Response to Short Comment #2 by Dr. Zengyun Hu

General comments:

The paper entitled "Aerosol-induced changes in the vertical structure of precipitation: a perspective of TRMM precipitation radar" by Guo et al. is nicely written and presenting a good quality work on the response of vertical features of precipitation to aerosol in the PRD region of China using TRMM observations. Author used a long data series consisting of 6 years of data and it is really a good for statistical analysis on aerosol-precipitation interaction and there is scope for further extending the work on aerosol-induced changes in inner dynamics of precipitation in future. However, some results are not properly discussed.

Response: First of all, we appreciate the positive and constructive comments provided by Dr. Zengyun Hu. In response to his comments, we have made relevant revisions to the manuscript. Listed below are our responses and the corresponding changes made to the manuscript according to the suggestions offered by him. Each comment is echoed in normal front, followed by our responses in bold italics.

Minor comments:

1. Page 16 line 4: Regarding the results of "An invigoration (suppression) effect for convection (stratiform) precipitation types can be observed", the authors may consider to add the following discussion in Manuscript:

When the tropical convection systems developed and matured, its precipitating cloud cluster consists as follows: 1) deep precipitating convective towers characterized by vigorous updrafts; 2) stratiform precipitating cloud connected to the deep convection exhibiting weaker, mesoscale vertical motions; 3) non-precipitating thick anvils attached to either the stratiform or convective precipitating areas (Houze 1993; Li and Schumacher, 2011; Yang et al., 2015). Because the samples are mainly restricted to local-scale precipitation (non large-scale precipitation) in the present work, the selected stratiform precipitation samples are mainly connected to the deep convection in tropical PRD regions. High-concentration aerosols over PRD easily enter into these deep convection under strong upward moment with enough water vapor, which will favor the development of convective precipitations, while for vertically weaker motion stratiform precipitation, high-concentration aerosols and non-abundant water vapor are supplied to suppress the development of stratiform precipitation.

References:

Houze, 1993: Cloud Dynamics. International Geophysics Series, Vol. 53, Academic Press, 573 pp.

Li, W., and Schumacher, C. (2011). Thick Anvils as Viewed by the TRMM Precipitation Radar. Journal of Climate, 24(6):1718–1735.

Yang Yuan-Jian, Da-ren Lu, Yun-Fei Fu, et al., 2015.Spectral Characteristics of Tropical Anvils Obtained by Combining TRMM Precipitation Radar with Visible and Infrared Scanner Data, Pure and Applied Geophysics., 172, (6), 1717-1733

DOI:10.1007/s00024-014-0965-x.

Response: Thanks a lot for a very clear elaboration of the development of a deep convective clouds and its association with aerosols, which alos points out the difficulties in classifying precipitation types. The significant role that vertical motion plays in convective and stratiform clouds has been analyzed in Figure 8, conditioned by the supply of water vapor. Therefore, part of your comments has been incorporated into section 3.1, as follows:

"Given the fact that deep convections sometimes develop from shallow convections (Houze 1993; Li and Schumacher, 2011; Yang et al., 2015), it is possible that the subjective compositing method will divide one precipitation event into different phases, which will lead to large uncertainties in determining precipitation regimes from TRMM data alone. This deserves more explicit analyses aided by geostationary satellite data in the future, which is out of the scope of this study."

2. Page 16 line 4: Regarding the inference of aerosol radiative effect in "which may be partly due to the aerosol radiative", key reference is missing, for example, Liu et al. GRL 2018.

Liu Z., Yim S.H.L., Wang C., Lau N.C. (2018). The impact of the aerosol direct radiative forcing on deep convection and air quality in the Pearl River Delta region. Geophysical Research Letters, 45(9), 4410-4418"

Response: The reference has been cited as suggested.