# amt-2022-85: Evaluation of the New York State Mesonet Profiler Network Data

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The paper examines data from 3 out of 17 NYSM Profiler Network stations and analyzes wind speed from the Doppler Lidar (DL), temperature and humidity profiles from the microware radiometer (MWR), and AOD from AODeSIR. Data from the DL and MWR are evaluated against radiosondes soundings and the usefulness for prediction of severe weather events evaluated. AOD at 2 sites is evaluated against data from the Aerosol Robotic Network.

The paper is interesting, and it presents a good overview of the Network data and capabilities. I do have some general major comments on the results and related discussion. All my comments are related to the MWR evaluation that in my opinion is the most problematic part.

**Major general comments**

The purpose of the paper as stated by the authors is "*to determine the robustness and accuracies of the instruments deployed with respect to well-defined measurements*" in view of their extensive use to "*complement radiosondes and satellite systems*". The purpose of the paper is therefore very relevant considering the need for such measurements.

With this perspective in mind, I feel that the conclusions that: "*Overall, the MWR is a robust and reliable tool for the continuous measurement of atmospheric data and derived forecasting parameters*" is not supported by the data presented. The MWR data in the paper unfortunately present a bleak outlook for those of us hoping to use microwave radiometers for temperature and humidity monitoring. In fact, the results seem to suggest that, unless radiosondes are available at the site (to help with corrections or debiasing) the RMS errors shown in this paper (Figs. 6 and 10) ranging between 2K and 8K are well beyond what is required for any purpose.

Therefore, the most important questions the authors should address in my opinion are the following:

1. Are these results due to poor calibration of the instruments and to poor retrievals? Are these issues resolvable?

2. What are the accuracy requirements we need to strive for in a ground-based network and how far are the Mesonet radiometers from these requirements? For example, in Table 1 of Wulfmeyer et al. (DOI: 10.1002/2014RG000476) a bias < 0.5 K with noise error of < 1K are reported as desirable for temperature profiling. I understand that microwave radiometers can't achieve that, but what are the accuracy requirements for the Mesonet network?

3. What are the implications of this analysis for the network itself? It seems to me that with those uncertainties only radiometers co-located with radiosondes can be reasonably used. How about the remaining 14 radiometers for which there are no radiosondes available?

This question brings the following consideration: what is the expected uncertainty in the forecast capability at a site where there are no radiosondes for correction? To this end, in my opinion, the paper would be more informative if the radiosondes were used only for evaluation purpose and the analysis was carried out entirely without the correction part. Table 5 and the whole case study (i.e. sections 4.6 and 4.7) should contain the results from the uncorrected MWR profiles. This would give us an idea of what can be reasonably expected from a profiler at a site without radiosondes.

**Major specific comments:**

1. Throughout the paper the MWR retrievals are called "measurements". Please change this. Some specific examples are reported later.

2. **Section 4.4** This section is a little bit puzzling, and I am not sure I understand it. I understand that, because the radiometer is pointing at 20-degree elevation, you may have a better chance of having less measurement degradation during rain. However, why should the radiometer do so much better during cloudy conditions than during clear sky? Or during rain than during cloudy? I assume that, if the effect of rain deposition is eliminated, the radiometer shouldn't distinguish between rainy and cloudy. To me the results could be easily explained by compensating measurement biases during precipitation, I am not sure this section should be kept at all as it is difficult to interpret.

3. **Section 4.4** How do you know what are the conditions off-zenith? The IRT is looking at zenith so how do you know whether off-zenith, where the radiometer is pointing, is cloudy or clear? Perhaps there are clouds over the radiometer and not off zenith, or the other way around. In my opinion this entire section 4.4 should be eliminated.

4. **Section 4.5** This section should be eliminated. Of course, it comes without saying, that if we do have radiosondes at the site and we correct the radiometer based on the radiosondes we get good results, we already know this. But this defeats the entire purpose of having a network of radiometers. As mentioned in my general comments, I think the manuscript would be much more valuable if the authors used the radiosondes only for evaluation and not for correction. With the correction in place the conclusion of the analysis should be that the MWR are a good "*complement*" to radiosondes and should be deployed at radiosondes sites to increase the temporal coverage but have no value at sites where there are no radiosondes.

**Minor comments:**

1. Page 6 L138 Please change vertical resolution to vertical grid
2. Page 9 Line 209 Please change MWR measurements with MWR retrievals

3. Page 9 Line 225 and following. It is important to understand that MWR measurements have no *vertically resolved information* above roughly 2 km. It will be enough to keep the MWR comparison between 0 and 3 km as well.
4. Page 10 line 230: “directly measured” please change to *retrieved* as you are comparing retrievals of temperature and humidity from the MWR with those measured by radiosondes.
5. Page 15 section 4.3: The high biases and RMSE of the MWR retrievals are obviously concerning and are probably due to poor calibration of the instruments combined to an inadequacy of the neural network retrievals. Both aspects can be improved operationally to lower the RMSE to less than 1.5 K between 0 and 3 km. Is the mesonet network planning to do that?
6. Line 363-406. The discussion of the vapor density profiles would be more informative if the author could provide the range of vapor density at the sites. This would give the reader an idea of the error percentage on the profiles (for example an RMSE of 1 $g/m^3$ would be about 10% if the average vapor density at the site is 10 $g/m^3$).

**Conclusions**

In conclusion, I think the information presented in the paper is valuable, however it would be more valuable if the authors could provide the reader with a true assessment of the value of the entire MWR network for forecast purpose. To this end the authors should not be afraid of presenting less than perfect results if that is what the MWR network is providing. Such information would be extremely valuable for those planning to deploy such networks where radiosondes are not available.
In order to evaluate the true capability of a network of radiometers for forecasting purposes the authors should use radiosondes only for evaluation and not for correction. After the uncertainties in the forecast parameters have been established (with the help of radiosondes) data from sites without radiosondes should be used to forecast events and to establish realistic uncertainties. If the results are not satisfactory the authors should discuss how the poor radiometric performance can be improved without help from radiosondes, i.e. by reviewing the calibration procedures and improving the retrievals.