivity of the SAP in the period of intense heat loss episode, but more work should be done on the subject before the new hypothesis will be fully accepted. The role of geostrophic currents in changing the circulation sense around the SAP and in favoring Po waters spreading should be validated as well.

Acknowledgements: This presentation is based on the paper by Najdek et al., 2014, with new data included (January cruise, modelled currents). Dr M. Batistić helped in its preparation. Data were provided during research cruises by the Institute for Marine and Coastal Research, University of Dubrovnik. Our work was supported by Ministry of Science, Education and Sport of Croatia.

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