Atmospheric Measurement Techniques Discussions

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Comment on amt-2022-2

Anonymous Referee #2

Referee comment on "Retrieval of ice water path from the Microwave Humidity Sounder (MWHS) aboard FengYun-3B (FY-3B) satellite polarimetric measurements based on a deep neural network" by Wenyu Wang et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-2-RC2, 2022

The paper develops the Neural Network for the FY/MWHS to retrieve global IWP parameters using the correlations between the CloudSat 2C-ICE IWP products and the MWHS BT measurements when collocations happen. Although the statistical NN method does not use any forward model calculations to involve physical radiative transfer processes, it provides a simple and quick way to obtain the global IWP coverage from the FY/MWHS observations. However, the entire methods including finding collocations, developing NN, and analyzing results have so many similarities to the paper in Holl et al., 2010; 2014, which raises concerns about the significance and novelty of this work. Further, major issues as summarized below exist in the developed methods. Due to these weaknesses, the manuscript is recommended to be rejected in the present form.

Section 2.2, lines 133-144
The procedure of finding collations is one of the key steps in the entire study, but the descriptions shown in lines 133-144 in Sect 2.2 are very vague. For example, the MWHS footprint size should change with the scanning angles since the instrument has a cross-track scanning mode. How accurate is it to always approximate the MWHS footprint using a constant circular pixel? How do you address the spatial response function inside each MWHS footprint? Also, when the MWHS scanning angle is too large, its field of view is likely to be different to that of the nadir-looking CPR even though the two sensors have similar geolocations, and readers might wonder how reprehensive the collations are in such situations. The sampling errors due to insufficient CPR pixels in each MWHS measurement are mentioned, but it is still not clear how significant the errors are and what the authors did to minimize the negative effects.

Section 2.2, figures 1-3
The random IWP cases in the collocation database essentially represent our prior knowledge about the ice cloud distribution. Considering that the topic of this paper is to address the global water path distribution, the collation database is expected to sample the global IWP coverage without biases. The results in fig.3, however, show that the latitudinal distribution of the dataset is highly ununiform. This suggests improper weights are given to the random database cases, and therefore systematic biases are

introduced during NN retrievals. How to make the collocation database cases to distribute according to our prior knowledge needs to be addressed.

Section 2.2, figures 4 and 5
The biggest problem of this study is the dramatic lack of validation and evaluation of the essential collocation database. Since there are so many error sources in collocating, adequate work on validating the dataset and evaluating the mismatch errors is necessary. The only results serving such purposes are given in figures 4 and 5, but the results are very confusing. The figures show that the BT observations spread over identical ranges no matter the ice clouds exist or not, at least in the way the authors show. How could you retrieve ice cloud parameters if the BT observations do not respond to the ice cloud change at all? Besides, I suspect that the collocation database should have many physically unreasonable cases due to various error sources, right? If so, the method to filter out the meaningless cases needs to be illustrated. Also, the effects of various error sources on the database and the retrieval accuracies need to be thoroughly analyzed. Overall, solid evidence must be provided to assure the critical collocation database is robust.

Section 4.2
Figures. 7 to 10 and table 2 show the statistics of the retrieval results using different inputs, and they are the primary results of this paper. However, the results become unpersuasive since the collocation database is not established, validated, and evaluated properly. Lines 270-273 give the estimations of the retrieval errors by combining the 2C-ICE product errors and the NN retrieval errors, but the errors from the collocation finding procedure are not considered. The testing dataset is obtained in the same way as the training dataset, which means the two datasets share the same inherent collocation errors. Besides, no descriptions and explanations of fig.10 are given, and more discussions should be added in the revision.

Section 4.3.1
Figures 11 to 14 show a case study to retrieve IWP of the typhoon Rammasun using MWHS measurements. Again, validations of the retrieval results are completely missing. The statements say that "the structure and the distribution of IWP are consistent with the characteristic of TB (line 324)" and therefore "the performance of the two neural networks appears to be good (line 328)", which are very crude. Besides, the atmospheric and cloud microphysical statistics in typhoon are likely to be very dissimilar to the globally averaged microphysics in the collocation database. Using a different training dataset with more accurate prior information should make the typhoon retrievals better. Also, the plots of BT measurements in figures 11 -13 occupy too much space. You should provide more analytical results instead of merely showing the instrument observations.

At last, there are many grammatical errors, and an English revision is necessary to improve the manuscript.