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Biogeosciences Discussions

Interactive comment on "Winter phytoplankton blooms in the offshore south Adriatic waters (1995–2012) regulated by hydroclimatic events: Special emphasis on the exceptional bloom of 1995" *by* Mirna Batistić et al.

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Answers on Referee #1 comments and sugestions:

We greatly appreciate all reviewer's comments and suggestions which have been accepted in revised version of the manuscript. Please find our response letter below.

General comments:

Reviewer (R): Title does not reflect the content of the paper properly. Firstly, the period

mentioned in the title (1995-2012) does not match the sampling period (starts in1994) Secondly, both sampled years were assessed in the same comprehensive way, which does not justify emphasizing 1995 only. I would suggest modifying the title.

Answer (A): We thank to reviewer comments and we changed tittle: "Is phytoplankton winter bloom characteristic for open South Adriatic waters or it occurs only during specific hydroclimatic events?

Specific Comments: a) Material and methods 1. R: (p. 3, lines 94-95): discrete sampling depths are listed from surface to the bottom of sampling stations. However, at these depths chemical parameters (oxygen, nutrients) were sampled, whereas is not specified that for phytoplankton community structure only the euphotic layer was sampled. (i.e. down to 200 m, as in the figures 9 and 10). This should be added.

A: We thank to reviewer comment and we'll put the phytoplankton sampling depths in Material and Methods (0-200 m).

2. R: Provide information on the depth of surface layer of the Ocean Colour observations (i.e. surface Chl-a).

A: Satellite sensor only observes the surface layer of the ocean call the penetration depth. This depth is defined by Gordon and McCluney (1975) as "the depth above which 90% of the diffusely reflected irradiance originates". This depth is generally shallow and only reaches 10 meter depth when water is very clear. Gordon, H. R. and W. R. McCluney. "Estimation of the depth of sunlight penetration in the sea for remote sensing." Applied optics 14.2 (1975): 413-416.

3. R: To track different circulation regimes in the North Ionian Gyre (NIG), we used average salinity values from 1993 to 2012 in the 200-800 m depth layer" It is not clear whether the average salinity was calculated for the upper 200-800 m deep layer or for the layer at the depth of 200-800 m. If the latter is true then it contradicts the statement in Conclusions (p. 13, lines396-400) saying that during anticyclonic years the inflow

into the Adriatic Sae can be observed in the 50-200 m layer.

A: The reason for this is the following: This layer (200-800 m) does not receive directly the Atlantic water, but this layer integrates the conditions of the salt quantity, after the winter convection in the Southern Adriatic Pit. Namely, if there is no significant Atlantic water inflow, and more salty waters enter into the Adriatic, both as a surface Ionian and intermediate Levantine and/or Cretan waters, the winter convection will transfer more salt into the water column between 200 and 800 m. The final depth will depend on the intensity of the convection. In order to capture the signal authors (Civitarese et al. 2010) take this layer as a reference. On the contrary, when the uppermost layer (first 50-200 m depths) receive more Atlantic water, the winter convection will transfer this less salty water into deeper layers, and dilute the effects of the saltier intermediate layer.

R: Check the statement "Year 2012 displays both 121 circulation modes: cyclonic mode which started in 2011, in the second part of the 2012 (May) 122 unexpectedly reversed to anticyclonic (Gacic et al., 2014), Fig. 2". To me it looks just opposite; year 2011 and the first half of 2012 was in the anticyclonic mode, which in mid-2012 changed to cyclonic.

A: The statement is true, and altimetric maps showed that the last cyclonic (C) mode started in 2011 but unexpectedly in 2012 reversed to anticyclonic (A). This can be inferred from the monthly absolute dynamic topography maps in their paper in Fig. 5 (Gacic et al. 2014). Anyhow, this fast change (C to A) could not be presented at long time scale so we put explanation in the text (Material and Methods). Cyclonic mode starts again in autumn of 2012, so for better insight we'll move red strip closer to the end of year.

R: Explain more in detail (or rephrase the sentence) which conditions are unfavourable for convection.

A: This sentence will be rephrased as follows:

Conditions in those months were unfavorable for convection, i.e. there are no cooling events and hence no density increase, although sporadic wind-induced mixing was possible.

In general, the vertical convection (that is, overturning of the water column, when the surface density increases) is controlled mainly by the two essential factors: atmospheric, and the hydrographic conditions, and occurs usually in areas characterised by the cyclonic gyres. The atmosphere cools the sea surface, through the heat flux exchange at the air-sea interface. Cooling is a consequence of a heat release into the atmosphere, both because of the cold air temperatures, and because of the evaporation. Both these processes are favoured by the cold and dry bura winds (Bergamasco et al., 1999; Beg Paklar et al., 2001; Jeffries and Craig, 2007). These atmospheric conditions are changing from winter to winter (Cardin and Gacic, 2003). In some winters, the absence of strong bura events provokes less convection, or less deep convection. The role of the hydrographic conditions is to facilitate or not the vertical convection. In case of less salinity and mild weather conditions, vertical convection is reduce or even absent (This was already explained in details in Discussion, see rows 270-284 in original version).

R: I'd suggest changing it to "Physical and chemical properties of seawater in February 1994 and 1995".

A: We agree.

b) Discussion

R: You claim that winters of 1994 and 1995 were characterised by the EMT "that drove nutrient-rich, lower oxygen, less saline water to mid-depths of the Adriatic. This was accompanied by a massive intrusion of Atlantic Water (AW)". Decreased oxygen at mid-depths was observed only in 1995, whereas salinity profiles of both years show a constant increase throughout the water column. Regarding nutrients, peaks were registered at different depths in both years: roughly from 200 to 400 m in Feb 1994 and

around 600 m in Feb 1995. Are all these peaks related to the intrusion of EMDW and at which depth this water enters the Southern Adriatic? Authors should also mention which are the characteristics (salinity) of the AW and at which depth can be traced.

A: The nutrient peaks (200-400 m in 1994 and below 600 m in 1995) lay below the intermediate salinity maximum. Thus, are contained in the lower salinity intermediate waters (older low salinity EMDW waters uplifted from the newly produced Aegean Dense waters overflowing during the EMT) which inflow into the SAP across the Strait of Otranto (eastern side). AW has salinity between 38.0 and 38.20 in the upper 100 m (down from the surface). It can be traced at the 50 m depth.

R: Anticyclonic circulation characterized the NIG in 1994, 1995, 2007, and 2008 (Gacic et al. 2010; Civitarese et al. 2010; Bessières et al., 2013)." According to Fig. 2, 2007 and 2008 were in the reversal phase. Moreover, do you have data, besides satellite observations of Chl-a, for years in the reversal phase - 1997, 1998 and 1999?

A: This statement is valid. According to Gacic et al. (2010), Civitarese et al. (2010), Bessières et al. (2013) years of 2007 and 2008 are anticyclonic. But, we marked these years as reversal due to results of Mihanović et al. (2015) who concluded that between 2006 and 2008 BiOS reversal from cyclonic to anticyclonic was slow (2–3 years). Therefore, actually indicating that the Adriatic water mass properties did not completely change in a short time as during the exceptional conditions of BiOS regime shift in the 1990s when the prevalence of low-salinity water masses in the Adriatic happened rapidly (in less than a year). Unfortunatelly, winter phytoplankton data does not exist. This was the reason why we used Chl-a satelite data.

R: When you are saying that winter blooms in the OSA could account for a large fraction of OSA annual production have you any indication for this statement. Can you sustain this evidence with some publish data of the inter-annual variability of primary production that could match years of winter blooms?

A: We'll rephrase the sentence and ommitt term "production". Actually, we haven't

mentioned primary production. According to our results (phytoplankton blooms) we just wanted to highlight the importance of winter season for the pelagic ecosystem of open South Adriatic in the whole.

Technical comments: All technical comments and suggestions are accepted and corrections will be included in the final version of the manuscript. In figures 5, 6, 7, 8, 9, 11 the deepest station P-1000 is indicated as P-1200 and these were corrected.

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