EGUsphere, referee comment RC2
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# Comment on egusphere-2022-294

Anonymous Referee #2

Referee comment on "Wind work at the air-sea interface: a modeling study in anticipation of future space missions" by Hector S. Torres et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-294-RC2, 2022

This study extends the work of Rai et al. (2021) to examine the importance of additional scales of variability in the context of wind work. It nicely shows the importance of high frequency variability. However, it seems to leave several aspects of this problem untouched, and these aspects substantially change the numerical results.

The selected drag coefficient is a reasonable choice for neutral boundary-layer stability, however, it is likely that locations with strong currents will also have substantially non-neutral boundary-layers. While I concede that considering stability won't qualitatively change the results, it might change the numbers by 10%, with greater impact on the high frequency numbers. The use of this assumption seems to be needless presuming that the model stress was saved, which seems like a certainty as the stresses curls are shown in the Strobach et al. 2022 paper.

Studies by Rhys Parfitt and colleagues suggest that the mesoscale atmosphere couples with the ocean on the same spatial scales. Does the ability to represent ocean gradients in the stress calculation (and hence ocean forcing) on spatial scales of roughly twice as fine as the atmospheric gradients cause any problems? This would be a concerning choice of resolutions if the atmospheric boundary-layer responds substantially to the ocean, and hence would oddly impact the feedback on ocean forcing. The authors suggest that this concern might not be a serious problem because the stress in Fig. 1 does not seem to be responding to the currents. This interpretation may be an artifact of the color bar, but in this form the image suggests that the atmosphere is not responding to changes in the current, suggesting that the stress described in this paper is experienced by the ocean but not be the atmosphere, consistent with the seemingly strange use of a calculated neutral stress. Guabe et al. (2015) shows that the impacts of current gradients curl are greater than the impacts of stability, further supporting the concern that winds and currents are not coupled in this study.

Neither this paper not the cited papers explain what information is exchanged between the ocean and atmospheric model, nor is it clear that the stress mentioned in this paper was

experienced by the atmosphere, which might explain why the modeled stress values were not used in this study. In other words, it appears the atmospheric response to changes in the ocean is due only to thermodynamic changes in the ocean, as was typical with much of the early work on this subject. This raises the question of the importance of the missing atmospheric response and how those atmospheric changes would impact the ocean forcing. It would be fascinating to see this analysis carried out with a two-way coupled model that includes physics correctly coupling winds to currents, and hence changes to wind work. An evaluation of how atmospheric resolution impacts wind work would also be interesting, but is also clearly too much to ask. While this work demonstrates the importance of a high-resolution ocean on wind work and that it is important to consider surface relative winds in the calculation of wind work, it seems to largely neglect the importance of the atmosphere in the coupled ocean-atmosphere system, for which related changes in wind speed and direction could substantially impact wind work.

Technical corrections:
1) Better explain how the models are coupled by detailing the variables that are exchanged.
2) Be clear about why a neutral drag coefficient is used when model stress are available.

References:
Gaube, P., D. B. Chelton, R. M. Samelson, M. G. Schlax, and L. W. O'Neill, 2015: Satellite Observations of Mesoscale Eddy-Induced Ekman Pumping. J. Phys. Oceanogr., 45, 104–132, https://doi.org/10.1175/JPO-D-14-0032.1.
Strobach, E., Klein, P., Molod, A., Fahad, A. A., Trayanov, A., Menemenlis, D., and Torres, H.: Local Air-Sea Interactions at Ocean Mesoscale and Submesoscale in a Western Boundary Current, Geophysical Research Letters, 49, 1–10, https://doi.org/10.1029/2021GL097003, 2022.