

Interactive comment on “Temporal variations in the wind and wave climate at a location in the eastern Arabian Sea based on ERA-Interim reanalysis data” by P. R. Shanas and V. Sanil Kumar

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Response to the comment on “Temporal variations in the wind and wave climate at a location in the eastern Arabian Sea based on ERA-Interim reanalysis data” by P. R. Shanas and V. Sanil Kumar

We would like to thank the referee for the constructive comments. We have revised the paper based on the the referee comments. Responses to referee comments are given below.

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Reply to general comments:

Abstract and the conclusions revised to reflect the statistical significance of the findings of the present work. The difference in trends between annual maximum wind speed and the mean speed is now added in the abstract and conclusions.

Replies to the specific comments are given below.

Comment 1: Introduction: please mention Honnavar at line 18, since it is shown in figure 1, referred to in the same section. Moreover, is Figure 1 presenting the considered area in terms of reanalysis data? Or it is a subsection of the area shown? Or it is just referred to the buoy location? This is unclear from the paper.

Reply: Honnavar added in the introduction at line 18. Figure 1 represents the buoy location and the study location refers the extracted point of reanalysis data.

Comment 2: Section 2 starts describing the data, but it would be more useful first to provide the reader with a description of the main climatological features of the area (e.g. monsoon variability during the year) to put in a context all the discussion of the results in section 3. Some readers may be unfamiliar with the local phenomenology of the Eastern Arabian Sea.

Reply: The below paragraph describing the local phenomenology of the Eastern Arabian Sea is now added in section 2. Indian ocean exhibits a number of modes of climate variability, ranging from intra-seasonal to inter-annual and longer time scales, most of which are coupled to the strong seasonal cycle (Schott et al., 2009). The surface waves in the North Indian Ocean mainly depends on the wind conditions prevailing over the three different seasons; viz. south west (SW) monsoon or summer monsoon (June-September), north east (NE) monsoon or post monsoon (October - January) and pre-monsoon or fair weather period (February- May) (Glejin et al., 2012). Generally high wave activity is observed during the south west monsoon season and relatively calm during the rest of the season (Kumar et al., 2006).

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The below references are added. ĀĀ Kumar, V. S., Pathak, K. C., Pednekar, P., and Gowthaman, R.: Coastal processes along the Indian coastline, *Current Sci.*, 91, 530–536, 2006. ĀĀ Glejin, J., Kumar, V. S., Chempalayil, S. P., Singh, J., Pednekar, P., Kumar K.A., Dora, G.U., and Gowthaman, R.: Variations in swells along eastern Arabian Sea during the summer monsoon, *Open J. Mar. Sci.*, 2, 43–50, 2012. ĀĀ Schott, F. A., Xie, S. P., and McCreary J. P. Jr.: Indian Ocean circulation and climate variability, *Rev. Geophys.*, 47, RG1002, doi:10.1029/2007RG000245, 2009.

Comment 3: Section 2.1, lines 5-6: it is inappropriate to talk about “resolution” of the model, what is mentioned in the paper is the grid size. The actual resolution of the model is coarser than the grid size.

Reply: The paragraph modified and removed “ resolution”

Comment 4: Section 2.1: it should be mentioned that ERA-Interim assimilates, among the various kinds of observations, also scatterometer and altimeter data.

Reply: This information is now added in the paragraph. The below reference also added.

ĀĀ Komen, G. J., Cavalieri, L., Donelan, M., Hasselmann, K., Hasselmann, S., and Janssen, P. A. E. M.: *Dynamics and Modelling of Ocean Waves*, Cambridge University Press, 532 pp., 1994.

Comment 5: Section 2.2 lines 14-16: the description of the methodology used to derive the wavespectrum is unclear.

Reply: The methodology modified as below. Measured wave data at 9 m water depth (14.304°N, 74.391°E) off Honnavar (Fig. 1) using a moored directional wave rider buoy during January 2011-December 2012 is used in the present study for comparison of the ERA-Interim SWH data. The directional waverider buoy is a spherical case of 0.9 m diameter containing three accelerometers oriented orthogonally in one vertical and two horizontal directions. The vertical and horizontal (eastward and northward)

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displacements are obtained by double integration of the respective acceleration signal without applying filter. The displacement data are recorded continuously at 1.28 Hz and the data for every 30 minutes are processed as one record. At every 200 s, a total number of 256 heave samples are collected and a Fast Fourier transform (FFT) is applied to obtain a periodogram in frequency range 0 to 0.58 Hz with frequency resolution of 0.005 Hz. The periodogram is smoothed using Hanning window with 25% overlap and the spectrum is obtained. Eight consecutive spectra covering 1600 s are averaged and used to compute the half-hourly wave spectrum (Kumar et al., 2014). Significant wave height (H_s) and mean wave period (T_{m02}) are estimated from the spectral moment. Significant wave height (SWH) which equals and mean wave period (T_{m02}) which equals are obtained from the spectral moments. Here m_n is the n th order spectral moment and is given , $n = 0$ and 2, $S(f)$ is the spectral energy density at frequency f .

Added below reference.

ĀĀ Kumar, V.S., Dubhashi, K.K., and Nair, T.M.B.: Wave spectral characteristics off Gangavaram, East coast of India, *Journal of Oceanography*, DOI 10.1007/s10872-014-0223-y, 2014 (in press).

Comment 6: Section 2.3 line 26: “better performance”: with respect to what? Another model ? Please clarify.

Reply: Modified as below. ERA-Interim data captures well temporal variability with better performance (~ 0.86 correlation) in near-surface parameters (wind, air surface temperature, humidity etc.) with respect to other reanalysis data like NCEP (Kalnay et al., 1996), NCEP-DOE Reanalysis 2 (Kanamitsu et al., 2002).

Added below references.

ĀĀ Kalnay, E., Kanamitsu, M., Kistler, R., Collins, W., Deaven, D., Gandin, L., Iredell, M., Saha, S., White, G., Woollen, J., Zhu, Y., Chelliah, M., Ebisuzaki, W., Higgins, W.,

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Janowiak, J., Mo, K. C., Ropelewski, C., Wang, J., Leetmaa, A., Reynolds, R., Jenne, R., and Joseph, D.: The NCEP / NCAR 40-year reanalysis project. Bull. Amer. Meteor. Soc., 77, 437-471, 1996. Kanamitsu, M., Ebisuzaki, W., Woolen, J., Potter, J., and Fiorino, M.: NCEP/DOE AMIP-II Reanalysis (R-2). Bull. Amer. Met. Soc. 83, 1631-1643.2002.

Comment 7: Section 2.3: Some validation of the model is provided in this section using buoy data and figure 2 shows a reasonable matching in terms of the SWH. Is there any buoy wind data available to check also the wind fields?

Reply: Measured wind data are not available for the location studied to check the comparison of wind fields.

Comment 8: Section 3.1: as said, discussion of results would be eased by a previous description of the local phenomenology (e.g. south west monsoon season).

Reply: Local phenomenology added in data and methodology section

Comment 9: Section 3.2: discussion is referring also to Table 1, but it is never mentioned in the text. Reply: Table is now referred in the text also.

Comment 10: Section 3.2: a comment on the statistical significance of different trends of annual maximum SWH and mean SHW (as in section 3.1 for winds) would be useful when commenting Figure 8 (lines 22-24).

Reply: Statistical significance for SWH added.

Comment 11: Section 3.3: discussion is referring to Figure 10, but it is never mentioned in the text. There is also reference in the text to non-MKS units (line 18, mph). However this was a bit puzzling as mentioned earlier: there is a discussion of few single events. But as figures 5, 8 and 10 show, these affect mainly the maximum values, which give a general "impression" of what can happen in the area. However, as clearly said in section 3.1, those few events drive the statistics of the maximum values in a statistically meaningless way.

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Reply: Figure 10 is now referred in this section. Non-MKS units changed. This section is to describe the peak events happened during the study period and how they influenced the wind and waves in the study area. The trend in annual maximum SWH depends on the individual events and hence the 90th and 99th percentile values of SWH are estimated and presented in the paper.

Comment 12: Section 3.4: Focus is on the outliers, trying to put them in relationship with the modulation from other phenomena (e.g. ENSO). This appears unbalanced considering the limited statistical significance of these outliers and the weak (if any) link to climatological large scale forcing.

Reply: As per suggestion section 3.4 is removed and also the Figure 10 c.

Comment 13: Section 3.5: It is unclear if you are referring to/using annual means or monthly means in these tests. A bit more discussion should be spent in commenting the results and the structure of this section should be improved to improve readability. Initially it should be mentioned that the t and Z tests are performed to check if the slope of the regression lines is 0. The t test should follow a t-distribution with n-2 degrees of freedom if the null hypothesis is true. Please check.

Reply: The analysis is based on annual mean value and is now mentioned in the paper. It was a mistake and the degrees of freedom is n-2. This section modified as per the suggestion.

Comment 14: Section 3.5: it is mentioned that statistically significant trend is found for wind speed and wave period mean trends. However Table 4 indicates significant results (SG in the table) for the wind speed mean and wind speed 90th percentile. Please clarify. By the way, "man" is "mean" in Table 4?

Reply: Corrected. It is wind speed mean and 90th percentile wind speed. Corrected 'man' as "mean" in Table 4.

Reply to Technical corrections

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Comment 15: Section 2.3 line 21: instead of “are done”: “have been done”.

Reply: corrected

Comment 16: Section 3.1: many “show” should be “shows” (e.g. “the monthly mean wind speed shows...”)

Reply: corrected

Comment 17: Please spell acronyms out also when well known the first time they are mentioned in the text (e.g. ENSO, NOAA, JAMSTEC, etc.).Section 3.5, line 11: it is “degrees of freedom”, not “_ of freedom”. Please correct.

Reply: Section 3.5 deleted and hence most of these acronyms deleted. Corrected as “degrees of freedom”

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 1, 7239, 2013.