



Supplement of

Implications of Sea Breeze Circulations on boundary layer aerosols in the southern coastal Texas region

Tamanna Subba et al.

Correspondence to: Tamanna Subba (tsubba@bnl.gov)

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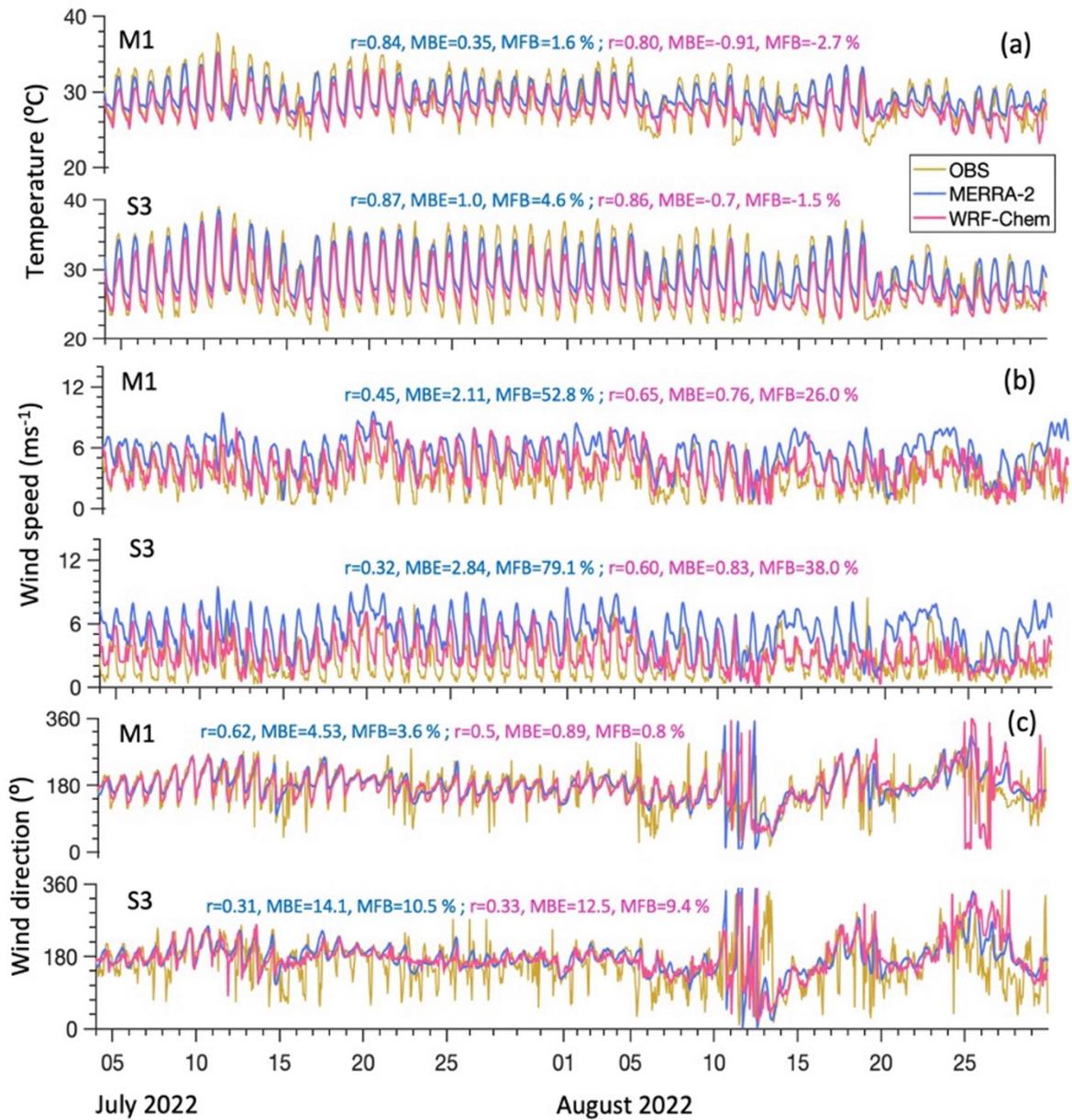


Figure S1. Time series of hourly meteorological variables from 04 July to 30 August 2022 at the M1 and S3 sites: (a) 2 m Temperature, (b) 10 m wind speed, and (c) 10 m wind direction. Observations (yellow) are compared with WRF-Chem simulations (pink) and MERRA-2 reanalysis (blue). For each variable and site, the correlation coefficient (r), mean bias error (MBE), and mean fractional bias (MFB) are reported in the panels, quantifying model performance relative to observations.

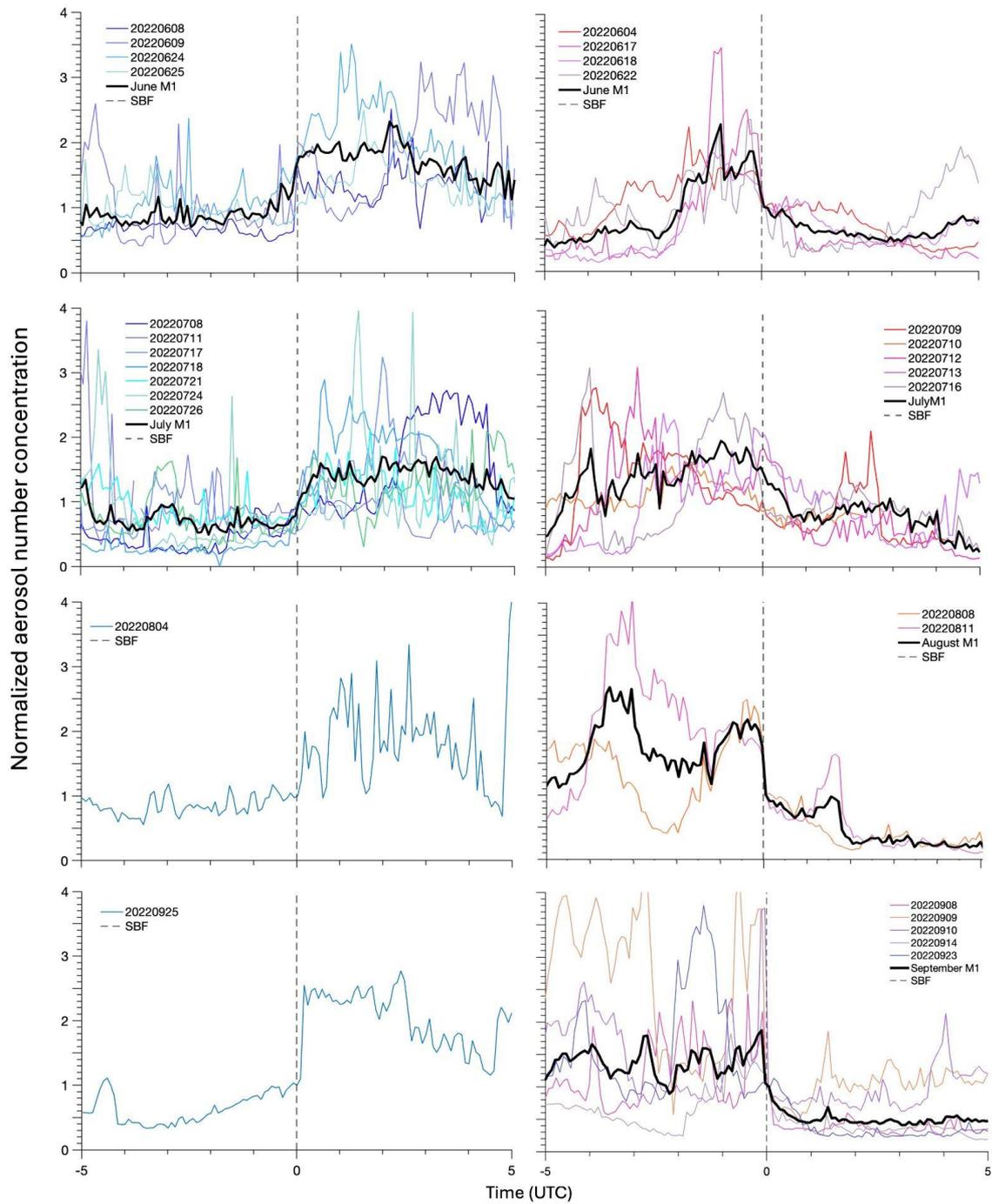


Figure S2. Time series of the normalized aerosol number concentration, with time normalized w.r.t the time of the sea breeze front (SBF)'s passing through the M1 site during individual SB event days, showcasing cases with enhancement influence (left) and reduction influence (right) on aerosol number concentration.

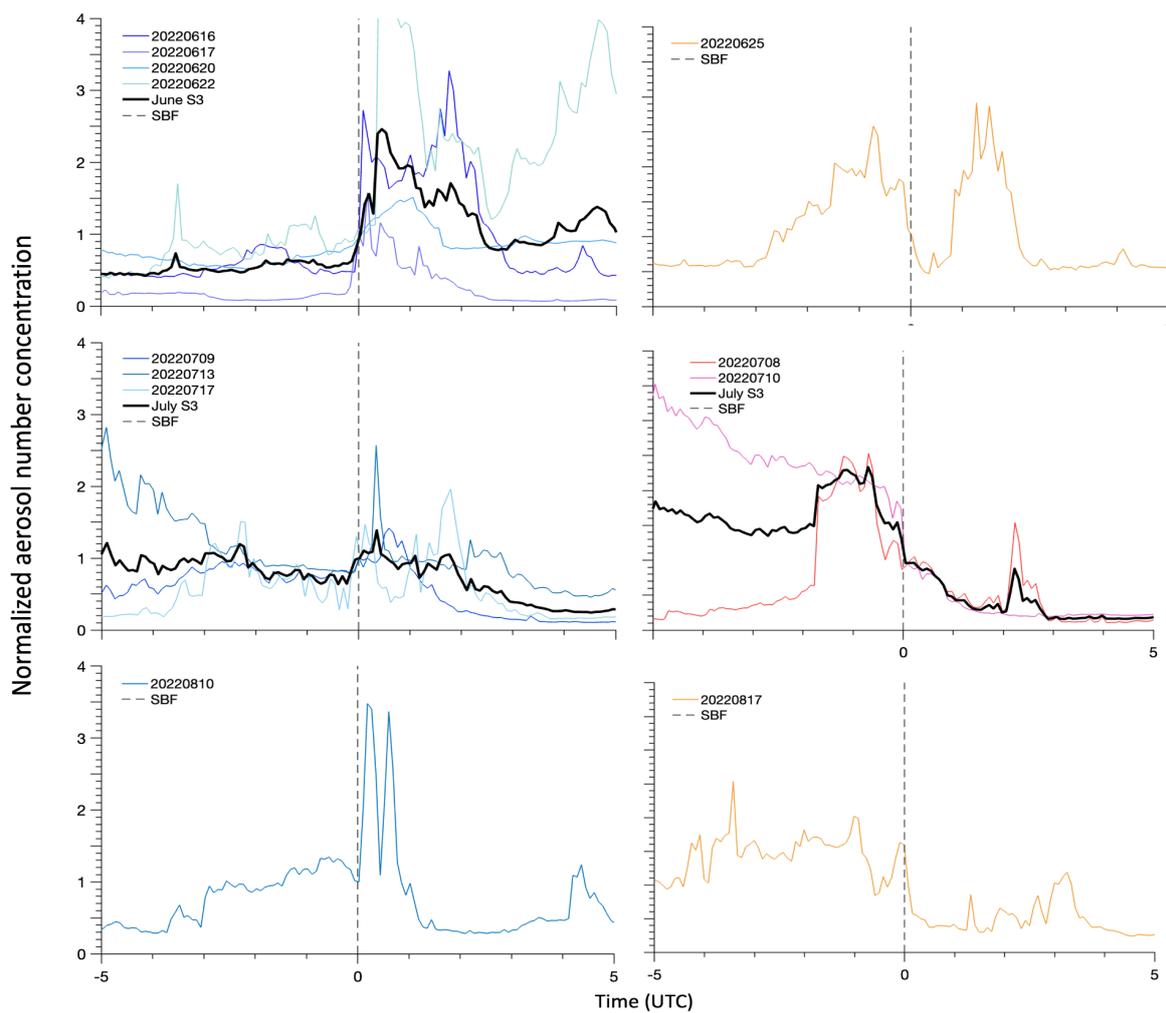


Figure S3. Time series of the normalized aerosol number concentration, with time normalized w.r.t the time of the sea breeze front (SBF)'s passing through the S3 site during individual SB event days, showcasing cases with enhancement influence (left) and reduction influence (right) on aerosol number concentration.

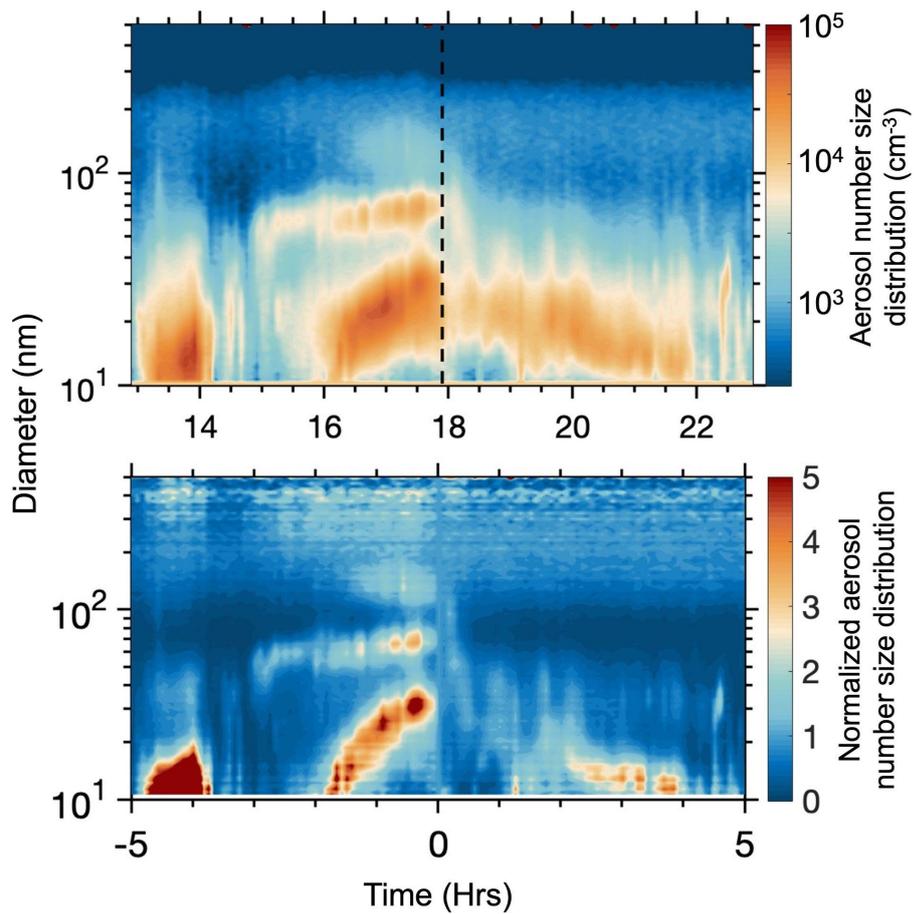
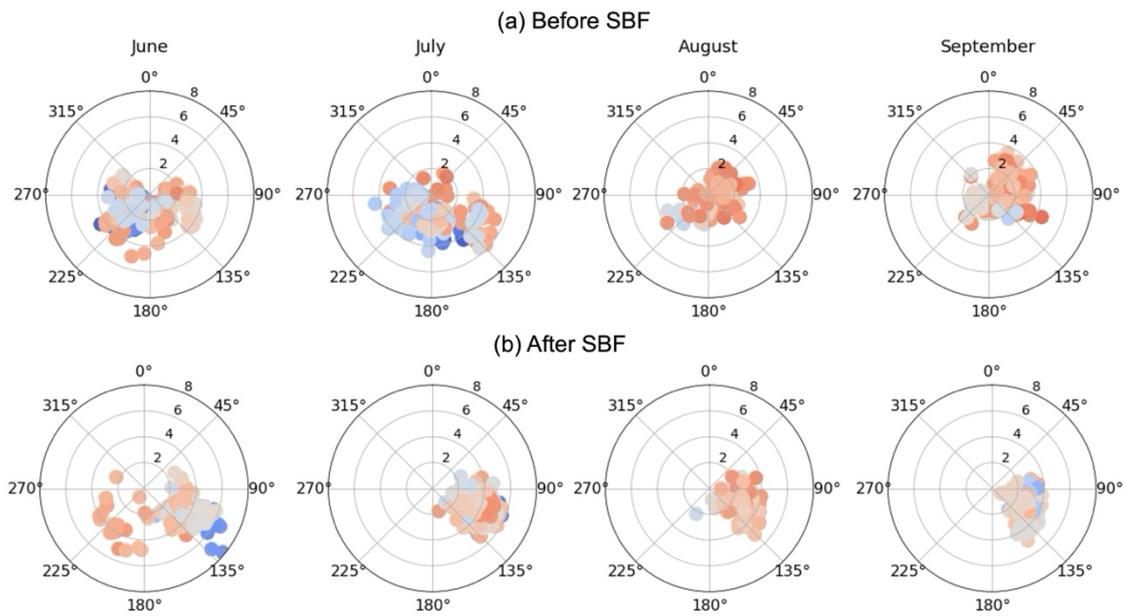


Figure S4. Aerosol number size distribution at the M1 site during an NPF event on 16 July 2022. (Top panel) Time series of measured aerosol number size distribution (cm^{-3}). The vertical dashed line marks the passage of the SBF (T_{SBF}). (Bottom panel) Normalized aerosol number size distribution (relative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

M1



S3

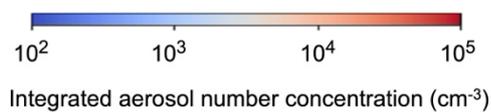
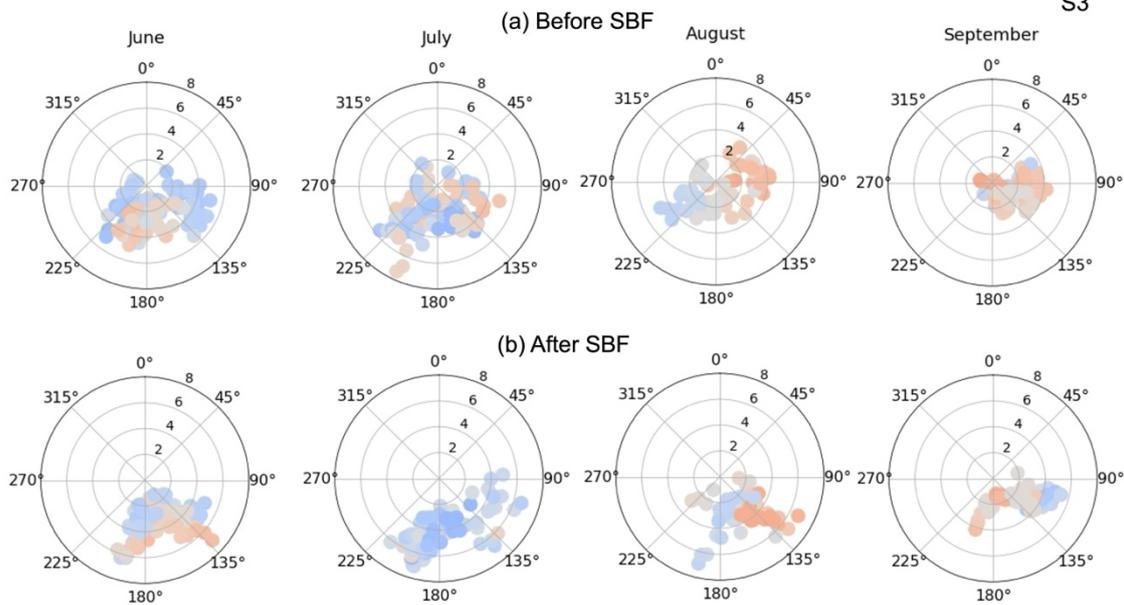


Figure S5. Open-air polar plots for integrated aerosol number concentration (a) before and (b) after the passing of the sea breeze front at M1 and S3 sites during June to September 2022. The wind speed (in m s^{-1}) grid lines are presented with black circles. The color scales represent the concentrations observed with each wind speed and direction combinations.

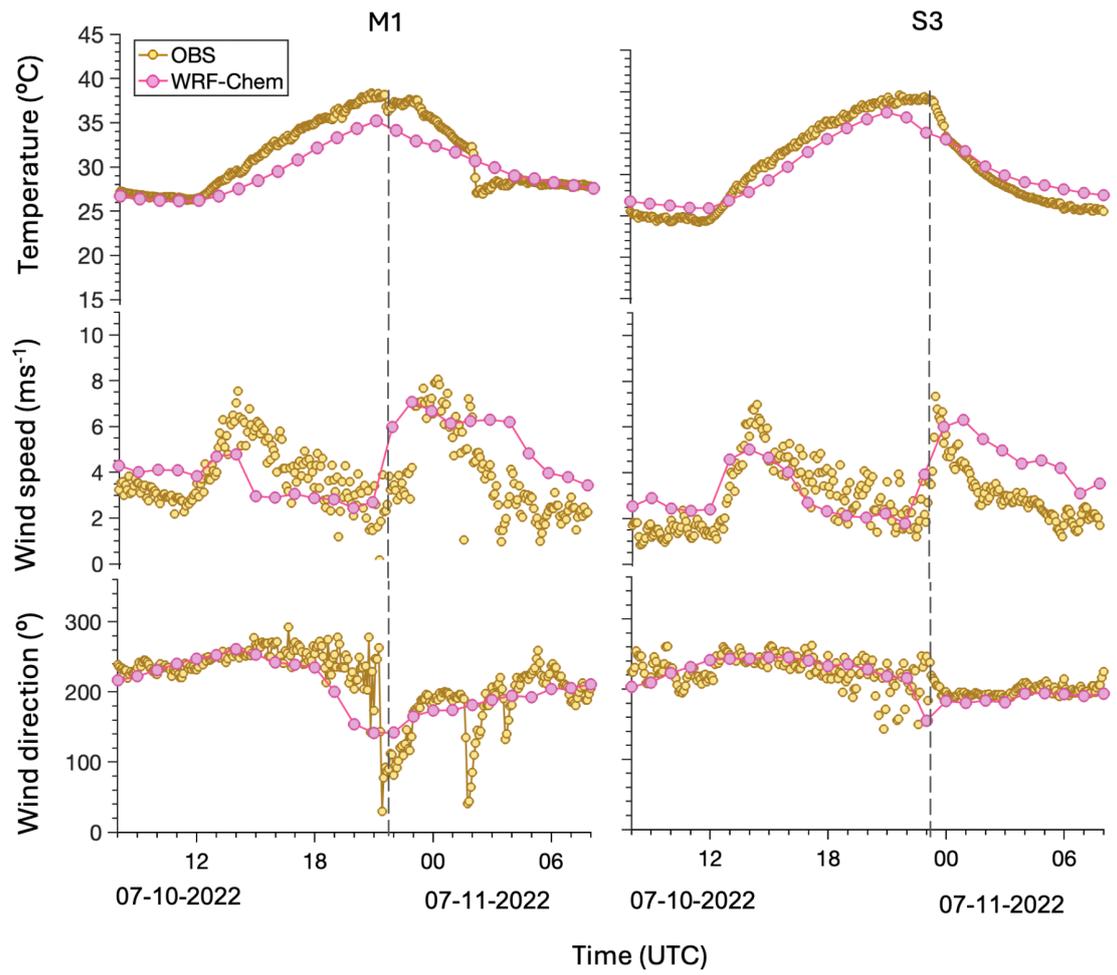


Figure S6. Time series of temperature, wind speed, and wind directions measured and modeled at M1 and S3 sites.

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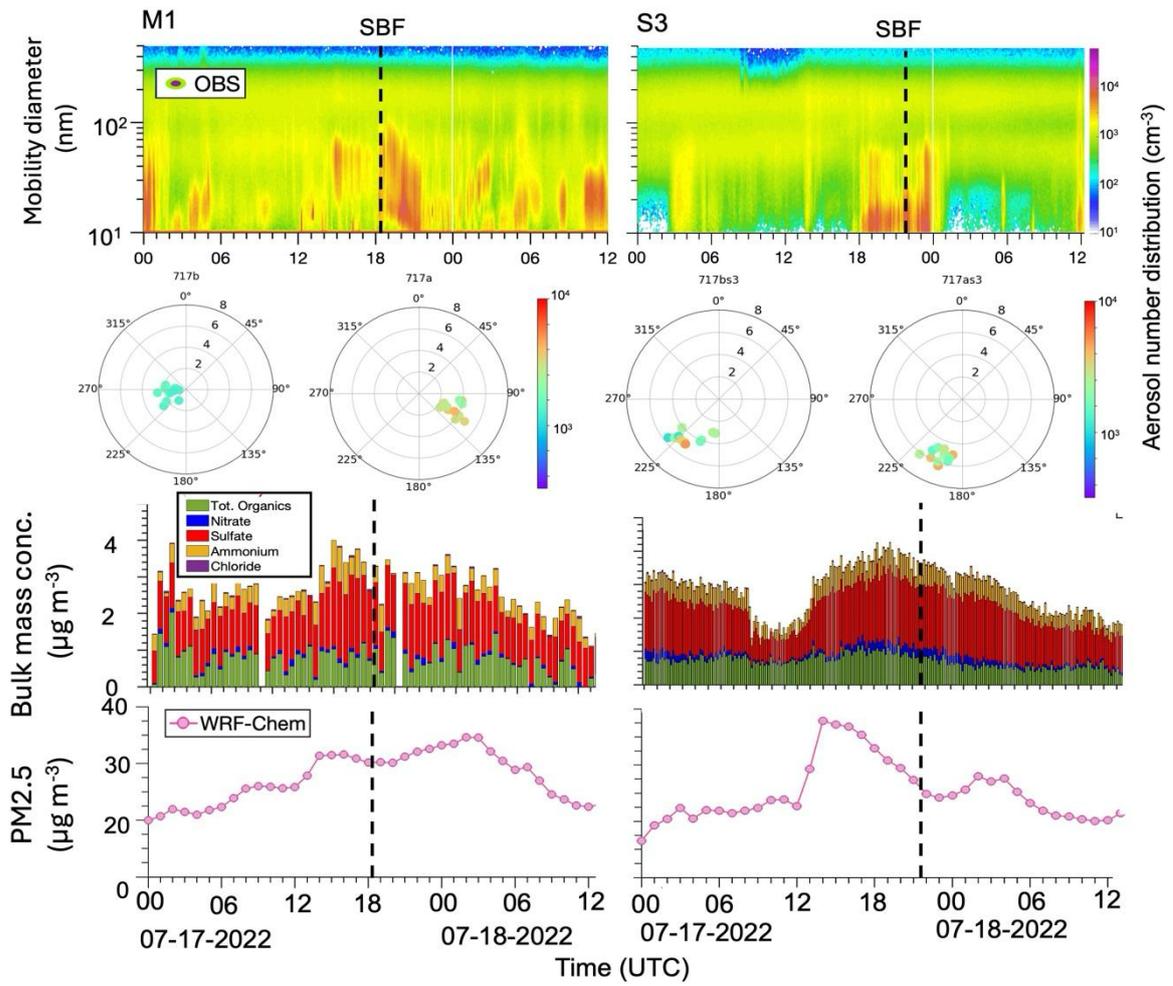


Figure S7. Time series of measured aerosol size distribution (1st row) measured bulk chemical composition (3rd row), and modeled and TCEQ measured PM_{2.5} mass concentration (4th row) at (a) M1 and (b) S3 on 17 July 2022. Polar plot showing the measured integrated aerosol number concentration during one hour before and after the passing of the SBF (2nd row). The black dashed line represents the time of the passing of the SBF (TSBF) at the respective sites.

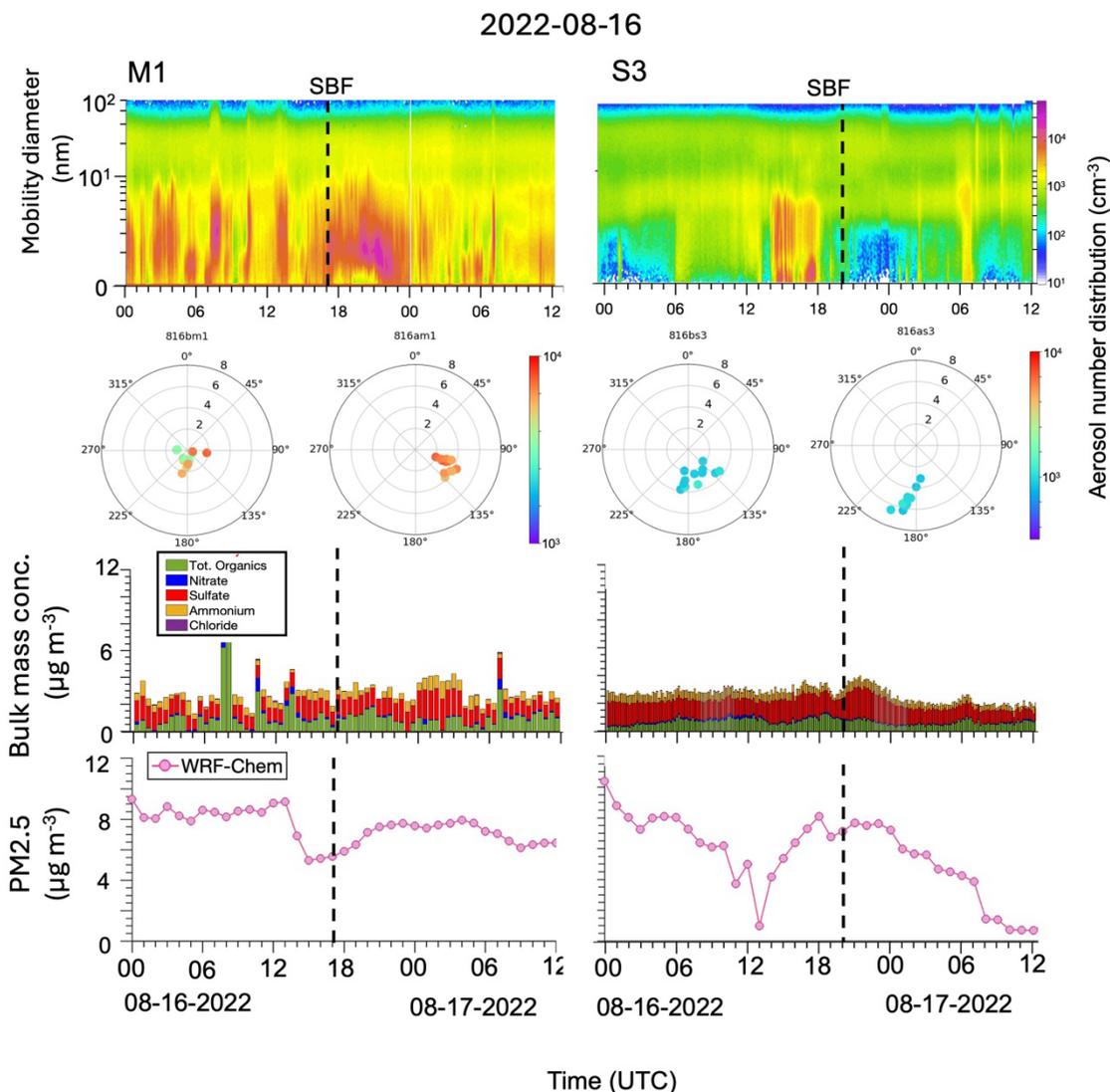


Figure S8. Time series of measured aerosol size distribution (1st row) measured bulk chemical composition (3rd row), and modeled and TCEQ measured PM2.5 mass concentration (4th row) at (a) M1 and (b) S3 on 16 August 2022. Polar plot showing the measured integrated aerosol number concentration during one hour before and after the passing of the SBF (2nd row). The black dashed line represents the time of the passing of the SBF (TSBF) at the respective sites.

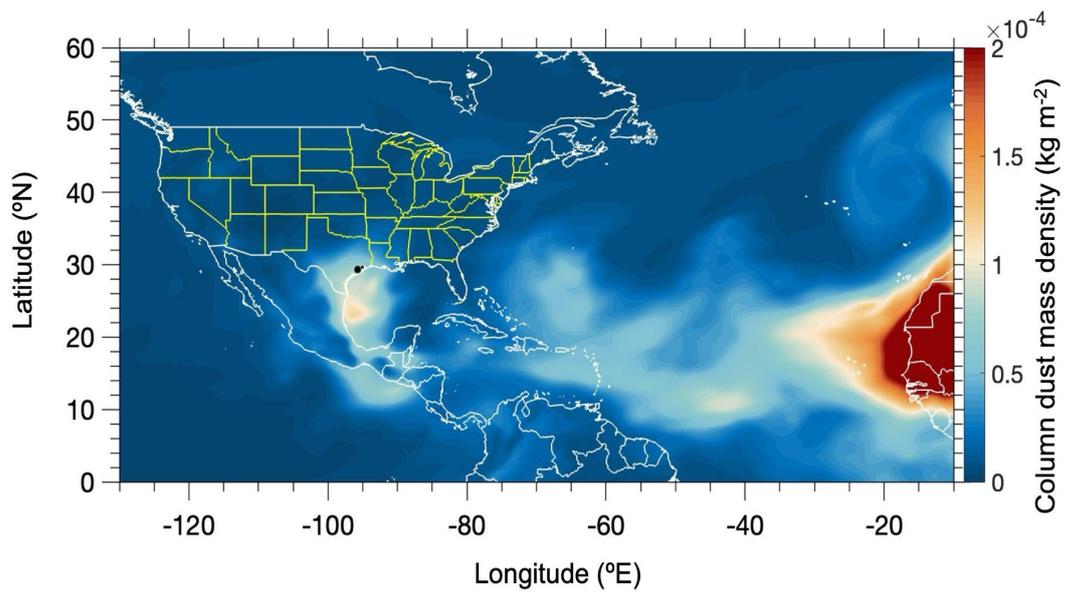


Figure S9. Spatial distribution of MERRA-2 derived dust column mass density, averaged over 16-17 July 2022. The filled-circle marker in the panels represent the TRACER site.

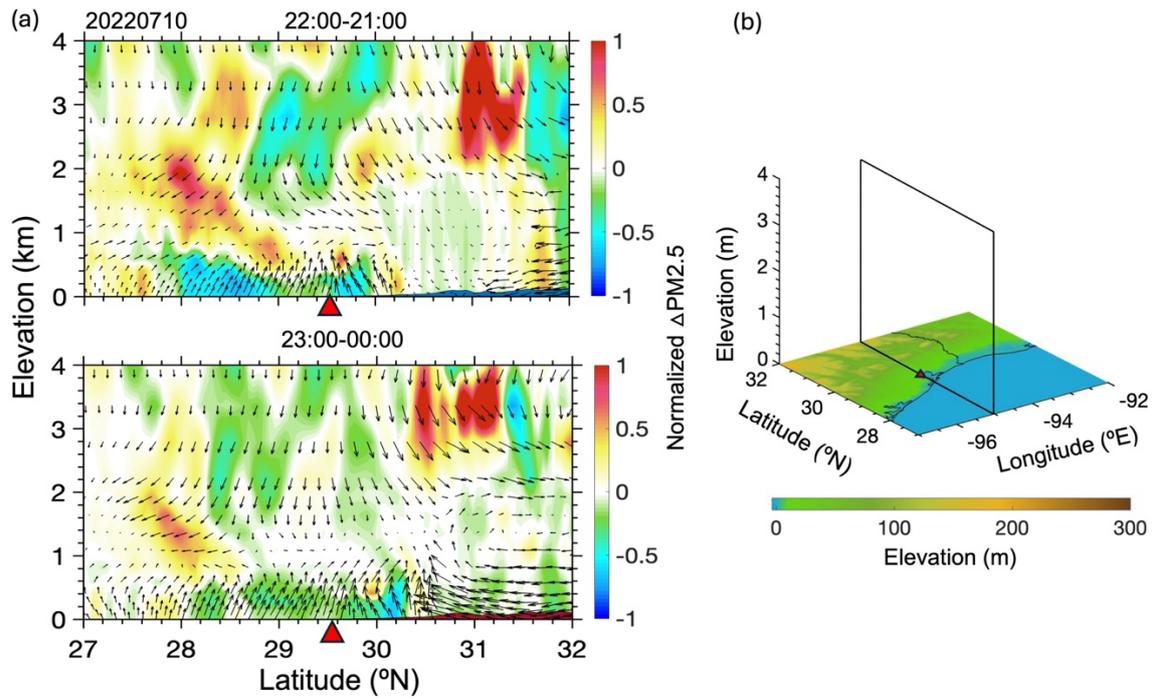


Figure S10. (a) Vertical distribution of the $PM_{2.5}$ bias between two time steps along the latitudes across the M1 site (marked by the red triangle). (b) The location of the cross-section.

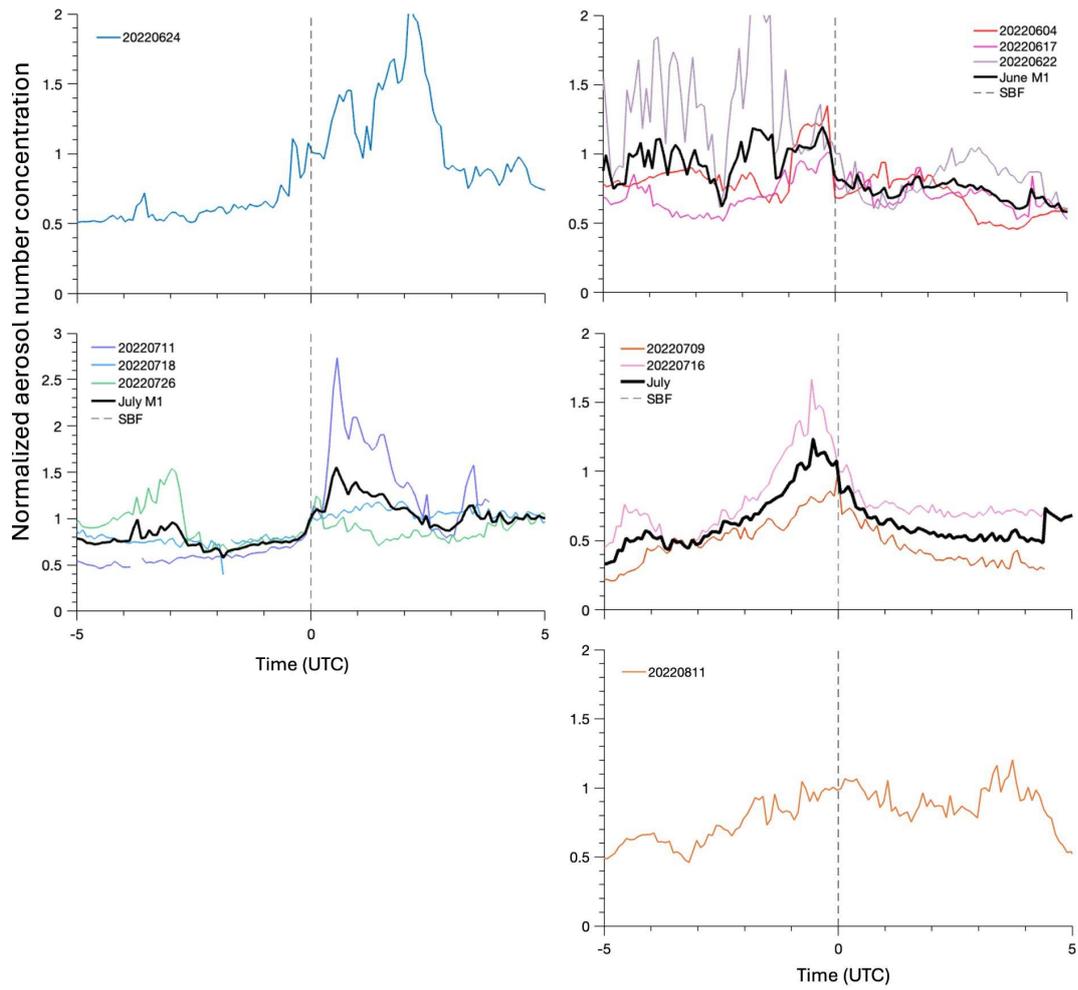


Figure S11. Time series of the normalized N100, with time normalized w.r.t the time of the sea breeze front (SBF)'s passing through the M1 site during the individual SB event days.

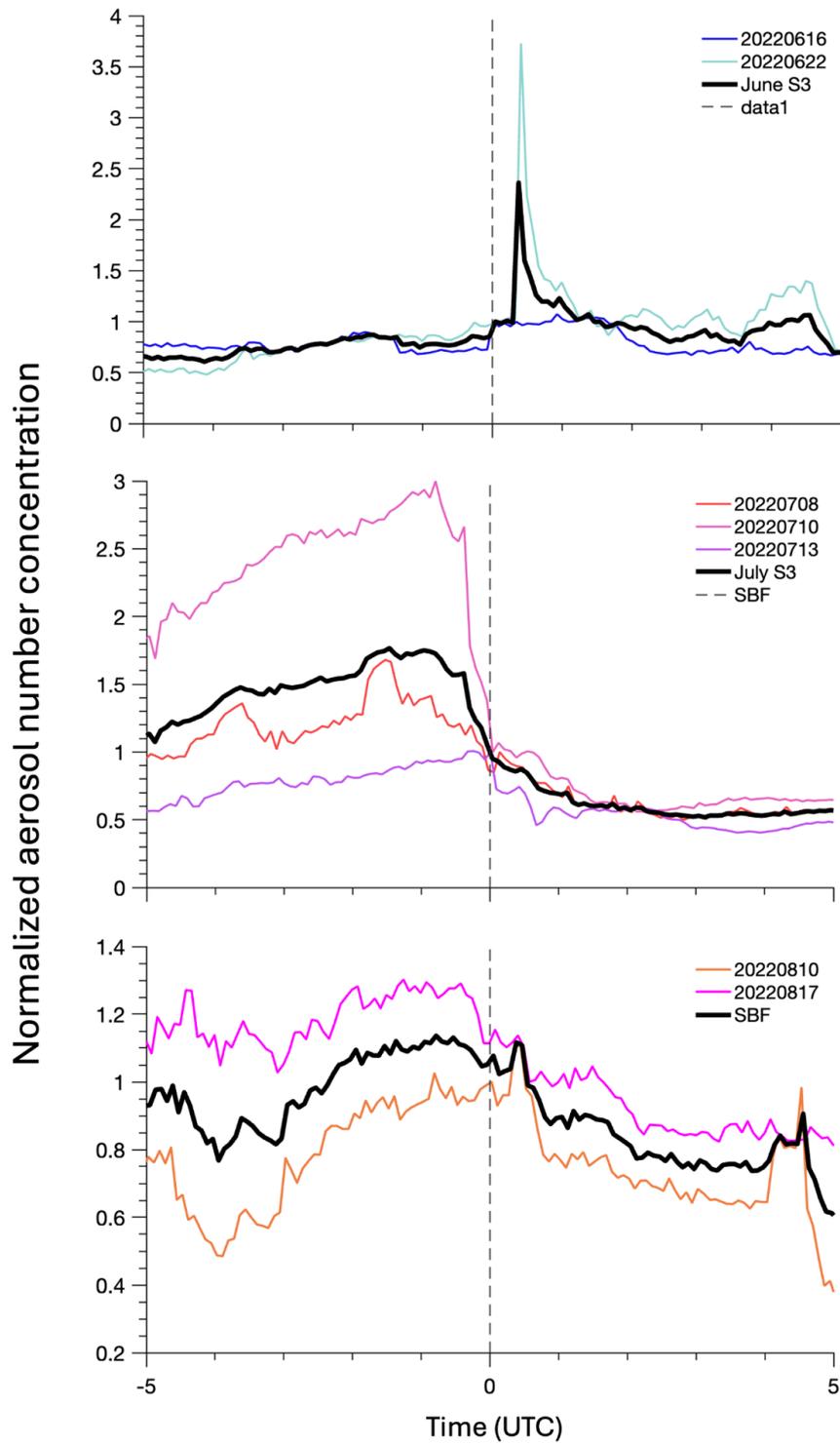


Figure S12. Time series of the normalized N100, with time normalized w.r.t the time of the sea breeze front (SBF)'s passing through the S3 site during the individual SB event days.

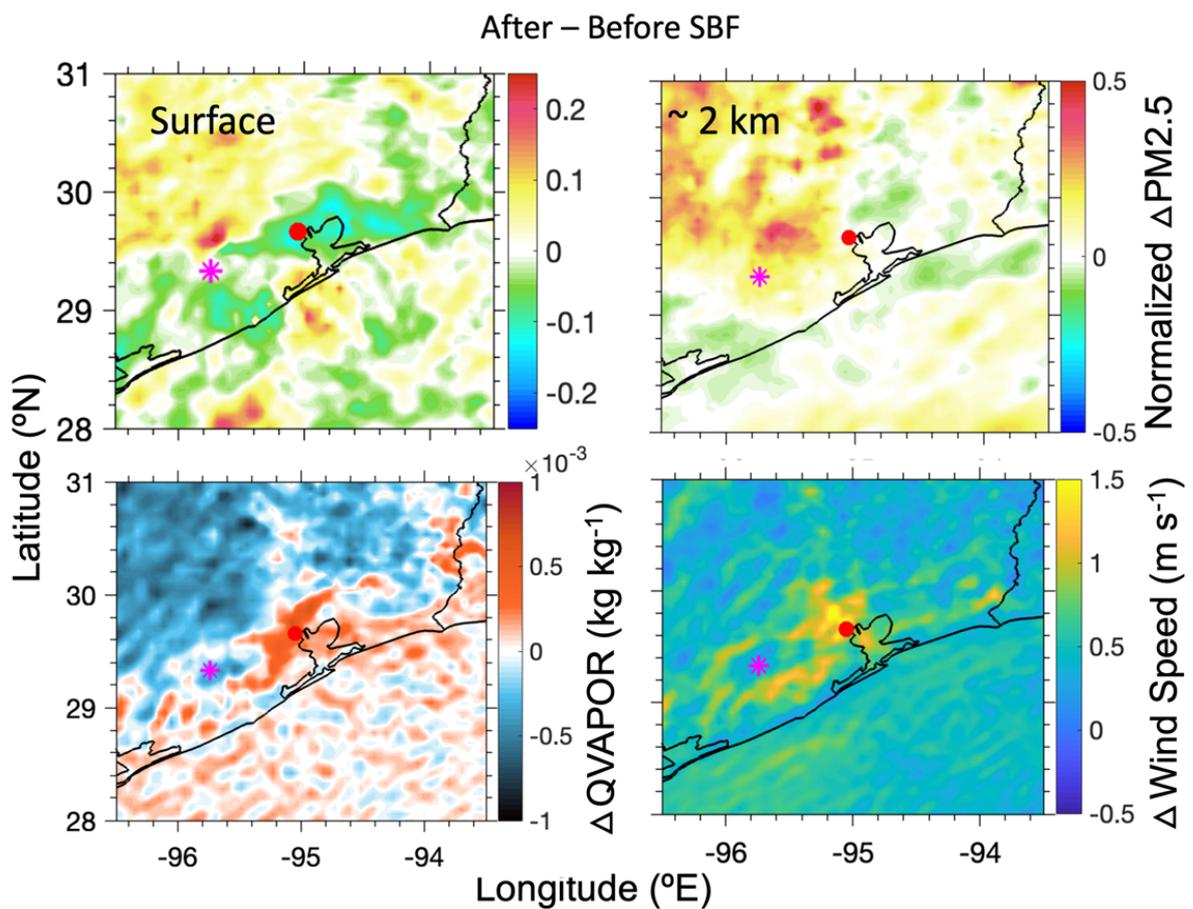


Figure S13. Modeled difference of $PM_{2.5}$ concentrations at the surface, at 2km, water vapor mixing ratio, and wind speed averaged over 18 sea breeze events before and after the passing of the SBF ($\Delta Time = Time_{SBF} \pm 1:00$ hour) at the M1 site.