General

The paper is fluently written and contains a lot of interesting results. The data quality is excellent. However, the manuscript makes an impression of a measurement report or an extended summary without a clear goal, research topic, or message.

There are so many results presented in this manuscript, but the big picture, the context, the links between meteorological conditions, dust background, sea breeze impact and anthropogenic pollution is not really obvious from all this. See the Details part for more comments.

It would be desirable to have a map of the region, and a trajectory analysis showing the main air mass transport clusters, and, finally, retrievals of the Polly lidar so that we obtain an idea about the impact of dust and non-dust (mainly pollution) aerosol components on all the in situ measurements. In this way, we would get a more complete view on the environmental and atmospheric conditions in that region of the world and even a rather modern (state-of-the-art) paper based on combined in situ surface observation and profiling observations with Polly and Halo Doppler lidars.

I have the feeling that is not so much work, therefore minor revisions are required

Details

P3, l81: It is stated: The Polly lidar was placed next to the container! That brings me to the question, why did you not use the backscatter and depolarization ratio profiles measured with this polarization Raman lidar? These profiles allow the separation of dust and non-dust backscatter profiles and the estimation of dust and pollution-related CCN contributions (as shown by Haarig et al., 2019, see Sect. 5.2, Figs. 7 and 8). These lidar profile data would be complementary to the high-quality ground-based in situ observations but one would be better able to quantify the contributions of dust and pollution to the detailed in situ observations. Such an approach would be a nice step forward in the field of environmental monitoring.

Haarig, M., et al., ACP, 19, https://doi.org/10.5194/acp-19-13773-2019, 2019.

P3, l83-90: This interesting paragraph on the meteorological conditions should be presented as the first subsection of Sect.3 (Observations).

P8, l233: It would be desirable to have a map with the experimental field site, oil refinieries, etc. big cities, countries. In this context, it would be desirable as well to have some typical backward trajectories, or even better, some kind of main trajectory clusters for the UAE region, for arrival heights of 500m, 1000m, 1500m. It would be interesting to see the typical wind field pattern over the day (sea breeze effects). The Halo Doppler lidar monitors such dynamical features day by day.

In the sections 3.1 and 3.1.1, many numbers are given in the text, but not as figures. It is thus not easy to handle all this information and to identify the key numbers. More visualization of results would be nice.

Sect. 3.1.2 Daily and annual variations: The question came up: Are all the findings dominated by anthropogenic pollution? What is the role or contribution of the background aerosol (dust, marine)? Again, many numbers are presented without having figures.

Sect.3.2 Halo Doppler lidar observations come into play. But then, an overview about dust and pollution layering from the Polly observations would be desirable as well. Such an overview is clearly missing. What shall we learn from Doppler lidar observations when we still have no idea about the pollution-dust mixing state as a function of height (PBL, free troposphere). By integrating Polly retrievals on dust and non-dust CCN concentrations (or other parameters) one would get a much better, more complete overview of the aerosol conditions in the UAE greater area.

P11, l339-340: As an example, you write: The reason why the activation fraction is higher…. is probably due to entrainment of the residual layer above back into the nocturnal boundary layer… But what is the aerosol in the residual layer and in the boundary layer? Only dust, a mixture of dust and pollution, or only pollution? The Polly lidar can support and help to clarify.

At the end of Sect. 3.2.1 I asked myself, what do we learn from all this. All the observations are just presented in form of a measurement report. Many data, a lot of reporting, the specific goal remains unclear.

Sect. 3.2.3 What about differences in NPF, winter vs summer?

Sect 3.3 Case studies, again a map would be helpful, trajectory clusters would be nice, Polly dust and non dust fractions …

Just to mention my main impression again: the big picture is missing based on the excellent in situ aerosol observations, Polly and Doppler lidar profile observations, trajectories, and if available, even AERONET optical and retrieved microphysical properties.

Table 2: What is the dust CCN contribution? What is the pollution CCN contribution?

Figure 4: Again, what is the dust fraction? What is the pollution fraction?

Figures 6 and 7: no seasonal differences?

Figure 8: What do we learn? Besides the impact of PBL height.

Figure 10: Without a map, typical windfields, trajectory cluster information, such a figure appears to be useless!

Figure 10f, what does the Polly lidar show?