

## **Review of “Vertical distribution of aerosols over the Maritime Continent during the El Nino” by Jason Blake Cohen et al.**

The manuscript uses satellite-derived AOD to spatially and temporally constrain the sampling of smoke aerosols with an aim to examine the aerosol vertical distributions, measured from CALIOP, over the maritime continent during the 2006 El Nino. The observed aerosol vertical distributions were then used to compare with the results of a simple plume rise model. The study provides some insights into the aerosol signature in terms of vertical distribution during El Nino conditions and the limitations of plume rise models. But additional evidences and analysis are required to support the conclusions. Several major comments have to be addressed. Furthermore, the manuscript readability and clarity has to be improved before the publication in ACP.

### **Major comments:**

1. More elaborations and descriptions are required for CALIPSO data processing. Which version and level of CALIOP product? Is each individual measurement under cloud-free conditions? If yes, which cloud mask data was used? How many samples in total? What is the threshold value of extinction from CALIOP data (please consider the daytime background solar illumination by Winker et al., 2013)? In addition, an analysis of the uncertainties of the CALIOP-derived vertical aerosol extinction, in particular over this region, is needed.
2. The effects of the uncertainty in boundary layer depth need to be considered. The authors simply use the 1000 m to approximate the boundary layer height. Assuming the boundary layer has +/- 300 m uncertainties during the CALIPSO overpass, which is totally possible, what are the uncertainties of the percentage of free atmosphere aerosol estimated by your method? When taking this into account, how does your result compare with previous studies?
3. The author uses aerosol-induced in-situ stabilization as a possible explanation to the underestimation of plume height by model. But the rationale seems problematic. The model does not account for the effect of aerosol-induced stabilization which actually happens in the real atmosphere. The stabilization causes weaker buoyancy, thus lower plume height. Therefore the model that misses such stabilization should overestimate, not underestimate, the plume height.
4. The comparison between model and observation is insufficient. The observation misses 3 days and the model misses 9 days with only 18 days left. This is rather a small sample. Since the fires lasts from September to November, it is worthwhile to expand the analysis to September and November. In addition, the analysis is primarily limited to the monthly averages. The authors do show the comparisons in daily basis in Figure 4, but do not analyze them. In particular, the three special days mentioned in section 3.2 are good example cases to analyze in order to shed more light on the observation-model comparisons. Such more comprehensive analysis is very worthwhile in order to support the conclusions of how to reduce model bias which is actually not well examined or indicated in the manuscript.

**Specific comments:**

Line 15: “measurements and modeling”. Please specify which measurement and which model.

Line 16: “underestimated” by what?

Line 51: Sentence not readable

Line 53 ~ 54: “underestimation” in “spatial, and temporal distribution”?

Line 60: Change “show” to “shown”

Line 75: Show full name of “CALIOP”

Line 77: Show full name of “SSA”

Line 77: “go with each pass”. Is it scientific language?

Line 82: grammar error

Line 85: Show full name of “MISR”

Line 157: Please provide the reference.

Line 158: delete one “are”

Line 162~167: Show full name of “AERONET”, “NOAA”, “RMS”, “RCP”, “GDED”

Line 167: what is R2 statistic?

Line 204~206: Please provide new plot to show them more directly.

Line 218: Show full name of “BC”

Line 272: add “of” after “and”

Line 285~286: Why not examining the hypothesis by looking at precipitation data from A-Train?

Line 290: Show full name of “MERRA”

Line 360-361: “vertical distribution” is not a parameter to be “estimated”.

Figure 1: What does the color stand for? Please add a title to the colorbar.

Figure 4: The comparison is really not readable. Please make it more clear.