RESPONSE TO REVIEWERS

Please note that in this rebuttal, *italics* refer to the text of the reviewers' comments, our detailed response is in black, the new text of the revised version is in **bold blue**.

REVIEWER #1:

GENERAL COMMENT:

This work describes the first steps towards an innovative fully coupled modelling system composed of a hydrodynamic (2DEF) and wind wave model (SWAN). Numerical simulations have been performed to identify the impact of extreme storms at Calabaia beach by combining sea level rise and extreme wave projections with the most recent georeferenced territorial data both in a case study and in a climatological perspective. The paper is appropriate for publication in NHESS but it requires major revisions.

We thank the reviewer for his/her constructive criticism. We seriously considered his/her suggestions, amended some points, and further improved the manuscript. Detailed answers are reported below.

MAIOR POINTS:

1) *The title "A coupled modelling system to assess the effect of Mediterranean storms under climate change" is extremely vague. It may refer to meteorological, ocean, wave models so you should clarify already in the title its specific focus on coupled hydrodynamical and wave models.*

   The reviewer is right. In the new version of the manuscript, we changed the title in:

   A coupled wave-hydrodynamical model to assess the effect of Mediterranean storms under climate change

2) *The abstract should focus on the results of the paper. Its first part is very generic and can be applied to any work in the field. There is no indication on the application of the model to a case study and to the climatology, which is not appropriate.*

   We agree with the reviewer. In the new version of the manuscript, we rewrote the abstract as follows:

   Climate change will have an undeniable influence on coastal areas, resulting in increased rates of both sea level rise and storm-related impacts. In this context, it is crucial to estimate the local probable extreme sea wave conditions, to properly reproduce the sea state and the coastal hydrodynamic, and to investigate the effectiveness of sea defenses under sea level rise. This work describes the first steps towards an innovative fully coupled modelling system composed of a wind- sea wave (SWAN) and hydrodynamic model (2DEF). Numerical simulations, focusing on Calabaia beach, Italy, have been compared to the MIKE outcomes in the same area. The simulations have been performed to study the inshore sea wave characteristics, to assess the effectiveness of the actual sea defence interventions, and to identify the impact of extreme storms, by combining sea level rise and extreme sea wave scenarios with the most recent georeferenced territorial data. The models are two-way coupled at half-hourly intervals exchanging the following fields: 2D sea level, surface currents and bottom elevation are transferred from 2DEF to SWAN; sea wave

characteristics computed by SWAN is then passed to 2DEF by modifying the radiation stress.

3) *Line 201: what do you mean with "wave climate"? here, you are not referring to a wave climatology and to different possible wave directions. Please, clarify.*

In the new version of the manuscript, we refer wave height, period and direction to "wave characteristics" and wave climatology to "wave climate". We corrected all these terms thorough the manuscript accordingly. Thank you for noting.

4) *Line 244-245: the meteorological description is confusing, for example: a strong divergence area may be relevant for cyclone development, but divergence does not originate cyclones; extra-tropical cyclones have diameters of about 1000 km, 300 km is not realistic at all. Line 251: "the medium wind speeds were within the range expected for a strong storm": sorry, but I do not understand what you mean here.*

In the new version of the manuscript, we slightly reduced the meteorological description by deleting the possible confusing sentences.

5) *Lines 267-287: this part provides unnecessary results, since they are well known and references would be sufficient; Figure 7 is not necessary, but if you want to include it, you should ask the permission for reproduction.*

Section 2.6 has been significantly reduced. The source of data of Figure 7 has been mentioned in the caption.

6) *Section 3: The entire section should be rearranged, distinguishing the case study analysis from the climatological results. Now you go back and forth, and the two parts are not clearly distinguished. I think that separating the two different analyses, the one referring to the case study from that considering the synthetic (climatological) analysis would strongly improve the readability of the paper.*

In the new version of the manuscript, we improved the readability of the whole paper, by moving/rewriting some part of the text. Thank you for the advice.

7) *Figures: Figure 8: what is the interpretation of the squares in panel a? Figure 9: the figure is not commented on in the text.*

In the new version of the manuscript, we fixed both the issues. Thank you for noting.

8) *Conclusions: I do not think you show in any place that "The coupled system improves the performance of the simulation with respect to the uncoupled system".*

In the new version of the manuscript, we deleted this misleading sentence.

MINOR POINTS:

9) Line 63: change "the Mediterranean cyclone" into "the presence of Mediterranean cyclones …"

10) Line 66: change into "… makes the Mediterranean sea subject to …"

11) Line 67: … southerly winds …

12) Line 68: … easterly winds …

13) Line 99: … affecting the …

14) Line 102: you mention that you are using ERA-INTERIM but in other points you indicate ERA-5. Please clarify!

15) Line 103: "The most important recent storm which affected the Mediterranean Sea (25 – 29 December 1999)": several intense storms affected the Mediterranean Sea in the last 20 years. It is not clear why this should be the most important.

16) Line 123: "the eastern, southern and eastern sides": please correct;

17) Line 126: I do not understand why you refer here to a meteorological paper while you are describing geographical features;

18) Line 133: defenses -> defences;

19) Line 139: third and fourth quadrant: you should clarify which direction you are referring to;

20) Line 146 and elsewhere: statistics instead of statistic and it is plural (e.g., statistics have …);

21) Line 197: "The model grid is closed 4 km north of Diamante, 3 km south of Cape Bonifati …": either you should report the places on the map or you should not mention them in the text;

22) Line 420: again, please clarify what you mean with wave climate;

23) Line 450: change into "A long term planning is crucial"..

In the new version of the manuscript, we fixed all the reported minor issues.

In particular:

- As concerns issues 15, we added a reference (**Ulbrich et al., 2001**).
- As concerns issue 17, we summarized the first paragraph of Section 2.1 in:

  Calabria region is in the south of Italy, ranging between 37°55' and 40° latitude North and between 15° 30' and 17° 15' longitude East. The western part of the region is bounded by the southern Tyrrhenian Sea, while the southern, and eastern sides are bounded by the Ionian Sea (Fig. 1).