The authors thank the reviewers for their comments. We believe we have addressed all concerns.

Reviewer 1:

Summary: This study shows deep research on the surface flux estimates from different numerical approaches and compares the observation, eddy covariance, simulated instrumentation and the theoretical flux-profile method results have been provided, turbulent transport impact on aerosol particles found has estimated. This article could be accepted after minor revisions.

L14: MABL(marine atmospheric boundary layer) first-time appearance should add the full name.

Thank you for catching this acronym introduction before the full name. We have now added the full name in the abstract.

L31: Coarse mode aerosols have many influences focusing on lighting and also growth larger contribute to air pollution, related reference also includes the following articles:

Pan, Z., Mao, F., Rosenfeld, D. et al. Coarse sea spray inhibits lightning. Nat Commun 13, 4289 (2022). https://doi.org/10.1038/s41467-022-31714-5.

Lee, S.- H., Gordon, H., Yu, H.,Lehtipalo, K., Haley, R., Li, Y., &Zhang, R. (2019). New particle formation in the atmosphere: From molecular clusters to global climate.Journal of Geophysical Research:Atmospheres,124, 7098–7146. https://doi.org/10.1029/2018JD029356

Wu, Hao & Li, Zhanqing & Jiang, Mengjiao & Liang, Chun-Sheng & Zhang, Dongmei & Wu, Tong & Wang, Yuying & Cribb, Maureen. (2021). Contributions of traffic emissions and new particle formation to the ultrafine particle size distribution in the megacity of Beijing. Atmospheric Environment. 262. 118652. 10.1016/j.atmosenv.2021.118652

We agree on the additional motivating factors for the study of coarse mode aerosol particles. We have added these references to the introduction in line 29-30.

L53：Atmospheric stability is a key parameter impact on particle transport, using Monin–Obukhov stability theory (MOST) has many progress the related reference: Irwin JS and Binkowski FS. Estimation of the Monin-Obukhov scaling length using on-site instrumentation. Atmos Environ 1981; 156: 1091–4.

Srivastava P and Sharan M. An analytical formulation of the Monin–Obukhov stability parameter in the atmospheric surface layer under unstable conditions. Bound-Layer Meteor 2017; 165: 371–84.

Thank you for these references. We agree that atmospheric stability (through MOST) has been a critical backbone for detailed analysis on particle transport. This reason is our primary motivation to explore the sensitivities of sampled net aerosol flux through different stability conditions (unstable, neutral). We have added these references in line 55-56.

L58: “other field-based studies” many launched in the atmospheric boundary layer found that interaction between aerosol exists in the atmospheric boundary layer, could relate to：

Li Z, Guo J and Ding A et al. Aerosol and boundary-layer interactions and impact on air quality. Natl Sci Rev 2017; 4: 810–33.

Lauros J, Sogachev A and Smolander S et al. Particle concentration and flux dynamics in the atmospheric boundary layer as the indicator of formation mechanism. Atmos Chem Phys 2011; 11: 5591–601.

Thank you for these references. These examples of additional field-based studies strengthen the overall message of the importance in capturing the vertical distribution of aerosol particles. We have added these references in line 60.

L101：direct numerical simulation(DNS) and other models also can simulate flux measurements has a high correlation to the aerosol turbulence interaction(ATI).

Chen S, Yau MK and Bartello P et al. Bridging the condensation–collision size gap: a direct numerical simulation of continuous droplet growth in turbulent clouds. Atmos Chem Phys 2018; 18: 7251–62.

Eaton JK and Fessler JR. Preferential concentration of particles by turbulence. Int J Multiph Flow 1994; 20: 169–209.

Li D,Wei A and Luo K et al. Direct numerical simulation of a particle-laden flow in a flat plate boundary layer. Int J Multiph Flow 2016; 79: 124–43.

WeiW, Zhang H andWu B et al. Intermittent turbulence contributes to vertical dispersion of PM2.5 in the North China Plain: cases from Tianjin. Atmos Chem Phys 2018; 18: 12953–67.

Thank you for providing these references. We have added them to the manuscript as examples of numerical models that explore flux measurements and their correlation to the aerosol turbulence interactions in line 103-104.

L153: “while K(xp) is the average subgrid momentum diffusivity obtained from the LES model, interpolated to the particle location”, this parameter should provide more methods or pathways to explain how to get it.

We have now provided more detail on the pathways to obtain the interpolated subgrid momentum diffusivity K(xp), which is used through a trilinear method. This is amended in lines 155-156.

L214: the concentration vertical distribution of aerosol has rare research, but we can find some evidence based on some UAV measurements, such as:

Mehta, Manu & Khushboo, Richa & Raj, Rahesh & Singh, Narendra. (2020).

Spaceborne observations of aerosol vertical distribution over Indian mainland

(2009-2018). Atmospheric Environment. 117902. 10.1016/j.atmosenv.2020.117902.

Kemppinen, Osku & Laning, Jesse & Mersmann, Ryan & Videen, Gorden & Berg, Matthew. (2020). Imaging atmospheric aerosol particles from a UAV with digital holography. Scientific Reports. 10. 16085. 10.1038/s41598-020-72411-x.

Thank you for providing these references. We have modified the manuscript to include this detail of UAV measurements capturing vertical concentration profiles in line 218-219.

L338: "The disaggregation technique employed here demonstrates the importance of areal coverage and directional sampling when calculating aerosol mass flux", the aerosol mass flux method and parameter setting in L286, and the reference?

We believe this comment is asking for clarity regarding the disaggregation technique sentence in line 338, and to what extent it is tied to the method mentioned in the literature cited in L286. Our sampled flux method is very similar to that of both Suhring et al. (2019) and Hutjes et al. (2019), in that we take horizontal sub-regions and compute the local net flux for each sub-region. We have repeated the citations from line 286 to line 343.

L495: "a horizontal average over the entire domain" how to deal with the surface layer and the ABL?

In the context of the theoretical flux-profile method, we believe the reviewer is interpreting the "horizontal average over the entire domain" as an average throughout the entire vertical extent. The flux-profile analysis considers the horizontal average over the entire domain for a **single vertical gridpoint** (see Fig 11(a): LES legend for resolution detail), including into the surface layer.

Reviewer 2:

We thank you for your comments and kind words regarding the importance of the study. We hoped to have addressed your concerns, mainly the Github link error.

General comments:

1. Codes on Github is not accessible: The URL for the codes used in this study jumps to the webpage: https://github.com/RichterL, and I cannot find the NTLP model there. If you decide to use Github as the code repo, please also attach a license (e.g., GPLv2/v3) to it.

Thank you for addressing this. It seems that the original LaTeX output has cut off the rest of the URL and has only shown https://github.com/RichterL; this should actually be https://github.com/RichterLab/NTLP/tree/EL-ABL. We have fixed this by putting a new line which shows the full link. Additionally we have attached a GPLv3 license to the code. We hope this output comes out clear on your end.

Specific comments:

1. Interpretation of Figure 9:

In Figure 8, we generally see the uncertainty grows with height. For example, Figure 8(c)-(d) shows shapes of upside-down triangles. Figure 9 shows the inferred surface fluxes from Figure 8 by using Equations (6)-(7). In Figure 9(c)-(d), the uncertainty shapes are no longer upside-down triangles. In Figure 9(c), the level with maximum uncertainty is now at $\frac{z}{z_{inv}} = 0.7$. Can you explain why this is the case? Same question for Figure 9(d).

This shape difference between Figure 8 and Figure 9 is primarily due to the effect of the 50 micron particles affecting the assumption of linearity of the turbulent flux (see Fig. 3(a)). As the curvature of the net turbulent flux skews downward, this effect results in the curvature behavior in the extrapolated surface flux (Figure 9), with the maximum uncertainty at $\frac{z}{z_{inv}} = 0.7$. We have added a sentence that describes the changes in the shapes between the local net turbulent flux (Figure 8) and the extrapolated surface flux (Figure 9) in line 365-366.

2. The schematic figure for your deployment of stationary and moving probes (L390-400): It would be great if you can provide a schematic figure showing the locations of the probes. For the moving probe, you can draw it as a moving line with its arrow head indicating its moving direction. Please also mark the direction of flow.

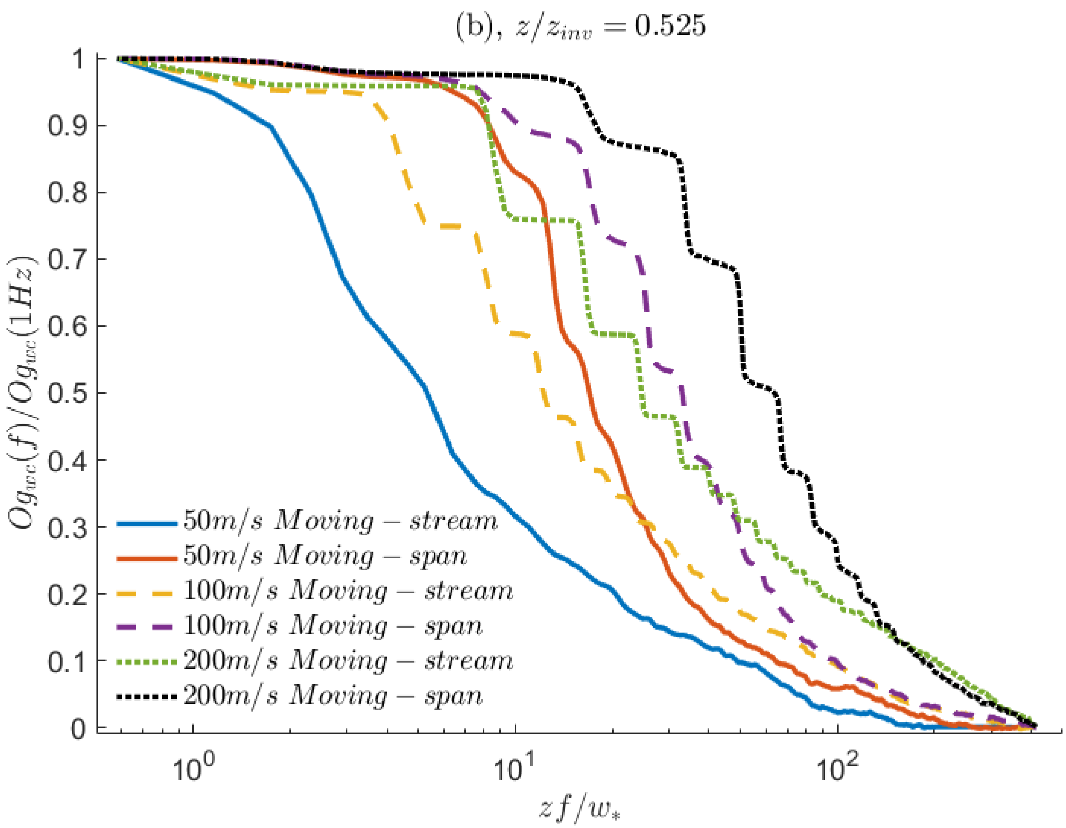
This is a great suggestion. We have modified the Ogive curve figure (Fig. 10) that now includes a smaller graphic of Figure 4 with examples of how we used the simulated instrumentation of moving- and stationary- probes. Additionally, we have added a sentence regarding a representative schematic in the manuscript at lines 405-406.

3. Calculation related to ogive probes.
    1. L 394: “at a user-defined speed of 50m/s”. Is there any justification for using this speed 50m/s? What is the normal speed of planes in the field campaign?

Yes, there is justification for the user-defined speed of 50m/s, and we have accidentally forgotten to mention its importance. We emulated the Center for Interdisciplinary Remotely Piloted Aircraft Studies (CIRPAS) twin otter research aircraft. Their wind speeds reported on the airborne science NASA website was 100 knots, which is equivalent to around 50m/s. We have now put in parenthesis a brief justification of the wind speed in line 401.

2. In Figure 10, you show the ogive curves for the moving probe in stream- and span-wise directions. I assume those calculations are based on a speed of 50m/s. Is it possible to calculate another two lines using a speed either higher or lower than 50m/s?. This will enable readers to know how moving speed affects the convergence rate.

   Yes, the moving probes were based on a user-defined speed of 50m/s. We have run additional simulations that were indicative of the DC-8 research aircraft. Its wind speed is upwards of 230m/s. By keeping all of the configuration the same, and adjusting for the moving probe to 100m/s and 200m/s, we recomputed the Ogive curves shown here:



   The figure setup is almost identical to Figure 10(b), without the stationary probes nor the newly schematic figure. The base 50m/s moving probes are displayed with full lines to be depicted as the control case. By considering a single direction (whether by stream or spanwise-moving probe), the faster a probe moves, the contribution of the total net flux moves toward higher frequencies. As a result, sampling faster through the boundary layer requires less sampling times to adequately capture the total net flux of aerosol particles. The “stair-case” nature of the Ogive curves is due to the temporal resolution for a frequency of 0.5 seconds (the timestep of our simulations). We have amended this information into the Simulated Instrumentation section in line 428-433.

4. Figure 13: the highly varying predictive ranges of flux at high levels (\frac{z}{z_{inv}}>0.9): Compared to the low level where the oscillation of flux range is of small amplitude, the flux range changes dramatically at high levels. Is it due to your LES setting, e.g., too few vertical levels in high altitudes, or low model top? Any explanation for this feature?

   This high level of oscillations in the flux variation near the boundary layer top is due to the particle number affecting statistical convergence. With a neutral boundary layer setting, the aerosol particles take much longer to reach the boundary layer top, especially with larger sizes (see comparison in Figure 12d between stabilities). For the flux range to be statistically converged at the boundary layer top requires too high of a simulation cost; we believe this cost is unnecessary in answering questions about obtaining a representative source function. We have appended this response to the manuscript in lines 549-550.

Technical corrections:

L383: “A common technique in field measurements, an ogive curve O_g_{wc}(f_0) represents a running integral…”: broken sentence?

We have carefully read this sentence and its overall placement in the Simulated Instrumentation section and believe it is currently not broken. The interpretation of a broken sentence might stem from the mathematical expression of the Ogive curve, which is then supplied with a definition of the covariance to finish the sentence. Nothing has been changed from the manuscript.