Authors response to AMT 2022-906 Anonymous Referee #1 Report

We would like to thank the referee for taking time to review our manuscript. We greatly appreciate your insights and suggestions and have taken them into consideration in revising our work. The referee comments/suggestions are in black, and our responses are in red; the listed line numbers refer to the lines of the original manuscript where the new corrections are observed.

This work by Karle et al. (Systematic analysis of virga and its impact on surface particulate matter observations) presented some very interesting results regarding the viga precipitation, which is rarely studied. I only have some minor comments before the work can be accepted.

General comments:

1. I did not quite understand the large picture between virga precipitation and aerosol. In the abstract and in the case studies, it is stated that "We observed that during some of the columnar virga events, surface PM levels displayed a sudden upward trend indicating aerosol loading in the surface layer after precipitation evaporation." Should it be the opposite? That is, during the precipitation virga process, PM level should be downward. That is, most of these PM are used as rain drop nuclei. Maybe I missed your point. Please explain.

This is an excellent point raised by the reviewer and we would like to provide the following clarification.

As part of a larger picture between the virga events and aerosols we are underlining the occurrence of dry microbursts that are usually associated with virga precipitation. (Fujita, 1981; Wakimoto, 1985) define dry microburst as convectively driven small downdrafts of less than 4 km in outflow diameter accompanied by little or no rain between the beginning and end of the intense wind gusts for a short period. The dry microbursts are frequently associated with virga precipitation.

The ceilometer not only successfully detected the virga precipitation, but it also observed the aerosol loading in the surface layer. Since we observed a substantial increase in the surface measured maximum wind gusts during the virga event, we attributed these horizontal winds to dry microburst. Based on these observations we conclude that the sudden increase in the surface PM level (lasting for only couple of hours) was due to wind gusts associated with dry microburst. We also observe that with the gradual increase in humidity levels, the PM levels eventually drop, since these PM would serve as the raindrop nuclei as rightly pointed out by the referee. More detailed explanation of the columnar case can be found in our response to referee #2 (https://doi.org/10.5194/egusphere-2022-906-AC1).

Fujita, T. T. (1981). Tornadoes and Downbursts in the Context of Generalized Planetary Scales, Journal of Atmospheric Sciences, 38(8), 1511-1534.

https://journals.ametsoc.org/view/journals/atsc/38/8/1520-0469_1981_038_1511_taditc_2_0_co_2.xml
Wakimoto, R. M. (1985). Forecasting Dry Microburst Activity over the High Plains, Monthly Weather Review, 113(7), 1131-1143.
https://journals.ametsoc.org/view/journals/mwre/113/7/1520-0493_1985_113_1131_fdmaot_2_0_co_2.xml

1. In your Table 1, the wind speed and PM, wind speed and DeltaT have very week correlation. Do you think this is an observation issue (that is, your observation does not have finer temporal resolution)? Please explain.

Another good observation from the referee. We agree that there is a week correlation between the PM and winds based on the ground measurements. It is also true that a finer temporal resolution of the ground measurements will be able to capture the fluctuations in the wind speeds and maximum wind gusts associated especially with dry microburst. However, finer resolution data was not available to us and hence we decided to use one-hour data which is readily available in the public domain for calculations as shown in Table 1.

Minor comments:

Fig. 7 and Fig.5, The legend for the "backscatter intensity", I think the unit is "Z"? Can you please change it to dBZ (like in Fig. 2)

The Figures 7 and 5 are revised by adding legend "dBZ" for the "backscatter intensity" .

For the sounding profile (e.g., Fig. 6b), please add a legend for different color curves.

All the soundings in the manuscript are revised in response to referee #2 comments (https://doi.org/10.5194/egusphere-2022-906-AC1).

We hope that these revisions address your concerns and fully demonstrate the significance and originality of our research.
Thank you again for your review, and we look forward to the opportunity to resubmit our manuscript for your consideration.