

**Referee Comments – Impacts of Thermodynamic and Dynamic Processes on the Vertical Distribution of Carbonaceous Aerosols: lessons from in-situ observations at eastern foothills of LiuPan Mountains, Loess Plateau**

(<https://doi.org/10.5194/egusphere-2025-3254>)

**General Overview:**

The manuscript (egusphere-2025-3254) presents an interesting study investigating the vertical distribution of light-absorbing aerosols based on in-situ observations over Liupan Mountains in China. The topic of this study falls within the scope of the journal Atmospheric Chemistry and Physics (ACP). The authors present data from field measurements and analyze the impacts of thermodynamic and dynamic processes on the vertical distribution of light-absorbing aerosols. The authors provide insights and helpful information for a better understanding of light-absorbing aerosols in the Loess Plateau of China and potentially other places with similar atmospheric environments. This manuscript is generally laid out well and shows its academic value. This manuscript is recommended to be published after addressing the concerns and comments below with minor revisions.

**Major Concern:**

- The definitions of the terms “UVPM”, “BC”, and “IRBC” in this study are not clear and thus might influence the interpretation of data and cause confusion for the readers. The terms are also used inconsistently throughout the manuscript, raising concerns of logical conflict in the study. In Line 20, UVPM seems to be the acronym for “ultraviolet particulate matter” while the other term “ultraviolet absorbing particulate matter” also appears to be the full form of UVPM in Line 605. More details are described as separate bullet points listed below.
- Lines 159 – 161: Is black carbon (BC) concentration measured at wavelength 880 nm denoted as BC or IRBC? From the context of the whole manuscript, it seems that BC represents the particle concentration measured at wavelengths 470 nm, 528 nm, 625 nm, and 880 nm, while IRBC represents only the particle concentration measured at wavelength 880 nm, and the particle concentration measured at wavelength 375 is denoted as UVPM. Please ensure consistency throughout the manuscript and avoid confusion for the readers.
- Lines 161 – 163: Where does this definition of UVPM come from? Please provide relevant citations or explicitly mention that it is specifically defined by this study as

the term “ultraviolet particulate matter” and “ultraviolet absorbing particulate matter” are not yet a standardized term in the literature. Please also provide the reason for using this term to convince the readers if using this term is necessary to be created as opposed to using the more commonly used brown carbon or dust aerosol when it comes to absorption. Based on the context of the whole manuscript, the term UVPM seems to be the total absorption contributed from dust, brown carbon, and black carbon at the wavelength 375 nm, but it would be great if this could be clarified by the authors.

- Lines 176 – 178: If only the absorption at wavelength 880 nm is considered as black carbon according to the statement in the previous section (Lines 159 – 161), why are the absorptions at multiple wavelengths (470 nm, 528 nm, and 625 nm) used for the calculation of light absorption coefficient of black carbon? Please revise the corresponding statements to avoid conflicts of logic throughout the manuscript.

#### **Minor Concerns:**

- Lines 156 – 158: Does this instrument “MicroAeth® MA350” attribute all light absorption to black carbon? How do the authors quantitatively distinguish black carbon from other light-absorbing aerosols? What is the corresponding uncertainty for this method to quantify black carbon?
- Line 183: Please cite the source of Equation 2.
- Line 200: Please cite the source of Equation 4.
- Line 203: Please cite the source of Equation 5.
- Lines 207 – 208: The definition of the term “planetary boundary layer (PBL)” should be provided when the term first appears in the text.
- Line 213: Please provide citations to support this statement “various methodologies exist for determining PBL height (PBLH)” or revise the text by simply describing the approaches used in this study. It is recommended to provide citations while stating that various methodologies exist.
- Line 227: Please cite the source of Equation 6.
- Lines 245 – 248: It would be great if this qualitative statement can be turned into a table for a quantitative comparison, which would make the argument more convincing and make this work more valuable and academically citable.

- Lines 253 – 254: Without showing the quantitative data for direct comparisons of emission inventories of air pollutants from daily human activities, it would be safer to use a more conservative statement like “probably lower” to ensure scientific rigor and avoid controversy.
- Line 288: It seems that only diurnal variations of IRBC rather than BC are shown.
- Line 290: Are the profiles for BC or IRBC?
- Line 295: The term IRBC is used here while referring to BC mentioned earlier (Line 290). It seems that IRBC only represents black carbon (BC) measured at wavelength 880 nm while the absorption measured at wavelengths 470nm, 528nm, 625 nm, and 880 nm are all considered as black carbon in this study. If this is the case, please revise the definition in earlier sections of this manuscript for consistency.
- Line 300: Are the profiles for BC or IRBC?
- Line 304: Is the BC here meant to be IRBC?
- Line 305: Is the UVPM-to-BC here meant to be UVPM-to-IRBC?
- Line 316 – 317: Could this change due to vertical mixing and dominance of black carbon? The disparity between UVPM and IRBC should not disappear at lower altitudes if the pollutants considered as UVPM mixed downward during the convection do not include black carbon. If UVPM is considered as the total absorption of dust, brown carbon, and black carbon, this reduction of disparity might indicate that the contribution of dust and organics (brown carbon) becomes less important, and IRBC is dominant during this period.
- Lines 321 – 324: This observation also indicates that the UVPM defined in this study is probably the overall contribution of black carbon, brown carbon, and dust aerosol. Please clarify the definition.
- The term “LT” is used in Lines 225 – 226 while the term “LST” is used in other parts of the manuscript. Please explicitly distinguish the difference between the two terms. Otherwise, please choose one and stick to it to ensure consistency and avoid confusion.
- Figure 3: It seems that IRBC rather than BC is shown in the figure. Please update the caption and revise relevant statements in the main text.
- Section 3.1.3: It seems that the BC used in this section should be IRBC. Please confirm.

- Lines 364 – 366: How are the weather conditions defined based on what parameters and what data? Please provide relevant information.
- Lines 375 – 377: Please provide citations of previous studies.
- Lines 407 – 408 and Lines 414 – 416: The potential-temperature gradient method is stated to yield accurate estimates at night and in the early morning in Lines 407 – 408. However, the potential-temperature gradient method is stated to overshoot the inversion top in Lines 414 – 416, which seems to be contradictory with the earlier statement of accurate estimates. Please revise the statements to clarify and avoid confusion.
- Figure 5: Why are the PBLH (Parcel) lines only shown in some of the panels in the figure while the PBLH (Gradient) lines are shown in all panels? Please clarify in the revision.
- Lines 504 – 505: Point sources have continuous emissions. How can they be linked to high concentrations only infrequently or attributed to the cause of infrequently occurred high concentrations under the same wind direction? Please provide supporting information or data to strengthen this statement.
- Lines 567 – 568: What about 14:00?
- Lines 570 – 572: Please double check the logic of this statement. It seems to be meant to contrast between thermodynamic and dynamic processes while the thermodynamic process is mentioned twice here.
- Figure S2: Is there a specific definition of the term “conventional air pollutants”? It would be great if the caption could be specifically listing the air pollutants shown in this figure.
- Figures S3 and S4: The terms “ascent” and “descent” are used in the main text and figure caption while the terms “rising” and “landing” are used in the figure legend, which are not consistent with each other. It would be great if the terminology could be consistent throughout the work.

#### **Technical Comments:**

- Line 23: The parameter “VTKE” seems to be a typographical error of “ $V_{TKE}$ ”.
- Line 413: The word “and” in front of the word “often” seems to be a typographical error and should be deleted.

- Line 637: The word “understanded” seems to be a typographical error of “understood”.