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Interactive comment on "Extreme waves analysis based on atmospheric patterns classification: an application along the Italian coast" *by* Francesco De Leo et al.

Anonymous Referee #1

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In the manuscript "Extreme waves analysis based on atmospheric patterns classification: an application along the The Italian coast" the authors propose a methodology for classifying data of a physical quantity, to be applied prior to perform Extreme Value Analysis, for complying with three key requirements of the data samples: independent and indentically distributed and, in addition for directional variables, grouped in homogeneous subsets. This last requirement is the principal objective of the manuscript, applied to significant wave height peaks along the Italian coast. Following previous works, they propose to use the atmospheric processes producing extreme wave conditions in a given location, (1) to select the homogeneous subset based on the weather patterns (WPs), and (2) to estimate the overall extreme values distribution starting from

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the distribution fitted to each subset.

The method rely on the physical connection between the atmospheric processes, spatial and temporal evolution of the surface pressure and wind fields, behind the ocurrence of the extreme wave conditions at a given location. Consequently, the classification of extreme events is based on observed surface wind fields during the hours before and concomitant to the time of the peaks and on the correlation maps between the wind velocities and significante wave height peaks. Once the wind fields producing the peak wave conditions are identified the wind fields were used for clustering and classifying the extreme events. Then, the classification of the peaks, once the threshold of the wave height is chosen, depends only on the normalized wind fields.

The manuscript addresses relevant scientific and technical questions within the scope of NHESS, wave climate extreme value problem, presents new data and some novel concepts, with well developed tools and very interesting results. Then it is worthy to be published in NHESS. However, before to recommend the manuscript for publication, there are, in my opinion, two important questions which the authors should clarify:

(a) The range of validity of the classification of extreme events, only based on surface wind fields. (b) The “quality” of the obtained homgeneous data sets resulting from the feeding the k-means algorithm with the normalized wind fields producing the wave height peak conditions.

Developed Questions The main difference between previous published research and present work is that the variable wind wave is generated under fecth and time limited conditions. Then, the correlation between observed wind velocity and wave height fields depends on the generation process quantified through the non-dimensional variables. Significant wave height and peak period, Hs*,Tp* depend on the non-dimensional fetch, F* and the non-dimensional time, t*

Hs* = gHs/Uˆ2 = f(gF/Uˆ2, gt/U) Tp* = gTp/Uˆ2 = f(gF/Uˆ2, gt/U) F* = gF/Uˆ2 t* = gt/U

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U is the mean wind velocity, at a certain height, over the fetch F. Fetch, and consequently U are defined based on the mean wind direction (well identified by the authors, figure 10).

These functional relationships between the non-dimensional quantities should be used to link the weather patterns, wind velocity and and significant wave height time series. Based on that, F* and t* should be relevant quantities (bring in the physics of the wave generation process) to classify the extreme events and the correlation maps for different lags. For that purpose the procedure defined by eqs (1) –(3) should be applied, not with wind velocity but with the non-dimensional quantities, and as well as to feed the k-means algorithm for finding the homogeneous subset.

In addition, but very important issue, the non-dimensional quantities for each direction will help to define asymptotic values of the extreme distributions, as seems to occur figure 11. In location B4, it seems that there is an upper limit around Hs=8 m. This trendcan be checked working with the non-dimensional quantities for bounded values of F and t for that direction. Similarly for location B7, the two hifhest data points (Hs > 6m) depart approximately a 15% from the third largest value of Hs. Belong to the same subset of data? Please use the non-dimensional quantities for checking the homogeneity of the subsets.

Finally, while working with the wave height and neglecting the wave period, any risk analysis on the coastline or relevant maritime structures would be not complete. By using non-dimensional quantities the values Hs and Tp are computed silmutaneously because they depend on F* and t*. Please, if possible include the peak period to complete the necessary information for developing a risk analysis.

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