Review of Evaluation of the New York State Mesonet Profiler Network Data

By Shrestha, Brotzge, and Wang (AMT-2022-85)

General:

This study presents an evaluation of part of the New York State Mesonet, with several stations providing microwave radiometer profiles of thermodynamic quantities and profiles of winds from a Doppler lidar. Multiple years of data are considered, and three sites located near radiosonde launch sites are evaluated by comparison to those soundings. Errors in thermodynamic quantities are large (and differ between clear-sky, cloudy, and precipitation conditions), and to resolve these errors a linear regression method is developed and applied to the MWR data. A brief case study is presented, that of a thunderstorm that would not have been characterized with the radiosonde network. Finally, some profile-related thermodynamic parameters are derived from the MWR and evaluated, but an opportunity was missed to evaluate important stability-related metrics like the Richardson number that would be available from conventional radiosonde datasets.

A manuscript like this, presenting a new, publicly available dataset, could be of interest to the AMT readership. The main novelty is the correction applied to the MWR, but insufficient detail on that correction is provided for a reader to understand the steps involved or how to implement a similar correction on a different dataset. I would recommend that the authors present this correction in more detail, and that the section on derived parameters be expanded to include the Richardson number and perhaps the boundary-layer height as well. The figures should be improved as discussed in my comments below.

Major:

1. The section on the "Correction to MWR biases" requires more detail. As lines 464-6 are written, it is not clear if the correction is derived separately for cloudy, clear, and precipitation days. Not enough information is given for a reader to attempt to replicate this correction. Are the profiles in Figure 11 taken from the 25% of the dataset used for testing, or from the 75% training? (I would presume the "testing" portion, but it is never explicitly stated.) Is this correction something that could be applied to other datasets in other locations? If so, what steps should a researcher take?

   Response: The correction is derived separately for precipitation, cloudy and clear sky days for both temperature and water vapor density. Profiles in Fig. 11 are only from the testing dataset (25% of total dataset for each weather conditions). The paragraph (line 475 – 486) is revised for better clarity.

   Our results have shown that limited clear sky days radiosonde data are found to be helpful to reduce biases in MWR retrievals. Therefore, the NYSM is planning to launch several radiosondes to bias correct remaining 14 MWRs in summer of 2022. As a long-term plan, one dimensional variational (1-DVAR) technique (Cimini et al., 2011) is under consideration and will be implemented in near future.

2. Some profile-related thermodynamic parameters are derived from the MWR profiles and briefly evaluated in section 4.6. Because both winds and thermodynamics are available from the RS, why not combine the MWR and the DL datasets to calculate stability metrics like the bulk Richardson number (Ri)? That would be a very useful test of the utility of the network. An important opportunity was missed here. The Ri could have been incorporated into the discussion of the thunderstorm case study as well. Similarly, the planetary boundary layer (PBL) height is easily calculated from the DL dataset, and that could have been compared to sounding-based estimates as well. Or, if the radiosonde dataset is not adequate for calculating the PBL height, pointing out the utility of the new mesonet capabilities could be a nice addition to the paper.

   Response: The single value bulk Richardson number used in convective storm forecasting that depends on CAPE and deep layer wind shear, 0 – 6 km AGL, (Weisman and Klemp, 1986; Evenson, 1993, https://glossary.ametsoc.org/wiki/Bulk_richardson_number) is not possible to derive due to lack of DL wind measurements at 6 km.

   It is possible to derive vertical profile of Ri (Sorenson et al. 1998) and PBL height; however, as the RS launch times (7 am and 7 pm LT) are not optimal times for the DL data availability, those two parameters are not included in this study. However, the authors plan to derive and compare those two parameters when we launch our own radiosondes (during the afternoon) to bias correct the remaining 14 MWRs. The PBL height using Ri and other DL methodologies will be extensively discussed in our next paper. The utility of the NYSM Profiler Network to derive those parameters is briefly mentioned in this manuscript (line 530-531)

Minor:

1. Line 133: can you comment on how often the lidar can actually retrieve wind estimates from 7000m? We see later that almost no data is available above 3km, so that should be noted here.

   Response: The DL data availability is very limited and rarely available above 3 km. There are occasional data availability above 3 km when long range transported wildfire smoke is detected in the region during the summer months. This information is added in line 133-135.

2. Figure 2 would be more intuitive with height on the y-axis. The colors are difficult to distinguish (especially for red-green colorblind readers) so please consider using different line styles.

   Response: Done. Fig. 2 is revised with different colors and height on the y-axis.

3. Lines 200-205: how sensitive is the agreement between the radiosondes and the doppler lidar to the averaging time selected?

Response: Using ±10 min (20 minutes averaging) and ±30 min (60 minutes averaging) centered at the radiosonde launch time produced slightly better DL/MWR comparison results (R^2 increased by 1-2%) than using only +10 minutes and +30 minutes starting from the launch time.

4. Near line 210: please explicitly state which RS sites were used to train the neural nets for each of the MWR sites

   Response: The RS sites used to train the neural network for three selected MWR sites are listed in line 210-212. The list of NWS RS sites used to train neural networks for all 17 MWR sites are as follows:

NYSM Site	NWS RS #1	NWS RS #2
Albany	Albany	
Belleville	Albany	Buffalo
Bronx	Upton	
Buffalo	Buffalo	
Chazy	Albany	
Clymer	Buffalo	Pittsburgh
East Hampton	Upton	
Jordan	Albany	Buffalo
Owego	Albany	Munich (Germany)
Queens	Upton	
Red Hook	Albany	
Staten Island	Upton	
Stony Brook	Upton	
Suffern	Albany	
Tupper Lake	Albany	Munich (Germany)
Wantagh	Upton	

5. Line 252: better to provide a textbook reference than a link that disappear over time.

   Response: Paper references added in addition to web link (line 249-251).

6. Fig 3, 6: again, please don't rely on red-green differences. Use colors that are more easily distinguishable or also use line style differences

   Response: All those figures are revised accordingly.

7. Why doesn't Fig 4 also include Stony Brook?

   Response: DL data from Stony Brook was not available for same date and time as for other two sites. Stony Brook DL data from different date is added in Fig. 4.

8. Line 347: explicitly point out the elevated inversion layer near 1 km in Fig7a, near 2.5km in Fig7b, etc.

   Response: The heights corresponding to the elevated inversion layers are added in line 347-348)

9. Line 459-460: write these statements out explicitly instead of using the confusing parenthetical formulation.

   Response: Done (line 469-470)

10. Figure 12 relies on the rainbow color table although extensive literature is available showing that it is suboptimal (Light and Bartlein, 2004; Stoelzle and Stein, 2021)

    Response: Thank you very much for the suggestion! We have made extra efforts to test different color schemes and replaced rainbow color map with plasma as suggested by Stoelzle and Stein, 2021.

References

Light, A. and Bartlein, P. J.: The end of the rainbow? Color schemes for improved data graphics, Eos Trans. AGU, 85, 385–391, https://doi.org/10.1029/2004EO400002, 2004.

Stoelzle, M. and Stein, L.: Rainbow color map distorts and misleads research in hydrology – guidance for better visualizations and science communication, Hydrology and Earth Systems Sciences, 25, 4549–4565, https://doi.org/10.5194/hess-25-4549-2021, 2021.

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