Responses to Reviewers (ACP Manuscript # ACP-2018-1102)

First of all, we would like to thank the editor and three anonymous reviewers for their thoughtful review and valuable comments to the manuscript. In the revision, we have accommodated all the suggested changes into consideration and revised the manuscript accordingly. All changes are highlighted in RED in the revision. In this point-to-point response, the reviewers' comments are copied as texts in BLACK, and our responses are followed in BLUE.

Anonymous Referee #3

This manuscript deals with non-ideal minor structures effect to optical properties of black carbon aerosols. The subject falls clearly to the scope of ACP and it presents new correction factor to account for the mass/volume normalized absorption and scattering of non-ideal aggregates in comparison to ideal ones. The manuscript is well written and it proceeds in logical manner, and it thoroughly enough explains the used methods and outcomes. The title reflects the content of the paper and the abstract provides complete summary. I recommend accept the manuscript with minor revisions with following consideration. What I am missing are the examples how this new factor would change e.g. radiative transfer calculations (radiative forcing) or analysis of the experimental measurements compared to present estimations. I highly recommend to add such examples.

Response: Thanks the reviewer for the positive comments on the manuscript, and the constructive suggestion makes this work more complete.

In the revision, we added an example to discuss the effects of minor structures on the radiative forcing simulations (starting from Line 25 of Page 12). To better explain the conclusion of this work and the effects of minor structures, three cases are designed to calculate BC radiative forcing: (1). BC aggregates with minor structures and a volume variance from the ideal case of 10%; (2). BC aggregates with ideal aggregate structures; and (3). BC aggregates with ideal aggregate structures but the same total mass as those for the non-ideal case (i.e., Case (1)). As expected, the effects of minor structures on radiative forcing are similar to those on the optical properties, and the influences are also mainly caused by the changes on aggregate total volume/mass. Meanwhile, we emphasized in the conclusion section that the importance of this study is not only to evaluate and to unify the effects of minor structures, but also to present an efficient empirical relationship to account for their effects. Whatever the effects are interpreted, the effects of minor structures are easily accounted for without the tedious simulations of the optical properties for particles with minor structures or without even knowing their details.

An example of how these BC minor structures would influence the interpretation of experimental studies can hardly be given, as to date the measurement accuracy in terms of the MAC and MEC are not good enough and at best in the 5% range that is expected for the minor structures. However, the measurement capabilities are continuously improving mainly in terms of optical detection sensitivity, particle mass determination, as well as measurement comprehensiveness (e.g. by including size-segregated and spectrally resolved measurements as well as by adding detailed microscopic analysis of the particle morphologies). Therefore, we are confident that our study will be used in future to interpret the results of such detailed laboratory studies and the remaining differences when comparing with fractal particle light scattering models.