Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2019-594-AC1, 2019

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modeling global radiative effect of brown carbon: A larger heating source in the tropical free troposphere than black carbon" *by* Aoxing Zhang et al.

Aoxing Zhang et al.

azhang76@gatech.edu

Received and published: 30 July 2019

Dear Dr. Taylor,

Thank you for your helpful questions and comments.

1. The BC MAE values used in this study are 10 and 8.1 m2/g for 345- 442 nm and 442-625 nm, respectively (Knox et al., 2009; Bond and Bergstrom, 2006). We will add this information in the revision.

2. We don't have a solid physical explanation about BrC convective transports, but observations in SEAC4RS and DC-3 clearly show evidence for the process. There are

Printer-friendly version

Discussion paper

some mechanisms related to the further transport of BrC. Zhang et al. (2017) showed BrC relative to BC enhancements for smoke plumes undergoing convection and suggested that in-cloud heterogeneous processing may produce BrC. Browne et al. (2019) also suggested that a fraction of BrC produced from heterogeneous oxidation by ozone is free from the bleaching effect and BrC produced from heterogeneous oxidation of OH has a longer lifetime. In addition, hydrophobic OC, such as humic-like substances (HULIS), is more likely to have high light-absorption compared to hydrophilic OC (Hoffer et al., 2006). BrC with high molecular weight dominates the aged biomass burning plume (Wong et al., 2017, Wong et al., 2019). Since higher molecular weight compounds have weaker hygroscopicity (Dinar et al., 2007), and it is harder to activate hydrophobic OC in cloud, less BrC is removed in deep convection.

We simulated that BrC DRE can be larger than BC DRE over strong deep convection regions such as the remote tropics. We expect this to be a real feature, and future measurements over the remote tropics will provide some evidence about the remote upper troposphere BrC.

3. Table. 2 in the manuscript describes the differences among the sensitivity runs (NCNB, ICNB, NCB, ICBB, ICB).

References

Bond, T.C. and Bergstrom, R.W., 2006. Light absorption by carbonaceous particles: An investigative review. Aerosol science and technology, 40(1), pp.27-67.

Browne, E.C., Zhang, X., Franklin, J.P., Ridley, K.J., Kirchstetter, T.W., Wilson, K.R., Cappa, C.D. and Kroll, J.H., 2019. Effect of heterogeneous oxidative aging on light absorption by biomass burning organic aerosol. Aerosol Science and Technology, 53(6), pp.663-674.

Dinar, E., Taraniuk, I., Graber, E.R., Anttila, T., Mentel, T.F. and Rudich, Y., 2007. Hygroscopic growth of atmospheric and model humicâĂŘlike substances. Journal of

Geophysical Research: Atmospheres, 112(D5).

Hoffer, A., Gelencsér, A., Guyon, P., Kiss, G., Schmid, O., Frank, G.P., Artaxo, P. and Andreae, M.O., 2006. Optical properties of humic-like substances (HULIS) in biomass-burning aerosols. Atmospheric Chemistry and Physics, 6(11), pp.3563-3570.

Knox, A., Evans, G.J., Brook, J.R., Yao, X., Jeong, C.H., Godri, K.J., Sabaliauskas, K. and Slowik, J.G., 2009. Mass absorption cross-section of ambient black carbon aerosol in relation to chemical age. Aerosol science and technology, 43(6), pp.522-532.

Wong, J.P., Nenes, A. and Weber, R.J., 2017. Changes in light absorptivity of molecular weight separated brown carbon due to photolytic aging. Environmental science & technology, 51(15), pp.8414-8421.

Wong, Jenny PS, Maria Tsagkaraki, Irini Tsiodra, Nikolaos Mihalopoulos, Kalliopi Violaki, Maria Kanakidou, Jean Sciare, Athanasios Nenes, and Rodney J. Weber. "Atmospheric evolution of molecular-weight-separated brown carbon from biomass burning." Atmospheric Chemistry and Physics 19, no. 11 (2019): 7319-7334.

Zhang, Y., Forrister, H., Liu, J., Dibb, J., Anderson, B., Schwarz, J.P., Perring, A.E., Jimenez, J.L., Campuzano-Jost, P., Wang, Y. and Nenes, A., 2017. Top-of-atmosphere radiative forcing affected by brown carbon in the upper troposphere. Nature Geoscience, 10(7), p.486.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2019-594, 2019.

Printer-friendly version

Discussion paper