Response to Referee Comment (RC2)
The Impact of Aeolus Observations on Wind and Rainfall Predictions

We thank the referee for the careful review and constructive comments on our manuscript. Our responses (in blue) and the corresponding changes made to the manuscript are detailed below.

General Comments:

The paper "The impact of Aeolus observations on wind and rainfall predictions" by Borne et al. is a comprehensive investigation of the impact of Aeolus satellite wind observations on wind and rainfall predictions by the global ECMWF forecasting system. Main findings are that wind forecasts are particularly improved in the tropics and in the Southern Hemisphere. Rain forecasts are particularly improved in the extended winter season at midlatitudes of the respective hemisphere. Main reason is that during this season precipitation is strongly correlated with the wind systems. Different from this, rainfall in the tropics is more randomly linked to convective events which are more difficult to predict.

Overall the paper is very well written and fits into the scope of WCD. The paper is therefore recommended for publication in WCD after addressing my minor comments as detailed below.

My main comment is that the authors should elaborate a bit more about the suitability of ERA5 as a reference for the winds.

Further, some additional discussion would help the reader to digest that improvements in the percent-range may appear small, but are quite relevant for weather foreasting.

Response to General Comments:

Thank you for this positive assessment of the manuscript. We have addressed the main comment by expanding the discussion on the suitability of ERA5 as a reference for wind evaluation, including evidence from recent comparisons with Aeolus and radio-occultation-derived winds (see response to comment (2)). In addition, we added the following paragraph to the Conclusions to clarify the relevance of percent-range precipitation improvements:

Line 430: *"Although the absolute magnitude of the precipitation improvements is typically in the percent range, it is statistically robust and operationally relevant given the already high baseline skill of the ECMWF forecasting system. Importantly, the largest FSS gains occur at spatial scales and lead times where the baseline FSS is around or below 0.5, corresponding to forecasts with limited skill and those approaching useful performance. While these improvements are strongest at smaller spatial scales, where skill tends to degrade most rapidly with lead time, they also extend toward larger spatial scales. This indicates that Aeolus wind assimilation contributes to improve precipitation predictability across a range of spatial scales, including those of greatest relevance for medium-range forecasting."*

SPECIFIC COMMENTS:

(1) l.82: Please state more clearly that both the Aeolus Rayleigh and Mie products were used for the Aeolus OSE.

Response to SPECIFIC COMMENTS (1):

In l.82 we added following sentence: "*Both Rayleigh and Mie products were used in the Aeolus OSEs.*"

(2) l.116: Here you should elaborate a bit on the suitability of ERA5 as a reference. Particularly for the tropics where the geostropic constraint breaks down it has been shown that ERA5 zonal-mean zonal wind seems to agree better with Aeolus than other reanalyses, and also the signatures of tropical waves seem to agree well between ERA5 and Aeolus (Ern et al., ACP, 2023). When comparing with tropical radiosonde stations ERA5 and MERRA2 seem to perform similarly well.

Further, a comparison of geostrophic winds derived from radio occultations and ERA5 shows good agreement (Nimac et al., AMT, 2025).

Ern, M., Diallo, M. A., Khordakova, D., Krisch, I., Preusse, P., Reitebuch, O., Ungermann, J., and Riese, M.:

The quasi-biennial oscillation (QBO) and global-scale tropical waves in Aeolus wind observations, radiosonde data, and reanalyses,

Atmos. Chem. Phys., 23, 9549-9583, https://doi.org/10.5194/acp-23-9549-2023, 2023.

Nimac, I., Danzer, J., and Kirchengast, G.:

The added value and potential of long-term radio occultation data for climatological wind field monitoring,

Atmos. Meas. Tech., 18, 265-286, https://doi.org/10.5194/amt-18-265-2025, 2025.

Response to SPECIFIC COMMENTS (2):

Thank you for this comment. We reformulated the paragraph concerning the ERA5 wind reanalysis and added the following text:

Line 117: "While ERA5 does not assimilate Aeolus winds, it shares the same model and assimilation system as the forecasts, so it is not fully independent. *Recent comparisons demonstrate that ERA5 provides a suitable wind reference, including in the tropics where geostrophic balance is weak Zonal-mean zonal winds and tropical wave signatures show very good agreement between ERA5 and Aeolus, with mean differences typically below 2 m/s and smaller than for other modern reanalyses (Ern et al., 2023). Consistent results are found in comparisons with radio-occultation-derived winds, which also indicate differences generally within ± 2 m/s, apart*

from localized deviations near subtropical jet regions (Nimac et al., 2025). These results support the use of ERA5 as a robust reference for wind evaluation in this study."

(3) l.202: Please add reference Martin et al., QJRMS, 2023a to this list.

Response to SPECIFIC COMMENTS (3):

We added the reference.

(4) l.247: Please mention here that the coverage by radiosondes in the Southern Hemisphere is quite sparse. For illustration you should add the reference Durre et al. (2018).

Durre, I., Yin, X., Vose, R. S., Applequist, S., and Arnfield, J.:

Enhancing the data coverage in the Integrated Global Radiosonde Archive,

J. Atmos. Ocean. Techn., 35, 1753-1770, https://doi.org/10.1175/JTECH-D-17-0223.1, 2018.

Response to SPECIFIC COMMENTS (4):

We reformulate the sentence to include this statement concerning the sparse coverage of radiosondes in the SH:

Line 255: "*The larger Aeolus impact in the SH during austral winter may be due to increased baroclinic activity and associated rapidly growing forecast errors, as well as the sparse coverage of observations, such as radiosondes, in this region (Durre et al., 2018)*"

TECHNICAL COMMENTS:

l.44: Wind -> wind

l.58: please resolve abbreviation DWL

l.367: more ful -> more skillful

l.427: data availability statement for Aeolus is missing

l.493: delete: "A journal of the atmospheric sciences, applied meteorology and physical oceanography"

Response to TECHNICAL COMMENTS:

All technical comments have been addressed. We also added following sentence to the Data availablity section: "*Aeolus HLOS wind data (Rayleigh and Mie) are available at https://aeolus.services.*"