Supplementary Materials for

Satellite-based Diagnosis and Numerical Verification of Ozone Formation Regimes over Nine Megacities in East Asia

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Table S1. WRF-Chem configuration

Physics option	Adopted scheme
Microphysics	Lin et al. scheme
Longwave radiation	Rapid radiative transfer model (RRTM)
Shortwave radiation	Goddard
Surface layer	Monin-Obukhov similarity
Land surface	Noah Land Surface Model
Planetary boundary layer	Yonsei University scheme
Cumulus parameterizations	Grell 3D
Chemistry option	**Adopted scheme**
Photolysis	Madronich photolysis (TUV)
Gas phase chemistry	NOAA/ESRL Regional Atmospheric Chemistry (RACM)
Aerosols	Modal Approach Dynamics model for Europe/ Volatility Basis Set (MADE/VBS)
Anthropogenic emissions	KORUSv.5
Biogenic emissions	Model of Emissions of Gases and Aerosols from Nature (MEGAN) v.2.04
Biomass burning emissions	Fire Inventory of NCAR (FINN) v.1.5

Table S2. Summary statistics for comparison between WRF-Chem simulations and observed O_3 and NO_2 concentrations by surface and aircraft measurement for the KORUS-AQ campaign period (May 2016)

	Pearson correlation coefficient **(R)**	Index of agreement **(IOA)**	Normalized mean bias **(NMB)**	Root mean square error **(RMSE)**
WRF-Chem vs. Surface measurement (Seoul)				
O₃	0.50	0.53	-0.29	28.40
NO₂	0.84	0.91	0.30	2.09
WRF-Chem vs. DC-8 measurement				
O₃	0.67	0.74	-0.36	21.24
NO₂	0.52	0.68	0.13	16.03

$$R = \frac{\sum(O-\overline{O})(S-\overline{S})}{\sum\left((O-\overline{O})^2\right)^{\frac{1}{2}}\sum\left((S-\overline{S})^2\right)^{\frac{1}{2}}}$$

$$IOA = 1 - \frac{\sum\left((S-\overline{S})-(O-\overline{O})\right)^2}{\sum\left(|S-\overline{S}|+|O-\overline{O}|\right)^2}$$

$$NMB = \frac{\sum(O-S)}{\sum O}$$

$$RMSE = \sqrt{\frac{1}{N}\sum(S-O)^2}$$

N: sample size, O: observation, S: Simulation

Table S3. Simulated O_3 concentrations at 9 megacities averaged over the KORUS-AQ campaign period (May 2016) for base case plus 3 emission reduction scenarios (unit: ppbv)

City	Control	NOx 50% reduction	VOCs 50% reduction	Both 50% reduction
Beijing	37.04	41.07	30.67	36.72
Shanghai	31.98	41.45	25.46	34.60
Tianjin	35.90	39.03	30.28	35.41
Hebei	40.49	41.88	35.13	38.64
Shandong	51.68	49.81	45.12	45.73
Seoul	29.54	38.06	26.60	33.70
Busan	40.66	44.59	36.20	40.69
Osaka	39.37	40.56	37.59	38.87
Tokyo	34.62	38.79	34.02	37.01

Table S4. Simulated O_3 concentrations at 9 megacities averaged over the KORUS-AQ campaign period (May 2016) for base case plus 3 Chinese emission reduction scenarios (unit: ppbv)

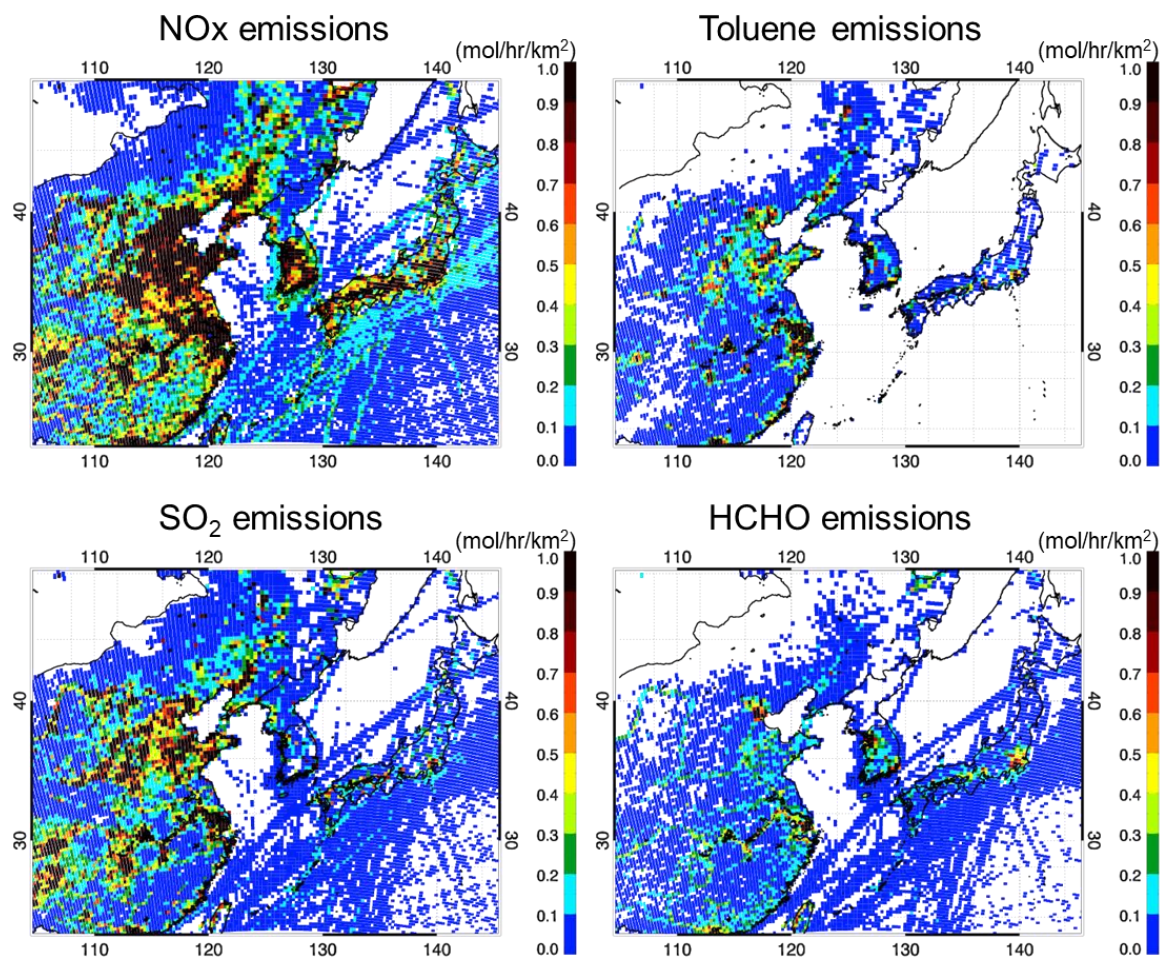| City	Control	NOx 50% reduction	VOCs 50% reduction	Both 50% reduction
Beijing	37.04	41.06	30.97	37.23
Shanghai	31.98	40.51	24.77	34.71
Tianjin	35.90	39.38	30.76	36.18
Hebei	40.49	42.19	35.50	39.24
Shandong	51.68	50.64	46.28	47.34
Seoul	29.54	27.30	27.43	25.91
Busan	40.66	38.28	38.47	36.75
Osaka	39.37	37.88	38.47	37.22
Tokyo	34.62	32.97	33.77	32.31

Figure S1. Horizontal distributions of emissions for NOx, SO₂, Toluene, and HCHO (KORUS-AQ v.5) used in this study