Response to Reviewer 1

EGUSPHERE-2025-2659

" Implications of Sea Breeze Circulations on Boundary Layer Aerosols in the Southern Coastal Texas Region."

Thank you for the opportunity to submit a revised version of our manuscript. We sincerely appreciate the reviewers' time and effort in providing thoughtful comments, insightful questions, and constructive suggestions. Their feedback has been invaluable in improving the manuscript's clarity, rigor, and overall quality.

Below, we provide a point-by-point response to the reviewers' comments and concerns. Reviewer comments are shown in blue, our responses are provided in black, and the corresponding revised statements in the manuscript are highlighted in *black italics*.

General Comments:

This paper presents an overview of aerosol and (to a lesser extent) meteorological changes associated with the passage of a sea-breeze front at two ARM sites during the DOE TRACER field campaign in the Houston region of SE TX during Summer 2022. WRF-Chem simulations supplement the point-based observational analysis. In general, the paper is largely descriptive (rather than explanatory) of broad changes in aerosols, providing analysis of before/after SBF passage changes. A key finding of the paper is the number and relative frequency of SBF passage events where aerosols increase, decrease, or stay the same during the SBF passage. As a general description of the field project and presumably regional climatology this paper has value. Where the paper lacks is in rigorous scientific investigation of the reasons why there are differences between sites or days that lead to increases vs. decreases in aerosols. The paper also seeks to tie changes in aerosol to changes in cloud microphysics and aerosol indirect and direct radiative effects. While these are interesting questions, there is not much depth to the analysis and it feels rather tacked on, and these topics may be better suited by separate more detailed analysis in other papers. I think a reframing of the paper that provides a detailed analysis of each of the three case study days (July 10, July 17, August 16) where the three regimes are observed that seeks to analyze air trajectories differences in SBF meteorology and timing on these days, and the factors that lead to different antecedent aerosol conditions would be more of more interest.

Finally, two recent papers in the literature focus on very related meteorological (Sharma et al. 2024 https://doi.org/10.1175/MWR-D-23-0243.1) an aerosol changes (Thompson et al. 2025 https://doi.org/10.1029/2025JD043353) in continental and maritime air masses divided by the SBF during TRACER. This may come across as shameless self-promotion since I was involved in both papers, but the analysis here complements those studies nicely since it focuses on analyzing ARM site observations while those papers emphasized TAMU TRACER (Rapp et al. 2024 https://doi.org/10.1175/BAMS-D-23-0218.1) measurements. Where possible, I think this paper should put its findings in the context of the existing literature and provide comparisons/contrasts where appropriate.

Response: We thank the reviewer for these thoughtful and constructive comments. We appreciate your recognition of the descriptive value of the study and your suggestions on how to strengthen the analysis. While the original framing emphasized broad before/after changes associated with SBF passage, we agree that the paper benefits from a deeper exploration of the factors driving site-to-site and day-to-day variability.

We took your concern seriously and revised the manuscript to strengthen the causal analysis behind increases vs. decreases in aerosols. In the revision, we have therefore reframed the manuscript to elaborate on three highlighted case study days (10 July, 17 July, and 16 August), each representing different aerosol response regimes. In addition, we have now included a table that summarizes the total number of SBC events, along with the number and percentage of days exhibiting enhancement, reduction, or neutral influence. This addition provides a clear quantitative summary to support the discussion of event-to-event variability.

We also recognize that aerosol–cloud interactions, indirect effects, and direct radiative forcing are complex topics that could each warrant stand-alone papers. Nonetheless, we believe it is important to include some of these aspects in the present study for these reasons:

The central goal of this work is to investigate the implications of sea-breeze circulations (SBCs) on boundary-layer aerosols and their broader consequences. We believe that integrating measurements with modeling is essential because it strengthens the interpretation of the observed processes and places the local-scale findings into a broader regional context. However, to streamline the manuscript and focus the narrative, in the modified manuscript, we have retained only the CCN-relevant analysis (Section 3.7.1) and removed the aerosol direct radiative forcing (ARF) analysis (Section 3.7.2). The radiative-forcing results will be developed as a separate manuscript, where we can treat methodology, uncertainties, and sensitivity tests in appropriate depth. In this way, the current paper emphasizes the complementarity of observations and modeling without detracting from its central observational focus. In the revised paper we:

- Clarified the limitations of using N_{100} as a CCN proxy and explicitly stated the assumptions.
- Kept the CCN figures (formerly Fig. 11 and related Supplementary Figs.) and emphasized how sea-breeze processes affect the cloud-relevant particle population.
- Removed text, figures, and references specific to ARF from the Abstract, Results, and Conclusions, and added a forward reference noting that a detailed ARF study is recommended.

We believe this change addresses the reviewer's concern while strengthening the focus of the current manuscript on CCN-relevant impacts of SAI.

Finally, we appreciate the references to the recent papers by Sharma et al. (2024), Rapp et al. (2024), and Thompson et al. (2025). We have revised the discussion to place our findings in the context of this literature, highlighting how the ARM-AMF sites-based analysis complements

TAMU-focused studies. In particular, we draw contrasts and comparisons to show how the ARM site perspective provides additional insight into the spatial variability of aerosol and meteorological responses to SBF passage during TRACER.

We believe these changes improve the rigor and relevance of the paper and strengthen its contribution to the growing body of work on sea-breeze–aerosol interactions in southeastern Texas.

Specific Comments

1. (abstract, line 24) The coastal vs. inland categorization of the AMF1 and ANC sites is somewhat misleading. While AMF1 is closer to Galveston Bay, it is about the same distance from the Gulf of Mexico as the ANC site.

Response: You are right, the AMF1 site is at a similar distance from the Gulf of Mexico as the ANC site. However, its proximity to the Galveston Bay allows the propagation of the SB to propagate over water rather than over land before reaching the site. That said, we agree with the suggestion to avoid categorizing the two sites simply as "coastal" vs. "inland". We have now revised as shown below:

Lines 24-27: "The main site, influenced by both Galveston Bay and the Gulf of Mexico, reflects a stronger marine influence. In contrast, a supplemental site, at a similar shoreline distance but exposed to the Gulf of Mexico and typically upstream of the urban core, samples SB air that has traversed land and partially regained continental characteristics."

2. (Page 2, line 50) I suggest adding "in the warm season" behind "along coastal regions."

Response: Added "in the warm season" as suggested. Please refer to *Line 56* in the revised manuscript.

3. (Page 3, line 65) I caution against using the relatively general terms "stable" and "unstable" here to describe the maritime and continental airmasses. While the low-level lapse rates may be more stable on the maritime side, we observed throughout forecasting for the project (and described in Sharma et al. 2024https://doi.org/10.1175/MWR-D-23-0243.1) that conditional instability (CAPE) was often larger on the maritime side of the SBF given the greater moisture in that airmass (similar to MAHTEs described by others, including Hanft and Houston 2018 https://doi.org/10.1175/MWR-D-17-0389.1). I suggest either simply removing these descriptors and leaving it at as "cooler" and "warmer" or adding a sentence or two here to add this nuance.

Response: We have modified the sentence to avoid generalizing the description as "stable" and "unstable". In addition, we have added a sentence to describe the above-mentioned distinction:

Lines 73-77: "While low-level lapse rates are often more stable on the maritime side of the SBF, the conditional instability (Convective Available Potential Energy-CAPE) is often observed to be greater on the maritime side due to the higher moisture content in that air mass (Hanft and Houston, 2018; Sharma et al., 2024; Boyer et al., 2025)."

4. (Page 4, Line 124 and throughout) Here the main site is referred to as coastal, and while it is coastal in the sense that it is very close to Galveston Bay, it is not much closer to the Gulf of Mexico coast than the ANC site. This should be clarified here and elsewhere were appropriate. More generally in the introduction, I think some distinction between air masses and SBCs associated with Galveston Bay vs. the Gulf of Mexico should be described. The SBFs associated with each body of water are often distinct at the onset of the SBF, but become more merged later in the afternoon/evening. There is likely considerable meteorological heterogeneity and aerosol variability within the maritime airmass that is heavily modified by Galveston Bay as compared with one only sourced over the Gulf of Mexico.

Response: We agree with the reviewer's observation. While the main site is indeed coastal in the sense that it is located very close to Galveston Bay, it is not closer to the Gulf of Mexico coast than the S3 site. We have clarified this in the revised manuscript by specifying the site's proximity to Galveston Bay rather than broadly referring to it as "coastal."

We have now revised the manuscript to include the above details wherever appropriate; some examples are shown below:

Lines 187-190: "Although both the M1 and S3 sites are a similar distance from the Gulf of Mexico, the M1 site is located near the western shore of Galveston Bay. This urban M1 site may experience different sea-breeze timing because of its location, the added influence of the Galveston Bay breeze, and urban heating that alters local circulations."

Lines 482-491: "The M1 site is influenced by the air masses and SBCs from both sources, whereas the S3 site is affected predominantly by those originating from the Gulf of Mexico. As discussed in detail by previous studies (Sharma et al., 2024; Wang et al., 2024), the SBFs originating from Galveston Bay and the Gulf of Mexico are often distinct at onset but tend to merge later in the afternoon or evening. Due to the M1 site's proximity to Galveston Bay, it is more directly influenced by maritime air masses that are heavily modified by Galveston Bay as the SBF originating from the Gulf of Mexico traverses the Bay. On the other hand, the Gulf-originating SBF must cross land before reaching S3. The difference in SBF pathways can lead to notable meteorological and aerosol contrasts between the two sites."

5. (Section 2.1) A few points that should be included in the description of the M1 and S3 sites: While the text accurately describes M1 as "urban" I would also suggest discussing the concentration of heavy industry surrounding the M1 site, which one might expect to lead to aerosol populations above and beyond the typical "urban" air mass. Conversely, while S3 is relatively removed from the Greater Houston area pollution, with a typical SSE wind direction, it is still downstream of some heavy industry on the SE TX coastline in the vicinity of Freeport and Lake

Jackson (as Figure 2b hints at, there are still some anthropogenic sources upstream of S3). Thus, S3, though rural may not always be expected to be as pristine as a typical rural site.

Response: Section 2.1 is now modified to include the above suggestions:

Lines 190-201: "The M1 site is expected to be strongly influenced by anthropogenic activities due to its proximity to the Houston urban core, large-scale industrial complexes and the HSC. The HSC is lined with dense clusters of industrial facilities, including major petrochemical complexes (Yoon et al., 2021), which can contribute to aerosol populations beyond those typically associated with an urban environment. Similarly, the Texas A&M University (TAMU) TRACER measurements also showed that short-lived ship emissions contributed to high aerosol concentrations (up to 34,000 cm^{-3}) (Rapp et al., 2024; Thompson et al., 2025). The S3 site, while relatively less impacted by the emissions from the Greater Houston area, is not representative of a pristine rural location in terms of aerosol loading. Under typical SSE wind conditions, this S3 site is located downstream of heavy industry along the southeast Texas coastline (Freeport, TX and Lake Jackson, TX) and can be influenced by upstream anthropogenic sources (Fig. 2b)."

6. (Page 7, Line 197) Please discuss the timing of the "simulations" in more detail. Was one simulation begun at the beginning of the 2 month period and run for 2months, or were daily simulations initialized at some fixed time for each day in that period? If so, what times, and how long was accounted for model spin up for the WRF domain before using the results? How often were the boundary conditions and emission sources updated?

Response: We have expanded the model description section to address the questions above.

Lines 268-291: "The model simulations were performed for the period from 1 July to 30 August 2022, using a 5x5 km horizontal grid spacing with 45 vertical layers. A model spin-up time of 3 days was used, and the restart files were used for the remainder of the simulations. Initial and boundary conditions for meteorology were provided by the North American Mesoscale (NAM) model every 6 hours. The model configuration was successfully set-up and is considered sufficient to resolve the key meteorological processes relevant to the aerosol chemistry examined in this study. To validate this assumption, simulated meteorological fields and aerosol variabilities are compared against observations. Similar model setups have been successfully applied in previous WRF-Chem studies over the continental US (e.g., Berg et al., 2015; Wang et al., 2021; Subba et al., 2023; Shrivastava et al., 2024), which demonstrate their suitability for representing aerosol-cloud interactions. The details of the configurations are shown in Table 2.

The model simulations were performed with (with aerosol-WA condition) and without (no aerosol-NA condition) full aerosol-gas chemistry, and land-atmosphere interactions enabled. Boundary conditions for gas-phase species and aerosols were provided by the Whole Atmosphere Community Climate Model (WACCM) (Gettelman et al., 2019). The WACCM output datasets, available on a horizontal grid resolution of 1°×1° were spatially interpolated to our model domain every 6 hours. Biogenic emissions were generated online by WRF-Chem model based on meteorology and land use data, using the Model of Emissions of Gases and Aerosols from Nature version 2.1 (MEGAN2.1) by Guenther et al. (2012). The U.S. Environmental Protection Agency

National Emission Inventories (NEI, Ma and Tong, 2022) was used to provide anthropogenic emissions of trace gases and aerosols from diverse sources, including point, area, on-road mobile, non-road mobile, and other sectors. These emissions are incorporated to WRF-Chem at hourly intervals."

7. (Page 7, Line 214) The word "feasible" here is vague/unclear. What is meant by feasible? Close enough to trust and use? If so, what criteria were used to judge this? To my eye, it looks like the model significantly under predicts the diurnal temperature cycle (meaning it is likely to also struggle handling the SBC, and it also over predicts the wind speeds during calm periods (presumably night time). I understand that this paper is more focused on the model performance as related to aerosols (which is described in some detail later in this paragraph), but since the hypothesized mechanism for variability in aerosols (the SBF) is after all a meteorological phenomenon, I think a more detailed discussion of the model's meteorological skill is needed.

Response: We appreciate the reviewer's observation. The purpose for these simulations is to provide a physically-reasonable approximation of the meteorological and aerosol environments across the southern Texas region that are not captured by point measurements during TRACER.

By "feasible", we intended to convey that the model's performance is within an acceptable range of our application. We have now replaced "feasible" with "adequate agreement for the purposes of this study".

Specifically, we assessed model performance using the metrics, mean bias (MB), root mean square error (RMSE), correlation coefficient (R) for temperature, wind speed, and wind direction. In addition, we also implemented widely applied MERRA-2: Modern-Era Retrospective analysis for Research and Applications to compare these meteorological variables to assess the performance of the model simulations. The model reproduces the measured temperature diurnal cycle at both the sites with high correlation (r up to 0.87) and low MBE ($<\pm 1$ ℃). Wind speed and wind directions show weaker correlation (r up to 0.65) and MBE of 0.76 m s^{-1} and 12.5°, respectively. Individual SB days are further analysed to compare the measured and modeled variables in later sections. These changes are now added in the modified manuscript:

Lines 303-313: "The simulated meteorological time series show adequate agreement for the purposes of this study at both sites (Fig. S1). We assessed model performance using metrics: mean bias (MBE), root mean square error (RMSE), and correlation coefficient (R) for the quantities of temperature, wind speed, and wind direction. In addition, we also considered Modern-Era Retrospective analysis for Research and Applications (MERRA-2) reanalysis products to further evaluate the model performance (Geralo et al., 2017). Our model reproduces the measured temperature diurnal cycle at both sites with high correlation (r up to 0.87) and low MBE (<±1 ℃). Wind speed and wind directions show weaker correlation (r up to 0.65) and MBE of 0.76 m s-1 and 12.5°, respectively. Individual SBF events are further analysed to compare the measured and modeled variables in later sections."

Lines 530-535: "In Fig. S6, we supplement these discussions with displays for the temporal variation of measured and model-simulated meteorological properties for this event. Both sites *suggest the typical temperature decreases and surface wind speed increase associated with the SBF reaching the site. The wind direction changes from east to south at the M1 site and from southwest to south at the S3 site."*

8. (Page 8, Lines 243-245) The authors state that the two sites have a statistically significant difference, but in what sense? Is every meteorological variable statistically different between the sites, or in the whole? Is the important difference in the magntudes of the variables or in their diurnal cycles? It's not clear what these differences actually are or why it's relevant that they are meteorologically distinct.

Response: We thank the reviewer for this comment and agree that clarification is needed. In our analysis, the statement that the two sites have a statistically significant difference refers to the difference in the mean values and the diurnal patterns of key meteorological variables, including temperature, wind speed, and wind direction.

Lines 330-360: "Comparisons between the background summertime meteorology around the TRACER sites help to identify the underlying factors that may influence the aerosol transport and transformation processes. Fig. 4. shows composite averaged diurnal variations of meteorological properties during the IOP period. When comparing meteorological variables between M1 and S3 sites, paired t-test results calculated a very low p-value (<0.0001) and a large negative or positive t-statistic, indicating a statistically significant difference. M1 exhibits higher temperatures during the cooler parts of the day (early morning) and slightly lower temperatures during the warmest parts of the day (early afternoon). w at M1 is slower during the warmer periods and higher during the cooler periods of the day. At both sites the value stays near 17-18 g kg^{-1} for most of the day, with a common moistening pulse around 13:00-15:00 UTC that coincides with increased wind speed. At similar hours, the wind directions are similar at both the sites. Except in the morning, winds at M1 are typically 1-2 m s^{-1} stronger than at S3. The M1 site shows an increase in w near 20:00 UTC, likely tied to the SBC. S3 exhibits a larger shift in the wind directions compared to that of M1. The two sites have similar directions during the late night (00:00- 05:00 UTC) and early morning (13:00-15:00 UTC) hours. During the dominant afternoon SBC period (around 20:00 UTC), winds are predominantly from the southeast at M1 and from the southwest at S3.

Although these sites are geographically close, their different proximities to water bodies and varying land cover types may account for the observed meteorological variations, such as differences in temperature modulation, humidity, and breeze development. M1 lies adjacent to both Galveston Bay and Gulf of Mexico, thus nearby water moderates temperature and promotes higher humidity, favoring sea- or bay- breeze circulations. In contrast, although S3 is at a similar distance from the Gulf as M1, it is more inland, separated from the shoreline by an intervening expanse of land, so it experiences stronger daytime heating and a weaker, more modified marine influence than M1. It has a land surface covered predominantly with vegetation and soil that cools faster at night than urban landscapes. However, urban landscapes retain heat, remaining warmer into the nighttime and potentially moderating temperatures during the subsequent daytime (Maria et al., 2013). These behaviors are consistent with the prior studies showing the coastal sites experienced moderate temperature and enhanced humidity (Hu, 2021; Subramanian et al., 2023), and that land-use influenced local temperature and boundary layer dynamics via evapotranspiration and surface heating (Fang et al., 2025)."

9. (Page 8, Lines 247-249) The authors say that "the opposite trend is observed for RH" which is true in the strictest sense, but for a constant amount of absolute moisture, the differences in RH are consistent with the differences in temperature between sites (RH for constant vapor pressure or dewpoint is lower when it is warmer and higher when it is cooler). Because RH depends on both temperature and moisture, I suggest that the authors use an absolute measure for moisture like vapor pressure, mixing ratio, or dewpoint temperature instead of RH. This temperature dependence of RH may obscure moisture changes associate with the diurnal SBC cycle.

Response: We thank the reviewer for this observation and agree that RH is influenced by both temperature and moisture, and that the difference in RH between the sites can be partially attributed to the corresponding temperature difference. Our intent in stating "the opposite trend is observed for RH" was to note the qualitative relationship between RH and temperature in the context of site-to-site differences. We acknowledge that variables such as vapor pressure, mixing ratio, or dewpoint temperature would provide a better measure of moisture. Considering this we have used the water vapor mixing ratio from measurements to understand the change in the moisture during the propagation of the SBF. For this section, we have now revised the statement as shown below:

Lines 335-343: "M1 exhibits higher temperatures during the cooler parts of the day (early morning) and slightly lower temperatures during the warmest parts of the day (early afternoon). w at M1 is lower during the warmer periods and higher during the cooler periods of the day. At both sites the value stays near 17-18 g kg^{-1} for most of the day, with a common moistening pulse around 13:00-15:00 UTC that coincides with increased wind speed. At similar hours, the wind directions are similar at both the sites. Except in the morning, winds at M1 are typically 1-2 m s^{-1} stronger than at S3. The M1 site shows an increase in w near 20:00 UTC, likely tied to the SBC. S3 exhibits a larger shift in the wind directions compared to that of M1."

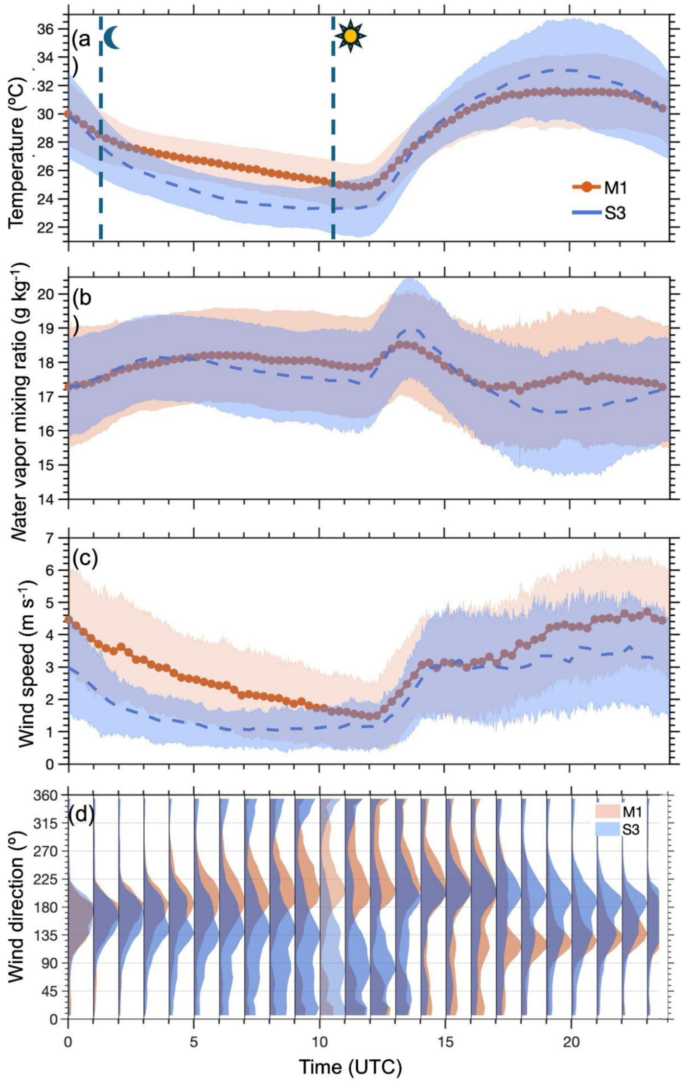


Figure 4. *Diurnal variation of meteorological variables (a) Temperature at 2 m, (b) water vapor mixing ratio (w) (c) wind speed at 10 m sites averaged during IOP, and (d) wind direction waterfall diagram at 10 m measured at M1 (in orange) and S3 (in blue). The shaded color represents the standard deviation from the mean.*

10. (Page 9, Lines 261-269) This paragraph largely describes methodology for identifying SBC from a prior paper that is used later in the analysis of this paper. Some or all of this text is more relevant in the data/methods section. It does bring to mind several relevant questions that this section could/should seek to answer, including: does the SBC have a notable effect on the observed surface meteorological variables at each site? Is this affect more pronounced at one site vs. another? What time does the SBF typically pass each site? There may be some hints of this in Figure 4, and since the paper is motivated by the effects of the SBC on aerosols it seems relevant to me to also analyze/discuss the effects of the SBC on the surface meteorology in this section where possible. Particularly relevant to the later aerosol discussion is addressing the questions of: Is the diurnal meteorological cycle distinctly different on days with a SBC than without (it seems

like Figure 4 includes all days regardless of if they feature a pronounced SBC)? This is important, because some of the observed aerosol changes could be diurnally forced rather than SBC forced. For example, as the surface temperature warms in the afternoon vertical mixing may increase which could lower aerosol concentrations independent of the SBC, which may confound later results that are attributed to the SBC. Alternatively, the diurnal inertial oscillation in the flow could affect aerosol variability without a SBC.

Response: We agree that some of the methodological description of how SBCs are identified is better suited for the Data and Methods section. We have moved portions of this text accordingly (*Lines 238-247*) to improve clarity and organization.

We agree that clarifying the extent to which SBCs influence surface meteorological variables provides important context. In the revised manuscript, we now include additional details describing how SBCs affect temperature, water vapor mixing ratio, and wind speed/direction, (Section 3.3.). This addition explicitly links the meteorological changes with subsequent aerosol variability. We have expanded the discussion to note that the M1 site, influenced by both bay and Gulf breezes, typically experiences earlier frontal onset and stronger fronts compared to S3, which is only influenced by the Gulf breeze. This site-to-site variability is now explicitly described (Sections 3.1 and 3.3). We have clarified in the revised text that M1 tends to experience earlier frontal onset due to bay-breeze influence, while S3 exhibits later passages. This point is now explicitly stated in the discussion of SBC variability:

Lines 248-252: "Overall, Wang et al., (2024) found that the SBF typically arrived at the M1 site at 20:30 UTC (i.e., 15:30 LT), and at the S3 site at 20:50 UTC (i.e., 15:50 LT). The M1 site, situated along the western shore of the Galveston Bay, was also influenced by bay breeze circulations, frequently resulting in an earlier shift in the local meteorological state compared to that of the S3 site (only influenced by the Gulf SBC). The M1 site was shown to experience an additional bay breeze contribution during 22 out of 43 SBC events."

We appreciate the reviewer noting the potential for misinterpretation. We have clarified in both the figure caption and main text that Figure 4 shows average diurnal cycles across all days, not just SBC days, and therefore does not isolate SBC-specific meteorological responses.

Lines 332-333: "*Fig. 4. shows composite averaged diurnal variations of meteorological properties during the IOP period.*"

We agree this is an important point, as some aerosol changes could arise from diurnal forcing rather than SBC passage. While a full comparison of SBC vs. non-SBC diurnal cycles is beyond the scope of this study, it has been previously studied extensively. We also reference prior work (Wang et al., 2024) that provides detailed analyses of SBC impacts on diurnal meteorological cycles. We also agree with the reviewer that processes such as enhanced vertical mixing from surface heating or inertial oscillations in flow could influence aerosol variability independent of SBCs. We have added text acknowledging these potential confounding factors, emphasizing that while SBCs are a major driver, other diurnal processes may also contribute to aerosol variability.

These changes are implemented here:

Lines 253-262: "Wang et al. (2024) also reported that M1 experienced higher intensity changes in the meteorological conditions associated with these SBFs as compared to S3, particularly when the background wind directions are southwesterly or westerly. At both the sites, these SBF passages were associated with a significant increase in water vapor mixing ratio and wind speed, along with a decrease in surface temperature. The arrival of the fronts also typically increased the vertical wind speed within the boundary layer, with a mean speed of up to 2 m s^{-1} within the lowest 1 km. The enhanced updrafts associated with SBF low level convergence also was shown to promote short lived-isolated convective clouds and likely associated with vertical mixing of aerosols by diluting near-surface concentrations and redistributing aerosols aloft."

11. (Page 10, lines 286-296) The percentages listed in this paragraph do not match those shown in Figure 5c. Since this figure is not cited here, it is not clear if they should match or if the statistics listed here are computed differently than in the figure. If this is an error, please correct. If it is intentional, please explain why the listed percentages should not match the pie charts.

Response: Thank you for pointing out the error, we have corrected it in the revised manuscript:

Lines 374-377: "The ACSM observations suggest a similar percentage contribution from various species, with organics having the highest concentration (59.2% at M1 and 53.0% at S3), followed by sulfate (23.3% at M1 and 30.6% at S3), ammonium (11.4% at M1 and 10.8% at S3), nitrate (5.2% at M1 and 5.0% at S3) and chloride (less than 0.9% at M1, and less than 0.6% at S3)."

12. (Page 11, first paragraph) While this paragraph is a nice summary of the possible changes on a local/regional airmass' aerosol, one key possibility is missing that should be included. Since much of the analysis relies on point measurements at the S3 and M1 sites, it's possible that small wind shifts caused by the SBC could lead to very large aerosol changes if the wind shift causes the upstream trajectories to shift away from or towards a very local emissions source. This is a highly localized effect that would lead the point observation sites to be less representative of the overall airmass. The authors somewhat account for this by including WRF simulations to fill in the gaps with approximate aerosol states, but this possibility should be mentioned here, and throughout when one of the site measurements could be unrepresentative of the larger airmass.

Response: We agree with the reviewer that this is a highly localized event, and M1 and S3 measurements may not always be representative of a broader airmass or regional conditions. Indeed, small-scale wind shifts associated with the SBC could lead to substantial changes in aerosols concentrations if local sources are intermittently upwind of the measurement sites. To address these limitations, as the reviewer correctly pointed out, we have incorporated WRF-Chem simulations, which will help provide a regional context and assess the broader impact of the SBC on aerosol distributions.

We have now revised the paragraph to explicitly acknowledge the possibility of localized source influence and clarify that the WRF-Chem modeling was used in part to bridge this spatial representativeness gap. Similar clarifications were added in other relevant sections where point measurements are interpreted.

Lines 422-426: "Finally, TRACER site measurements may not always be representative of a broader air mass or regional conditions (e.g., intermittent local source interactions with smaller-scale SBC features). WRF-Chem modeling may help to bridge these spatial representativeness gaps and provide reference for the regional context of the potential impact of the SBC on aerosol distributions."

Lines 695-698: "The model simulations supplement the observations by filling observational gaps and enabling the extrapolation of findings across a broader regional scale, an endeavor that would be challenging to achieve with limited in-situ observational sites or standalone models."

13. (Page 12, lines 353-355) Please provide some explanation for why +/- hour was selected as the before and after times. Is this because, as in the stated example that most enhancement or reduction effects last at least one hour? Or was some other criteria used for this selection?

Response: Thank you for the question. The choice of a 1-hour window is based on the observation that most of the enhancement or reduction effects are most pronounced during the first hour following the passing of the SBF. For instance, the normalized changes in aerosol number concentration (Figures S2 and S3) show a sharp shift within the first hour. In addition, please refer to the representative cases shown in Figure 6. Beyond the first hour, the observed variations are likely influenced by additional processes, such as secondary effects of meteorological transitions induced by the SBF, as well as changes in direct aerosols or precursor emissions from both local or regional sources. Moreover, the intensity of the SBF's influence typically dissipates or becomes less distinct after the first hour. There were no additional criteria applied in selecting this time frame. These clarifications have been added to the revised manuscript:

Lines 445-453: "Considering all the SBF passages we collected (Figs. S2 and S3), we suggest $\Delta T = TSBF \pm 1$ hr often best represents the "before" ($\Delta T- = TSBF - 1$ hr) and "after"- SBF ($\Delta T+ = TSBF + 1$ hr) times over a location. The enhancement or reduction effects are most pronounced during the first hour following the passing of the SBF. Beyond this period, the observed changes may be influenced by additional factors, such as the secondary effects resulting from meteorological transitions induced by the SBF. Additionally, the intensity of the SBF's impact may begin to weaken or become less pronounced after the first hour. With that assumption, a percentage change of the aerosol number concentration [(after-before)/before x 100%] can be further calculated."

14. (Page 12, lines 359-366) The percentages in parentheses (60% and 34% of SB days with a change in aerosol concentration) is somewhat unclear in the first sentence here Does this mean that 40% and 56% of SB days would be considered "neutral influence" days? It's also not clear if the total SB days are the same at each site. Some of this information is discussed later in this paragraph but it's a bit hard to decipher. I think that supplementing or replacing some of this text with a table showing the number and percent of SB days at each site showing the total, number with an enhancement, number with a reduction, and the neutral days would be helpful here. Moreover, the average aerosol change is stated for each site during SB days, but it's not clear if

this includes the neutral days with the enhancement/reduction days or only the latter. On line 368 the authors state that neutral days aren't included in the analysis, yet later in this paragraph they state the number of neutral days at each site, which leaves some ambiguity on which statistics include neutral days and which don't. This should be clarified. It also seems to mask the characteristic aerosol concentration for each regime (enhancement or reduction) by averaging them together. It would be more useful to show the average change of the enhancement and reduction days separately for each site. As is currently presented, the enhancement and reduction day concentration changes partially cancel each other out, so the "typical" change in each regime (likely a larger percentage change) is masked.

Response: We appreciate the reviewer for these comments and questions. We have now revised the statements as shown below:

Lines 458-466: "Out of 46 SBC events at the M1 site, 29 events (~63%) showed an enhancement or reduction influence on total aerosol number concentration, while the remaining 17 events (~37%) were classified as having a neutral influence. In contrast to M1, at the S3 site, out of 30 SBC events, only 12 events (~40%) exhibited a detectable change in aerosol number concentration, with the remaining 19 days (~60%) considered neutral. At the M1 site, reduction events (16 events) slightly outnumbered enhancement events (13 events). In contrast, at S3, enhancements (8 events) were twice as common as reductions (4 events). This opposite pattern underscores the site-dependent nature of the sea-breeze influence."

We agree that this information could be better presented in a summary table, so we have now included a supplementary table showing the total number of SBC events, along with the number and percentage of days showing enhancement, reduction, or neutral influence.

*"**Table 1**: Summary of SBC influence on aerosol number concentration at the M1 and S3 sites. Events are classified into enhancement, reduction, and neutral categories.*

Site	Description	Combined	Enhancement	Reduction	Neutral
M1	Days (fraction of the total events %)	46 (total SB events)	13 (28 %)	16 (35 %)	20 (37 %)
	Concentration change (after - before) %	-23 (all enhancement + reduction events) -7 (total number of events)	+55	-42	-11
S3	Days	30 (total SB events)	8 (27 %)	4 (13 %)	19 (60 %)

Concentration change (after - before) %	+9 (all enhancement + reduction events) +3 (total number of events)	+64	-45	-10

Again, we appreciate the reviewer's comments. To avoid confusion, we have removed the statistics that include neutral days, and now only present results based on days showing either enhancement or reduction. Clarifications have been made in the relevant section to specify that neutral days are excluded from all statistical summaries (*Line 457-458*). We have now included a discussion on the average changes on enhancement and reduction days separately for each site, to avoid partial cancellation when estimating the net change, as shown below.

Lines 467-476: "During enhancement days, the M1 site shows an average increase in aerosol number concentration of ~ 55%, rising from 3.8x 10^3 cm^{-3} during ΔT- to 5.9x 10^3 cm^{-3} during ΔT+. In contrast, during the reduction days, the concentration decreases by ~ 42%, dropping from 13.2x 10^3 cm^{-3} during ΔT- to 7.6x 10^3 cm^{-3} during ΔT+. At the S3 site, the average changes are ~64% (from 2.4x 10^3 cm^{-3} during ΔT- to 3.9x 10^3 cm^{-3} during ΔT+) enhancement and ~45% (from 4.9x 103 cm-3 during ΔT- to 2.7x 10^3 cm^{-3} during ΔT+) reduction. When averaged across all events, the aerosol number concentration at M1 shows a net decrease of ~23%, from 8.9x 10^3 cm^{-3} during ΔT- to 6.8x 10^3 cm^{-3} during ΔT+, while S3 exhibits a net increase of ~9%, from 3.2x 10^3 cm^{-3} during ΔT- to 3.5x 10^3 cm^{-3}. These contrasting trends underscore the regional variability in aerosol responses associated with SAI events."

15. (Page 12, lines 368-370) I'm glad that the authors differentiate between the Galveston Bay Breeze and the Gulf of Mexico Sea Breeze front here, which will be familiar to TRACER participants, however, as stated in an earlier comment, it would be good to mention some of these particulars earlier in the manuscript when describing the sites and the local meteorology. Moreover, I also suggest discussing how the maritime air masses behind each front may be different (Sharma et al. 2024 describe some meteorological differences), and also atypical for maritime airmasses. For instance, the recently published paper by Thompson et al. 2025 https://doi.org/10.1029/2025JD043353 shows that the "maritime" airmass near Galveston, TX is often heavily polluted compared to the typical maritime airmass, such that a bay breeze passage transitioning to a maritime airmass heavily modified by industry and shipping along Galveston Bay might not be that surprising if it often enhances the aerosol concentration rather than decreasing them.

Response: We appreciate and agree with the reviewer's comments on the importance of properly characterizing two types of frontal passage over the southern TX region. Please also refer to our responses for comments 1, 3 and 4. In the last paragraph of section 2.2, we have now included a description of the characteristics of Galveston Bay Breeze and the Gulf of Mexico Sea Breeze front, and how they would influence the maritime airmass. We have also incorporated a discussion of how these maritime air masses can vary, drawing on the recent findings of Sharma et al. (2024) and Thompson et al. (2025).

Lines 484-495: "As discussed in detail by previous studies (Sharma et al., 2024; Wang et al., 2024), the SBFs originating from Galveston Bay and the Gulf of Mexico are often distinct at onset but tend to merge later in the afternoon or evening. Due to the M1 site's proximity to Galveston Bay, it is more directly influenced by maritime airmasses that are heavily modified by Galveston Bay as the SBF originating from the Gulf of Mexico traverses the Bay. On the other hand, the Gulf-originating SBF must cross land before reaching S3. The difference in SBF pathways can lead to notable meteorological and aerosol contrasts between the two sites. In addition, as observed by Thompson et al. (2025), the maritime air masses near Galveston can deviate significantly from typical clean maritime conditions. As a result, bay breeze passages may not always lead to cleaner air but can, in fact, be more polluted. The consequences of this increased aerosol concentration in the modified maritime air mass are reflected in the enhancement aerosol response observed at the M1 site."

16. (Page 10, last paragraph, Page 13, first paragraph). A bit more description of how NPFs are identified from the data is needed here. For instance, it's not obvious to me from Figure S4 why this event is clearly a NPF event rather than simply representative of aerosol increases through transport/advection. Also, on Page10, the authors state there are more NPF events during the period than stated on Page 13, where only 11 events are stated to have occurred. Please correct/clarify. There is also some unclear wording in the NPF paragraph on Page 13. The authors state there were 11 NPF events on SB days, only 5 of which showed changes in the NPF characteristics during the SBF passage. However, later in this paragraph the authors state "the cleaner air mass trailing the SBF passage led to a sharp reduction in the aerosol number concentration" as a general statement without clarifying how often this occurred, which implies to me that the SBF always leads to a reduction in aerosol number after passage on a NPF day… but this is at odds with the beginning of the paragraph. Please clarify the text with more specificity.

Response: We thank the reviewer for these thoughtful comments and helpful suggestions. We have revised the manuscript to provide additional clarification on how NPF events are identified in our analysis. Specifically, we now state that NPF events are characterized by the sudden appearance of nucleation mode particles ($D_p < 25$ nm) followed by their continuous growth to larger sizes, forming the characteristic "banana-shaped" pattern in the aerosol number size distribution (Dal Maso et al., 2005).

Regarding the number of NPF events, we have corrected and clarified the text for consistency across the manuscript. We now clearly state that a total of 11 NPF events occurred on SB days, of which 5 showed clear changes in NPF characteristics associated with the passage of the SBF.

Finally, we have revised the wording in the relevant paragraph on Page 13 (original manuscript) to avoid overgeneralization. Instead of implying that all SBF passages lead to post-SBF reductions in aerosol concentrations, we now explicitly state that such reductions were observed only in the subset of cases (5 out of 11) where the cleaner air mass trailing the SBF directly influenced ongoing NPF events. This ensures that our interpretation is both accurate and specific.

These modifications have been incorporated into the updated manuscript for clarity and consistency.

Introduction-

Lines 47-54: "One such process is new particle formation (NPF), which is a common aerosol microphysical process that impacts the overall aerosol number concentration (Kulmala et al., 2004; Kerminen et al., 2005; Kuang et al., 2008; IPCC 2013). NPF events typically include a sudden burst of aerosols, i.e., the nucleation of gas molecules and formation of stable clusters of diameters 'Dp' > 2 nm, followed by subsequent growth, firstly to a size range with Dp > 50 nm and possibly growing to a size where the particles can act as a CCN (Dp > 100 nm) (Yu and Luo, 2009; Kerminen et al., 2012; Gordon et al., 2017)."

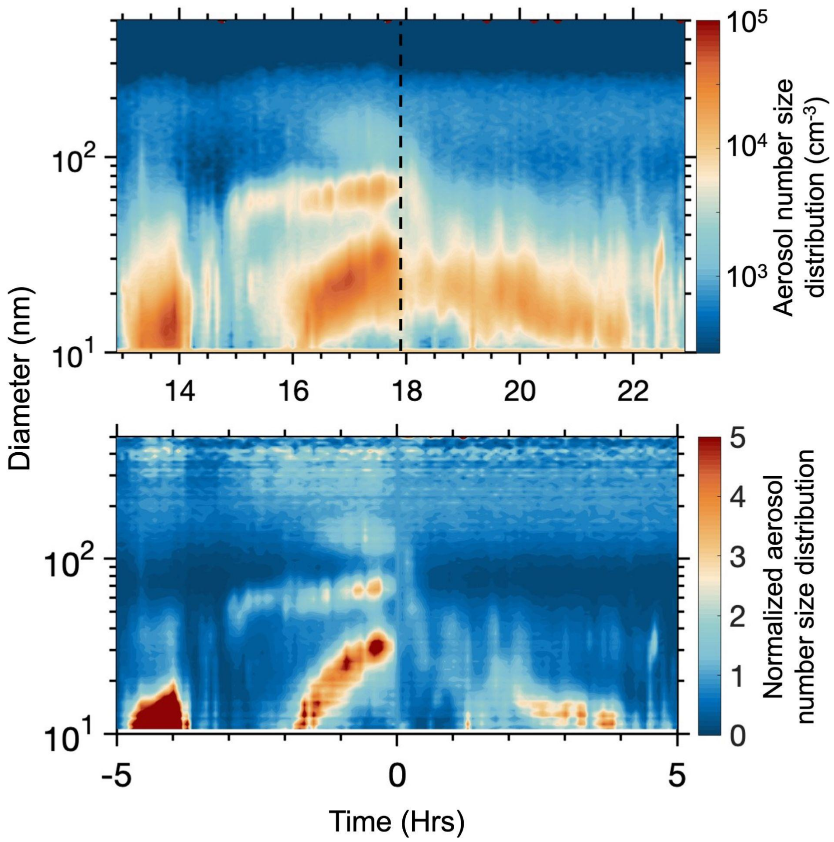
Section 3.2.-

Lines 381-395: "The NPF events are identified by analyzing the aerosol size distribution measured by the SMPS (Kuang et al., 2008; Dal Maso et al., 2002; Mikkonen et al., 2011). This is accomplished by designating characteristic features for NPF found in the size distribution behaviors in time, including the appearance of the nucleation mode at a diameter (Dp) < 25 nm, followed by distinct growth pattern (where the particles increase in size over several hours) forming the characteristic "banana-shaped" pattern in the aerosol number size distribution. NPF events were common at both the M1 and S3 sites. During summertime, NPF events were identified at both the M1 and S3 sites, finding 23 and 17 events, respectively. In approximately 35% of cases, NPF events were observed simultaneously at the sites, implying a regional-scale behavior. These regional NPF nucleation modes appear at Dp < 25 nm and grow consistently across a broader region, covering a minimum radius of tens of kilometers. However, these simultaneously-occurring NPF events displayed different characteristics in terms of their duration and growth, hinting at the possible influence of mesoscale to larger-scale meteorological controls on these processes (such as SBCs), the background aerosol concentration and/or the availability of necessary precursors."

Section 3.3.-

Lines 496-505: "SAIs can also interfere with NPF events. On SB days, a total of 7 NPF events were observed at the M1 site and 4 at the S3 site, with 3 occurring simultaneously at both sites. Among these, 45% (5 out of 11) events showed distinct changes in NPF characteristics during the SBF passage. For example, on 16 July an NPF event was observed at M1 prior to the SBF (Fig. S4). With the arrival of the SBF, particle growth abruptly ceased, and the elevated particle concentration (~14 e3 particles cm-3) rapidly decreased to ~5 e3 particles cm-3 (Fig. S4). The normalized aerosol size distribution further shows that the NPF activity evident in the hours before the SBF period (ΔT-=TSBF - 1 hr) disappeared in the hour following the SBF (ΔT+=TSBF + 1 hr). The low aerosol concentration air mass trailing the SBF passage thus led to a sharp reduction in the aerosol number concentrations in the after-SBF period."

Supplementary material-



"Figure S4. *Aerosol number size distribution at the M1 site during an NPF event on 16 July 2022. (Top panel) Time series of measured aerosol number size distribution (cm⁻³). The vertical dashed line marks the passage of the SBF (T_{SBF}). (Bottom panel) Normalized aerosol number size distribution (relative to aerosol number size distribution at T_{SBF}, i.e., T=0)."*

17. (Page 13, lines 388-392) This discussion seems to be at odds with earlier analysis. Here it's stated that "this transition" which the earlier sentence implies is an overall wind shift towards faster winds and a more SE direction after the SBF is "consistently accompanied by a reduction in aerosol concentrations" however, earlier in the paper the authors state that the M1 site had 16 events with a reduction and 13 events with an enhancement in aerosols, which is anything but a consistent reduction! Please clarify or adjust the text to be more consistent with earlier analysis.

Response: In response to Comment 18, we have modified Figure 7 (formerly Fig. 6b in the previous manuscript) and revised the corresponding paragraph accordingly. Please see our response to Comment 18.

18. (Page 13, line 394) The authors state that the S3 site responds "similarly" to the M1 site, but I don't really see the similarity at all. The M1 site more often (though not consistently) has a

decrease in aerosol concentration after the SBF, but the S3 site more often has an increase, and the average change is positive at S3 but negative at M1 (as discussed on Page 12). This analysis (showing the aerosol concentration with wind direction and the shift in winds before/after SBF passage) seems designed to explain why the S3 and M1 are different, not similar, yet there is no detalied discussion/analysis of these differences. I think this analysis/discussion could be improved with a more specific analysis of pre/post SBF wind direction and aerosol concentration at each site on days when there is an enhancement vs. reduction. This would seem to be more valuable/important than the current decomposition by month shown in the supplemental figure.

Response: Thank you for this helpful comment. The similarities exist in the meteorological aspects. We agree that our original wording overstated the similarity between the two sites and that the responses at M1 and S3 are in fact distinct. As you point out, M1 more often shows decreases in aerosol concentration following SBF passage, while S3 more frequently shows increases, with the mean change being negative at M1 and positive at S3. We have revised the text to clarify this distinction and expand the discussion to better highlight the differences in site response. Please refer to the response to comment 14 for this part of the comment.

In addition, following the comment of the reviewer, we have incorporated pre-/post-SBF analysis of wind direction and aerosol concentration at both sites, separated into enhancement and reduction cases, to more explicitly address how wind sector influences these changes. This will replace Figure 6b (in the previous manuscript) with Figure 7 (in the current manuscript), which we agree is less informative than the directional breakdown you suggest. We have modified the lines 384-396 (previous manuscript) accordingly as shown below:

Lines 506-525: "The open-air polar plots summarize the relationship between aerosol number concentration, wind speed and wind direction within ΔT= TSBF±1 during enhancement and reduction events (Fig. 7). At M1, enhancement events reveal elevated aerosol concentrations when the prevailing winds emanate from the east and southeast, where the airmass is influenced by industry and shipping along Galveston Bay. During the reduction influence the pre-SBF aerosol loading is higher compared to that of the reduction events. These high concentrations are associated with the influence from the Houston urban core in the northwest and the other influences from the east as mentioned above. These are also apparent in the monthly plots shown in Fig. S5. After-SBF winds, particularly from the southeast and south, are associated with markedly lower aerosol loads, indicative of cleaner marine air intrusion.

Meanwhile at S3, enhancement scenarios also manifest somewhat higher concentrations when winds shift southeastward, though to a lesser extent, reflecting rural aerosol dynamics. In reduction scenarios at S3, aerosol levels decrease most notably under southerly and southwest flow, reinforcing the interpretation that sea breeze incursions generally replace continental aerosol-laden air with cleaner marine air at both sites, albeit with stronger source influence at M1. This wind-direction-dependent concentration pattern aligns with previous findings: northwesterly to easterly winds bring continental aerosols, while southerly to southwesterly flows usher in marine-influenced clean air that modulates aerosol number concentrations (Levy et al., 2013; Pinto et al., 2014). However, as shown in Figs. S2 and S3, each SB event is unique in terms of the change in the aerosol concentrations."

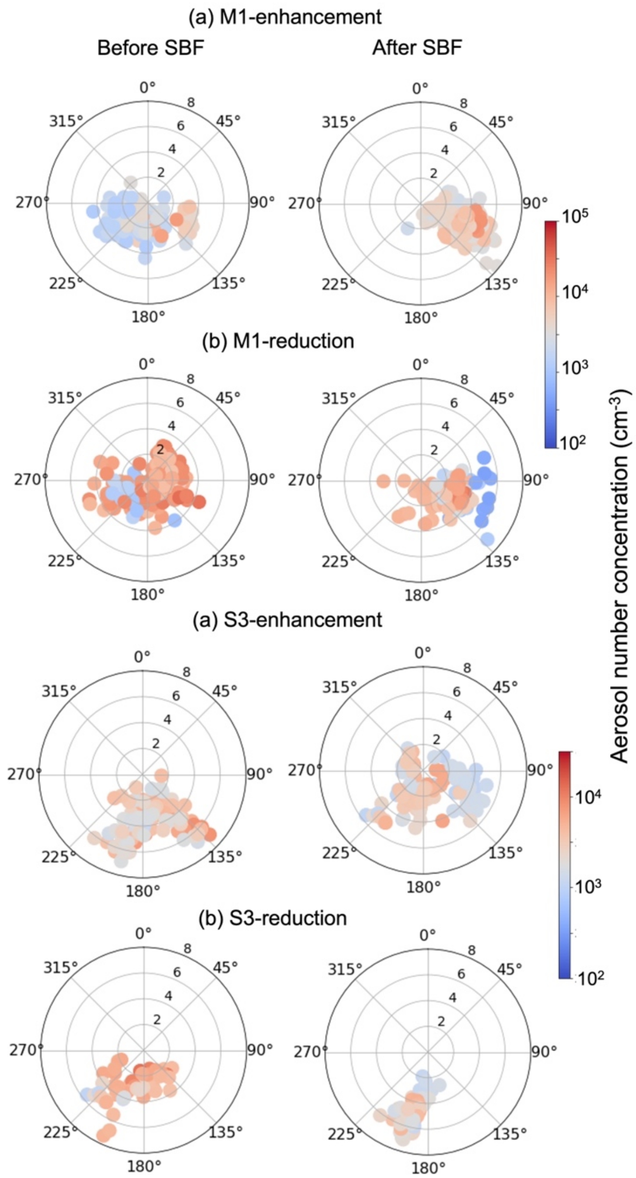


Figure 7. *Open-air polar plots for aerosol number concentration before and after the passing of the SBF ($\Delta T = T_{SBF} \pm 1$) during enhancement and reduction events at M1 and S3 sites. The wind speed (in m s^{-1}) grid lines are presented with black circles; the color scales represent the concentrations observed with each wind speed and direction combinations.*

19. (Lines 400-410) Much of this text seems more relevant to the introduction section since the authors have not conducted any analysis to show that any particular aerosol enhancement days are due specifically to any of these phenomenon.

Response: We agree with the reviewer's comment. These lines are now moved to the Introduction section (Line 116-125).

20. (Page 14, Lines 422-425) I think this statement is generally true, but this and the following analysis neglect some interesting differences in the size distribution changes at the M1 site that contradict this statement. For instance, at smaller sizes, the number concentration stays the same at the SBF passage time and even increases a few hours after the SBF passage. This might suggest a shift towards different aerosol species (for instance, the composition time series shows that the reduction at M1 seems mostly in the sulfate and ammonium categories) or sources rather than simply a transition to a "cleaner" maritime airmass. Indeed, the much greater aerosol concentrations after the SBF at M1 compared to S3 suggest that the maritime air mass near Galveston Bay and Houston is still quite dirty compared to the more pristine maritime airmass that comes straight from the Gulf of Mexico. The manuscript would benefit if such subtleties were pointed out and described rather than glossed over, as is currently the case.

Response: We agree with the reviewer's observation. The revised manuscript includes the discussion to capture the role of frontal passage on the aerosol characteristics in detail.

Lines 562-572: "The aerosol bulk chemical mass concentration at the M1 site shows a steady buildup through the day, peaking just before the passing of the SBF. Organics were the dominant species throughout, with sulfate and nitrate also contributing. After the passage of the SBF, concentrations dropped rapidly by about 1 to 3 μg m^{-3}, with the drop being more apparent in sulfate and ammonium. Within a few hours, concentrations returned to the background levels. These concentrations remained higher than those at the rural S3 site. However, the more pronounced changes in aerosol properties were observed at the S3 site. The concentrations of all species, including organic, decreased by 2 to 3 μg m⁻3. This is consistent with the earlier discussion that the maritime air mass near Galveston Bay exhibits higher aerosol concentrations compared to the more pristine maritime airmass originating directly from the Gulf of Mexico."

For details regarding the changes in aerosol properties please refer to the revised Section 3.3. (*Lines 527-605*). Please also refer to the response to comment 16.

21. (Page 15, line 439) Please provide a more physical explanation with references where relevant for how higher wind speeds would "dilute" the existing airmass in terms of the production of turbulent mixing that could do the "diluting". Do you mean that mechanical production of turbulence increases mixing with greater wind speed? If so, does such increased mechanical mixing compensate for reduce boundary layer buoyant production of turbulence with a more stable surface layer?

Response: Higher wind speeds increase wind shear near the surface, leading to enhanced mechanical production of turbulence, which expedites both horizontal and vertical dispersion of aerosols and vapor (Kgabi and Mokgwetisi, 2009; Dueker et al., 2017; Liu et al., 2025). Boundary layer height and vertical transport fluxes are increased with increasing wind speed, which will dilute the aerosol and water vapor concentrations (Glantz et al., 2006). On the other hand, lower wind speed causes atmospheric particles to accumulate in one area, which is aided by the lower boundary layer and decreased turbulent mixing. This is oftentimes associated with causing the air quality to worsen due to lack of dilution of air emissions (Seinfeld and Pandis, 2006). Under stable stratification, when buoyancy-driven turbulence is suppressed, shear turbulence becomes the dominant mechanism for dilution. This is supported by modifications in turbulent kinetic energy formulation that explicitly include shear production alongside buoyant production (Rodier et al., 2017). Thus, while mechanical mixing may not match the vigor of convective turbulence, it can significantly mitigate concentration buildup under stable conditions.

Lines 550-561: "However, we suggest that the higher wind speed associated with the SBF dilutes the existing air mass with marine air with lower aerosol concentration. Higher wind speeds enhance near-surface shear, mechanically generate turbulence, deepen the boundary layer, and strengthen vertical transport, thereby accelerating dispersion and diluting aerosol and water-vapor concentrations (Kgabi and Mokgwetisi, 2009; Dueker et al., 2017; Liu et al., 2025). Conversely, low winds with a shallow boundary layer and weak turbulence promote accumulation and often worsen air quality due to limited dilution (Seinfeld and Pandis, 2006). The modified near-surface air mass at S3 persists overnight until convective mixing begins the following day. Under stable stratification, buoyant turbulence is suppressed, and shear-driven mixing becomes the primary dilution mechanism; although weaker than convective mixing, it can still substantially mitigate concentration build-up (Rodier et al., 2017)."

22. (Page 16, Lines 473-475) I don't see where this statement is evident in Figure 8. In fact, it looks from the panels in Figure 8f that the normalized change in aerosol concentration is actually stronger at 00Z than earlier times. Please correct or clarify with a figure citation where this effect is demonstrated.

Response: We agree with the reviewer that the normalized change in aerosol concentration is stronger inland. We have now corrected the statement as shown below:

Lines 633-636: "Over time, a well-defined dipole pattern emerges, characterized by reduced concentrations over the coastal zone and enhanced concentrations farther inland, consistent with the inland penetration of the maritime air mass and displacement of pre-existing polluted air."

23. (Page 16, middle paragraph and Figure 9). In this section comparing the July 17 and August 16 cases to July 10, the authors demonstrate that the change in aerosols following the SBF passage at each site is highly sensitive to the initial aerosol distribution, which is intuitive. However, they neglect to show/discuss any differences in the meteorological properties of the SBC in this case. Another issue with this figure/discussion is that the times plotted are much earlier than in Figure 8 for the July 10 case. While the supplemental figures show that the SBF passes the ARM sites earlier on July 17 and August 16, the times plotted for the July 17 and August 16 case don't even include when the SBF passed the S3 site. For instance supplemental figure S7 shows this was 22Z on July 17 and figure S8 shows this was about 21Z on August 16—both of which are beyond the times shown in Figure 9. I think this comparison would benefit greatly from expanding Figure 9 into two figures that show exactly what is shown in Figure 8 (including meteorological variables and the times before SBF passes both sites, after it passes M1 only, and after passing both sites). This will allow for an apples-to-apples discussion of both the meteorological differences with the SBF on all three days (which may also contribute to the observed shifts in aerosols) as well as the

current focus on the antecedent aerosol distributions. In general, thema in paper currently focuses on a detailed analysis and discussion of the July 10 case, then casually mentions the other days. I think the paper would benefit from a more direct and comprehensive comparison of July 10 with July 17 to better get at the root of why some SBF passages lead to enhancement vs. reduction of aerosols.

Response: Thank you for these detailed and constructive comments. We agree that in original version of the manuscript, our discussion of the July 17 and August 16 cases was not as comprehensive as for July 10, and that the analysis would be improved by placing the three cases on equal footing. Specifically, we acknowledge that the omission of the associated meteorological properties of the SBC on July 17 and August 16 limits the ability to fully interpret the aerosol responses. Consideration the reviewer's comments, the following modifications are included in the revised manuscript:

Firstly, we include the approximate SBF arrival times at both sites and briefly describe the associated meteorological signatures. The two events are also described in detail in *Lines 573-605,* in the section when these two events are first introduced. For this we have made the Figures S7 and S8 identical as Fig. 8 (current manuscript).

Secondly, following the Reviewer's suggestions, we expanded Figure 9 (original manuscript) into two figures structured in the same way as Figure 9 (Figure 8 in the original manuscript), with consistent time windows that span before SBF arrival, after its passage at M1 only, and after its passage at both M1 and S3. These revised figures (Figs. 10 and 11, in the revised manuscript) include both meteorological variables and aerosol properties, allowing a direct comparison across July 10, July 17, and August 16. This way, these figures help track the inland propagation of the SBF.

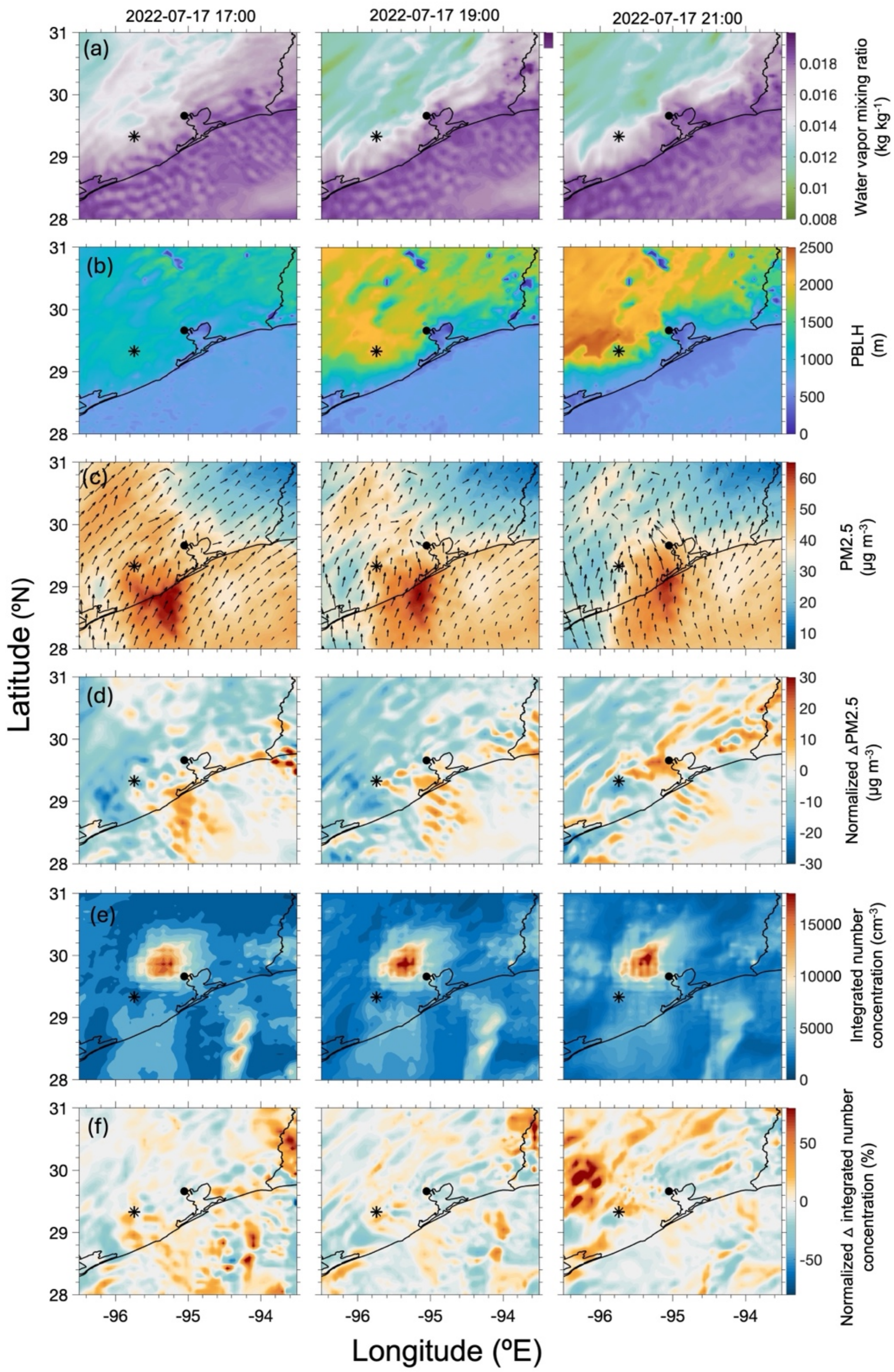


Figure 10. *Modeled surface distribution of (a) water vapor mixing ratio, (b) PBLH, (c) PM*$_{2.5}$*, and wind vector (black arrows, at the surface), and (e) integrated aerosol number concentration (nucleation + accumulation mode) at three-time steps: 17:00, 19:00, and 21:00 UTC on 17 July. Sub-panels (d) and (f) show the normalized changes, where Δ is the change from the previous time step. The filled-circle marker in the panels represent the M1 site, while the star represents the S3 site.*

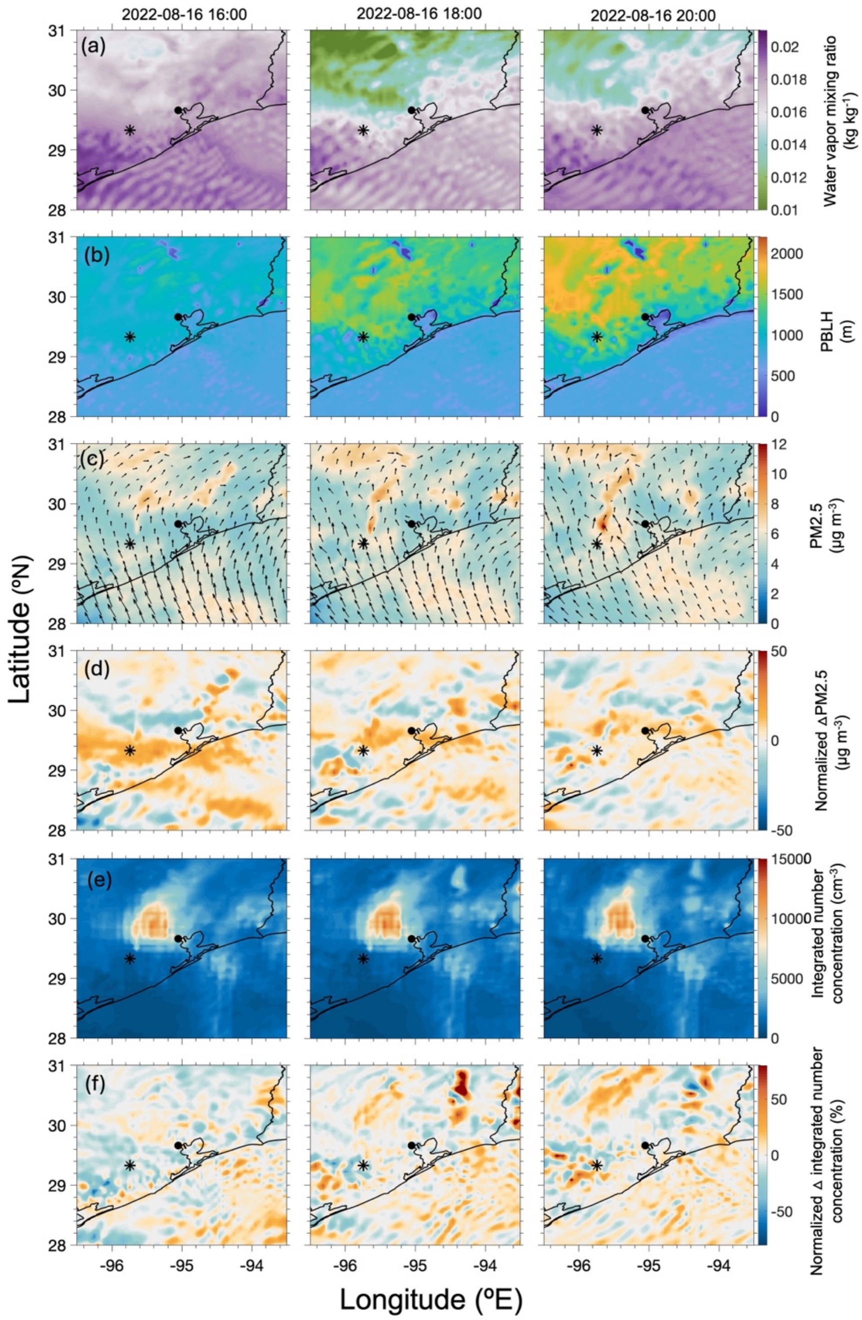


Figure 11. *Modeled surface distribution of (a) water vapor mixing ratio, (b) PBLH, (c)* $PM_{2.5}$*, and wind vector (black arrows, at the surface), and (e) integrated aerosol number concentration (nucleation + accumulation mode) at three-time steps: 16:00, 18:00, and 20:00 UTC on 16 August. Sub-panels (d) and (f) show the normalized changes, where Δ is the change from the previous time step. The filled-circle marker in the panels represent the M1 site, while the star represents the S3 site.*

We have further expanded the discussion in Section 3.4 to highlight not only the differences in antecedent aerosol distributions but also the variability in meteorological conditions associated with each SBF, and how these jointly influence whether an event leads to an enhancement or reduction in aerosol concentrations. These are the corresponding modifications in the revised manuscript:

Lines 637-656: "*The additional example on 17 July (Fig. 10) is suggestive of an enhancement in aerosol concentration associated with the SBF event, while the 16 August event (Fig. 11) is indicative of a neutral influence from the SBF passage. Similar to 10 July, both days exhibit an increase in water-vapor mixing ratio associated with passage of the SBF, relative to inland areas not influenced by the front (Figs. 10a, 11a). The SBF passage was also accompanied by a decrease in modeled PBLH (Figs. 10b, 11b). On 17 July, the SBF had reached M1 and S3 by ~19:00–21:00 UTC; winds were predominantly from southwest to east, with easterlies likely advecting emissions from the HSC and contributing to the observed enhancements.*

Notably, the 17 July event occurred in a different ambient aerosol environment than the 10 July event. MERRA-2 column dust mass concentrations (Fig. S9) indicate Saharan dust transport on this day, yielding elevated dust loading over the Gulf of Mexico and resulting in marine aerosol mass concentrations that exceeded those over land. The high concentrations are also observed to be more prominent to the southwest of the M1 site (Fig. 10c). Hence, as the SBF moves inland on 17 July, it transports this higher aerosol containing air mass, replacing the lower aerosol containing air over the site and causing an increased aerosol concentration at the M1 site. The onshore winds carry an air mass influenced by both local and long-range transport, originating from both land and sea. In contrast to the other two events, the 16 August event occurred under a transitional regime and likely influenced by the bay breeze. The aerosol environment was notably uniform over the wider regional air masses, thus SBF passage resulted in minimal changes to the aerosol distribution (Fig. 11c, d, f)."

24. (Page 16, lines 478-481). While this is evident from the figure and somewhat intuitive that it must be true for days to have an aerosol enhancement to have more antecedent aerosols in the maritime airmass, a more interesting question that could be addressed here is

Why are the antecedent aerosol conditions so different? Since your WRF chem simulations span the entire IOP, can you comment on differences in the synoptic or regional meteorology in the days leading up to these events that would cause the aerosol distributions to be so different prior to SBF passage?

Response: Thank you for this insightful suggestion. We agree that it is important to address why the antecedent aerosol conditions differ so markedly between cases. The antecedent aerosol distribution on July 17, for example, was strongly influenced by enhanced dust transport from the Saharan Desert in the days leading up to the event. This is evident in MERRA-2 column dust fields (included as a supplemental figure in the revised manuscript), which show elevated dust loading over the Gulf of Mexico and southern U.S. during this period. Our WRF-Chem simulations also capture this elevated dust transport, consistent with the observed higher aerosol concentrations in the maritime air mass prior to SBF passage on July 17. In contrast, July 10 and August 16 lacked comparable dust intrusions, leading to lower background aerosol levels in the pre-SBF maritime air.

In addition, Wang et al. (2024) categorize the July 17 case as a convective cloud type associated with local forcing, which may have further modulated the regional aerosol environment. We will incorporate this discussion into the revised manuscript to make clear how synoptic and regional meteorology, and specifically dust transport events, contributed to the different antecedent aerosol conditions observed across the case studies. Finally, we note that the potential two-way interactions, where cloud processes modify aerosols and feed back onto subsequent cloud formation, are indeed interesting but fall outside the scope of this study.

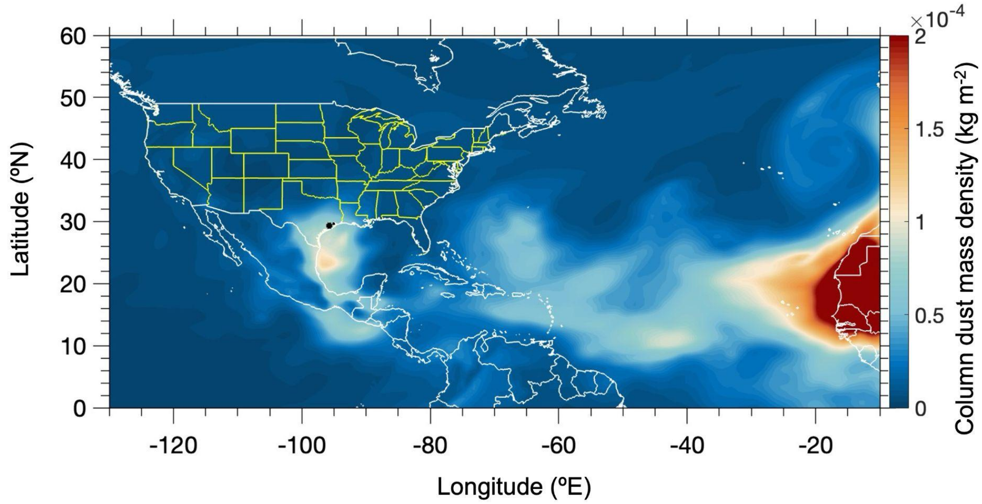


Figure S9. *Spatial distribution of MERRA-2 derived dust column mass density, averaged over 16-17 July 2022.* The filled-circle marker in the panels represent the TRACER site.

Lines 645-656: "Notably, the 17 July event occurred in a different ambient aerosol environment than the 10 July event. MERRA-2 column dust mass concentrations (Fig. S9) indicate Saharan dust transport on this day, yielding elevated dust loading over the Gulf of Mexico and resulting in marine aerosol mass concentrations that exceeded those over land. The high concentrations are also observed to be more prominent to the southwest of the M1 site (Fig. 10c). Hence, as the SBF moves inland on 17 July, it transports this higher aerosol containing air mass, replacing the lower aerosol containing air over the site and causing an increased aerosol concentration at the M1 site. The onshore winds carry an air mass influenced by both local and long-range transport, originating from both land and sea."

25. (Page 16, lines 493-500). The reference to the scanning radar wind data is somewhat out of the blue and not clear how it relates to the prior analysis. Do these results refer to a specific day/event or are they more generally true? To this point your analysis does not clearly differentiate between bay breeze vs. gulf-breeze passage, so it's not clear which results the scanning radar wind data support. Please clarify which findings/figures from the WRF simulations or site analyses are supported by the radar data.

Response: Thank you for pointing this out, we agree the reference to the scanning-radar winds read as abrupt. In the revision we state explicitly that the radar panel corresponds to a separate SB Day during the IOP (one of the events in Fig. S2), and it is not used to validate any of the three primary WRF-simulated case days in the main text. A comprehensive scanning-radar analysis is beyond the scope here and has been treated in prior TRACER studies.

Lines 662-666: "A study by Deng et al., (2025) using scanning radar data collected during TRACER reported similar findings during one of the SB events on 10 September 2022. They reported a reduced influence on the aerosol concentration immediately after the passing of the bay breeze front for the next few hours, due to the dominance of onshore flow consistent with the findings from this study (Fig. S2)."

26. (Page 17, Lines 511-518, Figure b,c) It's interesting to me that the magnitude of the changes in nu0 and ac0 tend to increase with altitude but the changes in PM2.5 do not. Do the authors have any explanation as to why this is the case? It's important to address this inconsistency because if the largest changes in nu0 and ac0 are occurring above the layer where the SBC is most prominent, it suggests there is another process causing changes in the aerosol at this time rather than just the SBC, and that not all the changes occurring here are due to the SBC.

Response: Thank you for pointing out this important observation. We agree that the apparent inconsistency between the vertical structure of changes in nu0 and ac0 versus surface PM2.5 warrants clarification. One explanation is that the largest changes in nu0 and ac0 occur aloft where the sea-breeze circulation interacts with residual or transported aerosol layers, while surface $PM_{2.5}$ reflects only the near-surface response and therefore shows weaker sensitivity.

Lofted layers of dust or aged pollution can undergo substantial modification in number and composition without producing a proportional change in surface $PM_{2.5}$. Another contributing factor is that nu and ac0 are microphysical parameters that are more sensitive to shifts in aerosol size distribution, whereas $PM_{2.5}$ is a bulk mass measure that may not change as much if mass is redistributed across size bins rather than added or removed.

Not all the observed vertical changes can be attributed solely to the SBC; other processes such as long-range transport, vertical mixing above the boundary layer, or localized convective activity likely also contribute. This interpretation highlights that the SBC signal is most prominent near the surface but that the column-integrated response reflects the combined influence of multiple processes. This raises the important consideration of the role of the SBC in particle formation and growth. A thorough analysis of this process, however, would require additional work and substantially lengthen the current manuscript. We have addressed some of the aspects of the aerosol size distribution in sections 3.3, 3.5, 3.6, and the response to comment 16.

27. (Section 3.7.1 and Figure 11) I find this section and figure 11 to be somewhat redundant and to be less than persuasive as a discussion of changes in aerosol indirect effects (as implied by its inclusion in Section 3.7). First, using N100 as a proxy for CCN is a rough approximation. Secondly, this information is available already in Figure 7. Finally, there are a lot of assumptions

required for the change in N100 to translate to a change in the aerosol indirect effect, namely that these aerosol actually form clouds on either side of the SBF and that the change in CCN meaningfully affects the cloud drop size distribution, which are not analyzed here. Thus, I suggest simply removing this section and then when discussing Figure 7 in Section 3.4, you could add a sentence or two that specifically describes the changes in N100 and the implications for CCN.

Response: We thank the reviewer for this valuable comment. We agree that using N_{100} as a proxy for CCN is a simplification and have now clarified these limitations more explicitly in the revised text. However, we believe that including this section and Figure 13 (previously Figure 11) is important for two reasons.

First, while Figure 8 (previously Figure 7) presents the overall aerosol number budget, Figure 13 isolates the N_{100} fraction, which is directly relevant as a CCN proxy. This allows us to highlight how sea-breeze-related processes affect particles that are most relevant for cloud formation, providing a more targeted perspective than the total number concentration alone.

Second, the Figures S10 and S11 demonstrate event-to-event variability, showing that while N_{100} is less frequently impacted than the total aerosol number concentration, reductions of up to 25–60% are still observed during certain events, which would not be evident from section 3.4.

We have also added text acknowledging the assumptions required to connect changes in N_{100} directly to aerosol–cloud interactions and clarified that our analysis is limited to observational evidence of N_{100} variability (Lines 702-704). We therefore feel that retaining this section provides valuable context, complements Figure 8, and strengthens the discussion of how sea-breeze interactions may influence the CCN-relevant aerosol population.

In addition, we now reference prior TRACER findings (ROAM-V measurements) which demonstrated that aerosol cloud-forming properties vary substantially between polluted marine and continental air masses due to differences in aerosol size, hygroscopicity, and CCN efficiency.

Lines 769-775: "This aligns with Thompson et al. (2025), which showed that aerosol cloud-forming properties differ between polluted marine and continental air masses, with variability in size, hygroscopicity, and CCN efficiency across sites. Given the complex mix of marine, terrestrial, and urban sources, and the strong spatial heterogeneity revealed by both our analysis and prior TRACER studies, future studies should include direct CCN and INP measurements and size-resolved aerosol properties to better capture the role of SAI in aerosol–cloud interactions."

28. (Page 18, lines 551-554) The details of these simulations need to be included either here or in the methods section when they differ from those of the other WRF-Chem simulations. How exactly is aerosol chemistry excluded vs. included? Are aerosols simply set to zero everywhere in the simulation NA simulation and the WA simulation is the realistic WRF-chem simulation as described earlier? What physical processes may be affected by this choice? How are CCN prescribed in the microphysics parameterization of the simulation without aerosol chemistry? Were these simulations conducted for the full IOP or only on particular case study days?

Response: Thank you for this comment. This section 3.7.2 no longer exists in the revised manuscript.

However, we have added additional details on the configuration of the simulations. The model simulations were performed for the period from 1 July to 30 August 2022 using a 5 × 5 km horizontal grid spacing with 45 vertical layers. A 3-day spin-up was applied, and restart files were used thereafter. Meteorological initial and boundary conditions were provided by the NAM every 6 h. This grid spacing and configuration is sufficient to capture the salient meteorology relevant to aerosol–chemistry interactions, and similar setups have been successfully applied in prior WRF-Chem studies (Berg et al., 2015; Wang et al., 2021; Subba et al., 2023; Shrivastava et al., 2024).

The NA (no aerosol) simulations were configured by turning off aerosol chemistry, effectively setting aerosol fields to zero such that cloud droplet activation relied only on prescribed background CCN and meteorology. In contrast, the WA (with aerosol) simulations were performed with full aerosol–gas chemistry, and land–atmosphere interactions enabled. Boundary conditions for gas-phase species and aerosols were taken from WACCM (Gettelman et al., 2019), interpolated to our domain every 6 h. Biogenic emissions were generated online using MEGAN2.1 (Guenther et al., 2012), while anthropogenic emissions were prescribed from the U.S. EPA NEI inventory (Ma and Tong, 2022). These simulations were conducted for the full IOP period (1 July–30 August) to ensure that synoptic variability and antecedent conditions were properly represented. The complete list of model configurations is provided in Table 1.

29. (Figure 12 and related discussion) In the second column of Figure 12b, it shows the “after” SBF time for the M1 site as 18Z, however supplemental figure S7shows the SBF time at M1 on this date is after 18Z. How can this time represent the post SBF time for that day? Please correct or explain the discrepancy in the analysis.

Response: Figure 12 from the previous manuscript is no longer included, as Section 3.7.2 has been removed in the revised paper. Please refer to the response to Comment 30.

30. (Section 3.7.2) While this is an interesting discussion of the ARF as it relates to SBC associated aerosol changes, A few additional pieces of analysis could improve this section and add more depth to the analysis. Have you compared the simulations to observations of surface radiative forcing from the M1 site? While the total ARF cannot be directly compared, a comparison of the simulated surface radiative flux to the observations would be enlightening and add confidence to the model simulations if they agree. Second, an implication of increased ARF is that it can lead to warming of the atmosphere, which would have effects on clouds/convection and other meteorological aspects. Do the simulated changes in ARF correspond to significant changes in the simulated vertical temperature profiles?

Response: Thank you for the comments. No, we have not compared the simulations to observations of surface radiative forcing from the M1 site in this paper. However, considering both the reviewers’ comments and to streamline the manuscript and focus the narrative, in the modified manuscript, we have retained only the CCN-relevant analysis (Section 3.7.1) and removed the

ARF analysis (Section 3.7.2). The radiative-forcing results will be developed as a separate manuscript, where we can treat methodology, uncertainties, and sensitivity tests in appropriate depth. In this way, the current paper emphasizes the complementarity of observations and modeling without detracting from its central observational focus. In the revised paper we:

- Clarify the limitations of using N_{100} as a CCN proxy and explicitly state the assumptions.
- Keep the CCN figures (formerly Fig. 11 and related Supplementary Figs.) and emphasize how sea-breeze processes affect the cloud-relevant particle population and its event-to-event variability.
- Remove text, figures, and references specific to ARF from the Abstract, Results, and Conclusions, and add a forward reference noting that ARF will be presented in a companion paper.

31. (Summary and Conclusions in general) As discussed in earlier comments, some of the summary statistics here for each site that average over both reduction and enhancement days mask some of the nuance/detail. I suggest adjusting this text to reflect any corresponding changes made earlier in the manuscript in response to earlier comments.

Response: Please refer to the response to comment 14.

32. (Page 21, line 638) Along the lines of an earlier comment, this paper has only shown the ARF, but it has not demonstrated corresponding heating/cooling in response, which might be implied by this statement in the conclusions. This sentence should be removed if such heating/cooling is not demonstrated in the simulations.

Response: Thank you for this helpful comment. We agree with the reviewer that our simulations did not explicitly quantify atmospheric heating or cooling rates associated with the aerosol radiative forcing (ARF). However, Section 3.7.2 has been removed in the revised paper. Please refer to the response to Comment 30.

33. (Page 21, lines 639-641) If, following an earlier comment, the CCN section is removed, this text should be changed accordingly. At the very least, it needs to be stated here that "N100, a proxy for CCN" is used rather than actual CCN measurements.

Response: Thank you for this comment. We agree that clarification is needed. In the revised manuscript, we explicitly state that N_{100} is used as a proxy for CCN concentrations, rather than direct CCN measurements.

Lines 702-703: "Due to the unavailability of measured CCN data at both M1 and S3, N_{100} serves as our proxy for the CCN (CCN_{proxy}) concentration (Ahlm et al., 2013)."

34. (Conclusions, general) If my earlier suggestion to discuss existing complementary literature from the TRACER field project is adopted, please include some high-level comparison/contrasts to that literature in the conclusions section.

Response: Thank you for the comment. We've added the discussion in the conclusion section.

Alignment with Rapp et al. (2024): Our fixed-site results complement the targeted mobile sampling, supporting the conclusion that characterizing the distinct maritime vs. continental airmasses across boundaries, and their timing is critical to disentangling aerosol vs. meteorological controls. Consistency with Sharma et al. (2024): The meteorological contrasts across SBF that Sharma documented are consistent with our concurrent aerosol and w/wind shifts, linking environmental changes to the observed aerosol responses. Consistency with Thompson et al. (2025): Our finding that CCN-proxy (N_{100}) decreases after SBF are infrequent (~25%) aligns with Thompson's airmass-dependent CCN variability and strong spatial heterogeneity, implying a weaker SAI imprint on the marine-influenced background accumulation mode without size/composition constraints.

Lines 721-785: "Sea breezes influence multi-scale processes across the land-ocean-atmosphere interface within the region of influence of the SBC. The TRACER field campaign provided a unique opportunity to understand how aerosol and meteorological processes impact weather and climate in the urban and rural coastal environment of Houston, Texas. A total of 46 (M1) and 30 (S3) instances of SB passages were identified during the summertime TRACER IOP period. Summertime measurements from the ARM sites coupled with WRF-Chem model simulations (July and August 2022) help to quantify aerosol changes resulting from onshore transport of marine boundary layer air masses due to SBF passage and the associated atmospheric SBC impacts.

Understanding the spatial extent and duration of SAIs is crucial for assessing their environmental and meteorological impacts. For inland-penetrating SBFs, aerosol responses fall into one of the three types: reduction (clean marine air replacing more polluted continental air); enhancement (import of more polluted air), or neutral (similar air masses). The sign and magnitude of changes depend on coastal proximity to the coast and the upwind air mass history prior to SBF arrival.

TRACER measurements indicate that the urban M1 site, closer to both Galveston Bay and the Gulf of Mexico, experiences more frequent aerosol concentration changes (increase or decrease during 63% of SB events) than the rural S3 site (increase or decrease during 40% of SB days), which is primarily Gulf-breeze influenced and farther from urban/industrial sources. During IOP events, surface aerosol number changed by up to a factor of two. On average, SBF passages were associated with a decrease of ~23% at M1 and increase of ~4% at S3. SBF passages produce distinct aerosol responses depending on the type of SAI event. At M1, enhancement days (28% of SB events) are associated with an average increase of aerosol concentration by ~55%, while reduction days (35% of SB events) show an average decrease of ~42%. At S3, enhancement days

(27% of SB events) exhibit an average increase of ~64%, whereas reduction days (13% of SB events) show a decrease of ~45%.

This study also provides support for how SAIs may interfere with aerosol microphysical processes, including NPF events, a key driver of the overall aerosol number budget. These changes occur with sharp meteorological shifts, including RH (+30%) and wind speed (+4 m s-1) increases, and backing to southeasterly flow (Figs. 7. and 8.). The relationship between wind and aerosol number concentrations showed that aerosol concentrations at the M1 site are higher when prevailing winds originate from the direction of the Houston urban core (northwest) to north, compared to the winds coming from the sea (south and intermediate directions) (Fig. S5). Recently, Rapp et al. (2024) emphasized using targeted mobile sampling that collecting measurements on both sides of SB boundaries are critical for disentangling aerosol from meteorological controls. These findings are complementary to the results in this study that boundary timing and air mass origin drive the different responses at M1 and S3.

WRF Chem simulations extend the site perspective regionally, indicating heterogeneous SAI footprints (Figs. 9, 10, 11, and 12). Across 18 simulated events, near surface PM2.5 tends to decrease by ~15% around the M1 site and increase by ~3% near the S3 site (Fig. S13). However, these responses vary with altitude (Fig. 12). The SBF may alter the vertical aerosol distribution in the boundary layer up to 2 km. Beyond thermodynamics, SB fronts also reshape convective environments (Wang et al., 2024). The storm characteristics across maritime vs. continental sides of these fronts drive the air mass contrasts produced by SBCs (Sharma et al., 2024), which can further influence the aerosol environment.

With respect to cloud-relevant particles, both observations and simulations indicate that the surface CCNproxy concentrations decrease by up to 60% following SBF passage (Fig. 13), although such changes are infrequent (~25% of the SB events at both M1 and S3 site), implying a weaker impact of SAI on marine influenced regional background accumulation mode. This aligns with Thompson et al. (2025), which showed that aerosol cloud-forming properties differ between polluted marine and continental air masses, with variability in size, hygroscopicity, and CCN efficiency across sites. Given the complex mix of marine, terrestrial, and urban sources, and the strong spatial heterogeneity revealed by both our analysis and prior TRACER studies, future studies should include direct CCN and INP measurements and size-resolved aerosol properties to better capture the role of SAI in aerosol–cloud interactions. It is important to remember that these effects are localized, occurring only during shorter timescales (~5 h) associated with daily SBC cycles over these locations. But these SAI timings align with periods of peak solar radiation and elevated aerosol concentrations, potentially leading to significant impacts on the radiation budget over the coastal regions. During times in close proximity to SBF passage, changes in solar radiation and cloud formation may influence the aerosol formation and distribution, modify atmospheric chemical reactions, and affect cloud formation and properties, thereby impacting various atmospheric processes and interactions. Because many coastal cities have high aerosol loading with frequent SBCs, accounting for SAI when estimating direct aerosol radiative forcing *is crucial. However, quantifying these changes is challenging, underscoring the need for detailed future studies across diverse coastal regions.*"

Technical Comments

1. (abstract, lines 27-28) I suggest moving the sentence starting with "SAIs modify cloud condensation nuclei…" to before the previous sentence since it is currently sandwiched in between two sentences that discuss the radiative impacts.

Response: The sentence is moved as suggested. Please refer to *Lines 29-30*.

2. (Page 11, line 318) "resulting to" should be "resulting from"

Response: Changed as suggested. Please refer to *Line 402*.

3. (Figure S2 and S3) Please make it clear in the captions to these figures why some cases are included in the left column and others are in the right column. Presumably these are dates when the aerosol concentration increased (left) or decreased (right) after SBF passage?

Response: You are right. The captions are now modified to reflect the columns with enhancement influence (left) and reduction influence (right).

4. (Page 12, line 343) "continental sites" is unclear here since I don't think this phrase has been used/defined previously. Does this refer to both S3 and M1?

Response: Yes, it refers to both S3 and M1 sites. To avoid the confusion, "continental sites" is now replaced with "both the M1 and S3 sites" (*Line 435*).

5. (Page 13, line 377) remove "that" before "occurred"

Response: The word no longer exists in the modified manuscript.

6. (Page 14, lines 425-427) This sentence is repeated from text at the beginning of this paragraph and can be removed.

Response: Repeated sentence is removed.

7. (Page 16, line 485) Insert “an” before “air mass”

Response: Inserted “an” as suggested.

8. (Figure 6a label) The x-axis label here states the time is UTC, but it appears to be the SBF-relative time. Please correct.

Response: Thank you for noticing. The x-axis label is corrected.

9. (Page 18, line 556) “ARM” should be “ARF”

Response: Replaced as suggested.

10. (Page 19, line 574) I think “preceding” here should be “following” since the air mass behind the SBF (or after it passed) had less aerosol on this date.

Response: The word no longer exists in the modified manuscript.

11. (Page 20, line 598) add “is” before “therefore warranted.”

Response: The word no longer exists in the modified manuscript.

12. (Page 20, lines 616-617; 618) I suggest replacing with “land-ocean interface” with “Galveston Bay” since M1 isn’t actually closer to the Gulf of Mexico than S3. Likewise replace “downstream” in reference to S3 with a more accurate modifier like “rural” or “farther removed from urban and industrial influences”

Response: The sentence is modified to include both the suggestions:

Lines 736-739: “TRACER measurements indicate that the urban M1 site, closer to both Galveston Bay and the Gulf of Mexico, experiences more frequent aerosol concentration changes (increase or decrease during 63% of SB events) than the rural S3 site (increase or decrease during 40% of SB days), which is primarily Gulf-breeze influenced and farther from urban/industrial sources.”

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