General Comments

This paper analyzes aircraft observations of aerosols collected along the coast of South West Africa during the DACCIWA field campaign in June-July 2016. The authors go on to speciate the observed aerosol types and identify the likely aerosol emission sources and atmospheric dynamics that led to their transport and eventual spatial distribution recorded during the case study. The paper is well-written, well within the scope of ACP, and it is refreshing to see an observational study from this region, which has historically been observationally-sparse, making it a new addition to the scientific literature. Overall, it is easy to follow the narrative and methodology of the paper, although there are a few places that may need clarification or further explanation, which are mentioned below.

It would be nice to see a description on why this day of the field campaign was chosen for analysis. It seems like there is two months' worth of data from this project, so what makes 02-July-2016 so unique that it warrants its own paper, and how representative is it of typical flow patterns for this regime in the region? The primary concerns raised in the specific comments section regard aerosol aging and water uptake in humid environments, and timing of tracer release and the interpretation of maximum aerosol extent in the model.

It is recommended that the manuscript be published in ACP after the specific and technical comments are addressed in the paper.

Specific Comments

Page 2 - Lines 32-34) States that the lower troposphere aerosol loading includes emissions from Lagos, but later in the paper the tracer experiment shows that the aerosol plumes over the ocean do not have a signal from Lagos. Is this a reference to Lagos being an aerosol source in the SWA region, instead of the over the limited ocean aircraft data from this case study?

Page 4 - Lines 81-84) Is the purpose of DACCIWA / this paper to understand how atmospheric dynamics influences aerosol emission rates (e.g. stronger surface winds will loft more dust), or only aerosol transport after emission, or both?

Page 7 - Lines 161-163) Even though the optical properties could not be retrieved with the ULICE lidar inversion procedures, they were retrieved using other instrumentation, correct? If not, what was excluded?

Pages 7-8 - Lines 178-186) Can sea salt be identified with this method?

Pages 7-8 - Lines 178-186) What happens when there is a mixture of aerosol species instead of homogeneous plumes? Looking at Figure 10-b, the CALIOP data suggests a heterogeneous aerosol air mass during this case study event (e.g. dust mixing with smoke).

Pages 7-8 - Lines 178-186) Because the aircraft measurements were taken over the ocean, the particles reside in a relatively humid atmosphere. Depending on the aerosol species and the humidity of the environment, particles can take up water, changing their diameter and their optical properties. Does this affect VDR values or any metric by which the aerosol species were partitioned? Would it change the analysis in later sections at all, especially pertaining to attribution of fresh versus aged plumes?

Page 8 – Lines 181-182) What about urban O3? Will that mislead the speciation between smoke and pollution?

Page 8 – Line 202) It is stated that "data were processed with a time resolution of 1 s" – is this for all data or just the CAPS-Mex data? Was there some standard time resolution used for interpolation across instrumentations to line up the time resolutions? If so, what interpolation technique was used?

Page 13 – Lines 322-324) Is this one-way or two-way nesting in WRF?

Page 13 – Lines 326-327) More description of the WRF setup and physics options is necessary, especially the PBL parameterization, since the WRF PBL height is used later on in the paper. Furthermore, the WRF parameterizations used generally get a reference citation. Does the statement that the model configuration is the same as in Deroubaix et al. 2018 mean that every physics option / parameterization is identical to their setup? What about time steps, output intervals, and nudging? The Deroubaix et al., 2018 simulation was for a similar region in SWA, but the grid spacing was coarser, the simulation was run for a much longer duration to study short-term climate phenomena, and they ran with active chemistry instead of tracers. Stating that the setup is the same as in Deroubaix et al. 2018 may be confusing when these differences are considered.

Page 14 – Lines 344-346) Is there any observational evidence or prior literature that supports scaling urban emissions by population in this way? For example, why couldn't an efficient metropolis have 5x the population as a baseline city, but only 2x the pollution? Does the linear scaling of population and pollution break down at some point for this region or other regions?

Page 14 – Lines 347-349) The naming of the simulations is a bit counterintuitive. Instinctively, I'd think that TRA_D1 would represent July 1st and TRA_D2 as July 2nd. However, TRA_D2 is July 1st and TRA_D3 is July 2nd. By the time these simulations were discussed 13 pages later, the numbering became confusing. Perhaps numbering related to the dates would help readers later on (e.g. TRA_D12 = July 1st-2nd, TRA_D1= July 1st only, TRA_D2 = July 2nd only).

Page 14 – Lines 353-355) What does it mean that the lifetime of the tracers is designed to be 48 hours? Why set the concentration to zero if they are still present in the domain after 48 hours? Is it because the tracers do not undergo gravitational settling? Would including the gravitational settling process change the interpretation in later sections?

Page 15 – Line 365) Why are the tracers released at 2500 m ASL?

Page 18 – Lines 462-465) Maybe the placement of the 'A' on Figure 3 is misleading. To me, it looks like the 'A' is pointing to shallow clouds and not an aerosol layer.

Page 20 – Line 503) Is there an explanation for why there is a reduction in O3 concentrations compared to background levels for Plume A?

Page 20 – Line 506) What is the significance of the O3 to CO ratio? Why does the value of 0.15 imply the plume is fresh versus a value of 0.25 implies that it is aged?

Page 23 – Lines 592-593) This is regarding the statement that the emissions come only from July 1st. Figure 4 shows the wind speeds above 500 m to be weak (1-2 m/s), so the emissions on July 2nd haven't had a chance to be advected far from their source regions in the weak winds. It makes sense then that

the emissions must be from July 1st, or an earlier date. Is it possible that due to the low wind speeds above the PBL that what we are seeing isn't just from July 1st, but also June 30th? Would the picture change if the tracers were released starting on June 30th?

Page 26 – Lines 671-675) Do you think the maximum extent that the plume reaches over the ocean in the model is related to the tracer lifetime and the end time of the simulation? If the simulation was run for longer, would the maximum tracer extent over ocean increase? This goes back to the previous comment about releasing tracers on June 30th. If the tracers have no settling velocity or cannot be scavenged by precipitation, they could be advected indefinitely in the model.

Page 30 – Lines 751-752) Why is the correlation here related to terrain? I'm not sure I see the connection between skin temperature, vertical velocity, and terrain.

Page 35 – Lines 897-905) Was the flight over the Mediterranean an aerosol-free environment for calibration? If not, how might that affect the accuracy or uncertainty in the retrievals?

Page 47 – Table 1) Not every entry has a time resolution associated with it. Also, if uncertainty estimates are available they should be listed here.

Page 65 – Figures a,b) From CALIOP we have aerosol speciation, as well as horizontal and vertical location, and from MODIS we have some idea of the concentration. What new information did the aircraft observations and tracer experiments provide the community that we did not already have with the MODIS AOD and CALIOP data?

Page 2 Sup. Mat. – Lines 31-32) What is meant by variability across WRF grid boxes? Is this a standard deviation?

Page 2 Sup. Mat.) Was there moisture information available from the radiosondes or flight instruments? If so, how well did WRF do compared to the observations in terms of moisture? This also goes back to the point raised for Pg. 7-8 on how humid the environment was for this case study and how that might affect the retrievals.

Page 3 Sup. Mat.) Is this following the trajectory of the balloon and matching it to the WRF grid boxes, or assuming it is constant in horizontal model space at the release site lat/lon at the surface?

Technical Comments

Page 18 – Line 452) The word 'Possibly' should be lowercase

Page 18 – Line 457) Should this be Figure 5c and 5e instead of 4c and 4e?

Page 21 – Line 524) Missing word 'of' between 'mixture long-lived'

Page 23 – Line 581) Magenta line

Page 32 – Line 803) The WRF / CHIMERE models

Page 35 – Line 886) Subscript 'a' on beta instead of 'p'

Page 61 – Line 1205) Magenta line

Page 69 – Figure 12-c) Green and blue reference lines for land / ocean missing

Page 3 Sup. Mat. – Line 38) Missing UTC from 1700 and 1612

Page 4 Sup. Mat.) Missing a reference arrow for wind speeds