

Reply to RC2:

Authors implement the direct reflectivity assimilation approach within MPAS-JEDI, introducing a multivariate BEC to represent cross-variable correlations between reflectivity and thermodynamic and hydrometeor variables, in a 3DEnVar framework. The study examines the added value of the multivariate BEC in direct reflectivity assimilation for heavy rainfall prediction in the deep tropics. The article is well written and covers many issues along the sections. The figures are well presented and the results are worth publishing. I recommend accepting the manuscript subject to minor revisions:

Reply: We appreciate the reviewer's positive feedbacks on our manuscript. We have carefully revised it following your comments and suggestions, as detailed below.

l. 370: Please revise this part of the sentence "...the analysis increments of in HybB all three variables exhibit structures..."

Reply: Thanks! We have revised it to "As expected, the analysis increments of all three variables in HybB exhibit a hybrid structure, combining the smooth patterns of StaB with some of the flow-dependent features of EnsB; their magnitudes generally lie between those of StaB and EnsB (Figs. 5c, f, i)".

l. 431: typo: there are 2 "and" (and a closer frequency bias)

Reply: Fixed.

Fig 9: Please include in the caption that the numbers inside each symbol indicates the forecast hour.

Reply: Thanks! We have updated the caption of Fig. 9 accordingly.

l. 459: typo: "an improvement"

Reply: Fixed.

Fig. 14: although the colors are consistent with previous figures, it is suggested to also include in this figure the legend indicating that orange is for HybB and lightblue is for EnsB

Reply: Thanks! We have included a legend in panel (f) of Fig. 14.