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 #1

This paper studies the optical properties of black carbon particles and introduces a new parameter, the "volume variation" to quantify several minor structural differences relative idealized structures such as fractal aggregates of same sized, spherical primary particles, etc.

This paper has some admirable properties. It provides a thorough review of the light scattering literature of aggregates such as soot and emphasizes the non-ideality of their real world structures. It also classifies the several ways structures can deviate from the ideal form. The results demonstrate that all these non-idealities can by represented by a volume variation that can be used to unify their effects. Then a simple empirical relationship quantifies their effects on the optical properties. Overall the effects are not large, a few to several percent. The authors make arguments that such effects can be important. Important or not, it is worthwhile to know the extent of the effects and compare them as this paper does.

The paper is well written and the results are of value. I recommend publication.
Response: We really appreciate the reviewer's recognition of the scientific merit of this study. We agree with the reviewer that it is important to understand quantitatively the effects of the non-ideal minor structures and to compare them.
More importantly, we agree with the reviewer to interpret and to explain 'the effects' more carefully. The manuscript shows that the effects caused by minor structure are mainly contributed by the volume differences, and, after removing the influence of volume, the effects on the scattering and absorption are in the order of a few percent. Thus, we conclude that, in future studies, the understanding and evaluation of the particle's volume are more important than those on the minor structures themselves, and our empirical treatment can be used to account for such effects efficiently. To better present these conclusions, we improved the discussions in the abstract (Lines 26-33 on Page 1) and conclusion (Lines 25-28 on Page 13) section, and also added a paragraph in Section 3 to present a more quantitative example to clarify the conclusions on radiative forcing simulations (starting from Line 25 on Page 12).