Theoretical analysis of mixing in liquid clouds. Part IV: DSD evolution and mixing diagrams by M. Pinsky and A. Khain

This study present analysis of mixing in cloudy and clear air. Evolution of DSD has been analyzed using poly-disperse initial DSD and varying cloud fraction μ. A diffusion-evaporation model was considered for the analysis. The main findings are

- Mixing diagram has multi-parameter characteristics.
- In dry volume, mixing leads to a rapid increase in RH
- DSD shape changes based on initial DSD chosen.
- The critical cloud fraction μ_{cr} with respect to total droplet evaporation are same for any mixing type.
- Mixing diagrams for homogeneous and in-homogeneous mixing for poly-disperse DSD do not differ much.

It was concluded that classical concept of mixing diagram is too crude to distinguish the mixing type in observation data.

General comment: Overall, the manuscript is worth to publish after explaining questions below.

Major comments:

1. Explain the reason for considering droplet concentration by averaging along X-axis only why not in whole domain? Also, why vertical velocity was neglected? Since, the analysis is done based on these assumptions, it is inappropriate to make strong general statement about mixing diagrams.
2. In this analysis, collision and coalescence was not considered which also contribute in broadening of DSD. Authors should make comments on this issue.
3. The result shows that in dry volume large, droplets do not change their size significantly. This is not the case in general because during mixing, droplet size starts decreasing as soon as they enter in dry volume. Authors should provide the reason for it.
4. Traditional mixing diagrams should be plotted for normalized values of cube radii vs. number concentration and then compare with mixing diagrams proposed in this study.

Minor comments:

1. All figure labels, legends should be bigger size to be visible enough.
2. Some references related to recent numerical simulation of entrainment and mixing should be added.