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Biogeosciences Discussions

Interactive comment on "NW Adriatic Sea variability in relation to chlorophyll-*a* dynamics in the last 20 years (1986–2005)" *by* L. Tedesco et al.

L. Tedesco et al.

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General comments

We thank Referee 3 for his/her detailed comments and useful suggestions to improve the manuscript.

As we discussed in our replies to Referee 1 (Replies to Anonymous Referee 1, page S1), the aims of the ms were, firstly, to analyse long-term trends and, secondly, to study the climatology of the region, since a more realistic picture was provided by the absence of chlorophyll–*a* trends. We recognize that the structure of the ms leads to misunderstandings of the general aims and also that the analysis of the annual climatologies have taken a big part of our work. We thank Referee 3 for pointing it out and suggesting a more adequate order of presentantion. Taking into account all the other

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Referees' comments, we believe that this new layout improves the ms without changing, but rather strenghting, our main results and conclusions. We have consequently moved Sect. 3.1, which is focused on trends, at the end of the Results section, after the analysis of the intra-annual variability of the different variables and the study of their relationships. We also followed Referee 1 suggestion and we have shortened the title of our ms (Replies to Anonymous Referee 1, page S3). About the Abstract and Conclusions sections, we have rewritten it according to the new order of presentation of the work.

The paper from Mauri et al.(2007) has been published in the same day that we submitted our ms, while the paper of Jeffries and Lee (2007) has been published more than a month later. We have now taken into consideration those papers in the text.

We believe that data analysis requires robust and objective measure of tendencies, even if some trends can be apparent. The Cox-Stuart test has been a valuable tool to study different trends in the physical variables (temperature and salinity) and to reject the hyphotesis of apparent chlorophyll–*a* trends in the medians at E06 and in the minimum values at C10.

Specific comments

In this section we will follow Referre 3 numbering, which refers to the published ms in BGD.

About Figures. During the preparation of the ms, we were asked to edit our ms following the instructions for the final paper version. Fig. 5, Fig. 6 and Fig. 7 are arranged in a different manner in BG comparing to BGD. In the portrait BG format, the graphs are arranged as 3 per line, bigger and all the values are more readable. The most comprehensive way to present Fig. 5 and Fig. 6 was in keeping the same interval between isolines, but to colour scheme's disadvantage. We will improve the figures, as Referee 3 suggests. We will also change the figure legends of Fig. 5, Fig. 6 and Fig. 7, mentioning that they refer to median values, as Referee 3 suggests.

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Several works present different kind of time-space plots as Hövmöller plots. But we agree with Referee 3 that, originally, Hövmöller plots were referred only to time/latitude or time/longitude plots. To avoid any misunderstanding, we will simply name those plots as time-depth plots.

Page 653, Line 9. Please, see our answer in the second paragraph of the General comments.

Page 654, line 4–6 and line 24–26. It is actually one of the final aims of the ms (objective(i) in the Introduction section) and it is shown in the Sect. 3.1 (Sect. 3.4 in the revised ms). We hope the new revised structure will help to clarify the analysis of long-term trends. Indeed, in the Discussion section we explained the different response of the chlorophyll–*a* to different trends of the physical oceanic variables at the two stations (Sect. Discussion, page 663, 3–19; Sect. Conclusions, page 668, line 6–14).

Page 658, line 4–6. The sentence was misplaced. It is now in the Sampling and Methods section (page 655 between line 9–12) and it is rewritten in the following way: " Because of the high short-term variability of the Adriatic environment, we decided to analyse the data on the smallest available scale (monthly), even if, in doing so, the winter months are less represented."

Page 658, line 24. We will replace "in the last 15 m of the water column" with "in the bottom 15 m of the water column" and "first 10 m of the water column" with "top 10 m of the water column", as Referee 3 suggests.

Page 659, line 22–24. The sentence was unclear and it is now rewritten in the following way: "Silicate concentrations (panel i) are high throughout the water column at both sites in December and January, because of mixing processes, while are high only at the surface at E06 (e.g. in June), reflecting low salinity concentrations and therefore the Po river's influence".

Page 659, line 2–3. We agree with Referee 3 that oxygen saturation levels below

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30% are usually considered the threshold limit between hypoxic and normoxic water conditions. Even if the data set presents some episodes of hypoxia (see the time series plots at http://flux.ve.ismar.cnr.it/ibm/html/socal/data/fig1.1.htm), in this case we are referring to the median intra-annual situation. Therefore, we will rewrite the cited sentence and we will refer to the minimum values of oxygen saturation as "well belove saturation levels" as Referee 3 suggests.

Page 661, line 16–19. To avoid a misunderstading of the word "drive", we will replace it by the words " are related to".

Page 662, line 2. This is an interpratation of the figure layout obtained from PCA analysis. It is thus an outcome and not a consideration based on other works.

Page 663, line 12–13. We agree with Referee 3 and we will rephrase the sentence in the following way: "...at C10 this does not happen, since no large effect is detected of the Po water spreading there during autumn." We do not agree that in the Northern Adriatic salinity values below 38 are indicative of fresh water influence. We believe that salinity below 37 are a suitable indicator of river inputs in the region.

Page. 663, line 25. We will replace the word "fitted" with the word "fit", as the Referee 3 suggests.

Page. 664, line 11. Since we will rephrase the sentence on page 663, line 12–13, as we mentioned above, the two sentences will not be in conflict anymore.

Page 664, line 20. We are in favour of rewriting this sentence, as the Referee 3 suggests.

Page 664, line 23–24. N-NH_3 is an indicator of bacterial activity on senescent phytoplankton cells and/or micro- and/or meso-zooplankton grazing. Several works (e.g., Fonda Umani, 1996; Mozetic et al., 1998; Fonda Umani et al., 2005) have showed that the November blooming of the Northern Adriatic is poorely controlled by micro- or meso-zooplankton.

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Page 665, line 1–7. We agree with Referee 3 that concentrations are supposed to be affected by the increasing diluition from the source, but in this sentence we wanted to discuss what factors might explain the absence of a gradient in nitrate and the different response of chlorophyll–*a* at C10 and E06. We have modified the sentence in the revised version of the ms to clarify this aspect.

Page 665, line 10. This sentence belongs to the Discussion section and it is further explained in the Conclusions section (page 667, line 27–29 and page 668, line 1–5) as one of the main findings of our work.

Page 666, line 1. We will replace the word "periodical" with the word "periodic", as the Referee 3 suggests.

Page 666, line 24. See our answer in the General comments.

Page 667, line 9. There is no international agreement between different indicators and indices regarding the assessment of the trophic status of seawater, mostly due to different criteria, methodologies of data analysis and restrictions to selected regions. For example, Giovanardi and Tromellini (1992) refers to oligotrophic status for the Northern Adriatic waters characterized by chlorophyll–*a* levels < 1.7 μg dm^{-3}, Ignatiades (2005) for Aegean Sea waters having chlorophyll–*a* values < 0.5 μg dm^{-3}, while Babin et al. (1996) for Northern Atlantic waters with chlorophyll–*a* concentrations < 0.05 μg dm^{-3}.

Consequently, we prefer not to classify the trophic condition of a water mass, using a simple indicator or a combination of different variables that result in a complex static index. For similar reasons, we did not agree with Referee 1 that suggested to calculate TRIX of our data set.

We prefer to define the trophic status of a certain region as the result of the complex interactions between all the dynamic processes that in time, as seasonal cycle, and space, as dynamic in the water column, bring to specific nutrients and chlorophyll–*a* patterns, oxygen saturation and vertical stability of the water column. The Wilcoxon

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Matched Pairs test (Table 3) has showed that, considering all the data set (in time and space), the two sites are affected by similar hydrodynamics, higly significant different nutrient inputs and slightly significant differences in chlorophyll–*a* concentrations. When we went to look for the intra-annual variability of chlorophyll–*a*, the same test (Table 4) showed that those differences are due to significant differences between June and August, when E06 mantains higher concentrations, and vice versa in September. Instead, when we studied the intra-annual variability, considering also the different depths, the time-depth plots (Fig. 5 and Fig. 6) showed that, in the same period, both stations were characterized by a reduction in nutrient concentrations, stable oxygenation, stratified waters and chlorophyll–*a* values with the lowest annual values (see also Fig. 7). Besides, the slightly higher values of chlorophyll–*a* in the deepest layer at both stations were a clear indicator of photosynthetic activity of the most bottom SL and thus water transparency. We consider those features as indicative of oligotrophic sea water masses, at C10 and E06, except E06 0 SL, as the Referee 3 noticed. We believe that those criteria may be used when there is the need to define the trophic status of several regions that simple static indeces would represent completely different, as we mentioned above. The above considerations will be added in the revised version of the ms to clarify this aspect.

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