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Interactive comment on "Statistical Analysis of Wave Energy Resources Available for Conversion at Natural Caves of Cape-Verde Islands" *by* W. M. L. Monteiro et al.

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Report No.4: Answers to the Anonymous Referee #2 The Authors: W. M.L. Monteiro A. J. Sarmento, A.J. Fernandes and J.M. Fernandes 16-04-2016 Dear Anonymous Referee #2, First we want to thank you for all the comments and suggestions you made in relation to our paper. In fact, the improvement of the paper is notable after yours comments. After the revision requested by the First Referee, the paper was completely remodeled. Many sections and information were added to the paper. So, we kindly ask you to read it again and note that most parts of your comments are answered and clarified. A paragraph is added to the data section (new) to highlight the methodology used to evaluate wave energy resources and the novel aspects of the

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Discussion paper

present work.

C1: It is not obvious to me that it gives any useful new insight to wave climate or surface wave physics (either of which would make it eligible). Furthermore, it is written with an emphasis on statistical analysis and some engineering details, but without very much on the science of surface wind waves and swell.

The procedures and software available for mapping wave energy resources ignore, in general, some important statistical aspects that can lead to errors in wave energy assessment. The outliers that may be present in the time-series of wave data, as a result of a specific event such as severe storms, could significantly influence the available average wave power. The present study have as novel aspect, the using of the adequate statistical tools to identify possible outliers in time-series of wave data, and the subsequent analyses of their influence in the inter-annual average power calculation. Another subject barely mentioned in papers, that can lead to error in the wave energy resources characterization are the effects of data aggregation. The information about the temporal behavior of the wave data is lost due to the aggregation effects. The present study shows that the aggregation effects may be a real problem that deserves to be analyzed when characterizing wave energy resources. Finally, based on the wave regime characteristics, this paper calculates the time duration necessary to carry on the experiments at Natural Caves aimed to quantify their output power with a minimum sample size that will guarantee its time representativeness. The estimation of the referred time duration is very important as it helps us to evaluate correctly the energetic performance of NCs. In fact, the statistical procedure presented in this paper for quantifying the mentioned time duration can be followed by any researchers to make a better sense of the behavior of their models of Wave energy devices, through the experimental studies in ocean, or in Lab, using irregular waves.

C2: It is also fairly poorly written both in respect to structure and style and grammar. We respect your opinion even though we disagree. The paper has been reviewed many times for proper style and grammar. Of course there may still be errors that if pointed

out to us we will correct.

C3: The introduction starts poorly be giving an absurd value for the global wave resource. Boyle (2004) in fact gives a similar value to most other sources, i.e. an average power of 2TW which equates to 17 500 TWh/year. This error is not relevant to the rest of the paper but makes a very poor impression.

The value of the global average wave power is, in fact, 2TW that corresponds to 17500 Twh/y. Our intention was to present the corresponding value in powers of 10. That is, approximately, 1.8 x104 TWh/y. For some reason, the first number went missing. Now the value is correctly presented.

C4: The simplest - but most important - technical deficiency of the paper is its failure to identify the original data sufficiently. We are told the data is obtained from the SOWFIA project, but as I understand it, SOWFIA was a conduit to gather data rather than responsible for any original data collection. We have a position and dates, but there is no clear indication whether this "data" is from a wave buoy (what type? whose?) or from a wave model (which?). If the data is from a buoy then 30 year time series are sufficiently rare that the data is intrinsically interesting in terms of wave climate. If it is a wave model output then there is little scientific reason to analyze at a single location in isolation, but there might be a case from relevance to Cape Verde Islands. In any case, the data requires an adequate "provenance".

We used the data produced by WW3 through the SOWFIA project to evaluate the wave energy resources at Cape-Verde. A data section is added to the paper. In this section we explain the SOWFIA project and present a real nature of our data and the inaccuracy associated with them (see new version of paper).

C5: The data is in the form of significant wave heights and peak periods at 3 hour intervals. The authors correctly point out that calculation of the wave power ideally requires an energy period rather than a peak period. The authors discuss methods to estimate an energy period, but fail to make a clear statement of the method that

they adopt (e.g. "In this study, we estimate an energy period by Te = 0.86 Tp". Other than this there is a reasonable analysis of the distribution of the data and monthly and annually-averaged time series are constructed.

We used the approximation Te=Tp, considered by Hagernam (2001), as good enough to make a preliminary study of wave energy resources.

C6: I found the discussion of the time series analysis opaque in places, but as I understood, simple analyses of the annually-averaged power suggests a decline, but analysis of each calendar month shows no obvious departure from stationarity in any calendar month. These two statements might appear contradictory, but I think are not surprising given that monthly values will be massively variable. The observation (Figure 7) that the variability is generally greater in the winter months is consistent with other studies that have observed very high inter-annual variability in North Atlantic wave climate in winter months. The monthly average power does not show any trend. However, the inter-annual average power presents a downward trend. If we delve deeper into the analysis of the data and we find that the trend shown in time-series of the inter-annual average power is illusory and caused by the aggregation effects of data. This fact is now well discussed in the paper.

C7: I will not go into every statistical analysis in detail, but I am skeptical whether the ARIMA projections are useful. I think it is sufficient to state that we can do no better than "take the past as a guide to the future" and describe the average and variation of wave powers within the 30 year time series.

The time-series of the predicted values of the inter-annual average power follows the trend of the historical data. A new figure is added to the paper to reinforce this fact. However, a better ARIMA model to predicate the future values of the inter-annual average power is found using the R software. The new version of the paper explains it better. We kindly ask you to read the new version of the paper.

Please also note the supplement to this comment:
http://www.ocean-sci-discuss.net/os-2015-108/os-2015-108-AC2-supplement.pdf

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