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Interactive comment on "Variability of water mass properties in the Strait of Sicily in summer period of 1998–2013" *by* A. Bonanno et al.

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We would like to thank the Anonymous Referee #1 for the comments to our manuscript. Most of the referee's comments, along with those proposed by the Anonymous Referee #2 (Referee Comment) and by dr. S. Ben Ismail (Short comment), have led us to revise the manuscript and to propose the editor to give us the opportunity to submit an improved version of the manuscript that may take into consideration most of the suggestions. In the following we answer to the referee's comments trying to face the specific aspects proposed.

Anonymous referee: line 1 "I do not see any new sound result". Authors: The main aim of the submitted manuscript is to examine the variability of thermohaline properties of the water masses ïňĆowing through the Strait of Sicily in summer during the period

1998–2013. The basic idea driving such study, supported by a 16 years long oceanographic dataset (3698 CTD casts) partly unpublished, is to integrate the previously acquired knowledge in a strategic area such as the Strait of Sicily. Using an excellent area coverage, we evaluated the inter-annual variability of surface and intermediate waters characteristics, and we tried to detect and recognize the main mesoscale phenomena present in the Strait of Sicily. The manuscript for the first time highlights the signature of WIW in the north-western part of the study area. Ismail et al. (2012) highlighted that "the transitional waters between AW and LIW, in the westernmost Tunisian waters, are characterized by intermittent signatures (Sammari et al.,1999; Lermusiaux and Robinson, 2001) composed mainly of two main water masses, the Western Intermediate Water (WIW) and the Ionian Water (IW)". The presence of WIW was observed in a Sicily-Tunisia transect, and it was located in the Tunisian side. Our data highlight the intermittent presence of WIW also in our study area (12.235°E; 37.705°N), in more coastal stations and not in all the surveys, suggesting a spreading of WIW also in the western coastal waters of Sicily. Another topic we tried to discuss in the manuscript is the link between water masses characteristics and the BIOS (Gacic et al., 2010). We have shown possible links between the alternation of the surface circulation in the central Ionian Sea with the salinification phases (1998-2007) in the intermediate and deep waters in the study area.

Anonymous referee: lines 2 - 5 " ... focusing only on LIW in the subsurface ... how are defined then the upper and lower limits of such a saline layer ? " Authors: As above mentioned, one of our main aims was to evaluate and interpret the inter-annual variability of intermediate water. So we decided, probably in a simplified way, to consider the maximum of salinity (Smax) to follow the LIW core. This procedure was also used by Sparnocchia et al. (The Interannual and Seasonal Variability of the MAW and LIW Core Properties in the Western Mediterranean Sea. Coastal and Estuarine Studies, Volume 46, Pages 177-194; 1994). In order to identify the LIW core, many authors use both the classical "core method" and the fairly fuzzy assumptions that the LIW upper and lower limits can be specified from the θ and S maxima (Millot, 2013). In our study

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area the S maximum is always evident, at least in the salinity profiles of stations deeper than 200 m, while the presence of a relative maximum in the θ profile is rare (e.g. in Fig. 2 of the manuscript). Other authors considered Smax as a signature of the LIW core in the Sicilian Channel (Gasparini et al., 2008). Taking into consideration one recent paper by Millot (2013), it could be “postulated that the average potential density that is representative of some heat and salt content associated with a given MW (as well as with all MWs) would have to be maintained up to the Strait of Gibraltar . . .”. In this case the author, analyzing the 1985-1986 GIBEX data set, proposed for the LIW core a density range 29.0 - 29.075 kg m–3. Lascaratos and Nittis (1998) proposed a little different density range for LIW (28.95 - 29.10 kg m–3). Astraldi et al. (2002), in the western part of our study area, evaluated a density range for LIW in the 28.95 - 29.14 kg m–3. Taking into account all of these studies, and mainly the θ-S profiles collected in the whole study period (1998-2013) in the Strait of Sicily, we evaluated the mean salinity per year in the density range 29.0 - 29.12 kg m–3, where the LIW core is located. The following figure shows the mean (per year) Smax values and the calculated mean salinity in the specified density range. From figure 1 it is possible to observe a good agreement between the two time series, and also that Smax values is able to follow the variability of salinity of the LIW core in the Strait of Sicily. According to the above results, we may modify the text (and the tables) of the manuscript in order to specify that we want to interpret the Smax values as a signature of LIW core in the study area. Moreover, in the manuscript we can add most of the above results in the section presenting the intermediate layer.

Anonymous referee: lines 6 - 9 "".....EMDW are not cleary signed, they are formed every year in the Aegean and Adriatic so that they must permanently outflow, i.e. not only during the EMT ..." Aurhors: Concerning the EMDW, in the manuscript we tried to focus on what the EMT was; what it has produced and the key role played by the Strait of Sicily in the propagation of the phenomenon from east to west. There is no doubt that the transient produced temporary displacement of the main source of deep water formation from the Adriatic to the Aegean. Some authors use the term “shift” to indicate

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the displacement of the site of deep water formation (Gasparini et al., 2005), other "switch" (Gacic et al., 2013), while Malanotte-Rizzoli et al. (2014) reports that "During the late 1980s to the early 1990s the Aegean deep water formation took over from the Adriatic". The major EMT event, lasted a few years (Theocharis et al., 1999; Malanotte-Rizzoli et al., 1999), has produced the alteration of the thermohaline circulation of the entire basin and has also been recorded in the Strait of Sicily (Gasparini et al., 2005). Our aim was to assess whether in the Strait of Sicily other similar EMT events had been recorded and, eventually, connect them with the BIOS (Gacic et al., 2010). In the manuscript we have shown possible links between the alternation of the surface circulation in the central Ionian Sea with the alternating of salification phases (1998-2007) in the intermediate and deep waters in the study area. Probably we were not clear in the manuscript, but we have no intention to argue that the EMDW crossed the Strait of Sicily only during the EMT.

Anonymous referee: lines 9 - 15 "...saying that CIW only outflow occasionally.....Who is able to cleary differentiate, in the study area, CIW from LIW?" Authors: We agree with the consideration that it is not possible to distinguish CIW and LIW in the Strait of Sicily due to complex mixing processes in this area. Recently, Millot (2013) proposed that the intermediate water, formed in all zones of dense water formation in the Levantine basin and that flow through the Strait of Sicily, should be renamed as Eastern Intermediate Water (EIW). We agree with this suggestion in the Strait of Sicily, but in the manuscript we prefer to highlight the distinction between CIW and LIW only when and where these two water layers are distinguishable in the θ-S plots. This was possible only in specific years and only in the eastern part of the Strait of Sicily (longitude > 15°E). Possible mixing phenomena between LIW and CIW did not allow us to differentiate the two water masses in other years.

Anonymous referee: lines 15 - 17 "The abstract indicates that the topography appears to play an important role . . ., but nothing is said in the data analysis (not in the introduction!) about the topography role". Authors: We do apologize for the format of the

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abstract that is very poor and in some parts may mislead the reader from the main aim of the manuscript. As reported also in the answer to the Anonymous Referee #2, we would like to work on the Abstract section and submit a new version of the manuscript in order to better highlight in this part the new contributions to existing knowledge.

Anonymous referee: lines 17 - 20 lines "... any clear link can be established between data collected here and there". Authors: We had some difficulties to interpret the referee's comment. As indicated above, for each year considered we have an average of about 230 CTD stations (in situ profiles), which offers a very good area coverage to monitor the characteristics of the different water layers in the Strait of Sicily.

Interactive comment on Ocean Sci. Discuss., 11, 811, 2014.

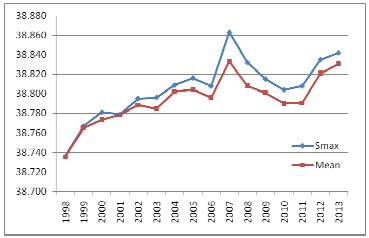

Figure 1. Smax values (blue line – mean value per year) and mean salinity in the density layer 29.0 – 29.12 kg/m^3 (red line).

Fig. 1. Smax values (blue line – mean value per year) and mean salinity in the density layer 29.0 – 29.12 kg/m3 (red line).

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