

Response to Reviewer 1:

Reviewer comments in black, response in blue

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 homogeneity in aerosol properties in a grid cell. This study wisely quantifies subgrid variability in 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.

Response: We thank the reviewer for these positive comments, which includes pointing out the following typos and suggested clarifications that have now been resolved.

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

Response: Changed date ordering to day/month.

Line 212: "cell" should probably be plural

Response: Changed "cell" to "cells".

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

Response: The G-1 flight team provided a cloud flag as part of the data files that is based on cloud liquid water content reaching a threshold of 0.001 g/m<sup>3</sup>. Other cloud probes were used for cross-checking this flag. The text now includes a phrase about the cloud flag.

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

Response: Fixed tense.

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

Response: The BL heights from the Doppler lidar are determined by the Tucker method (Tucker et al. 2009; Krishnamurthy et al. 2021). For situations in which the Doppler lidar data were not available and

we used soundings, BL heights were estimated visually using the aircraft measurements and radiosonde profiles that occurred close to the flight time. A specific threshold for vertical potential temperature or humidity gradient was not used. The text has been modified to include the citations and additional description.