EVENTS OF HYPOXIA IN RELATION TO CIRCULATION PATTERNS IN THE NORTHERN ADRIATIC SEA

Tamara Djakovac 1*, Nastjenjka Supic 1 and Robert Precali 1
1 Rudjer Boskovic Institute - djakovac@cim.irb.hr

Abstract
Marked hypoxia has been often observed in the northern Adriatic (NA) bottom layers during autumn. Assuming that the frequency of these events is significantly affected by the circulation regime in the NA, and not exclusively due to eutrophic pressure, datasets of bottom dissolved oxygen volume ratio at two stations in the area are compared to the velocity of geostrophic currents for the period 1972-2010. Significant correlations were obtained pointing the importance in circulation patterns.

Keywords: Oxygen, Currents, North Adriatic Sea

Introduction
Marked hypoxia in the bottom layer frequently develops progressively from August to November in the northern Adriatic. The region is under the impact of the Po River, one of the largest in the Mediterranean (Fig. 1) which nutrient richer waters can spread over the entire northern Adriatic region, remaining in a large portion entrapped within gyres, which usually extend from the surface to 10-20 m, or even more (Supic N., pers.comm.). An anticyclonic gyre often forms in the north-eastern Adriatic and is marked by the southward Istrian Coastal Countercurrent (ICCC; [1]). Alternatively, river waters do not spread significantly across the northern Adriatic and the region largely belongs to the Adriatic-wide cyclonic gyre. Thus, events of hypoxia/anoxia resulted from a combined effect of excess primary production and reduced lateral advection due to gyre formations [2]. To verify the importance of lateral advection, datasets of dissolved oxygen volume ratio of bottom layers of some northern Adriatic areas during the period 1972-2010 were correlated to the velocity of geostrophic currents of different direction. Material and Methods
Dissolved oxygen volume ratio in bottom layers of two stations (SJ107 and SJ108), located along the transect Po River Delta-Rovinj (Fig. 1) was determined by the Winkler titration technique described in Strickland and Parsons (1972).

Results and Discussion
The correlations between current velocities and hypoxia events were statistically significant (Fig. 2a, b). At the eastern, more oligotrophic station SJ107, southward geostrophic current (ICCC), which indicates the presence of an anticyclonic gyre (Fig. 1), appeared along with hypoxia events (Fig. 2a).

Fig. 2. A) Bottom dissolved oxygen volume ratio (DO) at station SJ107 in relation to the component of surface geostrophic current relative to 30 m between stations SJ107 and RV001; b) Same as a) but for stations SJ108 and SJ101; c) Seasonally cycle of geostrophic currents component between stations SJ107 and RV001 in years with (black) or without (gray) hypoxia event; d) Same as c) but for stations SJ108 and SJ101. Positive currents indicate inflow into the NA.

This gyre seems to form by the end of winter and persists throughout spring and summer, increasing the advection of low-salinity waters (enriched in nutrients) eastward, consequently with oxygen consumption in bottom layers in autumn (Fig. 2c). But, in years when hypoxia event does not occur, the gyre forms much later, in summer (Fig. 2c). Unexpectedly, in the western, more eutrophic part of the region (station SJ108), which is more directly influenced by nutrient inputs, low bottom oxygen concentrations coincided with intense surface southward current between stations SJ108 and SJ101 (Fig. 2b). This current seems to be present throughout the year (Fig. 2d), concurrently with hypoxia in bottom layers from August to September, that points to a presence of another anticyclonic gyre near SJ108 (Fig. 1). Conclusion
The results indicate that particular circulation patterns, especially when gyres form, are an important cause of hypoxia in the northern Adriatic.

References