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Discussions

Interactive comment on "Time-clustering of wave storms in the Mediterranean Sea" *by* G. Besio et al.

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Anonymous Referee #1

We thank the anonymous referee for the positive comments on the paper and his suggestions, which we fully taken into account in the revised version of the paper. We modified the manuscript following the reviewers suggestions and highlighted the modified parts in bold in the revised manuscript.

1) Pag. 5, line 4: delete "of below"

Amended as suggested

2) Considering the buoy data, the authors analyse three different datasets on the base of their total duration: 20 year, 10 years and 5 years. The total duration of the dataset

constrains the maximum available timescale that is respectively about 2 years, 1 year and 6 months. The AF computed for timescales above such maximum does not have so much sense. Figs. 5-7 show the AF for all the data in a time scale range between 0.1 days and about 300 days, which is only consistent with the 10 years long datasets. It would be probably better to show the AF taking into account the reliable maximum timescale for each group of datasets.

We agree on the suggestion by the reviewer about being consistent with different groups of data. We decided to exclude the newer buoys from the analysis. This was done because the group is non-homogenous itself (time series within this group have different lengths) and we had already enough support for the validation from other measurements. Text and figures are changed/removed consequently.

3) As rightly observed in the short comment by Serinaldi, the seasonality would affect the AF curve producing that "hump" centred at about 180 days. And this implies that the increase of the AF on the left-side of such "hump" is not a signature of fractal behaviour. The suggestion to compare the AF curves of the original data with those obtained by a cyclic Poisson process is good. However, from a visual inspection it seems that before 20-50 days the AF appears well approximated by a straight line, and the interpretation as a signature of fractality or clustering at timescales below 20- 50 days seems to be appropriate.

We agree with the reviewer consideration on the AF patterns and we carried out further analysis to clarify the nature of the processes that occur at different time scales as shown in the AF plots. We did this by using the approach described in Serinaldi and Kilsby (2013). We compared the AF pattern of a time series (hindcast in this case) to the AF distribution of a population of point processes with the same cyclic characteristics and intensity of the reference one. First we used the Fourier analysis to determine the dominant cyclic components in the time series; this led to identify 5 dominant components corresponding to the yearly cycles and, with much smaller amplitudes to cycles with periods of six, three, one months and one week. With the amplitudes and periods of these cycles we simulated a cyclic, hence non-homogeneous Poisson point process. This was done with the Integrate and Fire (IF) technique by Serinaldi and Kilsby (2013), for which Dr Serinaldi kindly provided a script. Subsequently, we compared the distribution of the AF of 1000 realisations of this process to the AF found in the time series under study, results are shown in the new Figure 7. The results of this analysis confirmed the reviewer's conclusions, i.e. that the AF corresponding to time scales longer than 50 days is associated to the cyclic components, while at time scales shorter than 50 days there is a significant departure from a Poissonian AF pattern and, as the reviewer correctly pointed out, there is a clear trend that gives us confidence in interpreting this as clustering. We also included the 95% confidence intervals to further identify the scales at which the AF pattern is within the limits of the cyclic process. We think that this analysis clarifies the significance of alpha and AF.

As a consequence of this analysis the paper has been revised and a subsection discussing the results of the comparison with a surrogate population of AF is added and it reads:

"4.2 Comparison with a simulated non-homogeneous point-process The AF pattern found from data and hindcast time series is compared with that of a simulated non-homogeneous Poisson process. This is generated using the IF technique employed in Serinaldi and Kilsby (2013). The rate function of the simulated hon-homogeneous Poisson process is generated as a sum of sinusoidal components with amplitudes, 5 periods and phases obtained from the Fourier analysis of the reference signal. A Monte Carlo simulation of 1000 time series is then carried out and the simulated population of AF is compared with the reference one. Hindcast points A, G and O (see figure 2) are chosen for this analysis because they show different AF patterns in the time scales t < 50 days. This analysis reveals that, as expected, the dominant cyclic component for all the considered time series is the one with 1-year period. This was also noted for the RON data in Briganti and Beltrami (2008), where the amplitude of the annual cycle component was estimated to be around 0.25 m in Alghero, which is consistent with

what found in the present work. Together with the annual cycle also the components with periods of six, three, one months and one week have been considered to simulate the non-homogeneous Poisson processes. The results of the comparison are shown in figure 8. For all three points it is clear that the simulated cyclic Poisson process well explains the pattern of the AF at ïĄť > 50 days in all cases. As expected, this is the signature of the annual cycle, which strongly influences the occurrence of above-threshold events. The AF departs from the Poisson distribution at t < 50 days, above all in points A and G. Note that these results show also that the α for t > 50 days is always above 1 and shows very little variability among points. For scales in which a departure from a Poissonian behaviour is seen, it has to be noted that this occurs at very low values of alfa, as for example in point O. However, data often show oscillations, above all for alfa < 0.1, and it is not possible to make conclusions about the existence of a clustering regime."

4) So, the authors may consider to focus their study only on the small timescale ranges for all the data, re-plot the figures and re-discuss the results accordingly.

We clarified the nature of the process at the different scales, hence we retained the AF at those scales and we explained that the process is a non-homogeneous and Poissonian in this region of t.

5) As additional analysis, it would be better to show also the 95% confidence limit for the Poissonian surrogates at each of the considered timescale (in the range below 20-50 days) in order to check the significance of the clustering.

As explained above, this has been done and shown in Figure 8.

A copy of the revised manuscript can be downloaded here https://www.dropbox.com/s/wodmffeg9iht60l/storm_cluster_rw_1.0RB.pdf?dl=0

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