Reply to the Gregory Schuster (referee #1) review on **Comparison of diurnal aerosol products retrieved from combinations of micro-pulse lidar and sun-photometer over KAUST observation site" by Lopatin et al.**

Authors would like to express our gratitude for the time and effort reviewers had dedicated to reviewing the article. We believe that the suggestions made have significantly helped us to improve the quality of the manuscript

Below we provide detailed answers to the specific comments of the reviewers:

Thus, I would like to suggest that the authors replace some of the scatterplots with boxplots (or mean & standard error plots), and re-tool the analysis towards a student's T-test or similar. For instance, it would be rather easy to turn Figures 3&4 into a single figure with 7 notched box-and-whisker plots (one box each for MPL_LR, S1_LR, S2_LR, MPL_LR(AOD>0.2), S1_LR(AOD>0.2), S2_LR(AOD>0.2), and AERONET_LR. Each box is essentially a mini-histogram, so you'll have a nice visual of 7 histograms right next to one another for easy comparison (or add Fig 11 to obtain 10 boxplots). Do the notches overlap, indicating statistical agreement? Or do the medians have large separations? Are all of the boxes about the same size (indicating similar spreads), or are some larger than others? I think that this would be a much more enjoyable and useful way to look at the data than scatter plots that are nearly spherical. This is not a requirement, but I think that you'll retain more reader interest if you make this change.

Answer: Authors are very greatful for such a suggestion, which certainly greatly improves the transparency of LR analysis. Figures 3 and 4 were replaced with one boxplot for the daytime comparison (both including filtering by AOD 0.2 and omiting one). Former Figure 11 (new Figure 10) also replaced with a boxplot, summarizing the nightitme retrievals. Discussions corresponding to figures and their analysiswere were re-done as suggested.

The authors do a nice job of showing day/night and seasonal variations of the complex refractive index in Fig 16, but why not do the same thing with lidar ratio? Some of their LR discussion already suggested that seasonal variation in the sea salt / dust partitioning was causing differences in the lidar ratio (e.g., line 389), so why not partition the data in that way? That would strengthen your hypothesis. One could even repeat the boxplots that I describe above for different seasons to see if the boxes actually do move up in the dust season and down when marine aerosols have a stronger presence.

Answer: Analysis of seasonal LR added in Fig. 15, discussion of seasonal variability of LR added into section 6 alogside with aerosol composition.

I am not a big fan of the Scenario 1 & Scenario 2 nomenclature, as it replaces something that has meaning (excluding and including volume depolarization ratio) with something else. At least consider labeling such as Scenario E and Scenario I, as that would be easier for the reader to track.

Answer: Nomenclature "Scenario 1" and "Scenario 2" were introduced in the related studies by Lopatin et al., 2021 which describe both methods, authors would prefer to keep them for better cross article treaceability. Clarifications were provided in the text:
Lines 222–224: "Table 1 summarizes instruments configurations of measurement times used for combined MPLNET AERONET retrievals using GRASP. The details of MPLNET data preparation and combined retrievals could be found in (Lopatin et al., 2021)."

I don't believe that I have ever seen steradians abbreviated as Sr... I've always seen sr.

Answer: Sr replaced with sr throughout the text.

Line 159: This is a 2nd description of the KAUST site, similar to the paragraph on line 136. There is good info in both of these paragraphs, so they should be merged and located at the beginning of Section 2 (currently line 136).

Answer: description of KAUST site was moved as suggested and updated.
Lines 137–146: "The KAUST campus is situated in Thuwal on the eastern coast of the Red Sea, in the western Arabian Peninsula (22.3∘ N, 39.1∘ E). The region experiences local dust storms that arise from the surrounding inland deserts (e.g., see, Kalenderski and Stenchikov, 2016), as well as distant dust from northeastern Africa through the Tokar Gap (Parajuli et al., 2020). Consequently, there is a year-round presence of desert dust in the atmosphere over the site. KAUST is unique lidar site on the Red Sea coast, and its co-location with the AERONET station allows for a more accurate retrieval of the vertical profile of aerosols (Welton et al., 2000; Parajuli et al., 2020; Lopatin et al., 2021). Additionally, KAUST has a meteorological station that performs measurements of air temperature, humidity, wind speed, and incoming short-wave and long-wave radiative fluxes. Stations that measure various parameters of interest for dust-related research, such as dust deposition rate, vertical profile, near-surface concentration, and spectral optical depth, are particularly rare across the global dust belt. The collection of these co-located data provides unique opportunity to obtain a more comprehensive understanding of dust emissions and transport in the region.
A Micro-Pulse Lidar has been in operation at KAUST site since 2014, being a part of the Micro-Pulse Lidar Network (Welton et al., 2001, 2018)."

Line 166: Passive tense is ambiguous here and in several places in the upcoming paragraphs. Here, the data 'was processed' using GRASP software. WHO processed the data? Consider "we processed almost three consecutive years of data... "

Answer: passive voice eliminated as suggested:
Line 166: "We have processed almost three consecutive years of data starting from"

Line 181: diluted?... or dissolved?

Answer: "diluted" replaced with more appropriate "dissolved".

Line 205: copped?... do you mean capped?

Answer: a typo corrected in "**cropped**"

Line 260: "...allowing the lidar signal to influence the photometric observations and vice versa".Do you mean 'calculations' or 'computations' instead of 'observations'?...The lidar signal won't influence the photometric observations unless you point the MPLNET at the AERONET.

Answer: passage re-phrased "...allowing the lidar signal to influence the photometric **retrievals** and vice versa."

Line 323: I am pretty sure that you do not mean "...nighttime liar retrievals."

Answer: typo in "lidar" corrected

Line 407: I don't consider Angstrom Exponent as an 'advanced aerosol product' (at least for AERONET).

Answer: passage re-phrased to "...**derived** aerosol products, such as Angström exponent ad SSA"

Line 412: Authors discuss potential issues associated with signal attenuation, but shouldn't that be easy to test?... just filter our high AOD cases.

Answer: After changing the scatter plots into boxplots the discussion of outliers was left out of the scope and was ommited.

Line 513: *(and elsewhere): 80.60% and 69.31%... that's a lot of precision. Why not round off to the nearest percentage?*

Answer: precision decimated throughout the text.

Line 520: *6000, not 6oo0*

Answer: Corrected to 6000.

Figure 9: *Light blue is difficult to see on white. Consider a grey background.*

Answer: Colorsceme in accordance with CVD-friendly recommendations [https://www.atmospheric-measurement-techniques.net/submission.html#figurestables] was changed to make **Figures 8 and 13** more contrast.

Table 3: *Would be nice to see the avg values as well.*

Answer: Lines containing average values for columnar LR and AOD were added to **Table 3**

Fig 15: *Some clarification about exactly what these mode fractions mean would be helpful. For example, should the winter nights from the three panels add to 100%? It doesn't appear that way, so I am not quite sure of what these fractions mean.*

Answer: Sum of all fractions should give 100% for each particular case, althgough this does not necessarily applies to the seasonal median values. Llarifications added to the text:
Lines 699-701:"It should be outlined, that generally, for each particular retrieval these fractions represent 100% of aerosol by volume, however median values may not add up to 100% for each of the seasons."

Line 683: *"It should be noted, that in autumn real part of refractive index has similar values,..." needs clarification. Similar to what? Also, Autumn has stronger absorption than in Winter and similar to Spring and Summer? Is this the fine mode or coarse mode? Either way, it is difficult to reconcile this sentence with the RRI and IRI of Fig 16.*

Answer: clarification added
Line 725: "real part of refractive index has similar values **with winter season**"