**Point-to-point responses to the reviewer #2's comments**

on "A Global Surface Turbulence Heat Flux Dataset resolving tropical cyclones"

We are grateful to the anonymous reviewer #2 for the valuable time, careful reading and crucial comments on our manuscript. Following the comments, we have substantially revised our paper. This document addresses reviewers' comments point-by-point. Reviewer comments are presented in **black**, our response in blue, and revised manuscript text in orange.

**Response to Reviewer #2:**

**General comments:**

***The current flux datasets are commonly associated with substantial uncertainties under tropical cyclones. This manuscript presents a new dataset of surface turbulent heat fluxes resolving tropical cyclones by merging various data sources of best track, satellite SST, blended surface winds, and reanalysis datasets using the COARE3.6 algorithm. Validations against observational data and high-resolution simulations show an evident improvement under tropical cyclone conditions compared with other limited-flux datasets. Overall, the work is scientifically meaningful, and the writing is clear and well-organized. It contributes to the community with an improved tropical cyclone-resolved flux data product that can be used for either tropical cyclone or global energy cycle studies. I only have a couple of minor concerns for the authors to consider to improve the work.***

**Response:** We are grateful to the reviewer for positive evaluations and crucial comments. We have followed the detailed comments to modify the manuscript carefully. Detailed comments are replied one by one below.

**Specific comments:**

***1. This dataset is especially useful for tropical cyclone analysis, where the wind speeds are high. The latent and sensible heat fluxes are calculated using Equations 11 and 12, in which Ch and Cq are used, Then, what are the relationships between the two variables and the wind speed? In other words, how do the authors determine the Ch and Cq in a high wind speed?***

**Response:** Following the comments. Both the $Ch$ and $Cq$ in our study are calculated using the state-of-the-art COARE 3.6 bulk flux algorithm. They are not prescribed as direct empirical functions of wind speed. Instead, they emerge from the iterative solution of the Monin–Obukhov similarity theory (MOST) together with physically based roughness length schemes.

In COARE 3.6, the transfer coefficients are defined as:

$$C_h = \frac{-u_* t_*}{U(\Delta T - \Delta T_{cool})}, \text{ and} \quad (1)$$

$$C_q = \frac{-u_* q_*}{U(\Delta q - \Delta q_{cool})}, \quad (2)$$

Where $u_*$ is the friction velocity, $t_*$ and $q_*$ are the temperature and specific humidity scaling parameter, $\Delta T$ is the air-sea temperature difference, $\Delta q$ is the air-sea specific humidity difference, $\Delta T_{cool}$ and $\Delta q_{cool}$ accounts for the cool-skin effect. The friction velocity and scaling parameters are also functions of wind speed. The robustness of these parameterizations is supported by extensive observational validation (Edson et al., 2013; Fairall et al., 2003), providing strong assurance of the reliability of $Ch$ and $Cq$ in high-wind regimes.

***2. The manuscript states the importance of global energy budget, especially in a warming climate. How large are the global mean (e.g., 60S-60N) latent and sensible heat fluxes? Please compare with other datasets.***

**Response:** Following the suggestion, we have calculated the global-mean latent and sensible heat fluxes (60S-60N) from different datasets. The surface latent heat flux is estimated at 113.4 W m$^{-2}$ for GHFD, 98.7 W m$^{-2}$ for J-OFURO 3, 92.4 W m$^{-2}$ for OAFlux and 90.6 W m$^{-2}$ for ifremerflux, while the surface sensible heat flux is estimated at 16.6 W m$^{-2}$ for GHFD, 6.8 W m$^{-2}$ for J-OFURO 3, 10.4 W m$^{-2}$ for OAFlux and 19.1 W m$^{-2}$ for ifremerflux. The relative discussion is in Line 165-168, Page 9, reproduced below.

The global mean (60°S-60°N) surface latent heat flux is estimated at 113.4 W m$^{-2}$ for GHFD, 98.7 W m$^{-2}$ for J-OFURO 3, 92.4 W m$^{-2}$ for OAFlux and 90.6 W m$^{-2}$ for ifremerflux, while the surface sensible heat flux is estimated at 16.6 W m$^{-2}$ for GHFD, 6.8 W m$^{-2}$ for J-OFURO 3, 10.4 W m$^{-2}$ for OAFlux and 19.1 W m$^{-2}$ for ifremerflux.

***3. Some variables are obtained from different heights, such as 2 m and 10 m. Then the COARE algorithm was used to construct the dataset. There is no depiction of how these variables at different heights are used for the flux calculation. Have the authors conducted a standardization? If not, simply merging them together would introduce bias, though presumably not significantly. If so, an illustration is needed for this procedure.***

**Response:** Thanks. In the COARE 3.6 framework used in this work, the heights of related variables need not be standardized in advance. The COARE 3.6 itself will handle these variables at different heights to calculate the surface flux.

***4. Figure 1: Please do not use a yellow background and white font together. The text cannot be well identified. IBTrACs in the blue bottom may change to TC data.***

**Response:** Thanks. Figure 1 has been revised as suggested. The revised picture is shown in Page 3.

***5. Figure 7: The 'two white dotted lines' are not identifiable to me. Please polish this figure or adjust the caption to make them consistent.***

**Response:** Thanks. "The intersection of the two white dotted lines marks the center of the TC" in the caption has been deleted.

***6. Figure 8c: Is '$\times 10^{-3}$' correct here?***

**Response:** Thanks for pointing it out. It's a typo and has been deleted from the Figure 8c.

*7.* ***Related to equations: Not all the symbols are sufficiently defined, such asVi and Vo. Please double-check them carefully.***

**Response:** $V_i$ and $V_o$ have been defined clearly, as Eq.(1) and Eq.(2) in Line 90-91, Page 4. We have double-checked the manuscript carefully to ensure all symbols are clearly defined.

***8. Line 7: Replace 'daily available from 1993 to 2023' with 'available daily from 1993 to 2023'.***

**Response:** As suggested, we have replaced 'daily available from 1993 to 2023' with 'available daily from 1993 to 2023'.

***9. L56, please full spell the CCMP here.***

**Response:** Thanks. We have added the full spelling of "CCMP" in Line 60-61, Page 2 as: "Cross-Calibrated Multi-Platform (CCMP)".

***10. L35-37, some references should be added.***

**Response:** The reference of Andersen et al. (2013), Song et al. (2021) and Xie et al. (2024) has been added in Line 38-39, Page 2.

***11. While most part of the manuscript is well written, I do find several places of typos or writing problems, as listed below. Please proofread the manuscript much more carefully during the revision:***

**Response:** Thanks for the careful review. All these points have been addressed accordingly. We have also proofread the manuscript carefully.

***Line 77: Change 'origin' to 'original'.***

**Response:** Done.

***Line 175-176: Please rewrite this sentence.***

**Response:** The sentence has been rewritten as:

Among the four datasets, GHFD yields the smallest bias in surface sensible heat flux. As for surface latent heat flux, GHFD performs better than OAFlux, with comparable but marginally larger bias than J-OFURO 3.

***Line 197: Change 'magnitude' to 'magnitudes', or replace 'are' with 'is'.***

**Response:** Thanks. 'magnitudes' has been changed to 'magnitude'.

***Line 203-204: Consider rewriting this sentence.***

**Response:** Thanks. The sentence has been rewritten as:

The peak surface latent heat flux of Earl is approximately 900 W $m^{-2}$ , and the surface sensible heat flux is approximately 250 W $m^{-2}$ . The GHFD values are closer to those of Earl compared with the other products.

***Line 207: Delete 'The max'.***

**Response:** Deleted

***Line 224: Delete 'under high wind speed conditions'.***

**Response:** Deleted

***Line 233: Should it be 'Francisco'?***

**Response:** Yes. Revised.

***Line 233-235: Too long a sentence. Please rewrite it.***

**Response:** Thanks. It has been rewritten as:

Compared with other products, GHFD shows better performance under TC conditions. A comparison of each parameter indicates that the bias of GHFD is significantly smaller than that of other products.

# References


Andersen, T. K., Radcliffe, D. E., and Shepherd, J. M.: Quantifying surface energy fluxes in the vicinity of Inland-Tracking tropical cyclones, J. Appl. Meteorol. Climatol., 52, 2797-2808, https://doi.org/10.1175/JAMC-D-13-035.1, 2013.

Edson, J., Jampana, V., Weller, R., Bigorre, S., Plueddemann, A., Fairall, C., Miller, S., Mahrt, L., Vickers, D., and Hersbach, H.: On the Exchange of Momentum over the Open Ocean, J. Phys. Oceanogr., 43, 1589-1610, https://doi.org/10.1175/JPO-D-12-0173.1, 2013.

Fairall, C. W., Bradley, E. F., Hare, J. E., Grachev, A. A., and Edson, J. B.: Bulk parameterization of air – sea fluxes: Updates and verification for the COARE algorithm, J. Clim., 571-591, 2003.

Song, X., Ning, C., Duan, Y., Wang, H., Li, C., Yang, Y., Liu, J., and Yu, W.: Observed extreme air – sea heat flux variations during three tropical cyclones in the tropical southeastern indian ocean, J. Clim., 34, 3683-3705, https://doi.org/10.1175/JCLI-D-20-0170.1, 2021.

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