Reply to referee 1:

Referee Comment 1. Page 1 Line 14-15: "We introduce a new parameterized fitting function that captures the characteristic S-shaped aerosol profiles associated with boundary layer processes."

The current sentence sounds a bit too technical and vague for an abstract because it does not clearly say why the fitting function matters. Can you include a phrase that mentions justification on the physical meaning of the fitting parameters?

Authors' Response: We thank the reviewer for the comment, and we agree that the abstract should include more motivation.

Line 14 now reads: A compact framework for describing aerosol vertical profile shape is needed to examine factors that influence aerosol vertical distributions and to represent them in model parameterizations or remote sensing retrievals. We introduce a parameterized fitting function for characteristic S-shaped aerosol profiles, with fitted parameters that represent aerosol-layer depth and stratification strength.

Referee Comment 2: Page 7 Line 153-176: "Equation 1 is well suited for representing aerosol vertical profiles,…to the transition zone."

This is scientifically reasonable, but this section reads a bit too repetitive. The main idea is strong: the fitting function gives a compact way to describe aerosol profiles when aerosols are surface-originating and no elevated transported layer is present.

A few clarifications would make this section stronger. First, the text could more clearly state the range of conditions where the function is valid, especially excluding cases with elevated transported aerosol layers or multilayer structures. Second, the physical interpretation of each parameter could be shortened and connected more directly to observable features of the profile. Third, the choice to fix $\gamma = 0.3$ is reasonable for fit stability, but it should be justified with a brief sensitivity test or goodness-of-fit comparison (e.g., some numbers instead of 'good fits'). Finally, the section would benefit from a concise statement explaining how this fitted transition-zone height will be used later in the analysis.

Authors' Response: We thank the reviewer for the helpful comment on reducing the repetitiveness of this section, clarifying when Equation 1 is applicable, justifying the fixed value of γ, and clarifying how the fitted r_m will be used.

Line 176 now reads: Equation 1 provides a parameterization for aerosol concentration that decreases from the higher concentrations fixed near the surface to the cleaner air aloft through a single S-shaped transition. It allows for flexible control over the key observable features of the profile as shown in Figure 3. To arrive at this equation, we define the transition zone as the altitude range over which aerosol concentration drops most rapidly from a well-mixed lower layer to the cleaner background aloft. The *transition zone height*, r_m, represents the midpoint of

the transition zone and is obtained by fitting Equation 1 to measured aerosol vertical distributions. Although r_m can coincide with the top of the planetary boundary layer, we use it here strictly as a metric of aerosol profile rather than boundary layer height. In Equation 1, X_0 controls the aerosol concentration at the surface, X_f represents the cleaner background concentration aloft, and k constrains how rapidly the aerosol concentration changes within the transition zone. The variables γ and f affect how aerosol concentration decreases with height below the transition zone. The parameters r_m and k are later compared with boundary layer height and potential temperature gradients to examine how boundary layer structure relates to aerosol vertical distribution.

Line 188 now reads: In this study, γ is fixed at 0.3 to improve fit stability and reduce parameter trade-offs. Because γ and f both affect the profile curvature below the transition zone, allowing both parameters to vary can produce similar fits from different parameter combinations. Fixing γ reduces this trade-off, thereby providing more stable estimates of f and other parameters. To determine a fixed value to use for γ, Equation 1 was first fitted with γ allowed to vary for all 313 aerosol profiles collected at AMF-1 during the six-month analysis period. The median fitted γ was 0.334, so we selected 0.3 as a representative fixed value near the center of the fitted distribution (Figure S.9a). Fitting Equation 1 to the same profiles with γ fixed at 0.3 retained high goodness of fit, with a median R^2 of 0.980 (Figure S.9b).

A new figure is added to the supplement:

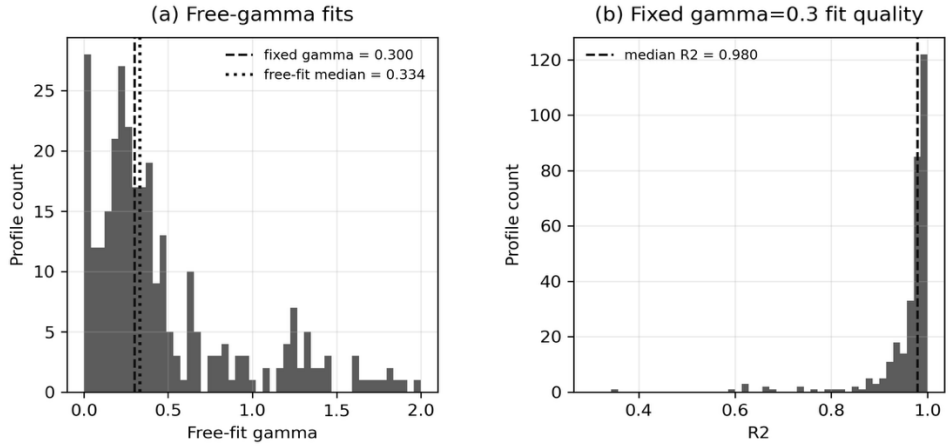


Figure S.9 Evaluation of the fixed γ value using 313 one-hour aerosol profiles centered on radiosonde sampling times between March and September 2022. (a) Distribution of fitted γ values obtained when Equation 1 was fitted with γ allowed to vary. The dashed line indicates the selected fixed value of 0.3, and the dotted line indicates the median free-fit value of 0.334. (b) Distribution of R^2 values obtained by fitting Equation 1 to the same profiles with γ fixed at 0.3. The dashed line indicates the median R^2 of 0.980.

Referee Comment 3: Equation 2: This is a reasonable extension of Equation 1. It clearly separates the background surface-driven aerosol profile from elevated layers caused by long-range transport or in-situ formation aloft. The Gaussian terms are a practical way to capture distinct layers without changing the interpretation of the original surface-anchored profile.
A few points could make the description stronger- The text could clarify how elevated layers are

identified before fitting, for example using local maxima in the lidar profile, threshold exceedance above the fitted background, or visual/manual selection. Otherwise, the Gaussian terms could appear somewhat subjective.

It is good that the method limits the number of Gaussian terms to avoid overfitting. However, the manuscript should briefly explain the criterion for choosing N = 0, 1, or 2, such as improvement in residuals, physical interpretability, or a minimum layer strength/width.

Authors' Response: We agree with the reviewer that it is important to discuss the identification of elevated aerosol layers and the fitting process of Gaussian peaks. We now state that elevated layers were identified by visual inspection of the lidar derived aerosol concentration profiles before fitting. Equation 2 was applied only when a distinct elevated aerosol layer was present above the surface-connected background profile and separated by a local minimum.

Line 202 now reads: Elevated layers were identified by visual inspection of the lidar-derived aerosol concentration profiles and were counted only when a distinct local maximum above the surface-connected profile was separated from the lower aerosol layer by a relative local minimum. Specifically for this study, we allow at most two Gaussian terms when elevated layers are apparent. The fitting function with N elevated aerosol layers is given by:

$$X_{\mathrm{aug}}(r) = \frac{X_0 - X_f}{1+f} \cdot \frac{1 + f e^{-\frac{r}{\gamma}}}{1 + \left(\frac{r}{r_m}\right)^{r_m k}} + \sum_{j=1}^{N} A_j \exp\left(-\frac{1}{2}\left(\frac{r - r_{c,j}}{\sigma_j}\right)^2\right) + X_f \qquad (2)$$

Line 208 now reads: The value of N was selected as the minimum number of Gaussian terms needed to represent visually distinct elevated layers, with N = 0, 1, or 2 corresponding to no elevated layer, one elevated layer, or two elevated layers, respectively.

Referee Comment 4: Page 9: Line 219-221: "The pronounced relative humidity dependence of the depolarization ratio in these layers, together with the HYSPLIT results, suggest a major contribution from hygroscopic sea salt aerosol."

The sea-salt interpretation should be stated more cautiously. The RH dependence, low-level Gulf trajectories, and depolarization behavior are consistent with hygroscopic aerosol such as sea salt, but they do not uniquely identify sea salt. Other hygroscopic aerosol types from marine or coastal sources may also contribute.

Authors' Response: Good point. We have revised the manuscript as follows:

Line 246 now reads: The pronounced relative humidity dependence of the depolarization ratio in these layers, together with the HYSPLIT results, is consistent with contributions from hygroscopic aerosol, such as sea salt aerosol or water soluble organic aerosol.

Referee Comment 5. Page 10: Line 238-240: "The thermal structure could also limit vertical mixing and help shape the observed aerosol layering. Aerosol radiative effects may, in turn, reduce solar radiation at the surface and therefore surface heating, strengthening the inversion and helping to maintain the layering."

Does this imply to aerosol direct radiative impacts? The sentence suggesting aerosol radiative effects may strengthen the inversion feels speculative. Unless this is supported by radiation measurements or model sensitivity tests, it may be better to say this is possible feedback rather than an inferred mechanism.

Authors' Response: It would be an overinterpretation of the results to draw conclusions about direct radiative impacts. Based on the Reviewer's comment, we acknowledge that this assumption was overly speculative. We have therefore removed that sentence and revised the text to focus on the observed potential-temperature structure and associated stability.

Line 266 now reads: The alignment of the sharp decrease in aerosol concentration with the potential-temperature inversion is consistent with the stable layer limiting vertical mixing and maintaining the observed aerosol stratification.

Referee Comment 6. Line 246-250: "BLH-LL, is 140 m in the early morning (10:59–11:59 UTC) and 320 m around midnight … that develops near the surface during nighttime."

The discussion of BLH-RiB versus BLH-LL is useful, but it should more clearly explain why they differ: BLH-LL captures the shallow nocturnal stable layer, while BLH-RiB and the fitted transition height may correspond more closely to the top of the residual aerosol layer or inversion-capped mixed layer.

Authors' Response: We agree that the difference between BLH-RiB and BLH-LL could be explained more clearly. We revised the text to clarify that the two methods are based on different diagnostics and can therefore identify different layer heights under nocturnal stable conditions.

Line 211 now reads:
2.4 Boundary layer height determination

Boundary-layer height may contribute to aerosol profile shape and therefore may covary with the fitted parameters in Equation 1. To compare the aerosol profiles with BLH, we use two BLH products from the Houston observational dataset from Lamer et al. (2024).

The first estimate, referred to as BLH-RiB, is derived from the bulk Richardson number, which combines virtual potential-temperature stratification and horizontal wind to characterize their influences on turbulent mixing (Stull, 2012). BLH-RiB is assigned to the lowest altitude at which (RiB) reaches 0.5 (Lamer et al., 2024).

The second estimate, referred to as BLH-LL, follows the potential-temperature approach adapted by Lamer et al. (2024) from Liu and Liang (2010). Each profile is first categorized as convective, stable, or neutral residual according to its near-surface potential-temperature structure. The boundary-layer top is then diagnosed using features appropriate to the identified regime. For convective and neutral-residual profiles, the method uses the increase in potential temperature from near the surface with its vertical gradient. For stable profiles, BLH-LL represents the top of

the shallow stable layer, identified from the minimum potential-temperature gradient (Lamer et al., 2024; Liu and Liang, 2010).

Line 274 now reads: As described in Section 2.4, BLH-RiB and BLH-LL are based on different measurements and criteria. BLH-RiB is defined using a bulk Richardson-number threshold calculated from virtual potential-temperature and wind profiles, whereas BLH-LL is determined from regime-specific features of the potential-temperature profile alone. While BLH-RiB remains near the ~1 km inversion described above, BLH-LL is much lower, 140 m in the early morning (10:59–11:59 UTC) and 320 m around midnight (05:00–06:00 UTC), consistent with a shallow nocturnal stable boundary layer near the surface. The two BLH estimates agree more closely in the early afternoon (17:00–18:00 UTC) and early evening (23:00–00:00 UTC). This separation between the shallow nocturnal BLH and the higher inversion is consistent with the formation of a residual layer. Aerosols that accumulate within the deeper daytime boundary layer often remain suspended above the much shallower nocturnal layer, forming a residual layer at night.

Referee Comment 7: Page 11. Line 271-272: "Figure 6b, which shows larger depolarization ratios in the 0-2 km and 2-4 km ranges, separated by a layer of smaller depolarization ratio in between."

Looks like there is some separation between the two layers instead of 0-2 and 2-4, I see more like 0-2 and 2.5-4. (between the low-level aerosol layer and the elevated layer). Please clarify.

Authors' Response: The referee is right to point out that there is separation between the two layers. We have revised the manuscript to distinguish the lower aerosol layer from the elevated aerosol layer and changed the elevated-layer range from 2–4 km to 2.5–4 km.

Line 301 now reads: An elevated aerosol layer between approximately 2.5 and 4 km is visible in Figure 6b, which shows larger depolarization ratios in the 0–2 km and 2.5–4 km ranges, separated by a layer of smaller depolarization ratio in between. The elevated aerosol layer becomes more distinct in the evening hours and persists into the night. A similar elevated layer between around 2.5 and 4 km is also faintly visible in the backscatter signal of Figure 6a.

Line 342 now reads: In addition to the low-level aerosol structure discussed above, elevated aerosol layers between 2.5 and 4 km can be seen in early evening (Figure 7c) and at midnight (Figure 7d).

Referee Comment 8. Figure 7: Could you please explain why BLH-RiB and BLH-LL do not agree in the first and 4th panels?

Authors' Response: As we described above, BLH-RiB is diagnosed using a bulk Richardson number, and BLH-LL is diagnosed using the potential-temperature profile. We add a sentence at the end of the paragraph to discuss the difference.

Line 339 now reads: In addition, the disagreement between BLH-RiB and BLH-LL in Figures 7a and 7d reflects the different sensitivities of the two BLH diagnostics under stable nighttime conditions.

Referee Comment 9: For both the cases: For all cases, it would be helpful to discuss the surface aerosol concentrations together with the vertical mixing and boundary-layer dynamics in more detail. The elevated layer above ~2.5 km appears to be associated with long-range transported aerosols. How much of this aerosol is mixed downward into the boundary layer, and how deep does the homogeneous mixing extend?

Comparing Figures 7 and 10, the aerosol vertical profiles are clearly different, which is useful for the case-study comparison. The case in Figure 10 appears to show cleaner aerosol conditions at higher altitudes. Can these profiles capture differences in synoptic aerosol regimes? For example, if there is synoptically driven dust loading, which is common in summertime, would these vertical profiles be able to identify and represent that elevated dust layer? For. e.g., Figure 7 could be compared with the vertical dust distributions from the columnar dust MERRA-2 analysis products.

Authors' Response: We acknowledge the referee's suggestion to discuss the relationship between surface aerosol concentrations, vertical mixing, and elevated aerosol layers in more detail. We revised the case-study discussion to clarify that the lidar-derived profiles can show whether an elevated layer remains separated from or begins to merge with the lower aerosol layer. For the 21–22 July case, the elevated layers between approximately 2.5 and 4 km remain separated from the lower layer by a region of lower aerosol concentration, indicating limited merging during the observed period. However, these profiles alone cannot quantify the amount of aerosol mixed downward.

Following the referee's suggestion, we examined MERRA-2 dust mass mixing-ratio profiles for the three case-study periods, as shown in the figure below. For the 21–22 July case, MERRA-2 shows dust extending from approximately 2 to 4 km, consistent with transported dust being a possible contributor to the elevated aerosol layers. However, the spatial and vertical resolution of MERRA-2 is too coarse to resolve the layer structure observed by the lidar or quantify downward mixing. We therefore present this comparison as a qualitative review in the response but do not include it in the revised manuscript or Supplement. A systematic comparison of lidar observations with different MERRA-2 aerosol fields could be an interesting direction for future research and could provide additional insight into the sources and transport of elevated aerosol layers. The focus of this study is still the surface connected aerosol profile and its relationship to boundary-layer dynamics. We fit the elevated layers so that r_m and k describe the lower aerosol transition.

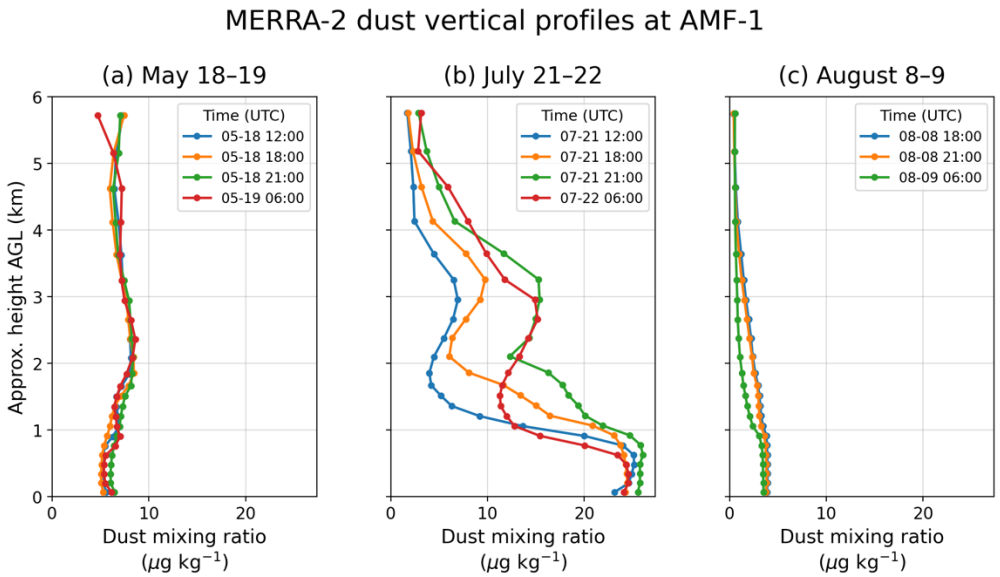


Figure R1. Modern-Era Retrospective Analysis for Research and Applications, Version 2 (MERRA-2) dust mass mixing-ratio profiles at the model grid cell nearest the AMF-1 site during the three case-study periods: (a) 18–19 May, (b) 21–22 July, and (c) 8–9 August 2022. Curves represent profiles at the UTC times listed in each panel. Altitude represents approximate height above ground level derived from the MERRA-2 model layers (GMAO, 2015).

Line 342 now reads: In addition to the low-level aerosol structure discussed above, elevated aerosol layers between 2.5 and 4 km can be seen in early evening (Figure 7c) and at midnight (Figure 7d). These layers remain separated from the lower aerosol layer by a region of lower aerosol concentration, indicating limited merging between the elevated and lower layers during this period. These layers also coincide with a high-RH layer aloft and are bounded by upper-level inversions, consistent with stratification helping maintain vertical separation. While these profiles suggest distinct layers, they cannot entirely rule out some degree of downward mixing; furthermore, the co-location with RH and inversions does not establish causality or rule out a shared driver.

Referee Comment 10: Page 14, Line 331-332: “The gradual change in 1-2 km backscatter around 16:00-02:00 UTC (18–19 May) may indicate some degree of vertical mixing.”

This is hard to see in the plot. It looks more like a clean and vertically well mixed in the types of the aerosols as indicated by the depolarization ratio, so it would help if the aerosol concentrations in the ground are also stable and have less variation in the diurnal cycle. Can you discuss more on the diurnal cycle of the aerosol concentration measured in the ground?

Authors’ Response: We agree with the referee that the original statement was not sufficiently specific and was difficult to verify directly from Figure 9. We revised the text to describe the feature more cautiously as a smoother transition between the low-level aerosol layer and air aloft, supported by the lack of a distinct depolarization separation. The surface and low-level aerosol concentrations are discussed in the following paragraph associated with Figure 10, where we describe their increase during boundary-layer development and subsequent decrease after the sea-breeze-driven air-mass transition.

Line 368 now reads: As seen in Figure 9, no notable elevated aerosol layers are observed on this day. The NRB field shows some variability near 1 km throughout the day, but the depolarization ratio does not show a distinct separation at this altitude. This suggests that the aerosol structure is more continuous than in the previous cases. Together with the weaker inversion shown in Figure 10, this pattern is consistent with weaker stratification and more effective vertical mixing within the lower atmosphere.

Referee Comment 11: Page 17, Line 394-396: "A profile was classified as having an elevated layer when it showed a distinct local maximum in aerosol concentration above the low-level aerosol layer and was separated from it by a relative local minimum."

This is a very impressive. Out of the 144 cases, how many days were classified as having elevated aerosol layers? This information could be useful for future model simulations, particularly for understanding how elevated aerosols contribute to the regional and seasonal aerosol distribution in the vertical dimension. Perhaps, there could be statistically relevant vertical profiles with the averages/stds in concentrations for different weather/aerosol regimes.

Authors' Response: The elevated aerosol layers were visually identified rather than automatically detected. 34 out of 157 selected profiles are classified as containing elevated aerosol layers and are fitted with Equation 2. In addition, we apologize that the number of retained profiles was not updated correctly in the original manuscript. The correct number is 157 retained profiles from 313 profiles, not 144. Among these 157 profiles, 34 were classified as containing elevated aerosol layers. Because elevated layers may be present in some profiles but not others collected on the same day, we report the number of classified profiles rather than the number of days.

Line 431 now reads: Profiles that were first fitted with Equation 1 with $R^2 < 0.98$ and were visually classified as containing an elevated aerosol layer were then refit using Equation 2 with one or two Gaussian terms. A profile was visually classified as having an elevated layer when it showed a distinct local maximum in aerosol concentration above the low-level aerosol layer and was separated from it by a relative local minimum. After model selection, only profiles with final fit quality $R^2 > 0.98$ were retained for the statistical analysis to ensure that the fitted parameters represented well-resolved profile structure. Overall, 157 of 313 profiles met this strict quality criterion. 34 out of 157 selected profiles are classified as containing elevated aerosol layers and are fitted with Equation 2.

Referee Comment 12. Section 3.5. Could elevated transported aerosol layers or humidity-driven aerosol growth bias the inferred relationship between stability and k? This is important because aerosol layering may not always be controlled by local thermodynamic structure alone, especially during long-range transport or strong hygroscopic growth conditions. How sensitive is the relationship between k and $d\theta/dz$ to the choice of ±100 m and the 100 m Gaussian smoothing? This directly tests whether the result is physically robust or partly an artifact of methodological choices.

Authors' Response: Yes. Although the manuscript only explored the relationship between stability and k, it is possible that other factors could influence the value of k. Factors could include transported aerosol layers entrained into the boundary layer mixing, boundary layer growth, collapse, and residual layer formation as discussed in the manuscript.

To address the referee's methodological question, we performed sensitivity tests by varying the Gaussian smoothing FWHM and the search-window width around r_m. The regression slope remained positive across the tested choices, although its magnitude and R^2 varied. This result indicates that the sign of the relationship is robust while its strength depends on the operational definition of local stability. The baseline 100 m choice was not selected to maximize R^2. The results have been added to the Supplement as Figure S.13, and Section 3.5 has been revised as follows.

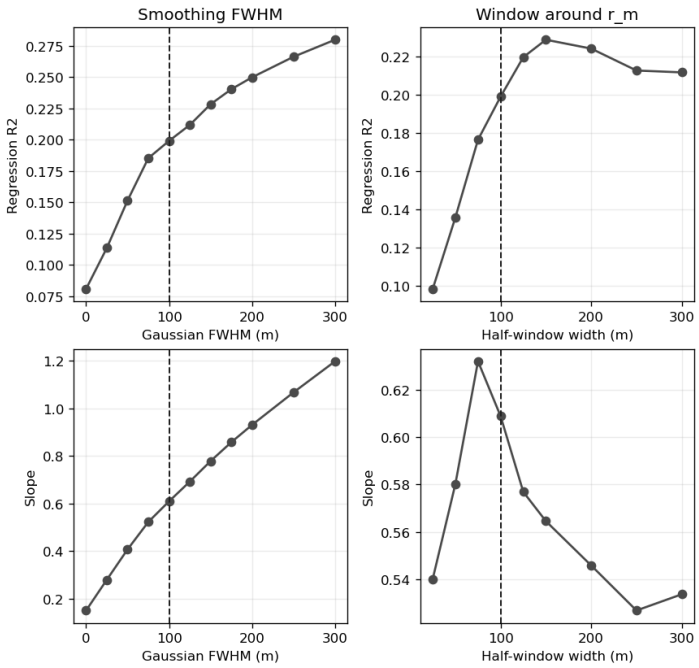


Figure S.13 Sensitivity of the relationship between aerosol transition sharpness k and local potential-temperature gradient to the definition of the stability metric. Left panels show how the regression R^2 and slope change when the Gaussian smoothing full width at half maximum (FWHM) applied to the radiosonde potential-temperature profile is varied. Right panels show how the regression R^2 and slope change when the half-window width used to search for the local maximum dθ/dz around the fitted transition-zone height r_m is varied. Dashed vertical lines indicate the baseline 100 m smoothing FWHM and ±100 m search window used in the main analysis. The positive relationship remains across the tested parameter ranges, while the regression strength and slope vary with the operational definition of local stability.

Line 505 now reads: A statistically significant ($p << 0.01$) and limited positive correlation ($R^2 = 0.20$) is found between the potential temperature gradient at r_m and the curve-fitted transition sharpness parameter k. Sensitivity tests using different Gaussian smoothing scales and search-window widths show that the positive relationship remains, although the slope and R^2 vary with

the operational definition of the local stability metric (Figure S.13). This result shows that the local atmospheric stability near r_m appears to contribute to the shape of the aerosol profile but does not fully define it. A possible physical explanation is that stronger stability can suppress vertical exchange across the aerosol transition zone, allowing a sharper aerosol concentration gradient to persist. In contrast, weaker stability may permit more gradual mixing between the lower aerosol rich layer and cleaner air aloft, resulting in a more gradual transition zone and smaller k values. Because the correlation is limited, we interpret dθ/dz near r_m as a partial constraint on aerosol stratification rather than as the only control on k. Additional variability may arise from transported aerosol mixing with the lower layer, residual uncertainty in the hygroscopic-growth correction, and the history of boundary-layer growth, collapse, and residual-layer formation.

Referee Comment 13. Section 3.6. This question might be out of the scope of the current work; however, it could be important to help understand some of the discrepancies in predicted profiles.

These analyses are based on bulk aerosol concentrations. Do you think the results, or the prediction of the vertical profiles, would change if aerosol size distributions were considered? For example, would the relationships differ if accumulation-mode and coarse-mode particle number concentrations were analyzed separately? It would be interesting to see.

Authors' Response: We thank the reviewer for this question. At this time, we expect that the results could differ if information on vertical variations in aerosol size distribution were available. However, the present retrieval is based on micro pulse lidar backscatter constrained by ground-based aerosol measurements, and it does not resolve size-resolved aerosol vertical distributions.

Referee Comment 14. Abstract: The abstract could be strengthened by presenting the main results more directly.

While it provides a helpful overview of the motivation and scope of the study, the specific findings are somewhat understated. I recommend revising the abstract to clearly state the key results, including the observed links between aerosol vertical profiles, BLH, static stability, and the predictive capability demonstrated in the study.

Authors' Response: Good point. We have revised the abstract:

Aerosol vertical distributions are a major source of uncertainty in quantifying aerosol–cloud–climate interactions. Using observations collected during the 2022 TRACER campaign in Houston, Texas, we investigate how atmospheric boundary layer dynamics shape the vertical structure of aerosol populations in a coastal urban environment. Our lidar retrieval combines micropulse lidar backscatter with ground-based aerosol measurements to obtain aerosol concentration profiles. A compact framework for describing aerosol vertical profile shape is needed to examine factors that influence aerosol vertical distributions and to represent them in model parameterizations or remote sensing retrievals. We introduce a parameterized fitting

function for characteristic S-shaped aerosol profiles, with fitted parameters that represent aerosol-layer depth and stratification strength. This parameterization is applied to case studies demonstrating how boundary-layer dynamics, including turbulent mixing, capping inversion strength, and sea-breeze circulations, influence aerosol vertical distributions. Case studies show that aerosol concentrations decrease rapidly near strong capping inversions, the depth of the lower aerosol layer changes with boundary-layer growth and collapse, and sea-breeze passage produces strong coastal–inland differences as maritime air replaces continental aerosol. Analysis of the six-month dataset shows weak but statistically significant positive relationships between daytime boundary layer height and fitted aerosol layer depth, and between the local potential temperature gradient near the aerosol layer top and fitted stratification strength parameter. Finally, we demonstrate an approach for estimating aerosol profile shape from boundary-layer height and potential-temperature gradients using the fitted parameterization. These results show that this parameterization provides simple, interpretable diagnostics for linking aerosol profile shape to boundary-layer dynamics.

Minor comments:

Referee Minor Comment 1: Page 6. Figure 3. Replot the figure with proper y-axis labeling. Please show the y limits and major and minor ticks in both the axes.

Authors' Response: The figure has been updated:

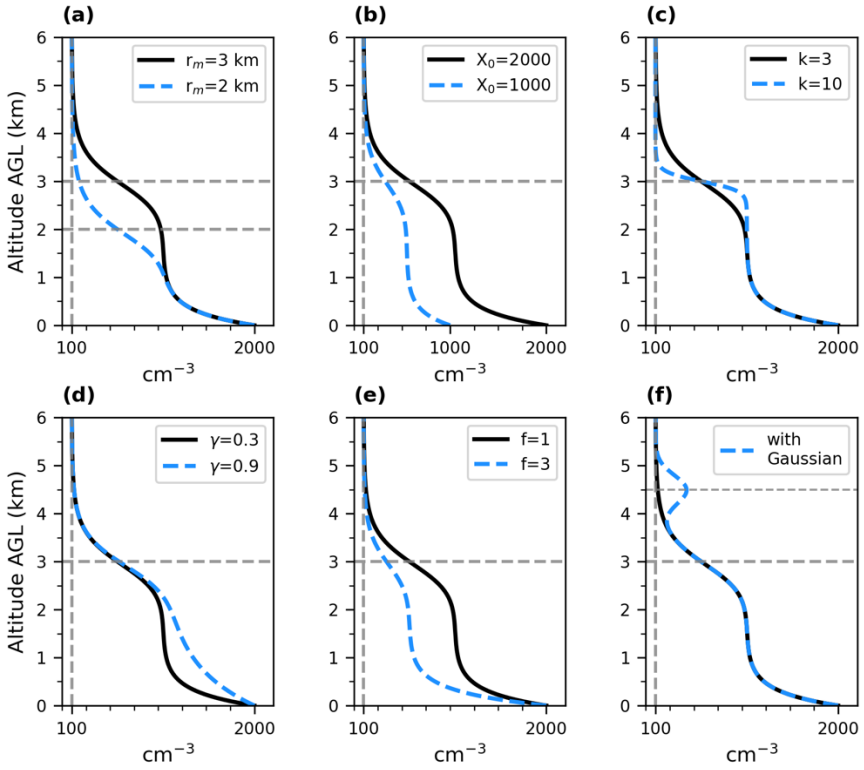


Figure 3 Effects of individual fitting function parameters on the aerosol vertical profile shape. Each panel varies one parameter while others are held constant. Solid black lines show the reference profile, and dashed blue lines show the parameter modified profiles. Horizontal gray dashed lines mark transition zone height r_m. Vertical gray dashed lines denote a constant

concentration of 100 cm^{-3} (a) r_m shifts the height of the transition zone; (b) X_0 sets the surface concentration; (c) changing parameter k changes the sharpness of the transition; (d) changing parameter γ changes the shape of near surface decline in concentration; (e) changing parameter f influences the magnitude of the exponential decay; and (f) adds a Gaussian peak to represent an elevated aerosol layer.

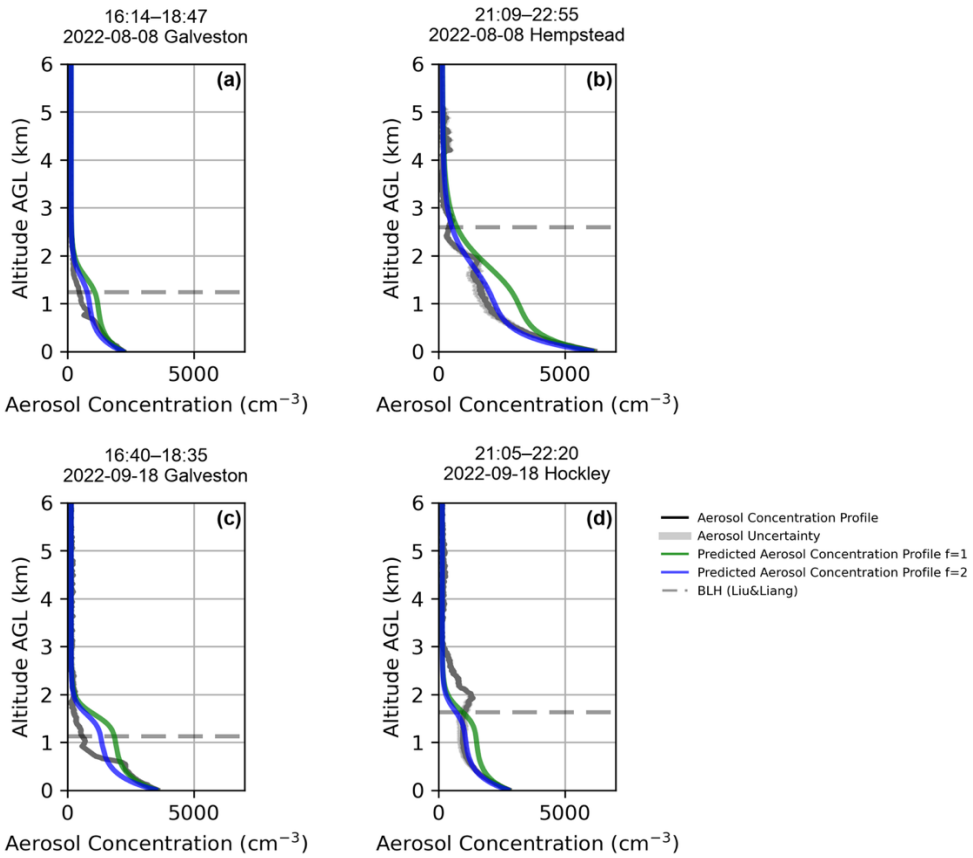
Referee Minor Comment 2: Figure 10: Can you please explain what was the motivation behind choosing a very wide variations in the averaging window and the frequency (even in Figure 13)?

Authors' Response: The averaging windows are longer for the TAMU Mini-MPL profiles because the portable Mini-MPL has a weaker laser and requires longer averaging to achieve signal-to-noise ratios comparable to MPL. The windows were still chosen to remain within periods of similar boundary-layer and aerosol conditions.

Line 385 now reads: The TAMU profiles use longer averaging windows because the lidar measurements required longer temporal averaging to obtain enough cloud-free profiles for the retrieval.

Referee Minor Comment 3: Figure 13: Is the dark gray line showing aerosol concentration? Could you please clarify that in the legend?

Authors' Response: Yes, the dark gray line shows aerosol concentration profile. The legend has now been updated as shown below:



References:

Global Modeling and Assimilation Office (GMAO): MERRA-2 inst3_3d_aer_Nv: 3D, 3-hourly, instantaneous, model-level, assimilation, aerosol mixing ratio V5.12.4 (M2I3NVAER 5.12.4), Goddard Earth Sciences Data and Information Services Center (GES DISC), Greenbelt, MD, USA [data set], https://doi.org/10.5067/LTVB4GPCOTK2, 2015.