Supplementary Information

Impact of introducing electric vehicles to the ground-level O_3 and $PM_{2.5}$ in the Greater Tokyo Area: Yearly trend and the importance of the change of Urban Heat Island effect

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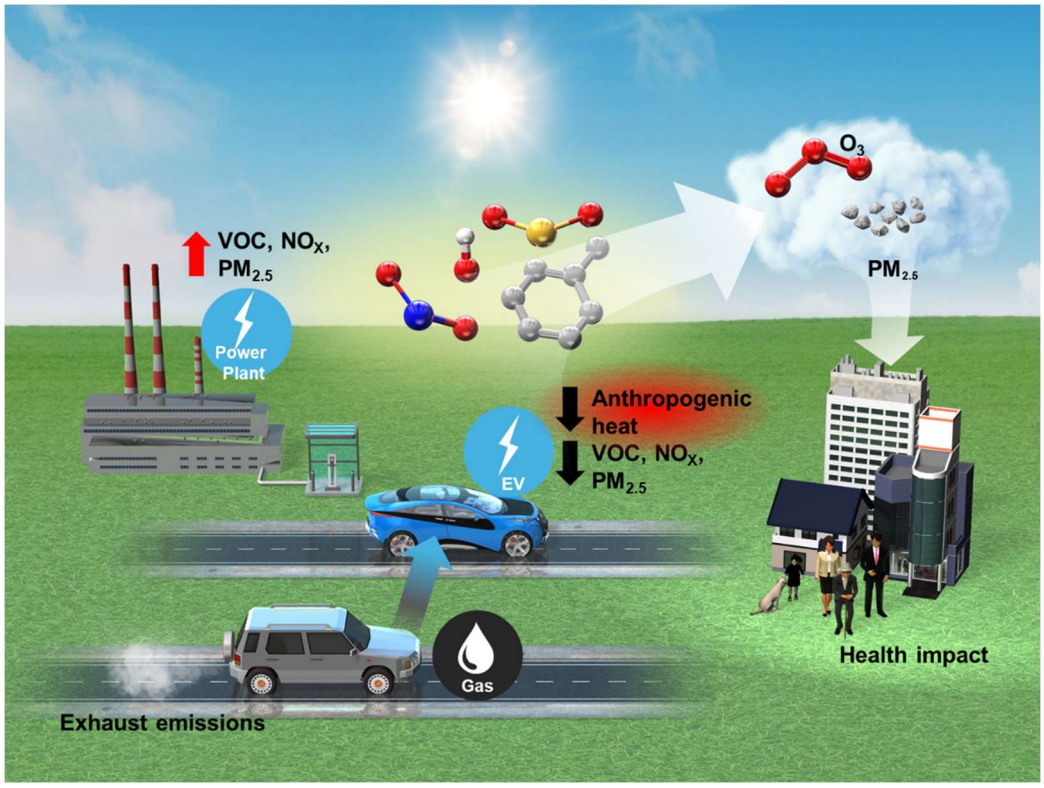
3 Tables and 8 Figures



Text S1 *Additional information on numerical simulations*

Table S1: Latitude and longitude of the four sites analyzed for model validation in this study.

City	Longitude	Latitude
Tokyo	139.75	35.69
Gunma	139.07	36.38

Table S2: Calculation settings for the WRF.

Model	**WRF-ARW v4.3.3**
Reanalysis	NCEP FNL (1 deg., 6 hr)
SST	NOAA SST (0.082 deg., 6 hr)
domains	220×170, 45 km (D1), 154×160 (D2), 64×70 (D3)
Minimum vertical pressure (p_top)	100 hPa
Grid nudging	k_zfac_uv = 10
	guv, gt, gq = 0.0001 (D1), 0.00005 (D2), 0.0000 (D3)
Microphysics	WRF Single-Moment 5-class scheme
Longwave radiation	RRTMG scheme
Shortwave radiation	RRTMG scheme
Planetary boundary layer	Mellor-Yamada Nakanishi and Niino Level 3 PBL scheme
Cloud Physics	Kain–Fritsch scheme
Urban physics	Urban-canopy model (UCM)

Table S3: Calculation settings for the CMAQ.

Model	**CMAQv5.3.3**
Boundary concentration (D1)	MOZART-4/GEOS5
Boundary concentration (D2)	Nested from D1
Boundary concentration (D3)	Nested from D2
Initial concentration (D1)	CMAQ default (profile)
Initial concentration (D2)	Nested from D1
Initial concentration (D3)	Nested from D2
Gas/Aerosol/Aqueous chemistry	saprc07tc/aero6/cloud_acm_ae6
Photolysis	phot_inline
Horizontal advection	Yamo
Vertical advection	wrf
Horizontal diffusion	hdiff/multiscale
Vertical diffusion	vdiff/acm
Dry deposition	m3dry

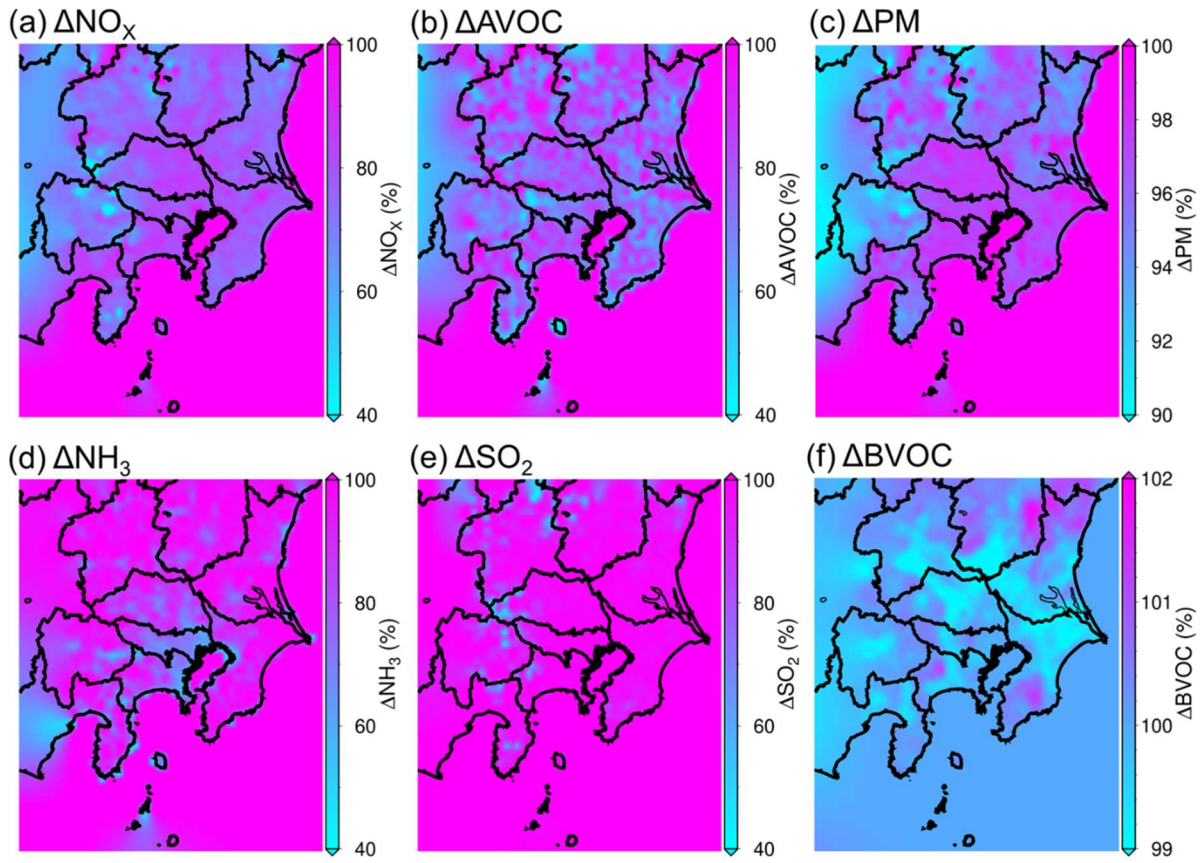


Fig. S1: Changes in the annual emissions from ALL and BASE scenarios (ALL/BASE) in terms of: (a) NO_X, (b) anthropogenic VOCs (AVOC), (c) particulate matter (PM), (d) NH_3, (e) SO_2, and (f) biogenic VOCs (BVOC). All factors affected by the introduction of EVs: reduction of tailpipe exhaust and evaporative emissions, increase in emissions from power plants owing to battery charging, and the change in BVOC emissions caused by the change in the UHI effect, are included.

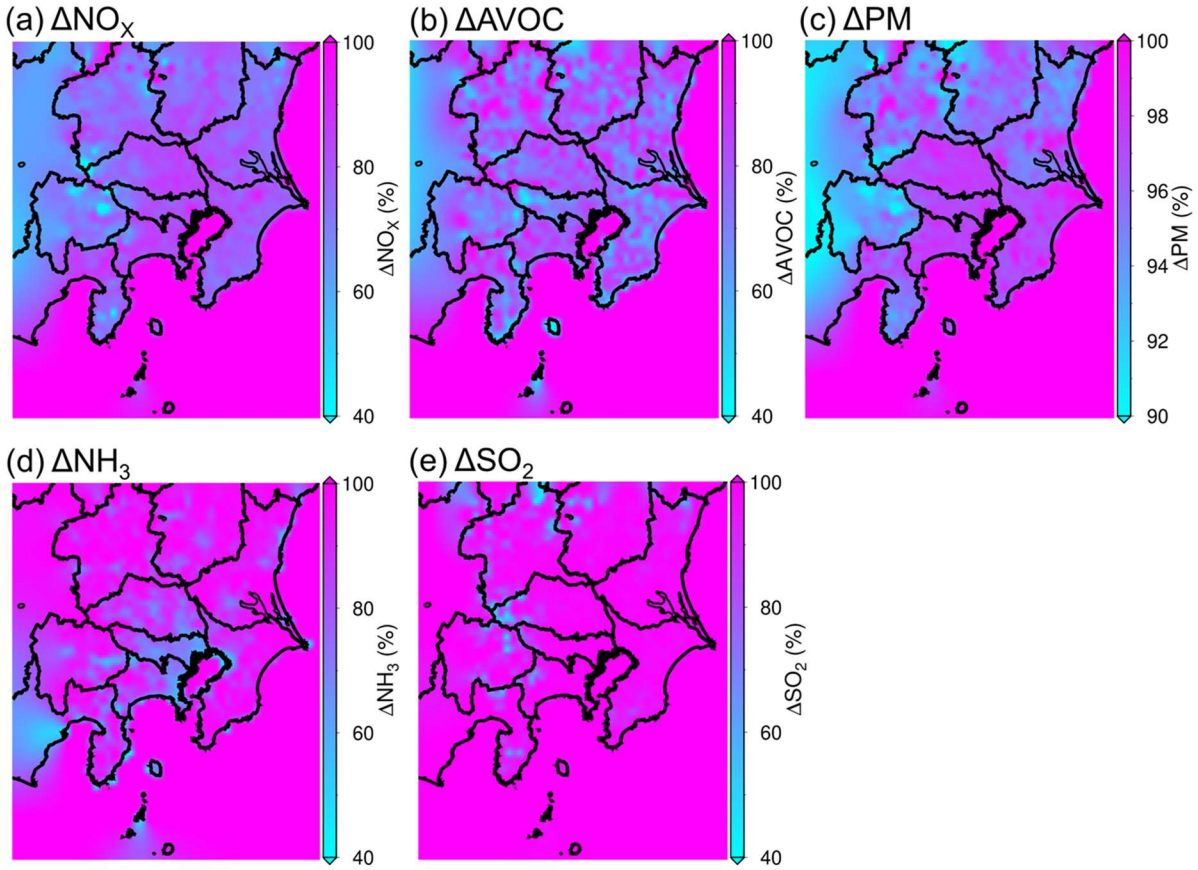


Fig. S2: Changes in the annual emissions produced by the S_{EV} and BASE scenarios (S_{EV}/BASE) for: (a) NO_X, (b) anthropogenic VOC (AVOC), (c) particulate matter (PM), (d) NH_3, and (e) SO_2.

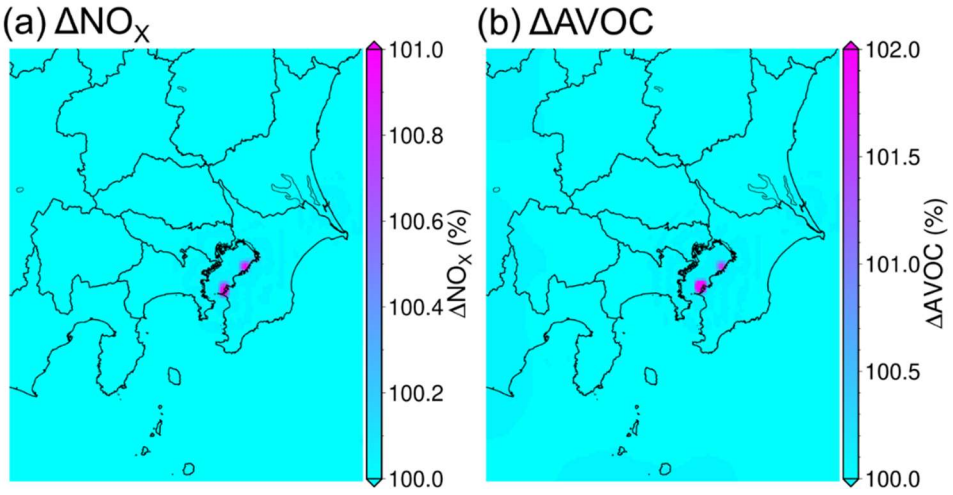


Fig. S3: Changes in annual emissions produced by the S_{PP} and BASE scenarios (S_{PP}/BASES) for (a) NO_X and (b) anthropogenic VOCs (AVOC). Significant changes were observed in the NO_X and AVOC emissions.

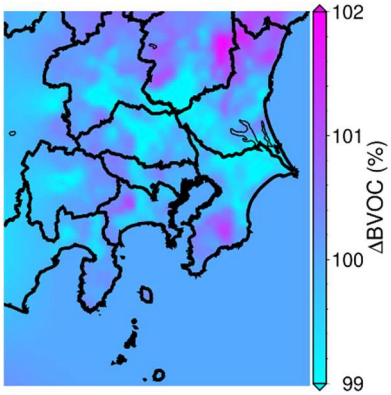


Fig. S4: Changes in annual BVOC emissions produced by the S_{BVOC} and BASE scenarios (S_{BVOC}/BASE). BVOC are defined as the sum of isoprene, monoterpenes, and sesquiterpenes. The change in BVOC emissions from the BASE scenario was caused by a change in the UHI effect owing to the introduction of EVs.

Text S3 *Additional information of results section*

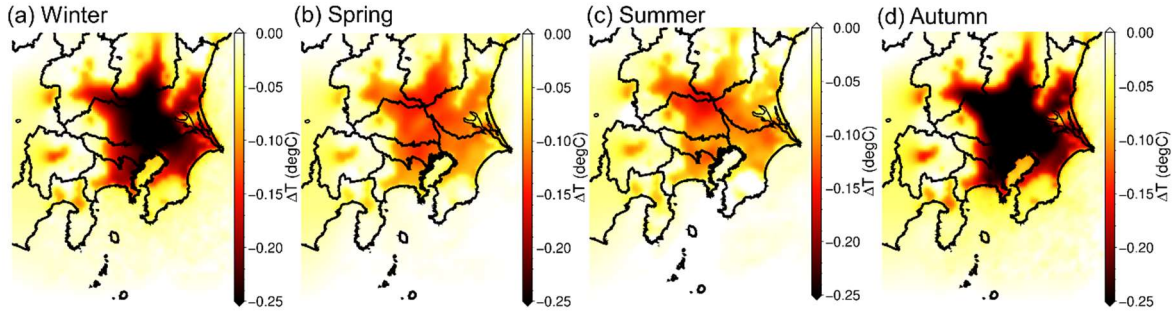


Fig. S5: Changes in ground temperature resulting from decrease in the UHI effect owing to the introduction of EVs in the GTA.

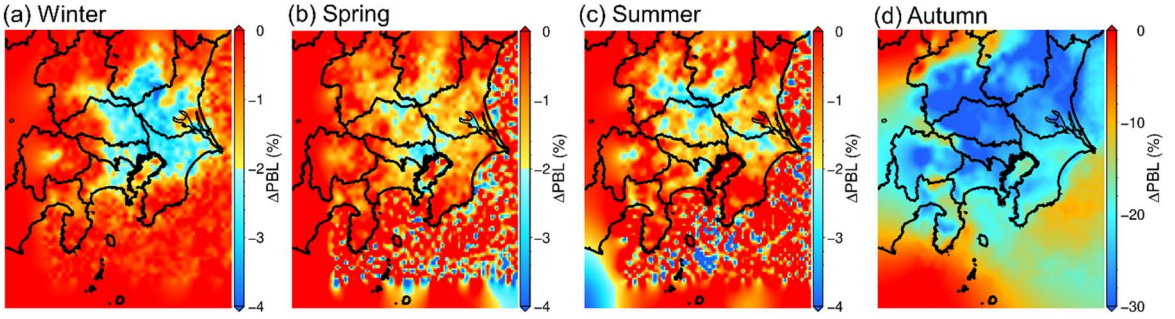


Fig. S6: Changes in planetary boundary layer (PBL: %) from the ground surface to the free troposphere resulting from decrease in the UHI effect owing to the introduction of EVs in the GTA.

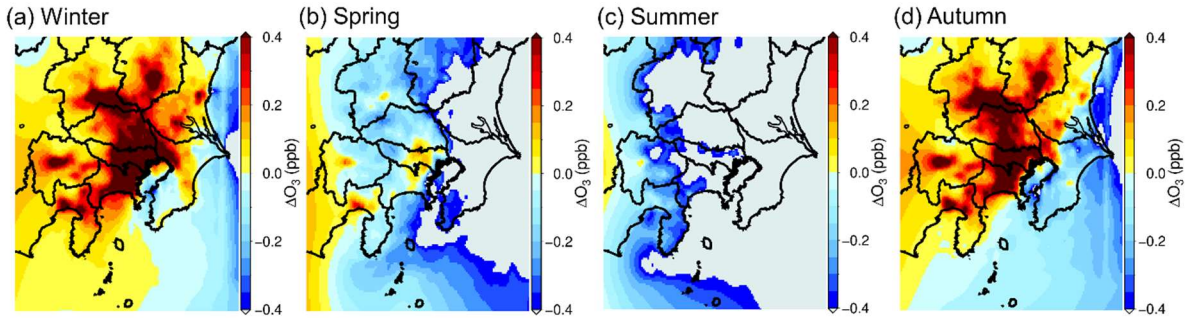


Fig. S7: Changes in O_3 concentration after the introduction of EVs in the GTA in four seasons.

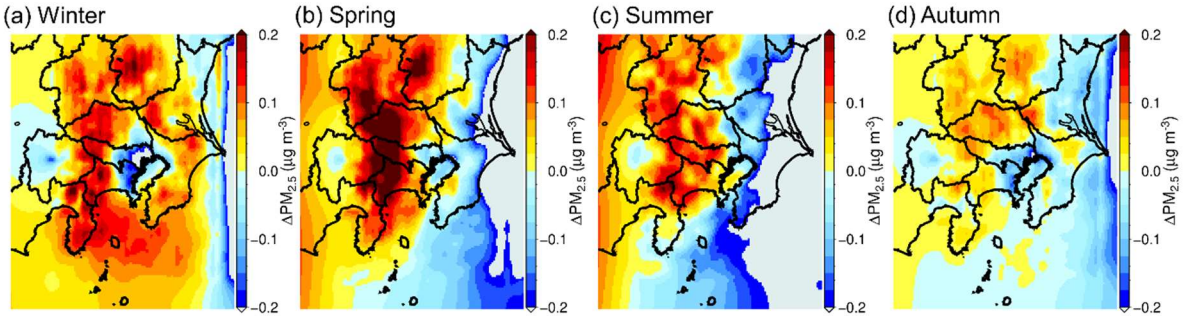


Fig. S8: Changes in $PM_{2.5}$ concentration after the introduction of EVs to the GTA in four seasons.