Referee report on ACP-2022-483 - Concurrent photochemical whitening and darkening of ambient brown carbon

Qian Li[1], Dantong Liu[1*], Xiaotong Jiang[1], Ping Tian[2], Yangzhou Wu[1], Siyuan Li[1], Kang Hu[1], Quan Liu[3], Mengyu Huang[2], Ruijie Li[2], Kai Bi[2], Shaofei Kong[4], and Deping Ding[2]

The manuscript titled “Concurrent photochemical whitening and darkening of brown carbon” by Li et al. describes the behavior of primary and secondary brown carbon (BrC) from field observation in a sub-urban site near Beijing, China. The main finding of this work is that it is offering field evidence of concurrent whitening and darkening of ambient BrC.

The reviewers and editor have raised several concerns and have given suggestions for improvement, most of which have been addressed by the authors. However, it appears that the authors’ have not fully grasped the reasoning for these comments and have failed to modify the manuscript in a significant way. Some of the comments have been addressed by adding one or two sentences in the suggested paragraph and the changes are not reflected anywhere else in the manuscript, even if it changes some of the main messaging. Take for example the comment by editor that additional evidence to justify the main claim of concurrent whitening and darkening, other than the percentage difference in primary and secondary BrC absorption, is needed. This has only been addressed in one line in the accompanying text, suggesting the enhancement in MAC of SOA, but not addressed in the abstract, where it only describes the percentage difference.

Furthermore, comments have been made regarding calculating the MAC of individual OA factors, and has not been addressed. With source-apportioned OA factors and total OA absorbance, several studies have used methods such as multiple linear regression analysis (Qin et al. "Chemical characteristics of brown carbon in atmospheric particles at a suburban site near Guangzhou, China." *ACP* 18.22 (2018): 16409-16418., Wang et al. "Wintertime optical properties of primary and secondary brown carbon at a regional site in the North China Plain." *ES&T* 53.21 (2019): 12389-12397. Kasthuriarachchi et al. "Light absorbing properties of primary and secondary brown carbon in a tropical urban environment." *ES&T* 54.17 (2020): 10808-10819., Wang et al. "Aqueous production of secondary organic aerosol from fossil-fuel emissions in winter Beijing haze." *PNAS* 118.8 (2021): e2022179118. and latest studies with ridge regression models (Zhang et al. "Impact of COVID-19 lockdown on the optical properties and radiative effects of urban brown carbon aerosol." *Geo. Front.* 13.6 (2022): 101320.) to obtain MAC of individual OA factors. The fact that authors have failed to do the same is questionable. The addition of this information has the potential to offer supporting evidence to the main claim of this work as it will help to identify how the MAC of each OA factor changed during the day.

A complete revision of this work, including MAC of individual factors and addressing the uncertainties of the calculation, assumptions etc., with more focus on the light absorbing properties in the Results and Discussion section (more than half is attributed to OA source discussion), with a thorough language revision may be re-submitted for revision.