Review Report

Title: Comprehensive Quantification of Height Dependence of Entrainment-Mixing between Stratiform Cloud Top and Environment

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Summary:

This study propose a new measure for the homogeneous mixing degree which is independent of any adiabatic values. This measure was developed using observational data of marine stratiform clouds measured from aircraft during the campaign of Physics of Stratocumulus Top (POST) data. It is proposed that new method of mixing degree can be alternative method to quantify entrainment-mixing mechanisms by overcoming difficulties of determining adiabatic microphysical properties needed in the traditional approaches.

Comments:

The paper is written well and provide another way to quantify the degree of mixing. It is worth to publish in ACP with minor corrections given below.

1. **Regarding observation:**
   (i) Cloud droplet size distribution is measured by CAS probe however, the particle size range is CAS is not mentioned such 0.5→ 50 μm.
   (ii) CAS has disadvantage of large size bin width (about 10 μm) for above 20 μm particle diameter, therefore, does not give accurate size resolution. On the other hand, CDP or FSSP probe has better size resolution. Why did the authors choose CAS probe for this study?.

2. **New microphysical measure of mixing degree:**
   The formula (14), at line 233, for new microphysical measure should be discussed in data and method section along with other methods.
   This new method does not give any theoretical basis like the other mixing degree methods. This is a relative measure of HMD as deviation from the extremely inhomogeneous mixing line. But, does not quantify the amount of homogeneous mixing precisely. A critical value for homogeneous mixing cannot be inferred from this method. This is a disadvantage of this method.
   Furthermore, the standard deviation of mean radius and LWC increases due to differences in mixing states (having different history of mixing) and in-cloud activation of CCN. These points should be discussed properly in the results.

3. Although, there have been several reports on HMD using in situ observations, a limitation of such quantification is missing. Like Khain et al. 2018 pointed out the drawback of mixing diagram to quantify HMD using in situ observations due to transient mixing state. Some discussion is needed on this point.

Other minor corrections are

4. Line 88: Sentence is not clear.
5. Line 135: eq (5): Express the log values clearly for example ln (nc)