

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2022-26

Anonymous Referee #1

Referee comment on "The impact of atmospheric motions on source-specific black carbon and the induced direct radiative effects over a river-valley region" by Huikun Liu et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-26-RC2>, 2022

Atmospheric Chemistry and Physics

Manuscript ID: acp-2022-26

Title: The impact of atmospheric motion on source-specific black carbon and the induced direct radiative effect over a river-valley region

Comments to Editor:

Dear Editor,

I apologize for the late feedback. More comments were needed on the manuscript and supplementary material than I had thought.

Best regards

General comments:

This manuscript describes how Black Carbon concentrations, measured over a little more than a month in winter 2018 together with other chemical species in PM_{2.5} in a Chinese city nestled at the bottom of a valley, vary with different transport regimes and motion scales (from local to regional).

The topic of the manuscript fits within the scope of the journal. The methodology should be described more precisely to build confidence in the results. The discussion section could be strengthened by comparing this work with other studies in similar topographic conditions.

The writing should be improved, I have suggested a few technical corrections in a specific section at the end.

Specific comments:

L30: What type of "change" between a mass concentration and a radiative effect is expected? I am not sure the word "change" conveys your meaning.

L37-38: "the second strongest light-absorbing substance in the atmosphere after CO₂". This wording is confusing since it seems an intrinsic property of BC whatever its concentration level. Besides it is clearly related to (1) its climate forcing ability and (2) human emissions only, by Bond et al. (2013) which state that "*We estimate that black carbon, with a total climate forcing of +1.1 W m⁻², is the second most important human emission in terms of its climate forcing in the present-day atmosphere; only carbon dioxide is estimated to have a greater forcing.*" (abstract) or "*Our best estimate of black carbon forcing ranks it as the second most important individual climate-warming agent after carbon dioxide*" (in 1.2.12 Policy implications). This sentence should thus be revised accordingly.

L60: "scale (it is atmosphere phenomena) ranges". I do not understand what the mention in brackets refers to?!

L62: I do not understand how an atmospheric dynamic feature (the local scale of motion) is eventually controlled by the concentration levels of BC?! Besides the land roughness, it can be influenced by thermals, turbulence, etc.

L72-79: The authors mention the specific case of atmospheric dynamics in the context of a valley site surrounded by mountains. I am surprised not to find a word about temperature inversions which are very common in winter in such environments and have a tremendous impact on trapping pollution in valleys. See for instance Glojek et al. (2022), <https://doi.org/10.5194/acp-22-5577-2022>.

L87: The description of the research site and its surroundings is too brief. No mention of any altitude (site, surrounding mountains), which is a crucial parameter. The authors should provide a more detailed map of the city and the main local expected sources of Black Carbon (highway, residential areas, industries, etc.), as well as the 12 monitoring stations mentioned later in the text. It would also be helpful to know about the local wind rose over the different seasons, as well as basic meteorological data (temperature, RH profiles; precipitation patterns).

L101: The time resolution of AE33 aethalometers can either be 1 min or 1 s. Do you mean you used 5-min averages of the 1-min data?

L105-106: What type of quartz filter was used? The correction factor is dependent on the filter model.

L133: What is the spatial resolution of the GDAS meteorological data?

L162: The PMF methodology is described in section 2.3 for its classical use with mass concentrations of chemical species. Here it is used for optical source apportionment and therefore it should be explained how (concentrations are being replaced by what?) as well as the uncertainty calculation in that case.

L184: Is equation 13 correct? Both L175 and L188-189 describe R as the ratio between L and S but this does not correspond to the expression.

L206: What is the time resolution of the three sets of data? Are you using hourly averages?

L303-318: I would suggest to include the four different average values (L(bj), S(bj), R(bj) and R(std)) for the four motion categories in Table 1 as well, and not repeat all the values in this paragraph but rather focus on the comparison and the interpretation.

L341-344: Are emission inventories available to support the assumption that eBC from

biomass burning is more regional than eBC from fossil fuel combustion? L388: A similar conclusion as above is reached here using the backtrajectory cluster analysis.

Non-parametric wind regression plots on these two variables could also be informative to assess the local vs. regional influence. See for instance:

Gu et al. <https://www.sciencedirect.com/science/article/pii/S0160412019342369>
or Pandey et al.: <https://link.springer.com/article/10.1007/s10661-022-09879-9>

Supplementary Information

Figure S5: eBC(diesel) is actually EC from the PMF factor attributed to diesel vehicular emissions if I understand correctly what is written in the main text (L248). I do not think it should be considered equivalent to an eBC(diesel) which is confusing with eBC(fossil).

Figure S8: The caption is not very informative. Do L24h and S24h correspond to L(bj) and R(bj) mentioned in the main text. Being not familiar with the SOM approach, it is hard to figure out what this represents and how to interpret it.

Technical corrections (list non-exhaustive):

L32: "It highlights". Do you mean "This study emphasizes the fact that"? (or something along that line)

L54: "Local concentrations of BC are"

L55: "predictable at to some degree". Delete "at".

L56: "the concentration of pollutants follows"

L57: "multiple" instead of "multiply"

L76: "it can play"

L78: "to converge"

L80: "fascinated". Maybe too strong a word? May I suggest "keen on studying" instead.
"eBCs" not defined.

L92-93: "located at the furthest west"

L93: replace "suffers" by "suffering from"

L107: "Aurora"

L151: "deconvolved" rather than "separated"

L171: "different scales"

L230: "minus"

L235: "was run"

L236: "2-factor solution (...) 7-factor solution (...) 4-factor solution" + L237, L239

L279: "were calculated"

L282-283: "Their diurnal variations showed varied". Please consider revising.

L282, 284: "diel" instead of "diurnal"

L293: "New para here" should be deleted.

L331: rather "clean" instead of "clear".

L333: "were carried"

L360-362: Consider revising this sentence: "emissions at in" (delete "at"); "(~75%) of the total population of Baoji)" can be replaced by "(that is to say 75%)"; "distributed located", pick only one.

L432: "outweighed the regional-scale motion"

L436: "found to be raised"

L717 : Figure 1 | x-axis title: "Pabs" instead of "babs"

L721: "diurnal" should be replaced by "diel" (24-hour period). At the least, standard deviations could be added for each hourly-averaged point; otherwise each point could be replaced by a box and whiskers that better show the dispersion of the raw data.

L724: Figure 3 caption should explain what the different marker colors and the shaded areas represent.

L731: Figure 5a | The 4th box and whisker plot (blue) should be labelled "fossil" and not "biomass" on the x-axis.

Supplementary Information

Table S2 would look better if numbers were aligned with column titles.

Figure S1: Add a scale on both maps. Topography should be indicated on the closer range map.

Figure S2 caption: "the modelled $b_{\text{abs}}(500 \text{ nm})$ (respectively, SSA) and the observed $b_{\text{abs}}(520 \text{ nm})$ (resp. SSA)". Right now, it reads like a ratio of the two parameters.

Figures S4, S5 and S6: What does each point represent? (daily average, other?)

Figure S9: "diurnal" should be replaced by "diel" (24-hour period). At the least, standard deviations could be added for each hourly-averaged point; otherwise each point could be replaced by a box and whisker that better shows the dispersion of the raw data.