Anonymous Referee #2

This study investigates the intra-regional transportation of black carbon (BC) between North China plain (NCP) and central China (CC) based on the simultaneously measurements at five cities located in the two regions during winter haze period. The authors have identified two important BC emission sources (i.e., biomass burning and fossil fuel) and their geographic origins during transportation. Since there are still limited studies on the intra-region transportation in China, this study takes insight in this topic. The manuscript is well written and organized. But there are still some minor issues, which need to be addressed before publication. Please see specific comments below.

AR: Thanks for your positive comments on this manuscript.

1. Lines 240-246: Taking the fossil fuel BC (BC_{ff}) as the control priority in WH and other cities in this study is not just because the BC_{ff} increases from clean to pollution period but also due to the much higher absolute conc. of BC_{ff} than biomass burning BC (BC_{bb}) under all the three conditions (Fig. 4b and c). Regarding Beijing case, in addition to the percentage of BC_{bb} increasing from clean to pollution episodes, are the absolute conc. of BCbb also higher than BC_{ff}? If not, it should be careful to state that the priority in North China is to control BCbb.

AR: Thanks for your comments and we have revised corresponding part. You concerns whether the absolute concentration of BC_{bb} was higher than BC_{ff} during pollution episodes in Beijing (Liu et al., 2018), the answer is yes as shown in Fig. R6. BC source apportionment using carbon isotope also suggests that BC emissions in BTH (North China) and PRD (South China) are characterized by coal-combustion-dominated and liquid fossil-combustion-dominated, respectively (Yu et al., 2018). This result supported our conclusion.

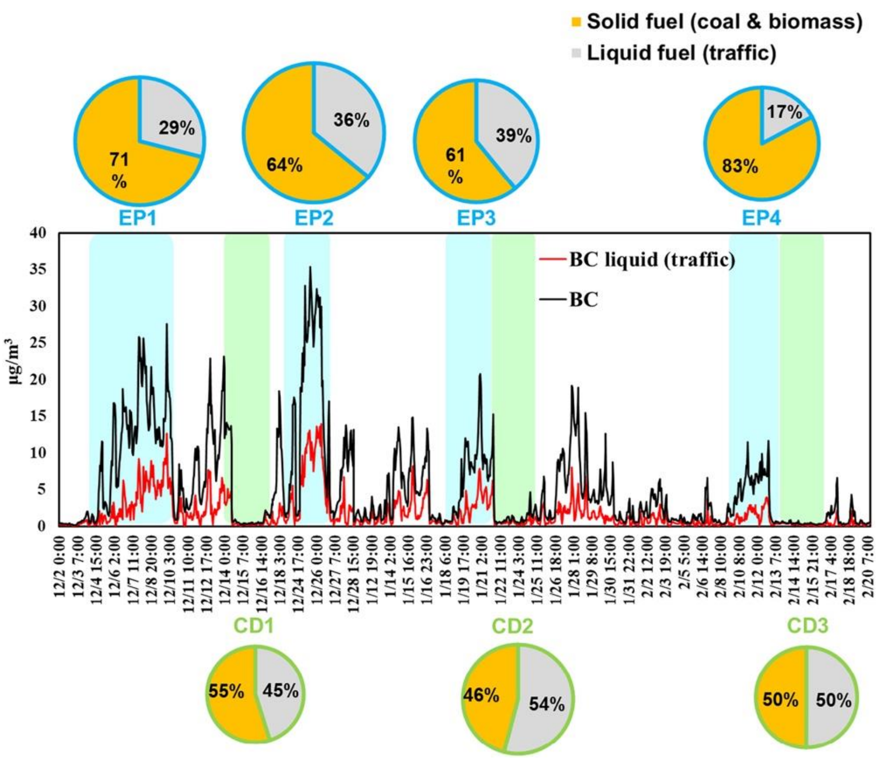

Figure. R6 Liquid and solid fuel source contributions to BC in pollution episodes (EP) and clean days (CD). The size of pies is proportional to average concentration of BC in each episode (Liu et al., 2018).

References

Liu, Y., Yan, C. and Zheng, M.: Source apportionment of black carbon during winter in Beijing, Science of The Total Environment, 618, 531–541, doi:10.1016/j.scitotenv.2017.11.053, 2018.

Yu, K., Xing, Z., Huang, X., Deng, J., Andersson, A., Fang, W., Gustafsson, Ö., Zhou, J. and Du, K.: Characterizing and sourcing ambient $PM_{2.5}$ over key emission regions in China III: Carbon isotope based source apportionment of black carbon, Atmospheric Environment, 177, 12–17, doi:10.1016/j.atmosenv.2018.01.009, 2018.

2. The aging process could significantly change the optical properties of BC aerosols (Peng J, et al., PNAS, 2016; Wang et al., J. Adv. Model Earth Syst, 2018). Are there any observed changes in BC absorption due to the aging during the intra-regional transportation?

AR: Thanks for your suggestion. We have observed the enhancement of BC absorption during the transportation according to two cases as shown in Fig. R7. In case 1, σ_{abs} significantly ($p<0.01$) increased from 25.6 ± 0.81 Mm^{-1} (LH) to 61.8 ± 12.5 Mm^{-1} (HA). In case 2, the enhancement of σ_{abs} was also observed from HA (53.4 ± 5.58 Mm^{-1}) to LH (59.9 ± 2.05 Mm^{-1}).

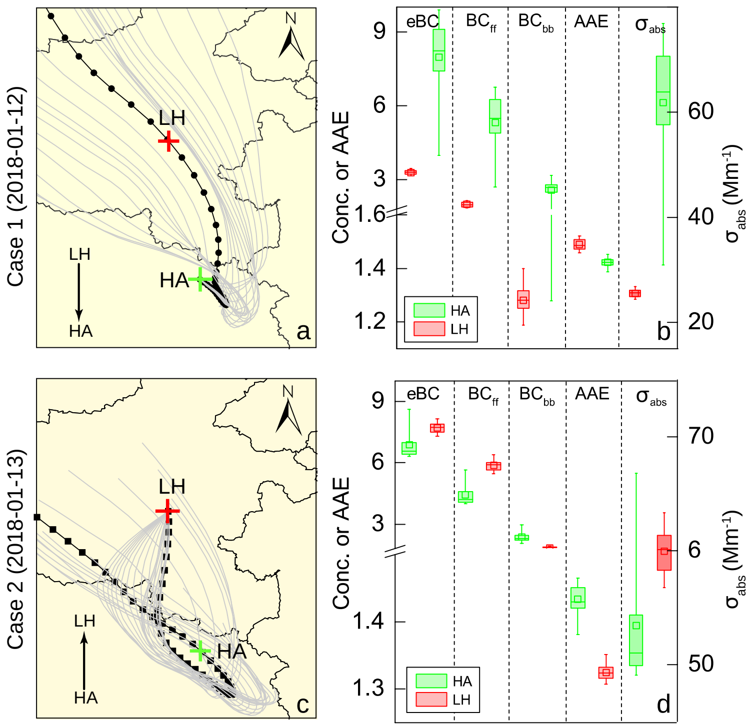

Figure. R7 Case studies of BC variation during the transportation from upwind to downwind direction. a (case 1): Hourly backward trajectories (grey line) reaching at HA on 2018-1-12 and the trajectory at 13:00 (GMT) (black line) was found passing through LH about 28 hours ago. c (case 2): Trajectory reaching at LH on 2018-1-13 07:00 (GMT) (black line) was found passing through HA about 31 hours ago. Box (25-75th percentiles) and whisker (5-95th percentiles) plots of eBC, BC_{ff}, BC_{bb} σ_{abs}, and AAE variations during the transport from LH to HA (b) and from HA to LH (d).

3. Fig.1: For air mass clustering panels, you may want to use different colors to differentiate the air masses from different directions.

AR: Thanks for your suggestions and we have corrected it (Fig. R8).

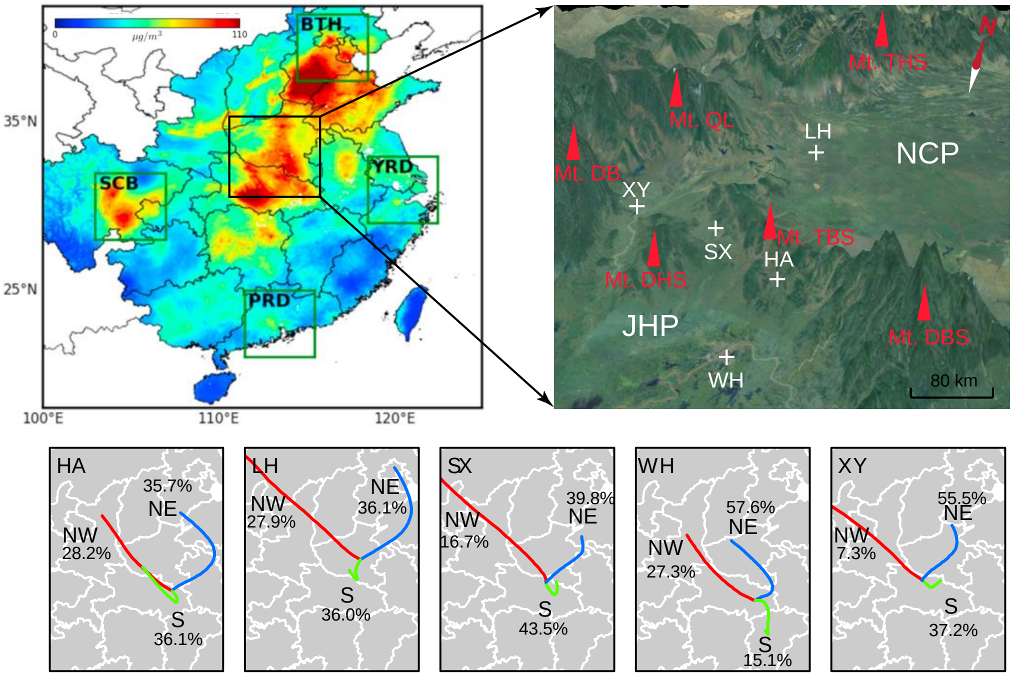

Figure. R8 Location, terrain of the study area and clusters of backward trajectories reaching at each observation site. Up left is the spatial distribution of the 15 years average $PM_{2.5}$ concentrations at a resolution of 1 km (Lin et al., 2018). Right up shows that the study area is surrounded by mountains and Mt. DBS and Mt. TBS blocks the North China Plain (NCP) and Jianghan Plian (JHP). Bottom shows that air masses reaching at the five sites were mainly from north directions (northwest and northeast) during the observation period.

4. Fig. 3: Does the count (y axis) denote the number of data points? If so, why there is much less data points at WH? The smaller total count might be because missing or not available data in measurements at WH?

AR: Yes, the y axis represents the number of data, the reasons why the number of data in WH ls less than other sites is due to the following two reasons: (1) there were much more missing values due to the instrument maintaining and power failure (2) the data resolution is 5-min at WH (AE31) and the resolution is 1-min at LH and HA (AE33).

5. Typos Line 227: Figure 3 is Figure 3b.

AR: Thanks, and it has been corrected.