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Interactive comment on “Self-Organizing Maps approaches to analyze extremes of multivariate wave climate” by F. Barbariol et al.

Anonymous Referee #3

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The study applies Self-Organizing Maps (SOM) method to long term wave measurements in the northern Adriatic, describing multivariate sea wave climate through three different approaches which enable better representation of extreme states. Namely, as SOM technique is not efficient where the density of events is low, the authors introduce an extra step for extreme wave states and discuss differences and benefits of varying strategies in representing the extreme wave climate.

General comments:

I find the paper appropriate for this special issue of Ocean Science journal, with a valuable dataset presented and an interesting method and strategies proposed and discussed to better represent multivariate wave climate in the northern Adriatic. The analysis is based on the SOM method, which is described in appropriate manner, par-

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ticularly focusing on the SOM publications dealing with the multivariate wave climate. However, the Introduction (page 1973) should include broader view of the SOM in climatology, oceanography, climatology, ... and present/cite at least some important SOM oceanographic publications outside of the Adriatic (as it is, it seems that the SOM was applied almost exclusively in the Adriatic oceanography). The results are well presented and conclusions supported by analyses performed. Still, some clarifications are needed when discussing double-sided map presentations of wave climate (see comments below). The paper is suitable for the publication on Ocean Science after a moderate revision which includes better referencing of the SOM (especially in oceanography in general) and certain discussions, clarifications and corrections given below.

Detailed comments:

- Page 1975, line 15: please use kilometers instead of miles, particularly since it is not clear if these are nautical miles or not.
- Page 1975, line 25-: The direction of waves in the Table 1, and throughout the text, tables and figures is given in oceanographic convention. This is not obvious for wave direction in general, and the authors should emphasize this in the text, that the angles given correspond to the direction (from North) the waves are propagating towards. The authors should also give more information related to the extreme Hm (5.23 m), by detailing when did the event occur, giving corresponding wave period and direction and related meteorological/wind characteristics that caused this extreme event.
- Page 1976, line 28: three extreme states are mentioned, however, Hm=5.23 m is missing both in figure and in the text? Does the difference in period between these extreme events correspond to different winds at the time (Bora – shorter periods, Sirocco – longer periods)? Which directions correspond to these pairs?
- Page 1980, line 21: Fig. 4 and similar figures (Figs. 7, 10, 13, where wave period is presented by the vector) should include a unit vector (in seconds), so that for each

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BMU the period could also be relatively easily deduced from the figure.

- Page 1981, line 9: 0.36 seconds? Do you mean 3.6 s?

- Page 1981, line 24: please provide more information about the event (storm) depicted in Fig. 5. Temporal axes should include exact time of the event (also in Figs. 8 and 11) and more details about meteorological conditions related to it should be given in the manuscript.

- Page 1983, line 11: is it “40% error on 99th percentile Hs” or “4% error on 99th percentile Hs”, Table 2 says it is 4%?

- Page 1984, lines 18-28: the left side map in Fig. 10 is the same as the map in Fig. 4 (and the same as the left side map in Fig. 13) , i.e. it gives the SOM representation of the entire dataset, not only climate below Hs*, since some of the BMUs have Hs larger than the threshold prescribed? The line 20 on this page should be reformulated, as it says: “. . .the first map on the left side describes the climate below Hs* . . .”, and is not consistent with the rest of the paragraph. The figure caption is not clear either, as it says: “Wave climate below the threshold (left panel) . . .”. Since the left panel also includes 6 BMUs with Hs above the threshold, than the left panel partly also describes climate above the threshold. Please check throughout the manuscript.

- Page 1985, line 12: “Sirocco” events as discussed here are in bottom-right part of the right map in Fig. 10, not bottom-left?

- Page 1985, lines 13-17: please discuss the most severe sea states along the diagonal, especially those with the highest Hs values. Apparently the largest number of extreme BMUs has direction towards $\sim 260-270^\circ$. Still, some of them (to the lower-right in top-right corner) obviously correspond to Sirocco. This could be then related to extreme Hs-Tm pairs mentioned at the bottom of page 1976 (including the one that is missing, 5.23 m, see previous comment). Which directions correspond to those extreme pairs? What was the meteorological situation during those extremes? Please

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provide some details. Does the majority of most extreme wave states at the Acqua Alta station correspond to Bora winds, as $\sim 260\text{--}270^\circ$ seems to be more related to Bora than Sirocco? Putting a limit between the Bora and Sirocco exactly at 270° could be somewhat confusing?

- Page 1985, Fig. 10: colorbar for the frequency of individual BMUs in the right panel is not really useful, as all the frequencies appear almost the same. A separate colorbar (different color pallets) should be related to the right-side map BMU frequencies, perhaps for Hs too. The same thing should be done in Fig. 13, although the color visibility is not as bad as in Fig. 10.

- Page 1987, line 13: is it completely correct/precise to tell that the left map/panel comprises only low/moderate sea states (also on page 1975, lines 1-10 where the authors propose a double-sided map). Namely, the most extreme BMUs correspond to the highest Hs values (when looking on temporal evolution of BMUs, e.g. Fig. 5 between 30th and 50th hour), but corresponding BMU reconstructions are relatively far from measurements due to the SOM characteristics/problems you described and emphasized in Introduction (rare events and distant from the others in multidimensional input data space)? Therefore the left side map represents the entire dataset, but it does not properly describe extreme sea states? That is what the authors essentially say at the top of page 1985: “Without such BMUs, the map on the left represents the low/moderate wave climate. . .”. Please make sure to be consistent with this throughout the manuscript (e.g., Page 1988, line 23 again says that the left map represents low/moderate wave climate).

Interactive comment on Ocean Sci. Discuss., 12, 1971, 2015.

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