

## ***Interactive comment on “Present-climate trends and variability in thermohaline properties of the northern Adriatic shelf” by Ivica Vilibić et al.***

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We thank the reviewer for very careful review and constructive comments, which will be used in improvement of the manuscript. As requested, we are addressing all raised comments and suggestions, as follows:

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The paper describes the analysis of a 38 year long time series in the northern Adriatic Sea which consists of 6 stations extending from the Croatian to the Italian coastline. The analysis examines seasonal to decadal variability and trends of the hydrographic parameters, temperature, salinity and density. The data and analysis is described well in the paper and the discussion and the conclusions can be well understood from the

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described analyses and the figures. The northern Adriatic is only a small sea area but it is extremely important for the Mediterranean Sea as a supplier of the dense bottom water AdDW. The discussion about long term changes (variability) of the deep water characteristics coming from the northern Adriatic is however only short. Nevertheless, I consider the paper to be relevant to Mediterranean research in this sense. The further results achieved are not new in the narrower sense (the authors have already published a number of publications on the time series here), but a consistent continuation of their work. Changes of decadal time scales require long observation periods, therefore I consider the continued analysis of this time series to be scientifically relevant. However, there remain some inaccuracies and questions about the text. These are specified below. All in all, I consider the paper to be suitable for publication after major revisions.

- Thanks for nice words, we are going to broaden the discussion and make some statements more precise as suggested.

Here some more detailed comments, questions and corrections: 1: In the abstract I would avoid making innuendos like “indicating different mechanisms which govern their variability” (which?, line 13) or “indicate substantial changes in the thermohaline circulation” (which, line 17).

- We will make the abstract more concise and avoid imprecise statements.

2: page 3, line 7: if you use abbreviations, please define them beforehand (ERA)

- Ok, to be done.

3: page 4, line 4: a winter, change just to winter

- To be changed.

4.: page 4, line 5 and 6: through “the” rest of the year / when “the” thermocline is / increasing again “the” stability

- Sorry, to be corrected.

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5: page 4, line 8: what means in this context “vertical mixing prevails to the buoyancy”? (stratification is less?)

- We will rephrase this sentence.

6: page 4, line 32: what are the “overall temperature changes”? Changes in the original time series?

- Yes. We will delete the word "overall“.

7: page 5, line 4: “the” variance of “the” salinity seasonal series

- To be corrected.

8: page 5, line 5/6: “as well transient changes occurring over a few month” how can they dominate in the series? I thought, they were filtered out?

- We didn't apply a low-pass filtering to the series, just filtered out annual and semi-annual cycles which are reflecting seasonal changes and are dominant in some variables. Intra-annual variations are still present in the series.

9: page 5, line 11: there is a discrepancy between fig. 7 and the text (SJ101 and SJ108?), so I can therefore not really understand what is said.

- The text is referring not just to Fig. 7, but to all stations among which SJ108 is the only one with no significant correlations between T and S at surface (0 m). We will rewrite the text and clarify this issue.

10: page 5, line 13: change to: bottom layer everywhere except at station RV001

- To be changed.

11: page 5, line 21 and 25: “the” residual salinity series / to affect “the” southern and middle ...

- To be corrected.

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12: page 5, line 28: are lagging a few years: Did you investigate this further? How many years? How big is the range of lag?

- The lag is 2 to 4 years between BiOS reversal and a change of salinity in the northern Adriatic, what is achieved by lagged correlation analyses. Yet, this finding we plan to publish in the subsequent paper, integrally with analysis of all drivers (local – heat flux, precipitation, river discharges, ..., and remote – hemispheric indices like NAO, EA, EAWR, SCA, ...) relevant for thermohaline variability in the northern Adriatic.

13: page 5, line 31/32: I don't get what is said in brackets and why do I know that interannual to decadal changes are dominantly affected by salinity?

- The text will be clarified in revised version.

14: page 6, line 8: “indicating a weakening of stratification” why? The gradient could have been remained.

- Fig. 8 (trends) are indicating positive PDA trend at surface of SJ108, i.e. an increase in PDA values in time, exactly where low mean values are persistent mostly due to river discharges (Fig. 3). The opposite is at the bottom, where PDA values are decreasing in time. In combination, vertical gradients in PDA are decreasing in time, i.e. mean stratification is weakening. We will make the text more concise.

15: page 6, line 18/19: I can't follow the example (i.e. ...) from the text or the figures.

- We will clarify this issue and make the text concise. If looking in positions of stations SJ101 and SJ108 (Fig. 1), salinity trend is large and positive at SJ108 (located south of the Po River delta) while negative at SJ101 (located east of the Po River delta).

16: page 6 line 24, 26, 28 and 31: “the” central part ... and at station SJ108 / “The” salinity trend follows “the” temperature trend / “have more complex spatial structure” / “the” central and eastern parts of the transect / “The salinity trend in July”

- Sorry, to be corrected.

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17: page 7, line 1-10: I really do not understand this! How can you discuss seasonal changes from your residual time series? Seasonal changes were removed, weren't they? Was the filter not effective?

- We will change the terminology, to avoid misunderstanding. Basically, we are discussing here residual trends obtained separately in different months, i.e. the trends in January, in February, ... Sorry to not putting it concisely.

18: page 7, line 11: differ more OR differ a lot

- To be corrected.

19: page 7, line 15-17: I don't understand this conclusion from what is said before.

- Ok, we will rephrase the text and make the conclusion concise.

20: page 7, line 23-24: Out of context. What's that sentence supposed to say to me here?

- We will remove the sentence.

21: page 8, 3-11: Why are the gaps mirrored and not chosen arbitrary to see the effect of gaps in the analysis?

- We choose such an approach as reflecting real problems in the data series which are already part of the calculations (at the beginning of the series). Yet, we agree that it might be done differently, as a kind of sensitivity analysis.

22: page 8, conclusion 2: very general, which different dominant mechanisms are meant?

- We will clarify this issue. Surface layers are dominantly driven by processes acting at the surface (water budget, heat budget), while changes in bottom layers are more reflecting processes advecting water masses from the southeast to the northern Adriatic.

23: page 8, conclusion 5: what does this mean for the circulation of the northern

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Adriatic?

- That is a good question. We will add some discussion on that in the manuscript.

24: page 8, line 28: “Our” observed temperature trends (because otherwise it is misleading)

- Ok, we will change the text accordingly.

25: page 9, line 7-16: what is meant by reflection of variability? The conclusion ii) confuses me, I don't really get what the authors want to say. Please reformulate.

- The statement will be reformulated.

26: page 9, line 20: “the” middle and

- To be corrected.

27: page 9, line 28: “which differs from trend” (skip from them)

- To be corrected.

28: page 10, line 2: one of “the” processes for weakening the Western . . .

- To be corrected.

29: figure 3, 6, 8 and 9: Please rotate the x-axes. West should be on the left and east on the right side as usual

- We will change orientation of these figures in the revised manuscript.

30: figure 7: Hardly to distinguish the different periods. Perhaps you can enlarge the figure.

- Following suggestion by Reviewer #2, we will remove the periods from the figure as relations between the BIOS and thermohaline oscillations are not sufficiently proven in this manuscript.

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