



Supplement of

Composited analyses of the chemical and physical characteristics of co-polluted days by ozone and PM_{2.5} over 2013–2020 in the Beijing–Tianjin–Hebei region

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Table S1. The comparisons of simulated OH concentrations with observations in BTH.

Site	Time period	Observed OH	Simulated OH	Reference for observation
Beijing (39.6°N, 116.2°E)	Summer 2017	5.82×10^6 (averaged)	2.4×10^6 (averaged)	Woodward et al. (2020)
Beijing (40°N, 116.3°E)	Winter 2017	$1.5-2.0 \times 10^6$ (daytime)	$1.8-9.2 \times 10^5$ (averaged)	Ma et al. (2019)
Wangdu (38.7°N, 115.2°E)	Summer 2014	$5-15 \times 10^6$ (daytime)	$3.7-9.5 \times 10^6$ (averaged)	Tan et al. (2017)

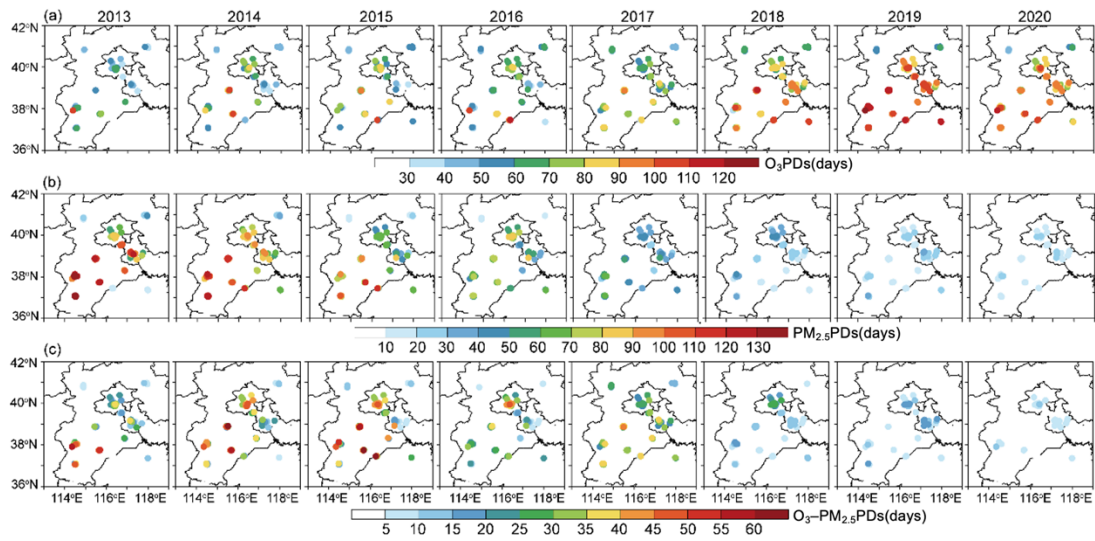


Figure S1. Spatial distributions of observed numbers of (a) O₃PDs (MDA8 O₃ > 80 ppb), (b) PM_{2.5}PDs (PM_{2.5} > 75 µg m⁻³), and (c) O₃-PM_{2.5}PDs (MDA8 O₃ > 80 ppb and PM_{2.5} > 75 µg m⁻³) summed over April-October from 2013 to 2020 in BTH.

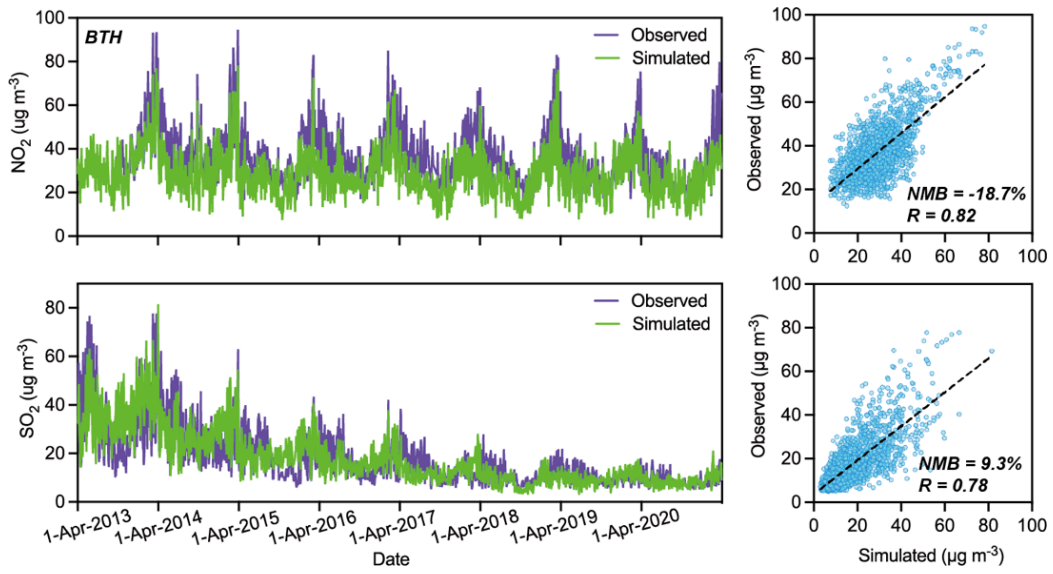


Figure S2. Simulated and observed daily mean surface-layer concentrations of NO₂ and SO₂ as well as the scatterplots of simulated versus observed values for April to October of 2013–2020 in BTH.

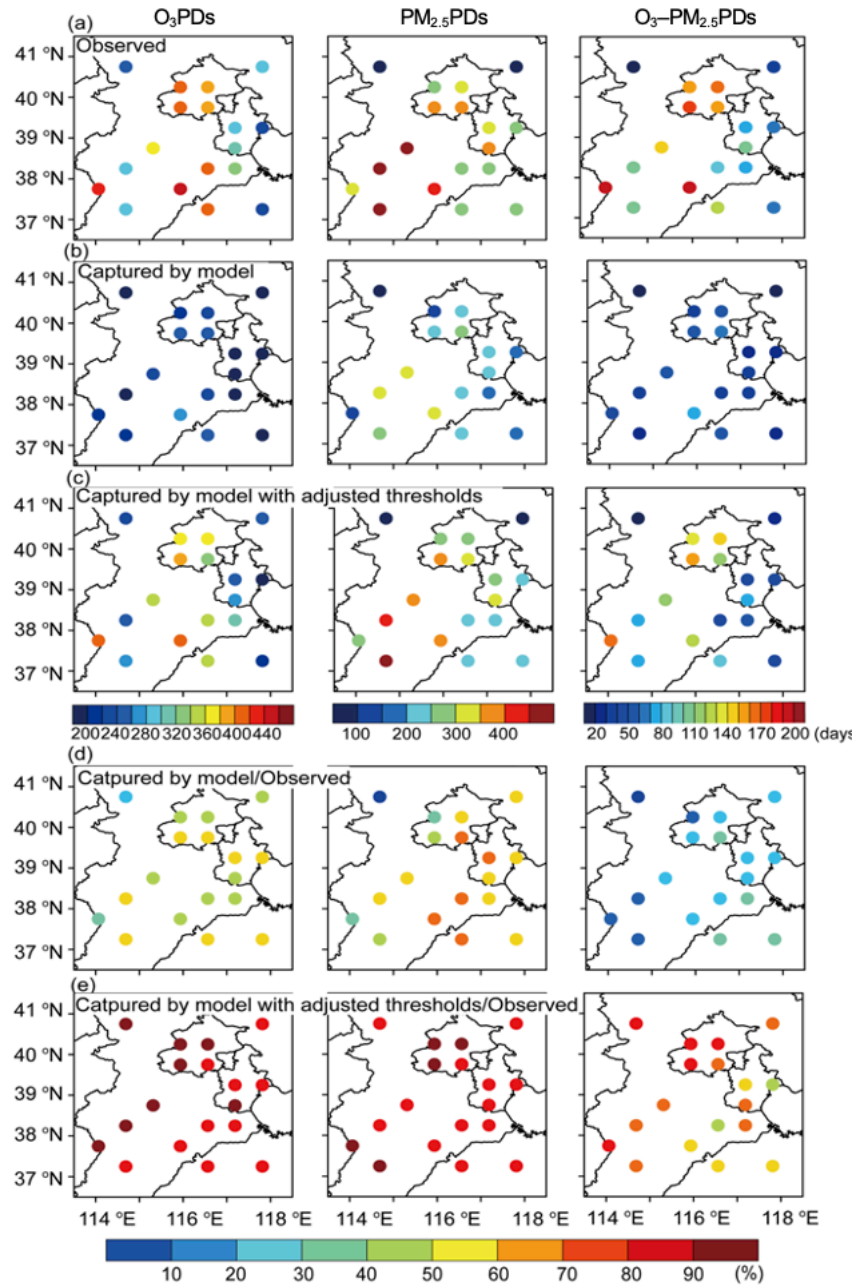


Figure S3. Spatial distributions of (a) observed numbers of O₃PDs, PM_{2.5}PDs, and O₃-PM_{2.5}PDs, (b) numbers of polluted days captured by the GEOS-Chem model with the threshold of 80 ppb for MDA8 O₃ and 75 $\mu\text{g m}^{-3}$ for PM_{2.5} and (c) numbers of polluted days captured by the GEOS-Chem model with adjusted thresholds. Percentage of polluted days (d) captured by the model and (e) captured by the model with adjusted thresholds. The values were calculated for the warm months (April to October) of 2013-2020.

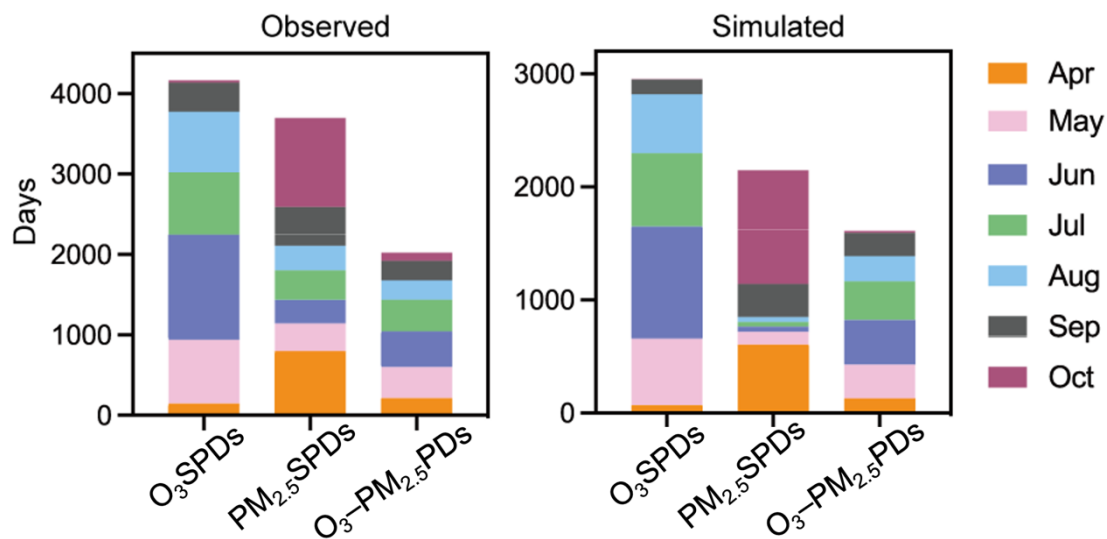


Figure S4. The observed and model-captured numbers of O₃SPDs, PM_{2.5}SPDs, O₃-PM_{2.5}PDs in each month summed over 2013-2010 in BTH.

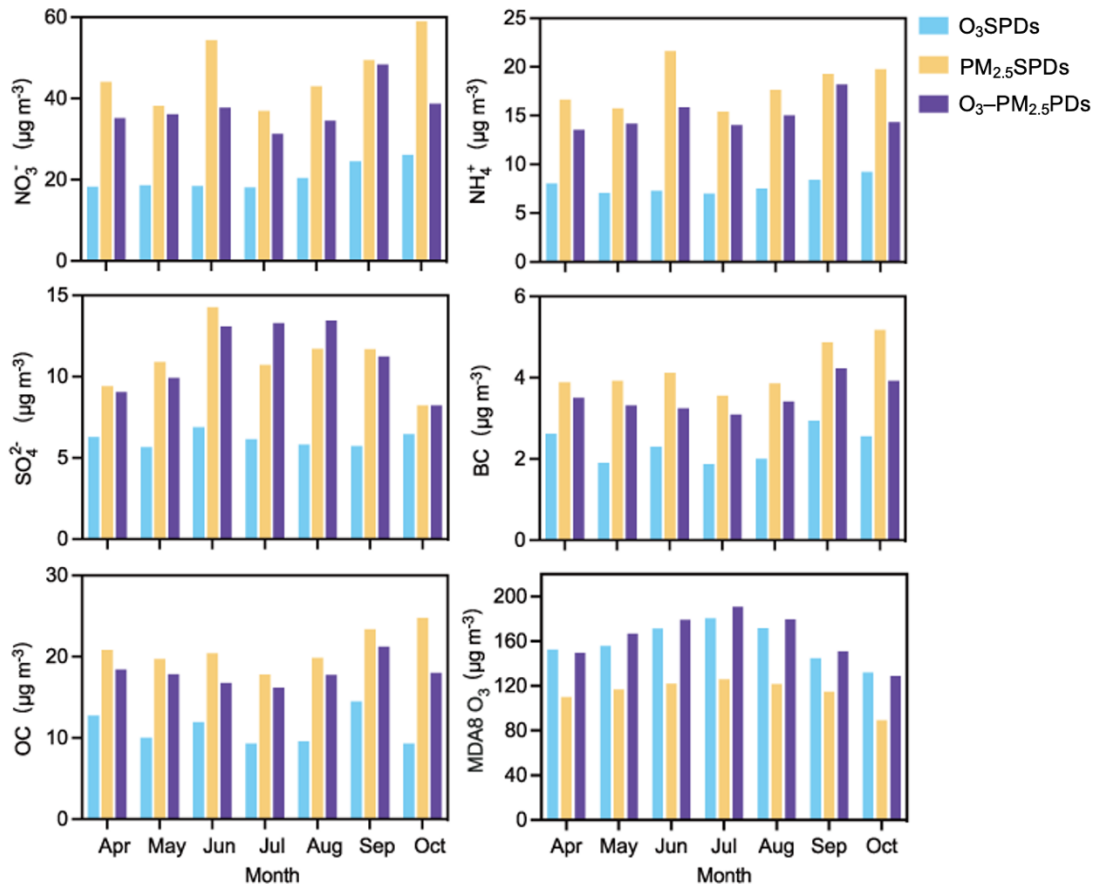


Figure S5. The concentrations of PM_{2.5} components ($\mu\text{g m}^{-3}$): NO₃⁻, NH₄⁺, SO₄²⁻, BC, and OC as well as MDA8 O₃ averaged in model-captured O₃SPDs, PM_{2.5}SPDs, and O₃-PM_{2.5}PDs over BTH in each month of 2013-2020.

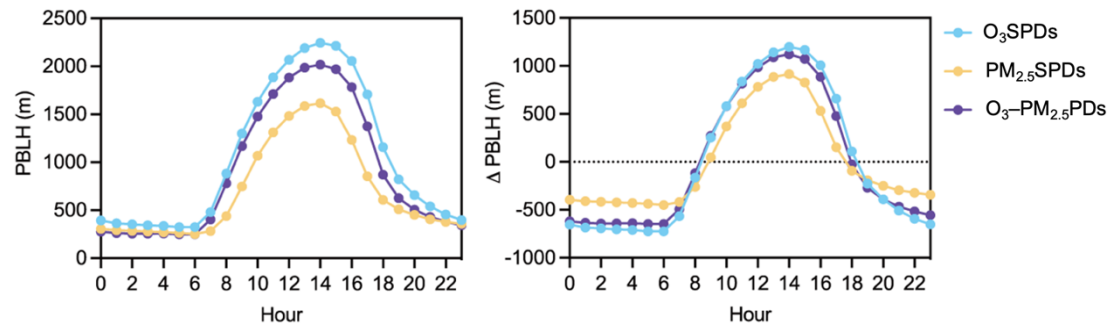


Figure S6. The hourly variations of PBLH (m) and Δ PBLH (hourly PBLH - daily averaged PBLH, m) averaged in all model-captured O₃SPDs (blue), PM_{2.5}SPDs (yellow), and O₃-PM_{2.5}PDs (purple) over the warm months (April-October) of 2013-2020.

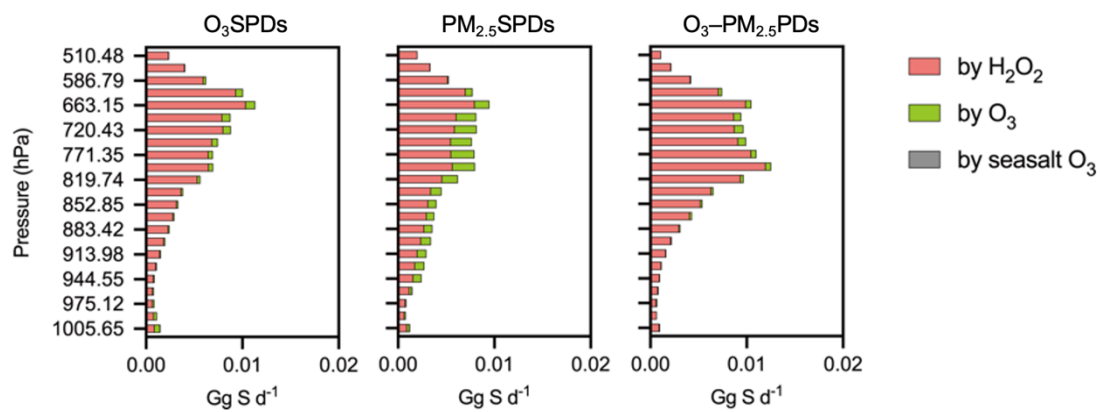


Figure S7. The vertical profile of SO_4^{2-} chemical production ($P(\text{SO}_4^{2-})$, Gg S d^{-1}) from aqueous oxidation of H_2O_2 in clouds, aqueous oxidation of O_3 in clouds, and O_3 on sea salt aerosols over BTH. The values were averaged over the model-captured regional O_3 SPDs, $\text{PM}_{2.5}$ SPDs, and $\text{O}_3\text{-PM}_{2.5}$ PDs in April-October of 2013-2020.

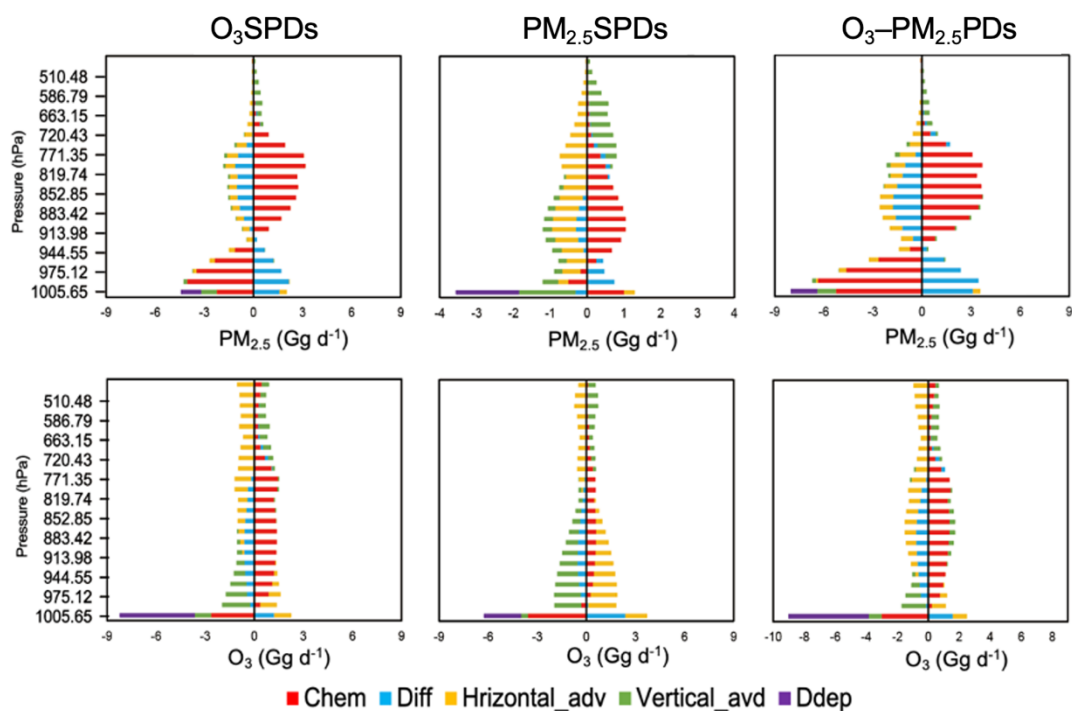


Figure S8. The vertical profile of net change in the total of PM_{2.5} components mass (NO₃⁻ + NH₄⁺ + SO₄²⁻ + OC, Gg d⁻¹) and O₃ mass (Gg d⁻¹) over BTH for each process. The values were averaged over the model-captured regional O₃SPDs, PM_{2.5}SPDs, and O₃-PM_{2.5}PDs in April-October of 2013-2020.

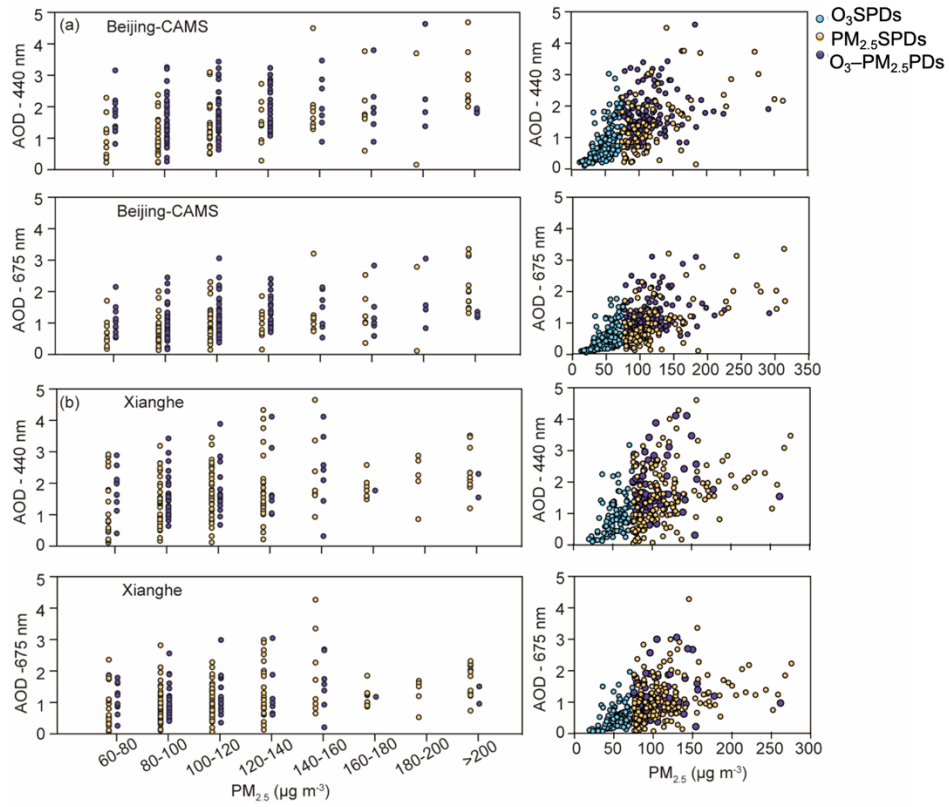


Figure S9. The same as Figure. 10 but for Beijing-CAMS and Xianghe station.

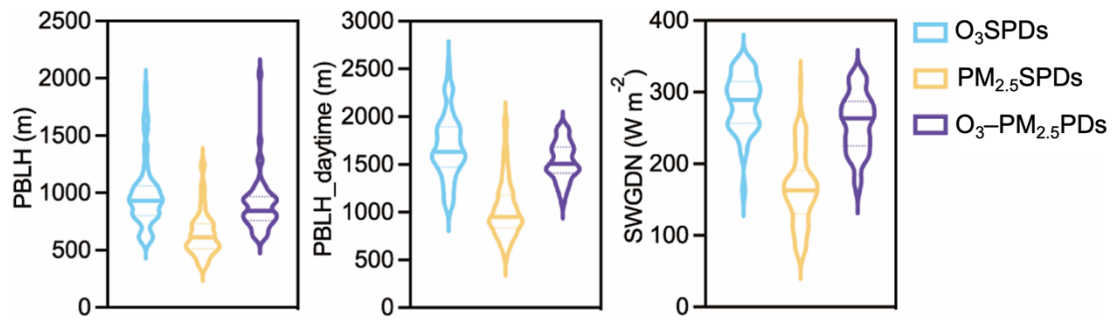


Figure S10. The violin plot of planetary boundary layer height (PBLH, m), daytime planetary boundary layer height (PBLH_daytime, m), surface incoming shortwave flux (SWGDN, $W m^{-2}$) in model-captured O₃SPDs (blue), PM_{2.5}SPDs (yellow), and O₃-PM_{2.5}PDs (purple) in the months of April to October from 2013-2020. The solid line in the middle represents the median value.

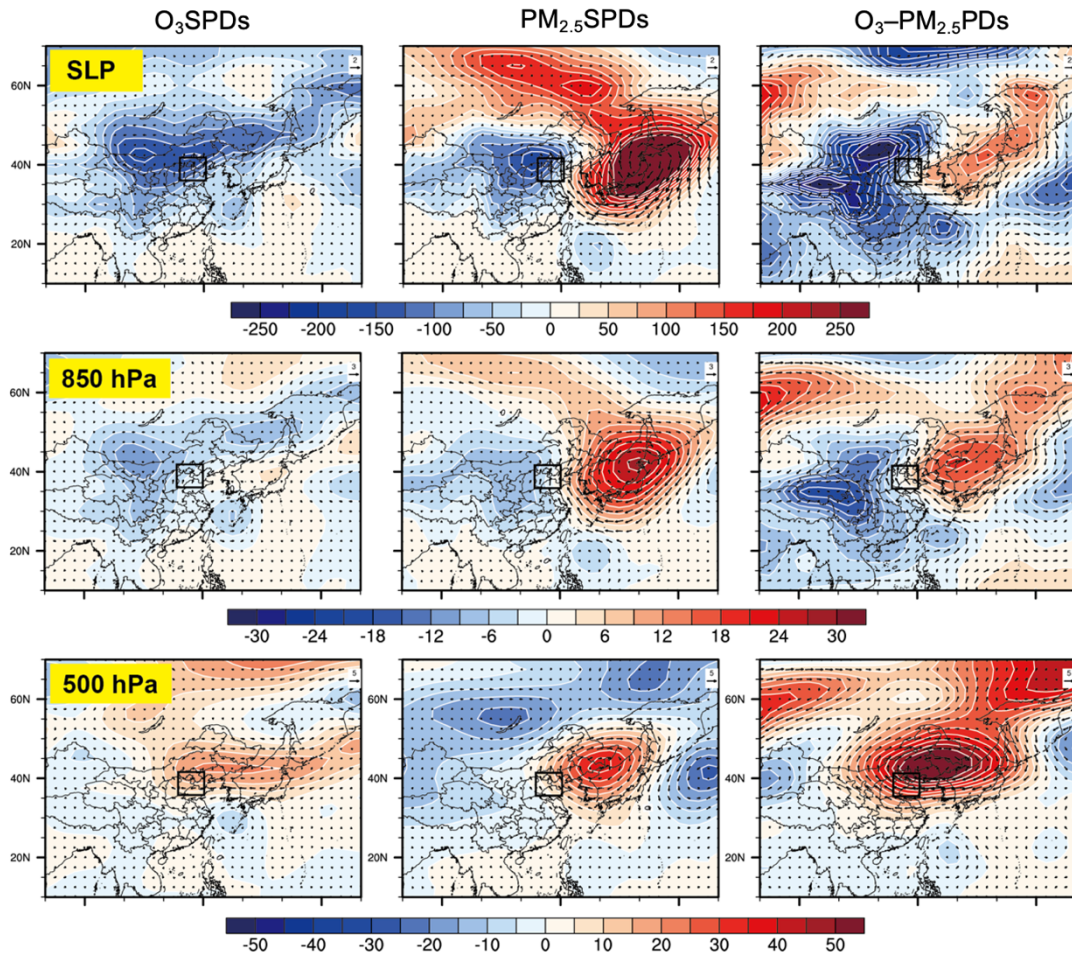


Figure S11. Composites of the anomalies of winds (m s^{-1}) with SLP (sea level pressure) and with geopotential height at 850 hPa and 500 hPa for regional O_3 SPDs, $\text{PM}_{2.5}$ SPDs, and O_3 - $\text{PM}_{2.5}$ PDs that were captured by the model during April-October of 2013-2020. The solid black rectangle indicates the BTH region.

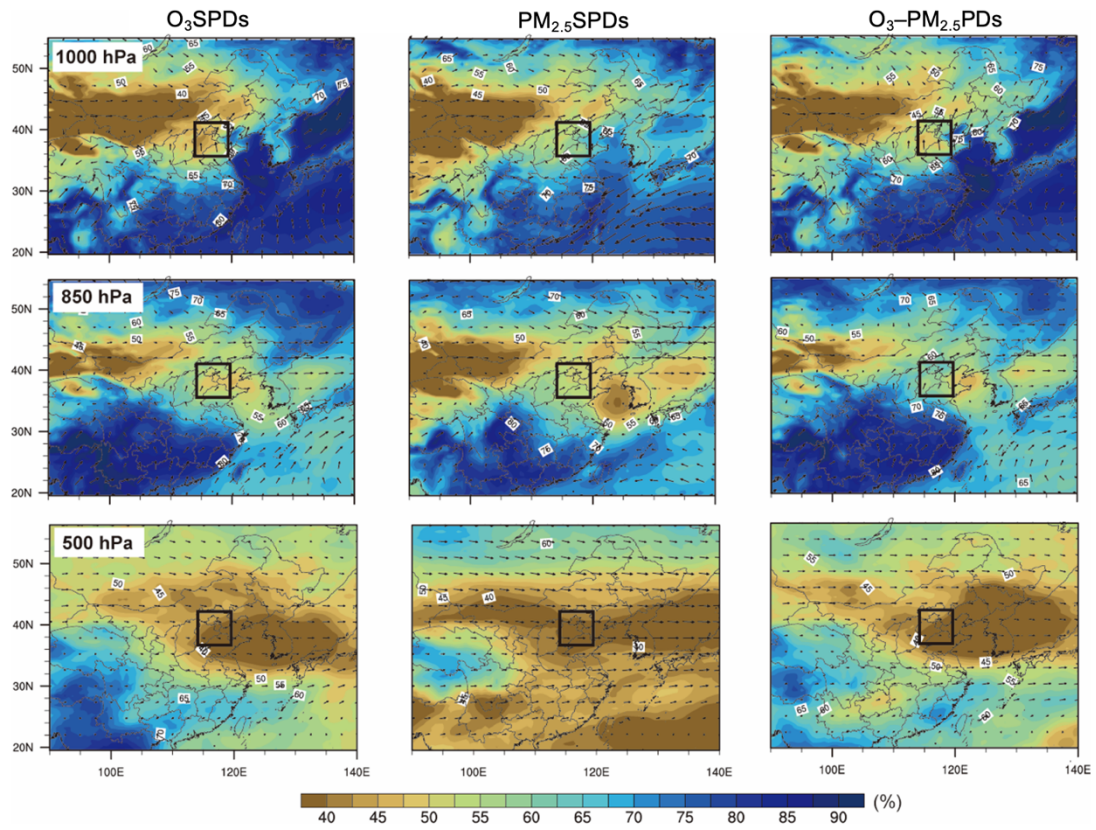


Figure S12. Composites of wind field (m s^{-1}) with RH (%) at 1000 hPa, 850 hPa and 500 hPa for regional O₃SPDs, PM_{2.5}SPDs, and O₃-PM_{2.5}PDs that were captured by the model in April-October of 2013-2020. The solid black lines indicate BTH region.

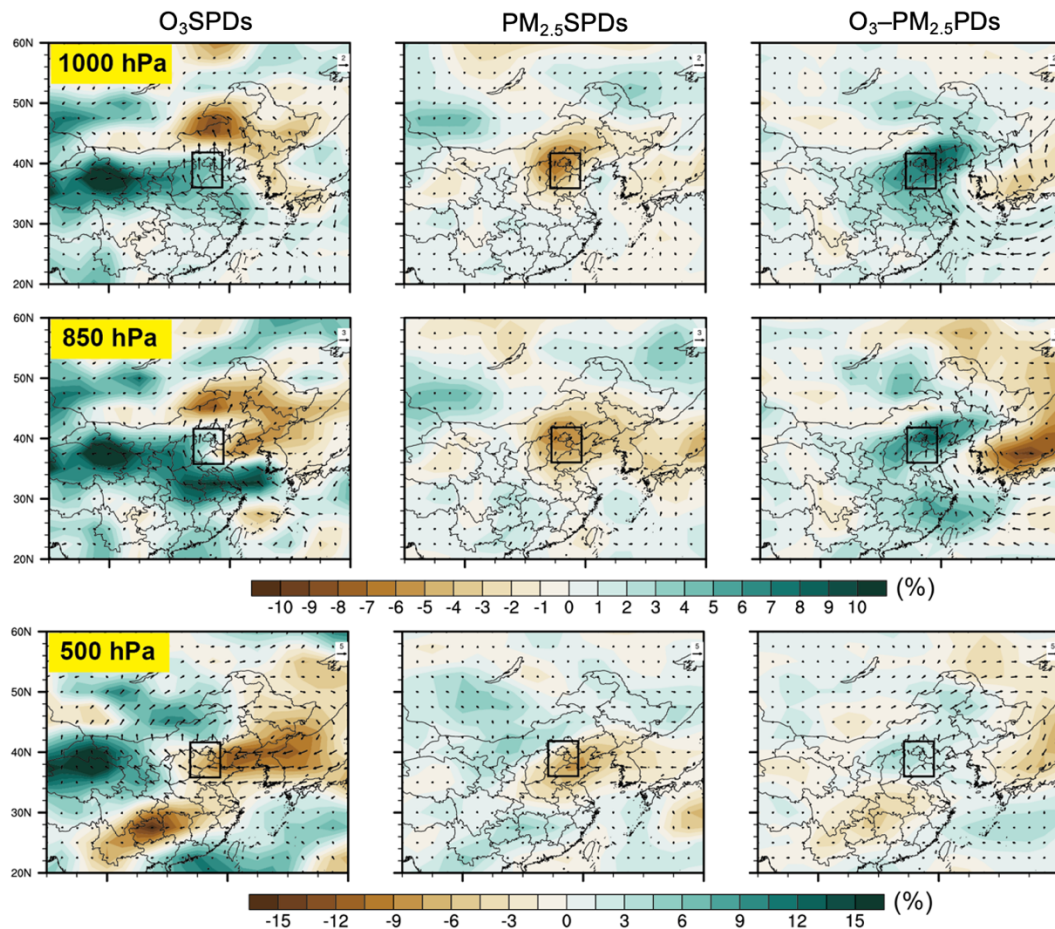


Figure S13. Composites of the anomalies of winds (m s⁻¹) with RH (%) at 1000 hPa, 850 hPa, and 500 hPa for regional O₃SPDs, PM_{2.5}SPDs, and O₃-PM_{2.5}PDs that were captured by the model during April-October of 2013-2020. The solid black rectangle indicates the BTH region.