## Referee #1

**Comment 1**

**Q:** Microwave profiles are obtained from what authors call “two methods”, that what it really means if the use of aneural network method for two different observations, zenith and off-zenith observations (with an elevation angle of 15◦).

**A:** “Two methods” in this manuscript is actually means “two observation methods”. We have replaced “methods” with “observations” in the manuscript for better understanding.

**Comment 2**

Q: However, I do not see any relevant result in this study that can be considered as an improvement of microwave technique under snow conditions or can help for a better understanding of the influence of snow on microwave measurements.

A: As well known, the measurement accuracy of microwave radiometer under precipitation condition is not good as that under non-precipitation, and currently there is no method that can completely eliminate the impact of precipitation especially for retrieval algorithm method. However, the off-zenith observation suggested by Radiometrics Corporation is proved to have positvie effect on reducing the impact of rainfall (Cimini et al., 2011; Ware et al., 2013; Xu et al., 2014). And this paper shows the snowfall also impacts the MWR measurement accuracy, but the impact of snowfall can partly reduce in the off-zenith observation. We added some discussion about the influence of snow on microwave measurements in the manuscript (Page 14, lines 6-21). As the snowfall cases are few, studies on how snow types and amount affect the measurement of MWR are not performed. This work can be carried out when we collect reasonal samples of snowfall.

**Comment 3**

Q: What the authors present as an improved method it is just the use of the neural network method for one observational angle (off-zenith, 15◦ elevation angle). At any moment there was something new in the method, as for example it could has been the consideration of snow properties (scattering, snow size distribution, etc.) in the microwave retrievals. So it cannot be considered as a new method or an improved method. It is well known that elevation scanning measurements increase the accuracy of retrieved microwave profiles (Crewell and Löhnert, IEEE 2007). So the fact that they use for these cond retrieval a different observational angle to the zenith is not new at all.

A: As mentioned above, there is no method that can completely eliminate the impact of precipitation/snow on MWR measurement accuracy especially for retrieval algorithm method by now. The off-zenith observation was suggested several years ago

and has positive effect on reducing the impact of precipitation. The purpose of this paper is to investigate the discrepancy of MWR retrievals under zenith and off-zenith observations, and check whether the off-zenith observation also has the positive effect in snowfall conditions as it plays in rainfall conditions.

Q: The only explanation that the authors give about why one retrieval (off-zenith retrieval)give better agreement with RSs than the other one (zenith retrieval) is that there is more ice or snow in the part of the window where the mirror point for the zenith observation,and that due to the shape of the window (inverted “U”) there is less snow for low elevation angles because the snow fall down more easily due to the gravity effect. From this explanation, I do not learn anything about how snow should be treated in microwave retrievals to improve the results. The only that I can learn is that I should clean the window. I miss in this study an evaluation of the effect of the snow on microwave measurements due to atmospheric emission.

A: The ice or snow on the radome has significant effect on the measurements of MWR, and cleaning the window when snowfall happens will be very useful to decrease the impact of snow or ice. However, in cases that there is no one in situ the MWR site all day under snowfall conditions, the off-zenith observation can be a better way to reducing the impact of snowfall on MWR measument accuracy. Although the off-zenith observation can not completely eliminate the impact of snowfall, the MWR retrievals in off-zenith observation are closer to the RAOB profiles than those in zenith observation especially when the snow/ice on the window is not cleaned in time. We added some discussion about the influence of snow on microwave measurements in the manuscript (Page 14, lines 6-21). As the snowfall cases are few, studies on how snow types and amount affect the measurement of MWR are not performed. This work can be carried out when we collect reasonable samples of snowfall.

Q: The authors assess the uncertainties of the microwave retrievals only for three snow events. If I understand correctly, they compare microwave profiles with three radiosondes. This is totally insufficient to obtain any significant result of the uncertainties of microwave retrievals under these conditions.

A: As few snowfall happens in Wuhan each year, only three snow events are used in this study, but there are eight temporal pairs of MWR and RAOB profiles (page 6, lines 21-22). According to the analysis in this study, the authors think the conclusions are reasonable. Of course, sufficient snowfall cases can benefit our better understanding on the impact of snowfall, such as snow types and amount, and we will carry out this work when enough snowfall cases available.

Q: The discussion about the two case studies is very speculative. The authors comparethe temperature, relative humidity and vapor density profiles for both microwave retrievals given as the best results the ones from the off-zenith methods

because it looks more reasonable. However, they should compare with independent measurements in order to confirm that what they consider reasonable is the real state of the atmosphere.

A: The results on Figs. 2-4 present that the MWR retrievals in off-zenith observation are closer to the RAOB profiles than those in zenith observation, which indicate the MWR retrievals in off-zenith observation is more reasonable. The case study shows the detail look on the MWR measurement discrepancy under zenith and off-zenith observations during the whole snowfall process, for confirming again that the MWR retrievals in off-zenith observation is more reasonable. In this section, we add the precipitation rate and type observed by a disdrometer in the same site (Fig. 5, page11, lines 12-21). This may be helpful for the discussion on snow cases study.