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Discussions

Interactive comment on "Seasonal and inter-annual temperature variability in the bottom waters over the Black Sea shelf" *by* G. I. Shapiro et al.

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The paper, undoubtedly, addresses the relevant scientific questions within the scope of OS: it is devoted to the analysis of the long-term changes of the temperature of bottom layer waters on the wide western Black Sea shelf (i.e., Bottom Shelf Waters – BSW) and the relation of these changes to the climatic forcing. The starting idea is that the BSW are formed due to winter cooling and vertical convective mixing during the cold season (December-April). During the warm season (May-November) BSW are covered from above by strongly stratified seasonal thermocline. Thus, they are protected from the atmospheric forcing and their characteristics reflect the winter conditions. First of all, authors pay a considerable attention to define the upper boundary of BSW. It follows from their analysis that the isopycnal surface sigma-theta = 14.2 is an optimal

definition of this boundary. For the lower level of BSW they use the shelf-break depth equal to 150 m. Large data sets of in situ measurements over the second part of the 20th century are used to construct the monthly climatology for warm season at different depth levels with high spatial resolution. Then, the temperature anomalies from climatic mean are calculated and analyzed. Several novel and interesting results follow from the analysis. First of all it is revealed that indeed, the month-to-month BSW temperature changes are rather low during warm season. That gives the evidence to the assumption that BSW are more or less isolated from heating from above. In contrast, the inter-annual and decadal variability is quite well pronounced. The last one is correlated well with regional climatic changes. During the warm climatic phase (1960-1980) the temperature anomaly in BSW was positive and reached the value up to +1.7 Celsius degree, while during the cold climatic phase (1980-2000) it was negative and reached the value down to – 1.2 Celsius degree. The correlation analysis revealed that BSW temperature over warm season has low correlation with previous winter air temperature over the western shelf. However the correlation of BSW temperature is much higher with the temperature of Cold Intermediate Layer (CIL) in the deep sea that reflects well the winter cooling over the deep basin. The author's explanation of this rather paradoxical result consists in the proposal of the existence of strong lateral (isopycnal) exchange between BSW and CIL. Most of scientific methods and assumptions are valid and outlined clearly enough. The presented results are basically sufficient to support the interpretations and conclusions. The data sources and the methodology of data analysis are described sufficiently complete and precise. Author's give proper credit to related work (publications) and indicate their original contribution to the Black Sea studies. The language is rather fluent and precise. However the manuscript has some imperfections that are listed below. 1. The title does not reflect that the study is provided for the wide western Black Sea shelf. This is important, because the shelf areas in other parts of the Black Sea are narrow and well ventilated due to cross-shelf exchanges. Thus, it is difficult to identify any original BSW at the Black Sea shelf except its western part. So the title should include the combination of words "western

shelf". 2. The abstract does not provide enough concise and complete summary. It should be rewritten in more strict way. The speculative sentences like that: "The effects of atmospheric processes at the surface on the BSW are hence suppressed as well as the action of "biological pump" should be excluded. 3. The section 2.2 "Mixing depth" seems to be a most problematic part of the manuscript. The basic aim of this paragraph is to provide scientific reasoning of the selection of the isopycnal surface sigma-theta = 14.2 as an upper boundary of BSW. It is provided by the calculation of the amount of mechanical energy required to mix the pre-winter stratification down to the specified density level. This procedure is not relevant from physical point of view. The real winter convective cooling from above is expressed more in permanent loosing of the buoyancy by the initially stratified water column than by its mechanical stirring. So depth of convective overturning should be determined from the balance between the pre-winter capacity of buoyancy in water column and the total winter losses of the buoyancy due to the ocean-atmosphere heat fluxes. The possible suggestion is to exclude this section. It's enough to make a reference to the paper by Ivanov et al., 2000 where such a criteria (sigma-theta = 14.2) was used. In that case Fig.2b also could be excluded from the manuscript. 4. At Fig.4 dashed lines are not identified in the legend (are they the isobaths, the same as at Fig.3?) 5. Section 3.2, first paragraph: ".. density range of BSW (from sigma-theta = 14.2 to a depth 150 m)". Of course, this is not a "density range".

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