Earth Syst. Sci. Data Discuss.,
https://doi.org/10.5194/essd-2020-255-AC2, 2021

Open Access Earth System Science Data Discussions

Interactive comment on "Wind, waves, and surface currents in the Southern Ocean: Observations from the Antarctic Circumnavigation Expedition" *by* Marzieh H. Derkani et al.

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Received and published: 9 January 2021

Response to Anonymous Reviewer #2

R#2: Line 106-107: Do you have an estimate of what proportion of the data (if any?) is not processed due to the ocean being too smooth? Is this much of an issue in the Southern Ocean?

AC: Although it is unusual for the Southern Ocean, there were conditions of very low wind speed, resulting in a smooth surface. In more general sense, WaMoS-II cannot detect the ocean surface accurately if wind speed is lower than 3 m/s. Low wind speed

affected about 9% of the whole observation. We commented on the low wind speed issue in the revised version of the manuscript in Section 3.2.

R#2: Line 128: "modes" = "mode"?

AC: This typo has been corrected.

R#2: Line 180: Is there a standard deviation or other measure you could include to show the variability of these variables over the 20-30 year time period? (This might be useful to include in Fig 6 to put your instantaneous observations in context with the inter annual variability?)

AC: We thank the reviewer for this comment. We have added error bars to climate statistics. To make the error bars more visible, we split the original figure 6 into two figures in the revised manuscript. Figure 6 shows variables for which climate statistics are available; Figure 7 shows all other variables.

R#2: Figure 5: perhaps add a contour showing the sea ice edge to the figures that show wave height to highlight the attenuation you mention in line 195? (Figure 5c and/or Figure 5d).

AC: We updated Figure 5 by adding the contour line of the sea ice edge as located at 10% ice concentration.

R#2: Line 202: "patter" = "patterns"

AC: This typo has been corrected.

R#2: Line 202: maybe add either the polar front or the legs to the figures showing surface currents to highlight the region you are describing here? It would be useful to reference Figure 5f here.

AC: Voyage's route has been added in Figure 5.

R#2: Figure 7: c and/or d - add the sea ice edge (or include the shading from Fig 1) so we can visualize where the sea ice is complicating estimations.

AC: Sea ice has been added to panels c and d of this figure. Note that figure 7 in the original manuscript is figure 8 in the revised version.

R#2: Line 283: Is there any other literature on WaMoS-II surface current observations that provides any assessment of the quality of the current observations? I.e. are you able to say anything about the quality of the WaMoS-II vs altimeter current measurements? How different are the current estimates - maybe it isn't appropriate to directly compare these quantities?

AC: We thank the reviewer for this comment. The accuracy of the ocean current measurements is discussed in Hessner et al. (2019), Lund et al. (2015a), and Lund et al. (2015b). A brief comment about accuracy has been added to the revised version of the manuscript (Section 3.1).

Regarding satellite observations, we used current data from COPERNICUS-GLOBCURRENT - https://marine.copernicus.eu, which provides the total velocity field based on satellite geostrophic surface currents and modelled Ekman currents, which take into account wind stress forcing obtained from atmospheric system and drifters data. In principle, this product is consistent with current measurements from WaMoS-II. Nevertheless, WaMoS-II also detects inertial oscillations (Treguier and Klein, 1994), which can be particularly intense in the Southern Ocean. These components are not

captured in the benchmark data and hence represent a source of inconsistency. Furthermore, Ekman components remain uncertain in the Southern Ocean due to inaccuracies in estimating wind stress from the atmospheric system, adding more inconsistencies between benchmark and our observations. A remark in this regard has been added to the manuscript in Section 5.3.

References

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Lund, B., Graber, H.C., Hessner, K. and Williams, N.J., 2015a. On shipboard marine X-band radar near-surface current “calibration”. Journal of Atmospheric and Oceanic Technology, 32(10), pp.1928-1944.

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