

Review for paper:

“Measurement report: Formation of tropospheric brown carbon in a lifting air mass”

by

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General Comments:

This paper presents an interesting dataset to analyze the formation of tropospheric brown carbon on mountainous area from a field campaign performed at the mountain foot (MF) and mountain side (MS) of Mt. Hua, China. The in-depth analysis of this dataset provides some evidence of the formation of light-absorbing nitrogen-containing organic compounds at MS. However, from my point of view, there is a lack of information on dynamical circulation in the observation area. Moreover, it is not obvious for me that results obtained on the ground at different altitudes can be related to vertical transport in the upper troposphere.

Overall recommendation:

I recommend that the paper should be accepted for publication in Atmospheric Chemistry and Physics after major and specific revisions listed below.

Major Revisions:

My main concern is about the dynamics of the circulation of air masses on the mountainous area of observations. In such a complex terrain, it is not obvious that both sites are dynamically connected all along the day especially since the two sites are 8 km apart.

The present study presents results from observations at the ground. Even if one of the sites is 800 higher in altitude, I find it difficult to consider that the conclusions can be generalized to the upper troposphere.

Specific Revisions:

I recommend that all data used to discuss the formation of light absorbing NOCs during the air mass lifting process are limited to observations during the day when a circulation mainly driving by anabatic winds is established. I think results should be more significant in this way.

Please provide more details in legends of figures. No indications were given for the box plots on Figures 2 and 4, for the blue sky area on Figure 4, etc.

Please re-read the text of the manuscript and its supplement carefully.

Part 2:

- 2.1:
 - Could you please indicate the altitude of both sites (line 111)?
 - If you precise the instrument used at MS, please do the same for MF.
 - There is a contradiction: line 109 “PM2.5 with 4-hour interval” and line 115 “Hourly concentrations of PM2.5”. Could you please clarify this?
- 2.3: I do not understand how optical absorption of BrC was determined. Text S1 explained how the optical absorption is determined for WSOC. Did you assume that BrC is the light absorbing part of WSOC?

Part 3

- 3.1:
 - I do not understand this sentence “Light absorption of BrC at the two sites markedly increased with a decrease in light wavelengths.”

- Figure 2d: It is explained in text S2 that the PMF was applied to “the daytime samples from both sites together as one data matrix”. Could please tell me how sources appointment for the two sites were obtained?
- Lines 233-237: I disagree with this sentence. In Yang et al. (2023), the authors did not arrive at the conclusions that “such a vertical profile of BrC is globally prevalent in the upper troposphere”. Moreover, their vertical profiles shown in Fig. 7 were not in the upper troposphere. In the present study, measurements were obtained almost in boundary layer, thus it is not clear that the processes are similar than in Zhang et al. (2017) to reach such a conclusion.
- 3.2:
 - Line 246: “considerable” seems exaggerated, significant would be more accurate.
 - Lines 250-251: “indicating that additional NOCs were produced in the air mas lifting process.” I find this sentence too affirmative with no information about the dynamical circulation of air masses.
 - Lines 253-254 “20% higher than that at the MF site (Figure S5)”: I do not see that on Fig. S5.
 - Lines 254-255: Information about the dynamical circulation is missing to be so affirmative.
 - Lines 256-259: Please nuance. The positive correlation ($R^2=0.45$) is not strong.
- 3.3:
 - Line 279: A $R^2=0.57$ is not a strong correlation.
 - Line 297: the term “upper troposphere” is not correct.
- 3.4: As WSON is higher at MF than at MS during the day, does this mean that the contribution of light absorbing NOC is very important at MS compared to MF?

Part 4: conclusion should be revised according to my major concern above.