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Comment on acp-2022-26

Anonymous Referee #2

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-RC1>, 2022

Review of "The impact of atmospheric motion on source-specific black carbon and the induced direct radiative effect over a river-valley region" by Liu et al.

In this paper, the authors describe the impact of different types of atmospheric transport and motion scales, from local to regional, on the black carbon concentrations in a city in China. I think the paper presents a few interesting results with implications also for the radiative forcing of black carbon particles. Therefore, I would recommend publications after a few aspects are clarified and the comments below are addressed.

General comment

- The site location should be described in more detail, and also earlier on. Some more comments on this issue are below.
- The English grammar and style could be quite significantly improved. A few examples of some issues are provided in the specific comments below, but many more instances are present in the paper. Maybe some editorial work by a native-speaking scientist could help improve the language and therefore clarity.
- The origin of the biomass burning BC is not well described or discussed. Is this agricultural biomass burning, wildfires, or residential biomass burning? Something else?
- The literature citations are a bit scarce and somewhat biased. A broader representation of the work published in the literature and relevant to the authors' work outside of their own work, would help.
- Maybe is my lack of familiarity with some of these aspects, but some of the data analysis methods (e.g., SOM, but not only) are not described in sufficient detail. The authors refer to existing literature, but a brief description of the methods' workings, input, outputs, limitations, etc. would help improve the clarity and broaden the audience of the paper.

Specific comments

Abstract:

- "Black carbon (BC) has a strong light absorption ability and is known as the second strongest light-absorbing substance in the atmosphere after CO₂" This is debatable.
- What does model refer to in "aethalometer model"?
- "chemical data and optical data" what kind of data?
- "The derived AAEs" over what wavelength range?
- "four featured atmospheric motions categories" what the four categories are remains a mystery until later, please provide a brief description here because the abstract should be self-contained.
- "The trajectory clusters" what trajectories? How were those determined?
- Lines 30-31: I don't understand the sentence "This study revealed the disproportional change between BC mass concentration and its DRE."
- Line 32: "It highlights..." what does "it" refer to? In general, this closing sentence reads awkward, and I would suggest rewording it.

Introduction:

- Light absorbing or agent with positive radiative forcing? The two whings are linked but not the same.
- Line 55: remove "at" before "to"
- Line 57: multiply -> multiple
- Line 62: Why the aerosol concentration controls the local scale motion?
- Line 64: diffuse -> disperse?
- Line 65: "decides" seems more to belong to an intelligent entity. Maybe "determines"
- Line 72: "river valley city" comes a bit out of the blue here, it might be good to provide a sentence with some background, like the general location, etc., even if that's then discussed in detail in the method section. Is the city specifically Baoji?
- Line 75: why the albedo makes the solar radiation uneven? Do they mean the reflected radiation? In general, I find this sentence awkward and unclear.
- The sentence starting on line 77 is also awkward and should be reworded.
- Line 80: eBC appears here without having been defined as equivalent BC. It has been defined only later, but it should be defined at its first appearance.
- Line 81: I believe the authors meant: "the contributions of fossil fuel combustion and biomass burning to eBC concentrations"

Method

- Line 88: Guanzhong Plain is where the river-valley city of Baoji is located, I guess? It

would be nice to say so right at the beginning.

- Section 2.1: a map of the region I think would help as figure 1.
- Line 94: dense population, provide some numbers such as the total population, and population density.
- Section 2.5 is quite confusing.
- Line 175: A ratio indicates a difference? That is confusing. Also, R is defined in 13 not as the ratio of L and S but as the ratio of the difference between S and L and S itself. Or is this a different R?
- Line 189: Again, if equation 13 is correct, then R is not the ratio of L to S but $1 - \text{the ratio of L to S}$. Same for line 191 (which seems a repetition anyway).
- Lines 192-193: this seems a bit of a circular argument (a tautology).
- Line 207: provide a citation.

Results and discussion

- Line 261: contain -> include
- Line 222: what is the default ratio in the model? And what model? OPAC?
- Line 230: at -> of?
- Lines 238-239: Provide some more background or at least some references
- Line 283: variations... varied... rephrase.
- Lines 293 – 294. Remove “New para here”
- Line 295: why did the biomass burning increase after 6 pm? Is it indoor biomass burning for cooking or heating, or is it some other biomass burning?
- Figure 3, caption: Explain the meaning of the gray and yellow areas even if that’s explained in the text.
- Line 344: can one try to verify this with the backtrajectory analysis, or satellite products. etc.
- Line 350: I would suggest briefly summarizing what the angle distance clustering method is and how it works even if that’s explained in detail in the cited paper.
- Lines 360 – 362: Rephrase this sentence, there are several awkward readability issues.
- Line 360: remove “at” before “in”
- Paragraph starting at line 405, specifically lines 411- 413: this is consistent with the higher MAC values.
- Caption of figure 5: explain what the different shadings represent. Also, x-axis label number four probably should be “DREeBCfossil, TOA” not “DREeBCbiomass, TOA”. It could be interesting to add another two panels with the equivalent calculations but in terms of efficiency to make more clear what is discussed in words in the paper.