Reply to Anonymous Referee #2

We thank the reviewer for the careful reading of the manuscript and helpful comments. We have revised the manuscript following the suggestion, as described below.

This study seeks to show the relationship between aerosol loading and deep convection within the Tibetan Plateau region and compare with the North China Plain. Model simulations are used to show the sensitivity of deep convection to various concentrations of aerosol loading. I believe this paper can be published after several grammatical errors and some technical questions are addressed. For most of the grammatical error revisions please see the attached PDF.

1 Comment: How confident are you in the aerosol assumptions used as input to your model? Aerosol chemistry is relevant when certain aerosols activate as CCN. Also, emission data is important since the Tibetan Plateau does not often witness heavy aerosol loading events, though you are correct about the summer season having the most polluted conditions. Also, coarse mode aerosols (mineral dust) tend to dominate that region throughout the year.

Response: We have clarified in Section 2: "*It is worth noting that the simple aerosol assumption is subject to cause rather large uncertainties in the aerosol activation to CCN and IN. Aerosol chemistry in clouds plays a considerable role in the aerosol nucleation and growth. Direct emissions from anthropogenic sources contribute substantially to the CCN and IN, even over the TP with increasing human activities. Furthermore, mineral dust from the natural source frequently dominates the TP throughout the year. Therefore, future studies need to be conducted to include all the aerosol modes, chemistry and emissions.*"

2 Comment: Do you expect to see much sulfate in the Tibetan Plateau? And if so, how does that compare to the ability of carbonaceous aerosols to activate as CCN since they too can be observed over this region.

Response: We have clarified in Section 2: "*Observed aerosol concentrations over the TP exhibit a large variation during the monsoon season, i.e., the observed sulfate concentrations range from 0.1 to several μg* m^{-3} *(Decesari et al., 2010). Therefore, a set of 28 initial aerosol size distributions with the aerosol number concentration ranging from 20 to 9000* cm^{-3} *and the*

sulfate mass concentration ranging from 0.02 to 9.0 μg cm^{-3} at the surface level are used. Other aerosol species are scaled using the measurement at the Nepal Climate Observatory-Pyramid (NCO-P) (Decesari et al., 2010). These aerosol distributions are designated for environments ranging from very clean background air mass to polluted urban plumes over the TP and NCP. Although the observed organic aerosol dominates the aerosol composition at NCO-P (Decesari et al., 2010), considering the large uncertainties in the hygroscopicity of organic aerosols, the hygroscopicity parameter for the secondary organic aerosol is set to be 0.05 in the study (Petters and Kreidenweis, 2007; 2008). Hence, sulfate aerosols (or inorganic aerosols) still play a dominant role in the CCN activation.".

3 Comment: I have no problems with the results you show from your model but both comparison regions should be equivalent. It seems that topography plays a large role in the development of deep convection over the Tibetan Plateau. I believe your point is that the monsoon may be affected by aerosol-cloud interactions over this region. However, is it a fair to compare aerosol impacts on storm development in the Tibetan Plateau region with the Northern China Plains where the topography is not only flatter but there are more sources of aerosol loading as well.

Response: We agree with the reviewer's comment and have clarified in Section 4: "*It is worth noting that, although the CAPE is similar for the Cu-TP and Cu-NCP, it might not be fair to compare aerosol impacts on the cloud development over the TP with the NCP, considering the difference of the water vapor profile, wind shear, topography, and anthropogenic and natural aerosol sources between the two regions. However, the comparisons have highlighted that the topography plays a large role in the development of cumulus over the TP.*".

4 Comment: Please also note the supplement to this comment: http://www.atmos-chem-phys-discuss.net/acp-2017-148/acp-2017-148-RC2- supplement.pdf

Response: We really appreciate the reviewer for the careful reading and revisions of the manuscript and have revised it as suggested.