

### **Overview**

This paper investigates the possibility of using the TB observations from the Microwave Radiance Imager-Rainfall Measurement (MWRI-RM) onboard the Fenyung-3G (FY-3G) satellite to reconstruct the 3D reflectivity profiles. The algorithm is based on a deep learning approach and uses the Ku profiles observed by the Precipitation Measurement Radar (PMR) onboard FY-3G as reference truth. Three deep learning models are trained using different sets of predictors, and two case studies are analyzed.

### **General Comment**

The results presented in the paper are really interesting and pave the way for new research activities. However, some aspects related to the training phase of the algorithm, in particular the selection of the training and test datasets, are not clearly explained in the text. This step plays a very important role in the development of a deep learning based algorithm. Therefore, I think that a careful revision of this part of the paper is necessary before publication.

### **Specific Comment**

- 1) Section 2.1: I would like to suggest that this section be split into two subsections, one (L 99-103) relating to PMR characteristics, the other to MWRI-RM (L 104-114).
- 2) L.107: Here the authors correctly cite the paper where a table of MWRI-RM characteristics is reported. However, I would suggest that this table be added to the paper, as MWRI-RM is the instrument on which the paper is based.
- 3) Section 2.2: I think a summary table of the main characteristics of the dataset used in this paper (time period, number of samples, number of precipitating and non-precipitating samples, number of samples over sea and over land) would make the paper more readable.
- 4) L.152: It is not clear to me what the oversampling consists of. Are the same data duplicated in the dataset? I think the authors need to specify this and discuss the consequences of this choice. In particular, how can this operation affect the dataset, which is split into two sub-datasets for the training and test phases? Also, I suspect that the precipitating samples were duplicated, not the non-precipitating pixels.
- 5) L.155-156: I think the authors need to provide more information on how the "training" and "test" samples were selected. Is this separation based on a random process? Or by selecting observations from a defined time period? This selection plays a very important role in the development of machine learning approaches. If the two sub-datasets are created by randomly selecting the pair samples, the two sub-datasets may be highly correlated, so the statistical scores calculated over the test dataset may be not representative. In this case, the authors must recalculate the statistical indices on a test dataset independent of the training dataset - using time periods or orbits not used in training.
- 6) Section 2.3: Again, I would suggest that the authors add a table summarising the input datasets of the three experiments reported.
- 7) L.214-218: It is not clear to me how precipitating/non precipitating pixels are defined. Is it related to a reflectivity threshold? Is it the 12 dBZ threshold cited at L. 135?

- 8) Table 2 and Figure 5: I guess that the statistical scores and the mean profiles are calculated over the test dataset; however, this information is not clearly reported in the text. I would like to suggest that the authors specify which dataset the scores are calculated on. Again, the RMSE, STD, and MBE have been calculated only for the true positive (for precipitating samples) and for the true negative (for non-precipitating samples)? This information must be added to the text.
- 9) L.234-235 and Figure 5: how the melting layer height is determined?
- 10) L. 258-260: The reported period is outside the period of the development dataset. This makes the results more valid but must be stated in the text.
- 11) Figure 8: A general weakness of the paper is the lack of references to the brightness temperatures observed by the MWRI-RM, which are the input data to the deep learning algorithm. I understand that reporting TB maps can be difficult given the number of channels, but perhaps a TB map could be added to Figure 8 - or, for example, a 3D reconstruction using the TB observed - similar to those for the reflectivity levels in Figure 8 - by the oxygen absorption band channels.
- 12) L. 324-325 and Figure 9: Certainly, the comparison between the reconstructed reflectivities and the ground-based radar observations is a very good element that makes the analysis more valid. However, it is not clear to me on which element the statement "*The reconstructed precipitation reflectivity distributions based on MWRI-RM observations are consistent with actual ground-based radar observations*" is based. A more precise analysis is needed - e.g. some statement about the areas where precipitation is detected, or about the position of the reflectivity maxima, or something similar.

#### **Minor Comments**

- 1) L. 15: "Precipitation" instead of "precipitation"
- 2) Figure 5: I would like to suggest that the authors add the highlighted shading to the center and right panels as well (b, c, e, f).
- 3) Figure 6: I would suggest that the authors add the section line to the other center panels (b, e, h, k) and a dashed line corresponding to a height of 4 km to the right panels (c, f, i, l). I suggest adding labels to the x axes (latitude values?) of the right panels (c, f, i, l).
- 4) Figure 7: same as Figure 6.
- 5) L. 273-309, Figures 6 and 7: In general, I suggest adding lat/lon references to the description of the left and center panels - e. g., L. 282: *underestimated reflectivity values in the northwestern rainbands (26 °N, 130 °E) while overestimating those east of Khanun's center (23 °N, 133 °E)* - and height reference to the right panel description - e. g., L. 283 *The reconstructed melting layer structure was overly smooth (between 4 and 5 km)*. The addition of labels to the x axes of the right panels will make this analysis easier.
- 6) L. 298-324, Figure 8 and Figure 9: It would be useful to add a lat/lon reference linked to the name of the regions - e. g., L. 318: *over southern Beijing (-°N, - °E), central Hebei (-°N, - °E), and Tianji (-°N, - °E)* - or a label above the map.