Review of nhess-2016-179

Title: Marine Rapid Environmental Assessment in the Gulf of Taranto: a multiscale approach

by Pinardi et al.

In the following we have listed the referee comments and immediately after our response, with an explicit reference to the insertion of the revised texts and figures.

Referee 1

The manuscript describes a oceanographic sampling experiment carried out to in the Gulf of Taranto in the Northern Ionian Sea. Four oceanographic campaigns were performed during around 10 days in October 2015, measuring T and Salinity profiles in both open ocean and coastal areas for a set of sampling stations covering the whole area with different spatial resolution. This multi scale approach has been followed to describe by means of a synoptic set of measurements both the large scale and the meso-scale circulation in the Gulf. The obtained results highlight the effectiveness of this approach as a possible standard procedure to be followed in case of MREA for this area.
The paper falls within the scope of the journal. The arguments treated are very interesting and promising, nevertheless a moderate revision of the manuscript is required before being published.

Authors

We thank the referee for his/her appreciation of our work.

Referee

As a general comment, I suggest to do not only concentrate on the observational strategy and the obtained results but also to deepen the discussion on the usefulness of the specific aforementioned strategy in view of both a support to operational oceanography and to the management of the emergencies at sea (pollution, S&R etc.,). Some comments should be specifically included into the Discussion section.

Authors

We have added a sentence in the discussion section that reads as follows:
This paper MREA sampling methodology could be also used to collect data in order to respond to environmental emergencies, such as oil spills or other pollutant dispersal. If the location of the source of pollution is known, the CS1 sampling strategy could be carried out in one day, and forecasting models adjusted to the measured fields through data assimilation, improving the forecast skill. Thus this paper has also put the basis for a protocol of in situ data collection that could support emergency management at sea.

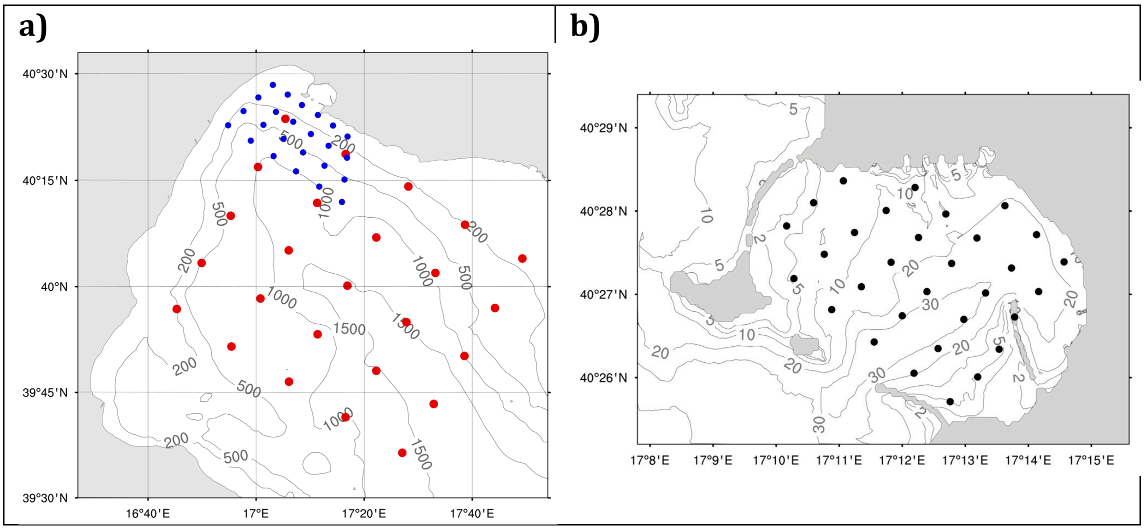
Referee

Page 3, line 20: “We argue that .. The MREA experiment partially clarified these questions”. In the following, any paragraphs specifically dealing with this issue are not found. Some information should be added in the results sections or, if not fundamental with respect to the scope of the paper, maybe the sentence should be changed.

Authors

The referee is correct, we left the question unanswered. We added a sentence in section 3 where we discuss the objective mapping of salinity and temperature fields in the Mar Grande. After line 10 of page 7 we then added the following sentence:
The MREA strategy in the Mar Grande finally elucidated the estuarine nature of the circulation in the Mar Grande at unprecedented resolution.

Referee
Page 3 and figure 3: I suggest to use different colors to highlight the sampling points of each survey.
Authors
We have changed Fig. 3 and used a color code, see new picture below.



Referee
Page 4: how do you compute the average? The adopted procedure should be explicated.
Authors
The post-processed observation profiles are given in 1 m regular vertical grid so the average is the arithmetic mean at each vertical point. We have added after line 19 of page 4 the following sentence:
The mean profile is estimated by taking the arithmetic average of observational points across the profiles, which are defined on a 1 m regular vertical grid.

Referee
Page 4, line 13: “the subsurface temperature maximum” probably it is the salinity.
Authors
The referee is correct we substituted temperature with salinity, thanks.

Referee
Page 4: some more details about the meteorological conditions during the 10 days measurements, e.g. the wind intensity and directions, could help with the comprehension of the results. Especially when comparing the LS1 and LS2 sampling results.
Authors
We have added a new figure 7 on the wind magnitude and precipitation conditions for the 10 days of the surveys. The new Fig. 7 is reproduced below and a sentence has been added at the new page 5 that reads as follows:
“ The weather conditions deteriorated after October 4 and large winds developed on October 5 while precipitation started October 3 and continued up to October 5. Such atmospheric forcing changes can justify the temperature and salinity decrease at the surface, as discussed below.”

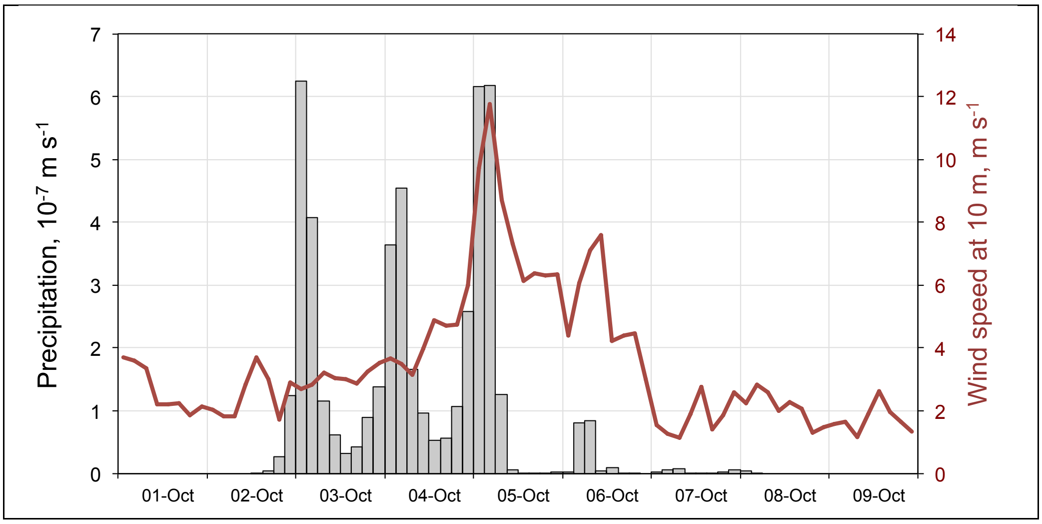


Fig. 7 Area average precipitation and 10 m wind magnitude during the cruise period from a limited area high resolution weather forecasting model of the Mediterranean Sea (Bonavita et al., 2008). Precipitation is visualized as an histogram (units of m s^{-1}) and wind magnitude is the red curve (units of m s^{-1}).

Referee
Page 5: paragraph from line 16 to line 21 need to be rephrased, it is not completely clear.
Authors
We realized that in Fig.1 there is no indication of the Mar Piccolo channels so we modified Fig. 1. We believe this was the problem.

Referee
Page 5, line 26: why only CS1 and LS2 were combined together? It is better to explain.
Authors
CS1 was taken at the beginning of LS2 so in order to maintain a synoptic data collection we merge it with LS2. We explain this now after line 27, page 6 now, by saying:
CS1 was merged only with LS2 since it was taken at the beginning of the LS2 survey and the combination was still synoptic.

Referee
Page 5 and figure 8: I suggest to include in the panels some number or letters to identify properly the dynamic structures.
Authors
We re-plotted Fig. 8, now Fig. 10, indicating the frontal structure and the eddies with letters, making reference to them in the text. The new Fig 10 is reproduced here. Text has been modified at page 6 to refer to symbols in Fig. 10.

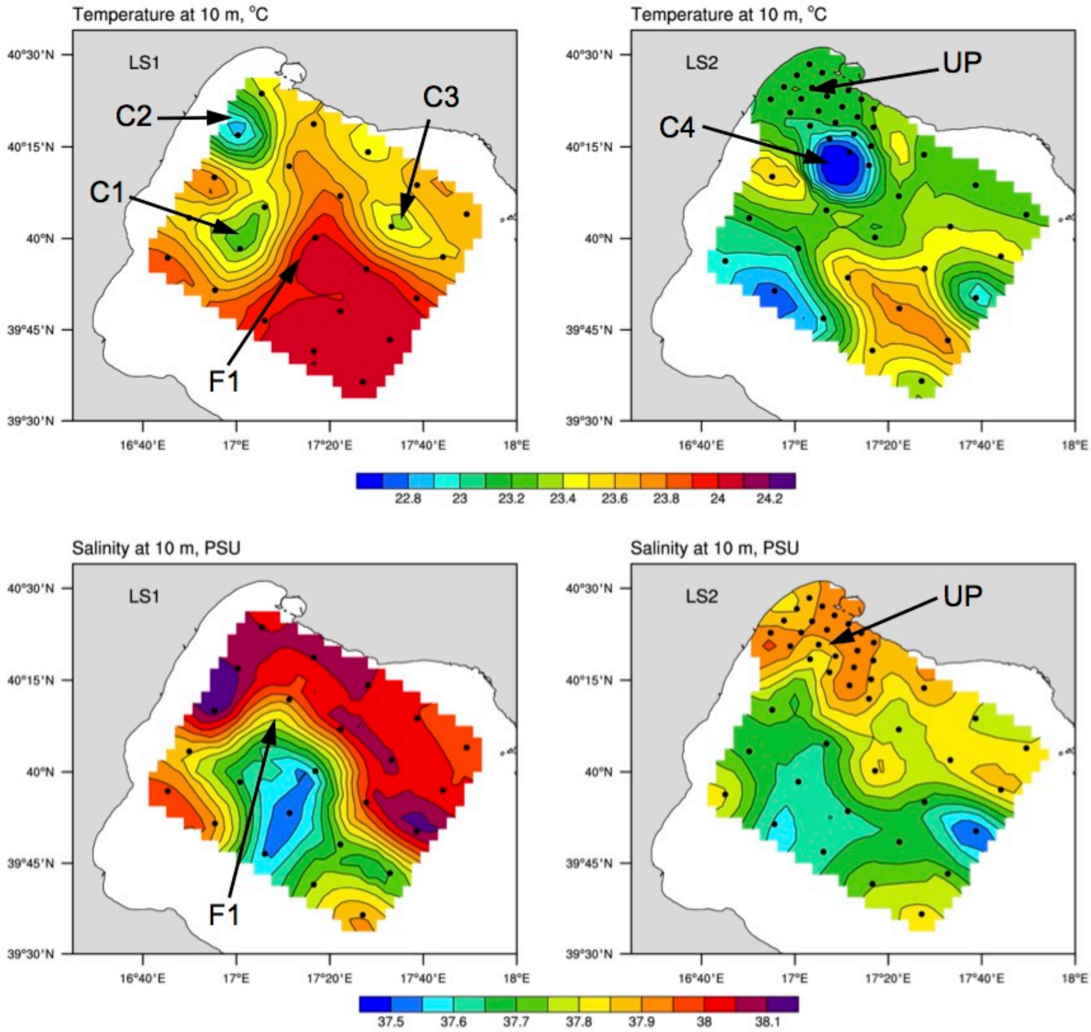


Fig. 10 Temperature and salinity objective mapping at 10 m. Left top and bottom panel: LS1 temperature and salinity fields. Right top and bottom panel: LS2 temperature and salinity fields. Symbols indicate four cold core eddies (C1, C2, C3, C4), the temperature and salinity front (F1) and the upwelling area (UP).

Referee

Page 6: in the left top panel, in the northwestern corner of the image, the small gyre subsequently observed in right top panel seems already existing or at least starting. Also the dynamic height analysis and the geostrophic velocity fields (figure 13) seem to put into evidence. I am not sure this could be a reasonable evidence or just a speculation.

Authors

We do not believe we can make such a conjecture and we prefer not. Only a modeling study, dynamically interpolating between LS1 and LS2, can really proof that C1 (now in Fig.9) becomes the top right sub-mesoscale eddy, C4. We prefer not to add any speculation. We did not add any comment.

Referee 2
The manuscript "Marine Rapid Environmental Assessment in the Gulf of Taranto: a multiscale approach" by Pinardi et al., is about a multiscale sampling experiment carried out in the Gulf of Taranto to collect synoptic oceanographic data over a 10-days period and subsequently study the thermohaline structure and the geostrophic circulation of the area and its variability. The data analysis from the four surveys carried out in the area from 1 to 10 October 2014 provides evidence of the large scale circulation structure and associated mesoscale variability of the area consisting of an anticyclonic large scale Gyre that occupies the central open ocean area of the Gulf of Taranto and a rim current on the periphery of the gyre that undergoes large changes over the 10-days period. Overall, I found the manuscript and the work very interesting and I think that it deserves publication to the NHESS journal after some minor revisions are made according to the following comments:

Authors
We thank the reviewer for the appreciation

Referee
1. Introduction section: "A new multi-scale sampling strategy was used …. the coastal-harbor scales of Mar Grande (Fig.1). The authors should explain better the novelty of the approach adopted to measure the T/S structure of the Gulf of Taranto.
Authors
We added a sentence in the Introduction, line 28 as suggested, that reads this way:
The novelty of this data collection experiment is related to the different resolution of the stations carried out in the different areas under the strict constraint of synoptic time coverage (3-4 days in the ocean).

Referee
2. Circulation structure and data collection methodology: "From a large scale point of view : : : in Fig. 2". As the Ionian basin circulation has undergone significant interannual changes over the period 1987 – 2013 the authors should present more evidence that the long term average of this period is representative of the hydrodynamic situation in the Gulf of Taranto in June and October.

Authors
We have modified Fig. 2 introducing the June and October 2014 reanalysis field that became available after the cruise and that does not contain the MREA data set. It is evident that June and August have different circulation patterns. The interannual variability of the Gulf of Taranto circulation is outside the scope of this paper that provides the first confirmation of reanalysis model results for October 2014. The new Fig. 2 is reproduced below and the sentence at page 3, line 12-18 has been modified accordingly and it is reported below:
From a large scale point of view, the mean circulation in the area can be assessed by taking the current fields from a reanalysis product (Pinardi et al., 2015) that does not contain the MREA data. The surface circulation (Fig. 2) is anticyclonic in October 2014, while in June 2014 it is cyclonic. This opposite circulation pattern is probably connected to the different Western Adriatic Coastal Current (WACC, Guarnieri et al., 2013), Northern Ionian Sea outflow/inflow system in the two months and the local atmospheric forcing.. One of the major aims of the MREA experiment was to verify the October circulation shown in Fig. 2.

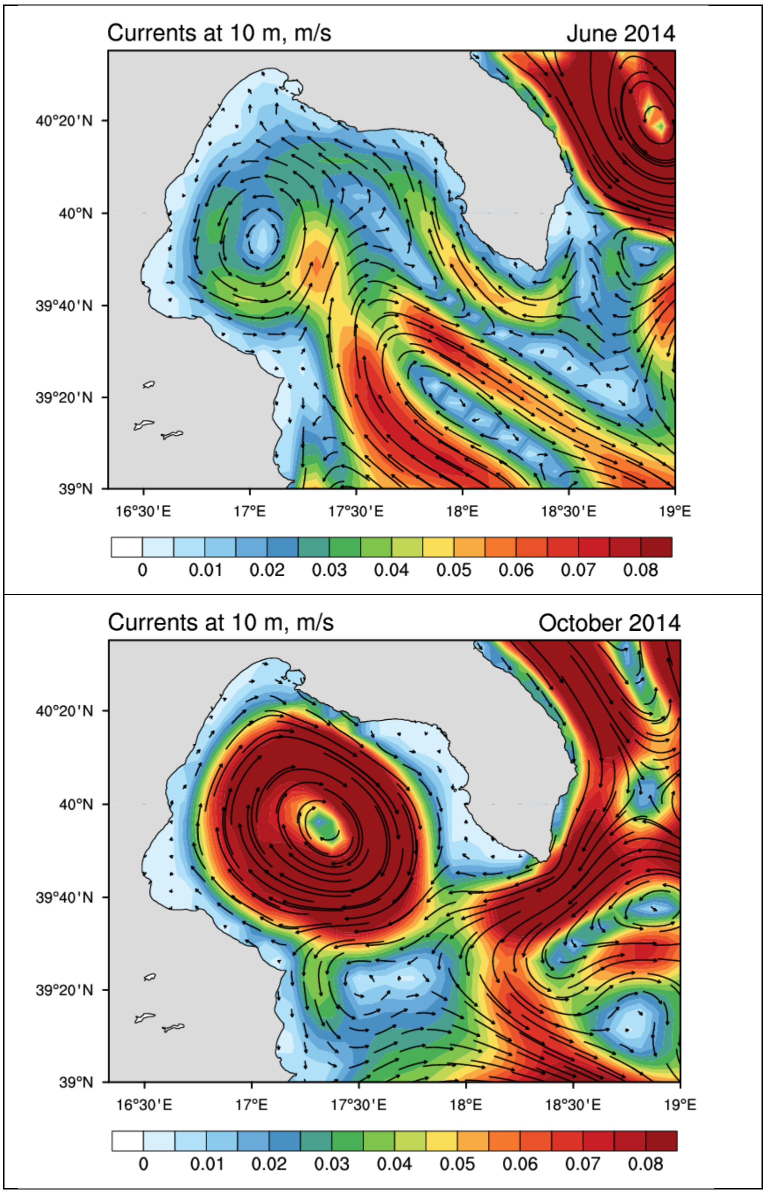


Fig. 2 Monthly mean surface currents from reanalysis (Pinardi et al., 2015) in the Gulf of Taranto. Top panel: June 2014. Bottom panel: October 2014. The units are m s^{-1} and the color indicates the amplitude

Referee

3. T/S diagrams could be useful to depict the water mass structure of the area.

Authors

We have added a T-S diagram as new Figure 5 and a comment after line 26, page 4 which we reproduce below.

Fig. 5 shows a T-S diagram of the LS1, LS2 profiles to better identify the water masses and types. Some of the profiles extended to 900 m depth, in the central Gulf of Taranto trench (Fig.1) so that four water masses can be detected, one more with respect the three already discussed for the first 300 m. The first water mass is the surface water mass, indicated by water type 1 in Fig. 5, corresponding to low salinity and almost constant temperature. The second is the thermocline water type (number 2 in Fig. 5), due to the mixing of the surface waters and MLIW as shown clearly by the clustering of the T-S points around a line joining the two water types. Furthermore, MLIW (point 3 in Fig. 5) is now clearly detectable with a salinity and temperature increase with respect to the thermocline water mass type. Finally a deep water mass type (4 in figure 5) is also evident, with temperatures lower than 14 C and relatively low salinities, probably of Adriatic origin.

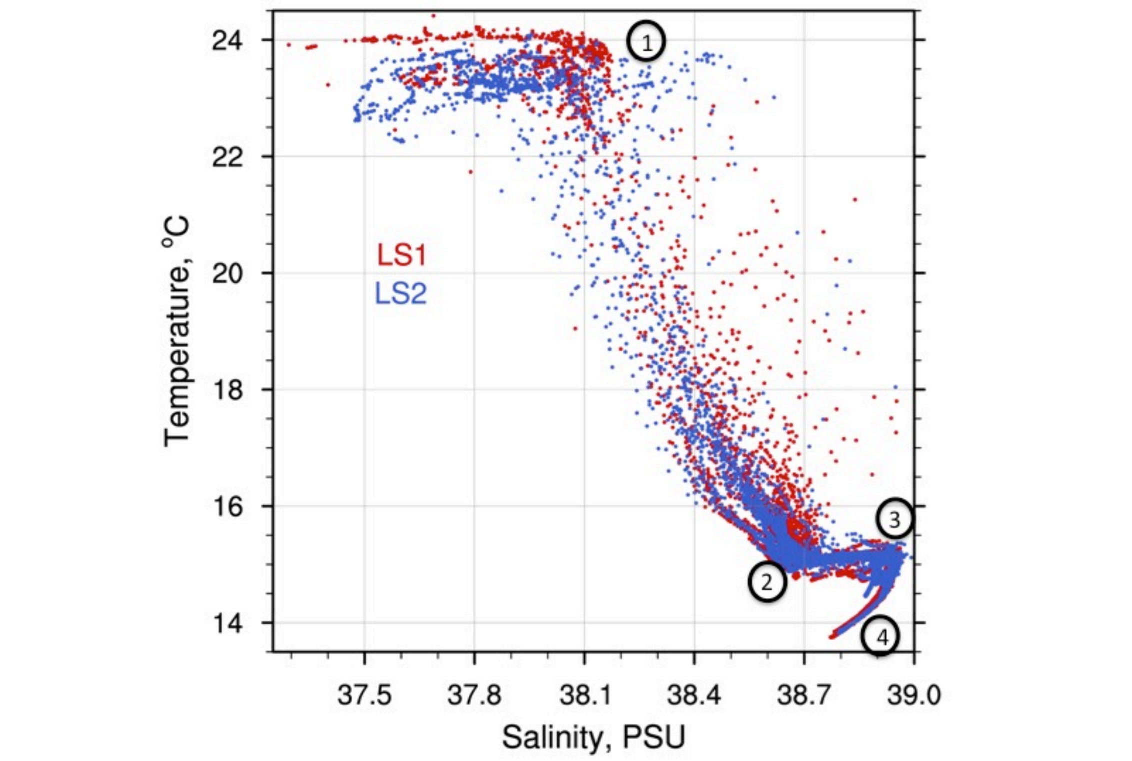


Fig. 5 T-S diagram for all the LS1-LS2 profiles, covering the depths of 1-900 m (the deepest point is in the central trench of the Gulf of Taranto, see Fig. 1). Numbers refer to the 4 water mass types found in the profiles and discussed in the text.

Referee
4. A more detailed discussion on the instability of the rim current is expected.
Authors
We have added a whole new sentence in the discussion and conclusions section since we believe this is a matter of work for the future years. The text is reproduced here:

The instability of gyre rim currents and/or large mesoscale eddy field borders has been studied in the past (Mc Williams et al., 1983, Pinardi et al., 1987, Staneva et al., 2001) and more recently for submesoscale generating fronts (Hamlington et al., 2014). The instabilities of rim currents connected to temperature frontal structures generate eddies, which are due to cyclogenenetic processes such as mixed baroclinic/barotropic instabilities. In our case the observations show that instabilities occur in a week long time and most importantly modulate the upwelling phenomena at the open ocean-shelf areas interface, a mechanism that could be very important to support good environmental conditions in the near coastal regions. Numerical modelling studies have now started to understand the vorticity and energy dynamics of the flow field observed in this experiment.

Referee
5. "Furthermore a precipitation event occurred between LS1 and LS2 which lowered the surface salinity of 0.1 PSU concomitantly changing the mixed layer temperatures of 0.5 C"
The authors should explain better how the precipitation event changed the mixed layer

temperatures by 0.5 C

Authors

Following the suggestion also of referee 1 we added a new Fig. 7 showing that together with the large precipitation event there was also an intensification of the wind which then cooled down the surface of the measured amount. We have added now a sentence at page 5, new lines 8 through 10.