Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC2
https://doi.org/10.5194/acp-2022-349-RC2, 2022

Comment on acp-2022-349

Anonymous Referee #2

Referee comment on "Aerosol size distribution changes in FIREX-AQ biomass burning plumes: the impact of plume concentration on coagulation and OA condensation/evaporation" by Nicole A. June et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-349-RC2, 2022

This manuscript presents airborne observations of some aerosol parameters (aerosol particle median diameter, number concentration of particles > 100 nm, organic aerosol enhancement ratio (OAER, deltaOA/deltaCO) and O:C ratio) as function of atmospheric age for eight major wildfire plumes in the western US in 2019. The main finding of the manuscript is that the median diameter of particles > 100 nm increases faster in plumes that have higher OA concentration. A box model suggests that this change is mainly due to coagulation, OA evaporation and condensation having a minor role.

Biomass burning aerosol size distribution and its evolution in sub-grid scale is an important topic for climate and air quality. However, it is unclear what are the novel findings in this study and there are also some major comments need to be addressed before this manuscript can be accepted.

Major comments

The evolution of the size distribution is described through two parameters only: median

diameter and number concentration. Furthermore, the size distribution is available only for particles > 100 nm in diameter - were there really no measurements below 100 nm? Even for particles > 100 nm, please show the actual size distributions. Does the initial size distribution depend on OA concentration? Does the width of the size distribution agree with the modelled time evolution? Is one mode enough to describe the size distribution or should more modes be used?

It seems that most deviations from the modelled time evolution (e.g. Fig. 7) are explained by sampling not being Lagrangian. Please try to identify the processes that cause these deviations and discuss them in more detail. Can the model be used to evaluate whether changes in dilution and photochemical age would be enough to explain the observed differences, or if the differences are due to other factors (e.g. emission changes)?

The coagulation parameterisation by Sakamoto et al. (2016) is mentioned (e.g. lines 85-92), but no comparison is made. Please evaluate the Sakamoto et al. (2016) parameterisation with your observations.

Minor comments

On line 254 “N” is used for nitrogen, which could be confusing as it is used for number concentration lines 251 and 257.

line 258 “N is the number concentration between 50 nm and 800 nm, the range of diameters used to fit the dN/dlogDp measurements.” So are you showing only the fitted N, and not the directly measured parameter? Please use the measured quantity in the figures.

line 262 “number enhancement ratio” defined for the 2nd time.

line 293 I believe the Pasquill stability classes are defined for boundary layer, including convective mixing. Can this method be applied to mixing above boundary layer, where the measurements were done (line 174-175)?

line 322-323 “Additionally, this assumes volume-controlled growth/shrinkage, where all particle sizes grow/shrink by the same fractional amount, preserving the lognormal modal width.” Examining the initial size distribution as function of OA concentration could help validate this assumption. At least for the median diameter (Fig. 2), there seems to be a clear distinction between more diluted plumes (Dpm ~150nm) and the more concentrated plumes (Dpm ~200nm).

line 341-343 “Castle 8/12 also has a larger uncertainty range due to a constant increase in Dpm for the first five hours of aging, but then a decrease in Dpm during the final three transects, potentially due to deviation from Lagrangian sampling.” Can you use the size distributions to rule out growth of < 100 nm particles into the sizes where they can observed?

line 428 Do you mean Fig. 6a-b?

Figure S2 Please check x-axis label.