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Comment on acp-2021-945

Anonymous Referee #1

Referee comment on "The optical properties and in-situ observational evidence for the formation of brown carbon in clouds" by Ziyong Guo et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-945-RC1, 2021

This study attempted to investigate the role of cloud on the formation of brown carbon. A comprehensive and valuable dataset was collected, including the light-absorption properties of the cloud droplet residual, the cloud interstitial and cloud-free particles, the light-absorption and fluorescence properties of water-soluble organic carbon in the collected cloud water and PM2.5 samples, and the concentration of water-soluble ions. The presented data further indicate the formation of secondary BrC during cloud processing and a considerable contribution of water-insoluble BrC to total BrC light-absorption. Such results improve our understanding on the optical properties and secondary formation of BrC in cloud, and thus merit publication in ACP. Here are some minor issues that need to be addressed.

(1) Experiment section: why was PM2.5 inlet applied to rule out the cloud interstitial particles? Discussions should be provided on the possible uncertainty that may be introduced.

(2) "The contribution of water-insoluble BrC to the light-absorption is estimated to be ~75% for the cloud INT particles and ~48% for the cloud RES particles on average, based on these differences (Fig. 3)." It is interesting to know that water-insoluble BrC contributes to such a high fraction of BrC in the cloud INT particles and the cloud RES particles. I wonder if some of this insoluble fraction is secondary origin.

(3) Lines 197: The authors presented correlation analysis between the Abs365 of cloud water and PM2.5 aqueous extract with SNA (sulfate, nitrate, and ammonium) ($r > 0.77$, $p < 0.01$), and NOx ($r > 0.58$, $p < 0.01$), and the result supports the secondary formation of BrC. Why was PM2.5 aqueous extract included in the analysis? Does this result also indicate the significance of secondary production of BrC in PM2.5?

minor:

(1) Line 53ï¼□what does "These light-absorption species" refer to?

(2) Line 134ï¼□"(SUVA, m2·g-1,)" error typo.

(3) Line 156ï¼□"As expected, there is a positive correlation between Abs365 and WSOC concentration in cloud water and PM2.5 aqueous extracts ($r > 0.61$, $p < 0.01$)." Does it mean that WSOC in cloud water is mostly from PM2.5?

(4) Line 160ï¼□"much lower than those in urban areas (as summarized in Table S1)". I suggest to include the observed values.

(5) Line 197ï¼□what does "wet particles" refer to?

(6) Line 208ï¼□revise "Consistently, the source and contribution apportionment of BrC" to "the source apportionment of BrC".