

Interactive comment on “Snapshot observation of physical structure and stratification in deep-water of the South Caspian Sea (western part)” by P. Ghaffari et al.

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Thank s a lot to Prof. Leroy for her valuable and constructive comments.

Concerning the specific comments: 1- According to Figs 4 and 5, the surface water of the Caspian Sea is located at first 50 m depth, between 50m and 150 m shows transitional properties, below 150 m waters are categorized as deep water in the Caspian Sea. Considering Fig 2, our CTD profiles are mostly carried out and covered the deep waters; therefore we believe that deep-water term is applicable in this study. 2- Indeed the winter temperature field of the Caspian Sea is characterized by its significant increase from the north to the south. Additionally in the near-shore shoals the cooling

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proceeds more efficiently. Although we think that the northern basin has main role and could be the main deep water supplier but lateral cooling in some specific years in the south basin could be another source for deep water formation in the south basin. Therefore the net reply could be like this; yes it is coming from north and in some extreme winters it can be formed partly in lateral boundaries in the southern and central basins. 3- As you know the ionic composition of the Caspian Sea is completely different from the world ocean ionic composition. UNESCO developed EC to salinity relations according to the world standard seawater ionic composition. Therefore the UNESCO based EC to salinity conversion is not applicable in this water body. In this section we tried to adapt the CTD measurements to the Caspian Sea waters with different chemical characteristics. Based on referee recommendation we change the section title to “Methods”. But stability calculation could not be sorted as methods. 4- The vertical salinity structure of the Caspian Sea in the early of the 1970s might be referred to as the subtropical type. During this period, at the end of summer each year, conditions were favorable to the development of deep autumn and winter convection. Owing to the negative freshwater balance, lenses of more saline waters formed in the surface layer. They kept their near-surface position due to the existence of the seasonal thermocline. Owing to the autumn erosion of the seasonal thermocline, it should inevitably sink down to the deeper layers of the basin. In the late 1970s, owing to sea level rise and increasing fresh water budget, the salinity of the Caspian waters decrease in the entire water column from surface to the depth. At the same time a hydrostatically stable vertical salinity stratification of the Caspian Sea was formed. By the middle 1990s, the vertical salinity structure of the Caspian Sea was transformed; salinity grew with depth, so that the structure could be classified as the subarctic type. A layer of the subsurface salinity minimum had formed beneath the thin seasonal thermocline. Under these conditions, at the autumn destruction of the seasonal thermocline, the surface waters had no chance to sink to depths (see Tuzhilkin and Kosarev, 2005). As all aforementioned materials are well addressed by Tuzhilkin and Kosarev (2005), it will be trivial to repeat it again. On the other hand explaining the reasons what happened

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and why in fresh water budget and sea level increased at that period is beyond of current manuscript scopes. There is a misprint in the page 2562, line 24: it should be "in the late 1970s". 5- There are two common accepted scenarios for deep water formation in the Caspian Sea. According the first scenario, river water entering the Caspian Sea mainly in the north (e.g. Emba, Ural, Volga, Terek) and along the western shore (e.g. Samur, Sulak, Kura) is transported along the western shore to the southern basin and from there northwards again along the eastern shore. During transport evaporation increases the salt content of the surface water resulting in relatively warm water with a large salinity near the east shore. In late fall and winter this water with high salt content moving northwards eventually reaches the ice boundary in the northern part of the central basin. Because freezing of the water increases the salinity in the water phase and water temperature is close to zero, the density of the surface water might become sufficiently large that convection can take place close to the boundary of the ice cover in the central basin. In the southern basin convection is caused by cold central basin water propagating across the sill separating the central from the southern basin. The second scenario would like to suggest assumes rare large-scale convective mixing events that are followed by long periods with very little mixing mainly due to turbulent diffusion. A major mixing event occurred in 1976, which caused oxygen concentrations to reach 9.6 to 9.9 mg l⁻¹ (about 80% O₂-saturation assuming T=4°C and S=12.5 g kg⁻¹) in the deep water of the central basin (Kosarev and Yablonskaya, 1994). 6- As explained in different part of the manuscript particularly among the lines 16 to 20 in the page 2566, horizontal winter temperature difference cause by cooling process could partly trigger lateral mixing (not complete mixing). The boundaries and shoals are more susceptible parts to winter cooling, additionally at that period AL inflow added cooler water to the system which was more capable to sink. However as AL inflow is fresh water (low salinity), we think that high amount of suspended loads in this inflow could play an important role in the lateral convection. Unfortunately we did not calibrate the OBS sensor of our CTD by water sampling and lab procedure to get SSC. But the raw turbidity data support this idea and attached figure shows high

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turbidity values (20 and higher values) which comes from AL.

Technical corrections: - Page 2558, line 10: Fig. 5 is removed - Sepidrood and Se-fidrood both of them are common and two different pronunciations but the same meaning. - Unfortunately it is not practical to zoom in on the shallow waters of the continental shelf; if we do this we will drop deeper part. - Absolutely not. Adding more contour lines in Fig. 2b does not help to maintain further resolution and or better understanding of salinity structure. - More contour lines in Fig. 2d are added.

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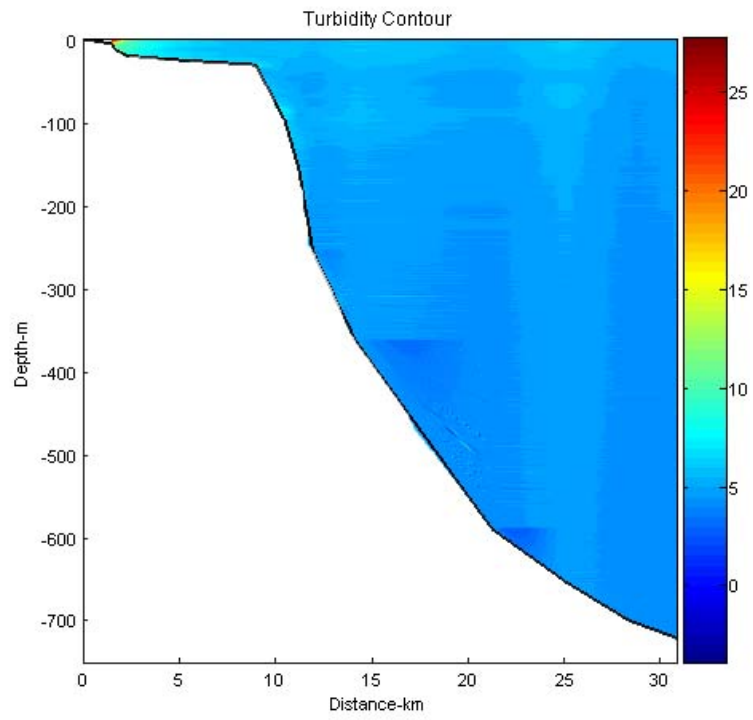


Fig. 1.

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