Comment on acp-2022-384

Anonymous Referee #1

Referee comment on "Using aircraft measurements to characterize subgrid-scale variability of aerosol properties near the Atmospheric Radiation Measurement Southern Great Plains site" by Jerome D. Fast et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-384-RC1, 2022

Review of "Using Aircraft Measurements to Characterize Subgrid-Scale Variability of Aerosol Properties Near the ARM Southern Great Plains Site" by Fast et al.

This study reports an analysis of airborne measurements over the Atmospheric Radiation Measurement (ARM) program's Southern Great Plains (SGP) site during the Holistic Interactions of Shallow Clouds, Aerosols and Land Ecosystem (HI-SCALE) campaign, with a focus on sub-grid scale variability. This is of course important as it relates to model applications as models typically assume homogeniety in aerosol properties in a grid cell. This study wisely quantifies subgrid variability iin terms of both normalized frequency distributions and percentage difference percentiles using grid spacings of 3, 9, 27, and 81 km; the rationale for this spacing choices is that they represent those typically used by cloud-system resolving models as well as the current and next generation climate models.

As someone involved with many field campaigns, I found this study to be very refreshing and useful. The results are significant showing large horizontal gradients for this rural location. Number concentrations were shown to be quite variable owing to events such as nucleation. The degree of spatial variation was shown to vary seasonally. Aircraft measurements were in similar for many (but not all) aerosol properties measured at the ground SGP site. An application of the findings is that the reported variability from the airborne data can serve as an uncertainty range when comparing the surface data to model predictions that rely on coarse grid spacings. I recommend publication subject to minor corrections below which are all of mostly an editorial nature. The science and analysis was robust and i do not have much to add in that category.

Specific Comments:

~Lines 134-140: state year of measurements by day/month info.

Line 212: "cell" should probably be plural

Line 215: what criteria were used for knowing when data were not contaminated by cloud?

Line 223: should be "…increases for the…"

Line 233-235: it would be informative to know exactly what criteria were applied to do this separation within and above the BL.

Line 271: "usually10"…space needed

Line 297: "1flights"…space needed

Line 310: change "are" to "is"

Line 351-353: this sentence does not read well. I suggest revising.

Line 294:"he" should be "the"

Section 6: I felt this section was quite long and leave it up to the authors if they want to consider a more concise version or to leave as is.

Figure 11 caption: "Right panels compare coincident in time surface and aircraft measurements." This line doesn't read well and I suggest revision. Same issue with Figure 12 caption.