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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "The effect of cyclones crossing the Mediterranean region on sea level anomalies at the Mediterranean Sea coast" *by* Piero Lionello et al.

Anonymous Referee #3

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The manuscript presents an interesting analysis of the relationship between large sea-level anomalies (SLA) and cyclones in the Mediterranean Sea. The assessment is based on the 100 largest positive and negative SLA from a 22y hindcast at 9 coastal sites along the Mediterranean coast; and the characteristics of cyclones that occurred in the Mediterranean region during the hindcast period. The links between the largest SLA and the cyclones intensities and the location of their centers are statistically analyzed in order to associate the SLA to the synoptic atmospheric conditions that generate them. For most of the stations, the results show that large positive SLA are caused by the presence of a cyclone in the area of the station i.e. the large positive SLA are caused by the inverse barometer effect. On the other hand, some large negative SLA

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arise from the presence of a cyclone at the other side of the Mediterranean basin, which generates a MSLP gradient along the basin.

The manuscript is well written and structured; the topic is relevant and the results and findings are interesting and relevant. However, I think that there are few important points that should be addressed and I also have few minor comments.

My major comments are:

1) My major concern about the study is related to the variability of the events sample. First, it is not clear to me why 100 events were selected; is this a subjective decision? From the results shown in Table 2 and 3 it is clear that the different synoptic MSLP fields (i.e. both the cyclones associated to different regions and those not assigned) caused both large positive and negative SLA in most of the stations. However, all events are analysed as a single sample and in some cases the SLA or MSLP fields associated to all events are averaged. This can "hide" or weaken the links between the SLA and the MSLP fields due to the variability of the sample. In my opinion, the results would benefit from clustering the events sample in order to reduce the variability, e.g. by a principal component analysis of the MSLP fields associated to the SLA, and performing a separate analysis to each cluster. At least, this issue should be addressed in the discussion.

2) Following the previous comment, it is not clear in some cases how the presented composites are generated. For example, are composites of Figures 4 & 5 showing average values of MSLP fields from all events? Composites shown in Figures 11 and 12 show the total anomaly, is this the sum of all SLAs? Giving the range of the magnitude of the selected SLAs could also give an idea of the variability within the events.

3) I would suggest to add more details about the cyclone characteristics because it is unclear what is the largest MSLP that can be associated to a cyclone center, or what the differences between shallow and depth cyclones are.

4) Regarding negative SLAs, the analysis is only focused on their correlation with the presence of a cyclone in the opposite region of the Mediterranean basin, but I would imagine that large negative SLA will be highly correlated to high pressure systems (which can be supported by the large number of events not assigned to cyclones reported in Table 3).

5) From the analyses presented it is very difficult (or even impossible) to observe the effects of the wind set-up discussed by the authors. For instance, the wind effects can be represented by adding MSLP gradients maps.

Some minor comments:

P2-L26. It is not clear what “their variations” refers to.

P3-L25. Remove one 0 from “20012”

P3-L26. Parenthesis missing after Marcos et al. (2009)”)”

P3-L35. Is there any reason for selecting a time window of 120h? e.g. is this value based on any previous study on the duration of storm surges in the region?

Section 3.1. In this section, I am missing the bias between SLAs from the modelled and observed datasets in order to give an idea of the model performance (also e.g. RMSE)

P12-L21. Repetition Tripoli

P12-L29. Change is-> it

P13-L8. Remove n from An

P14-L4. Repetition “also”

Figure 4. The station locations of Toulon and Trieste in the graphs of the first column are shifted.

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