

# ***Interactive comment on “Assimilation of Himawari-8 Imager Radiance Data with the WRF-3DVAR system for the prediction of Typhoon Soulder” by Dongmei Xu et al.***

**Dongmei Xu et al.**

aqshu@nuist.edu.cn

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Reply to reviewer 1

General comments, This study implemented the assimilation of JMA himawari-8 AHI radiance with the framework of the mesoscale numerical model WRF and its three dimensional variational assimilation system (3DVAR) for the analysis and prediction of typhoon "Soudelor". The results are impressive in terms of the AHI radiance simulation and the forecast skill of the tropical cyclone for both the track and intensity. This action is meaningful, when geostationary meteorological satellite radiances provide valuable information of the weather systems with high spatial and temporal resolutions. How-

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ever, there are several issues to be fixed to better clarify the methodologies and results. Specific comments, 1) section 4.1 Please explain why there is some oscillation in the variation of the gradient with increasing iteration? \_\_\_\_\_

Reply: 3DVAR works by minimizing the cost function through iterations, which will not guarantee the decrease for the gradient for each step monotonously. The similar oscillation in the gradient can be also found in Wang and Liu (2019). Reference: Wang, S. and Z. Liu, 2019: A radar reflectivity operator with ice-phase hydrometeors for variational data assimilation (version 1.0) and its evaluation with real radar data, *Geosci. Model Dev.*, 12, 4031–4051.

2) This study assimilates clear-sky radiances. However, Figure 6 gives a very confusing picture. The data over the cloudy regions are presented in the observations. Radiances over the cloudy region are still calculated. Please provide the procedure for the verification results in Fig.6 with all the data shown as only clear-sky data are applied. \_\_\_\_\_

Reply: The simulation of the brightness temperature is conducted as one of the verification methods. More explanation is added as “It should be pointed that even only parts of the AHI radiance data are applied after quality control in the data assimilation, the radiative transfer model is able to simulate the brightness temperature for all the pixels with the background and the analysis respectively for the verification purpose. The similar verification method is also applied in Yang et al., (2016).” Reference: Yang, C., Liu, Z., Bresch, J., Rizvi, S. R. H, Huang, X.-Y., and Min, J. AMSR2 all-sky radiance assimilation and its impact on the analysis and forecast of Hurricane Sandy with a limited-area data assimilation system, *Tellus A: Dynamic Meteorology and Oceanography*, 68, 1, 2016.

3) Please point out the reason channel 10 yield smaller RMSE? \_\_\_\_\_

Reply: It is found from Fig. 8g that the simulated brightness temperature for assimilated pixels fit best with the observation compared to other two channels, which is likely related to strict cloud detection scheme for channel 10 with rather lower detecting peak. The authors have plotted the weighting function for the three water

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vapor channels. Thus, the manuscript is revised as “Among them the RMSE of channel 10 is smallest as 0.234 K in Fig. 8i, which is likely related to strict cloud detection scheme for channel 10 with rather lower detecting peak (Wang et al., 2018).”

Technical corrections 1) L35 use accurate instead of exact \_\_\_\_\_

Reply: Thanks for the helpful advice. Corrected at line 43

2) L39 together with the microphysics and .. \_\_\_\_\_ Reply: Thanks. Added.

3) L54 radiance data are .. \_\_\_\_\_ Reply: Thanks. Corrected.

4) L104 positive impact \_\_\_\_\_ Reply: Thanks for pointing it out. Corrected.

5) L106 Please reorganize the sentence “Wang, et al (2018). . .”and check this kind of problem thoroughly for the whole manuscript \_\_\_\_\_ Reply: Thanks for the helpful advice. The sentence is reorganized and the language is further edited by an English native speaker for the whole manuscript.

6) L112 previous researches \_\_\_\_\_ Reply: Corrected.

7) L147 This work focuses. . . Please check this problem for the whole manuscript \_\_\_\_\_ Reply: Corrected. We also improved these expressions with active words to an objective statement. Revisions can be found by tracks in detail.

8) L243 Please change the word rarefy \_\_\_\_\_ Reply: Thanks for the helpful advice. We use thin to replace rarefy at line 283, now the sentence is “20 km is chosen to make thinning of AHI radiance data”.

9) L261 Fig. 6a shows or provides. Please fix this problem for the whole manuscript \_\_\_\_\_ Reply: Thanks. corrected.

10) L262 of channel 8 \_\_\_\_\_ Reply: corrected.

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11) L332 after the bias correction. \_\_\_\_\_ Reply: Thanks. This expression is corrected as “before and after the bias correction”, see line 353.

12) L350 are also calculated \_\_\_\_\_ Reply: Thanks. This expression is corrected as “The RMSEs of the simulated brightness temperature by the NWP model before and after the assimilation are also calculated against the AHI radiance observations.” at line 370.

13) L427, this manuscript. . . \_\_\_\_\_ Reply: Thanks for the helpful advice. This expression is corrected as “In this study, the AHI radiance data assimilation is conducted under the clear sky condition.” at line 460.

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