FACTORS FAVORING LARGE ORGANIC PRODUCTION IN THE NORTHERN ADRIATIC: TOWARDS THE NORTHERN ADRIATIC ECOLOGICAL MODEL

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Abstract

The high interannual variability in the primary production of the northern Adriatic possibly reflects on the secondary production of the entire Adriatic. Although phytoplankton blooms are usually high in summer, the winter phytoplankton blooms are of special interest as in that period of low stratification especially large amounts of organic matter can be produced. Applied PCA analyses show that interannual variability in the winter production is primarily related to circulation, while the one in the spring/summer production is an immediate response to the Po River discharge. In addition, forcings from the previous period, up to a year, play a significant role in interannual changes of bioproduction.

Keywords: Circulation, Organic matter, Monitoring, Models, North Adriatic Sea

Introduction

The northern Adriatic (NA) is held to be one of the most productive regions of the Mediterranean Sea. However, its productivity is high only when influenced by the Po River, whose impact on the region significantly varies on seasonal and annual scales (Fig. 1). If waters of the Po River do not reside in it, the NA is oligotrophic like the rest of open Adriatic areas. Long-term changes in the NA organic production are therefore highly pronounced, and, most likely reflect on the secondary production of the entire Adriatic region or even wider.

An ecological model could explain and eventually predict long-term changes in the organic production of the region. In order to prepare grounds for it, we have tried to distinguish the main factors responsible for large organic production of the NA, throughout empirical analysis of long-term measurements in the region.

Although phytoplankton blooms are very high in summer, we have mainly focused to the winter ones [1]. When, in conditions of low stratification the nutrient rich Po River waters spread across the NA, they can fill volumely large spaces and induce exceptionally large organic production in general (as observed in 2004). Such events could probably result in an exceptional increase in the secondary Adriatic production.

Data and methods

Oceanographic data were collected monthly to seasonally in the 1990-2000 interval at six stations at a section in the NA (Figure 1). PCA and simple linear correlations were used to investigate relations between phytoplankton blooms and surface geostrophic currents relative to 30 dbar between the stations, Po River discharge rates, and atmospheric fluxes.

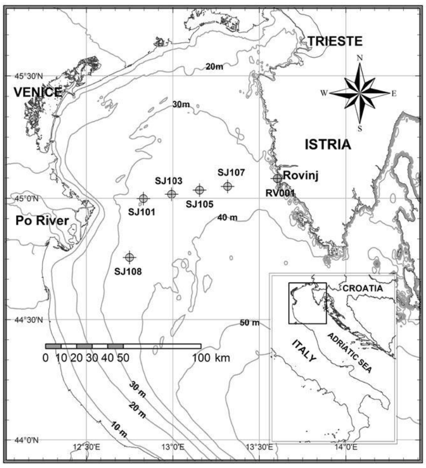

Fig. 1. The northern Adriatic with map of sampling stations.

Results and discussion

Long-term changes in phytoplankton abundances at the section between the Po River delta and Rovinj in winter (Jan and Feb) significantly depend on the circulation patterns, while in spring/summer (May-Jul) a direct Po River influence could be attributed (Table 1). However, discharge in the previous period, up to 45 days earlier, reflected possibly on winter blooms (Table 1).

High Po River discharge rates in the preceding summer along with intense evaporation and low Po River rates in the preceding autumn favoured large winter (Feb) blooms at st. SJ108, SJ101 and SJ107 (not shown). On the contrary, intense blooms in summer (Jul) at the same three stations were favoured concomittantly by high Po River rates in previous summer, autumn and winter, by heavy rain in the preceding autumn, and by enhanced insolation in the previous spring.

Tab. 1. Correlation coefficients between the first (F1) or second (F2) mode of interannual changes in phytoplankton abundance at 6 stations of Figure 1 in a chosen month (I to XII; abundances were normalized before performing PCA) and first two modes of geostrophic current distribution across the Po section at the sampling time (C1 and C2), Po discharge rates on the same day (Po), as well as cumulative values of Po discharge rates in period preceding the sampling, up to 1 (Po-1), 5 (Po-5), 10 (Po-10), 30 (Po-30) or 45 (Po-45) days. Correlations significant at 95% CL are bolded.

Month		C1	C2	Po	Po-1	Po-5	Po-10	Po-30	Po-45
I	F1	**0,66**	0,05	0,08	0,03	0,02	0,04	0,12	**0,76**
	F2	0,43	**0,63**	0,17	0,06	0,12	0,04	0,25	**0,61**
II	F1	**0,65**	0,21	0,18	0,16	0,16	0,11	0,09	0,02
	F2	0,32	0,36	0,00	0,00	0,05	0,30	0,24	**0,59**
III	F1	0,27	0,17	0,07	0,02	0,02	0,17	0,24	0,31
	F2	0,40	0,13	0,39	0,45	0,54	0,25	0,32	0,38
IV	F1	0,54	0,47	0,17	0,23	0,08	0,19	0,55	0,59
	F2	0,38	0,53	0,56	0,52	0,33	0,29	0,40	0,28
V	F1	0,04	0,08	**0,67**	0,57	0,42	0,38	0,37	0,25
	F2	0,11	0,09	0,07	0,17	0,03	0,08	0,33	0,27
VI	F1	0,15	0,00	0,51	**0,61**	**0,55**	**0,75**	0,06	0,21
	F2	0,33	0,46	0,00	0,12	0,00	0,39	0,41	0,23
VII	F1	0,21	0,40	**0,76**	**0,72**	**0,75**	0,34	0,05	0,24
	F2	0,15	0,46	0,41	0,44	0,41	0,73	0,10	0,20
VIII	F1	0,04	0,21	0,33	0,23	0,26	0,22	0,05	0,00
	F2	0,25	0,42	0,04	0,05	0,00	0,30	0,18	0,24
IX	F1	**0,62**	0,37	0,41	0,42	0,44	0,20	0,12	0,39
	F2	0,14	0,32	0,38	0,26	0,17	0,15	0,00	0,00
X	F1	0,00	0,30	0,43	0,46	**0,72**	**0,63**	0,00	0,23
	F2	0,26	0,54	0,36	0,38	0,24	0,00	0,14	0,24
XI	F1	0,34	0,48	0,12	0,14	0,06	0,16	0,22	0,16
	F2	**0,75**	0,29	0,50	0,51	0,56	0,30	0,48	0,27
XII	F1	0,04	0,00	0,30	0,27	0,33	0,68	0,24	0,42
	F2	0,41	0,12	0,61	0,58	0,61	0,62	0,58	0,58

Conclusion

The obtained results, showed that oceanographic forcing at the time of sampling and in previous periods, are important for the understanding of the long-term variability of the NA organic production, and can be used to forecast such events. In addition, they can be used for development of the NA ecological model.

References

1 - Kraus, R. and Supic, N. 2011. Impact of circulation on high phytoplankton blooms and fish catch in the northern Adriatic (1990-2004). Est. Coast. Shelf Sci. 91: 198-210.