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High-resolution mapping of on-road vehicle emissions with real-time traffic datasets based on big data

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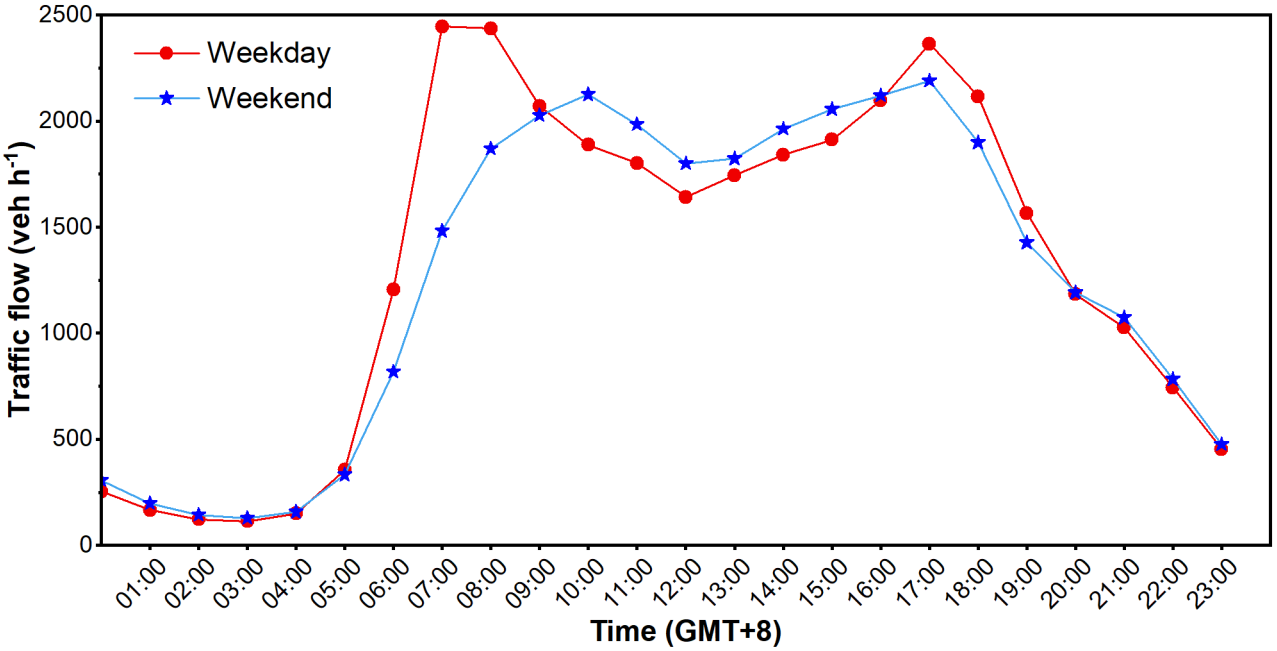

Figure S1. Hourly variation of traffic flows on weekdays and weekends.

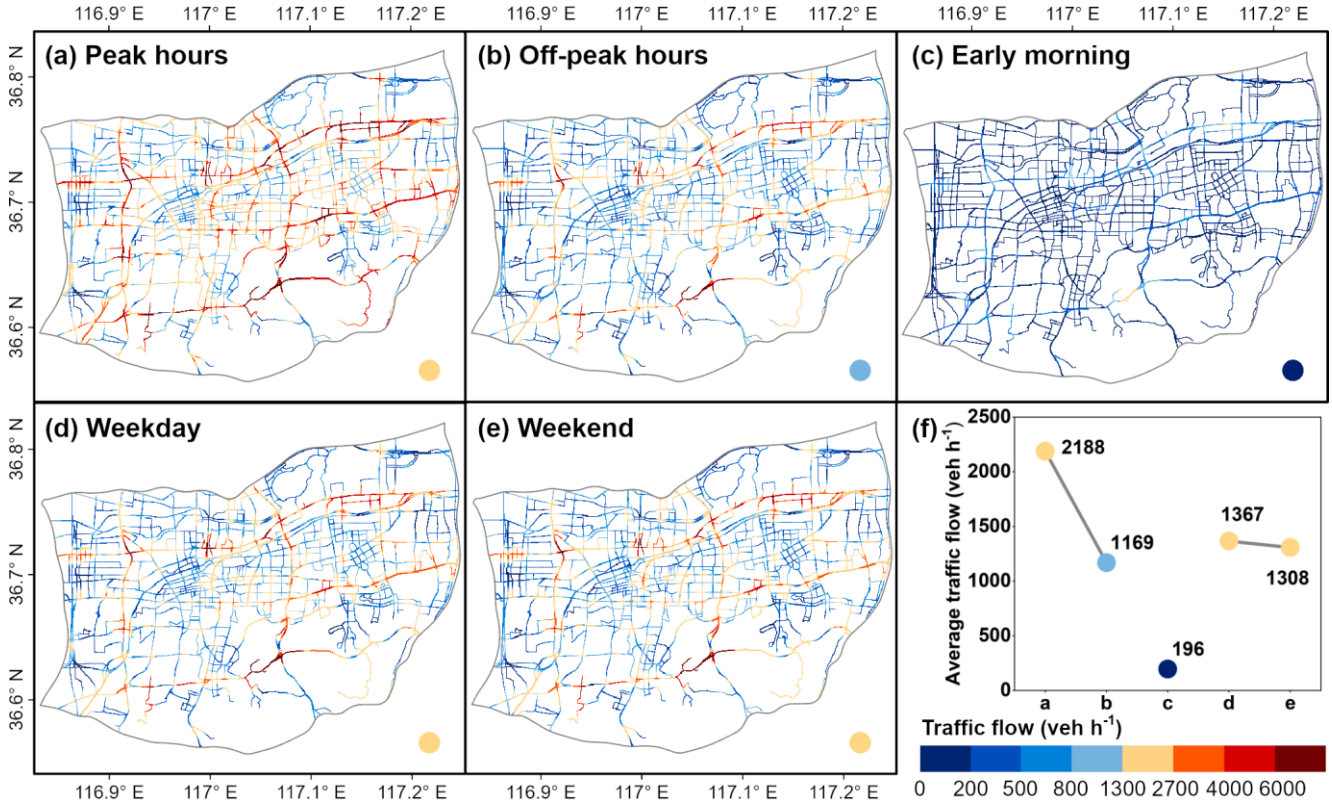

Figure S2. High-resolution mapping of traffic flows during (a) peak hours, (b) off-peak hours, (c) early morning, (d) weekday, and (e) weekend and (f) average traffic flows during each time period.

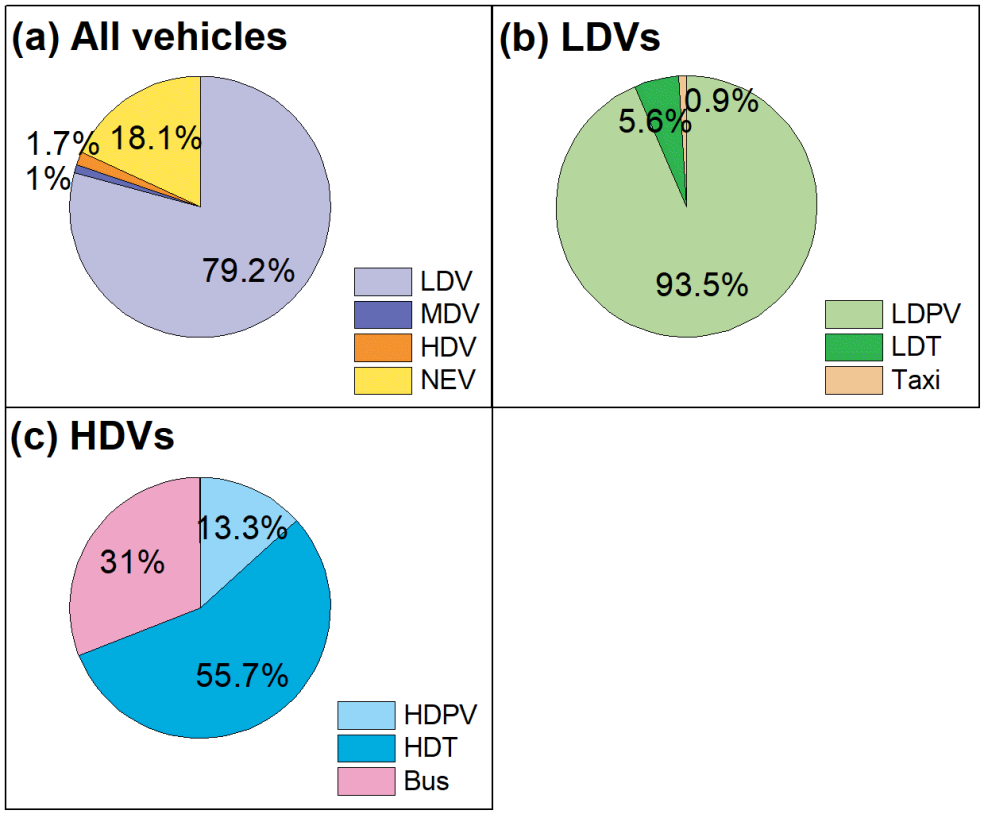

Figure S3. Composition of on-road vehicles for (a) all vehicles, (b) light-duty vehicles, (c) heavy-duty vehicles.

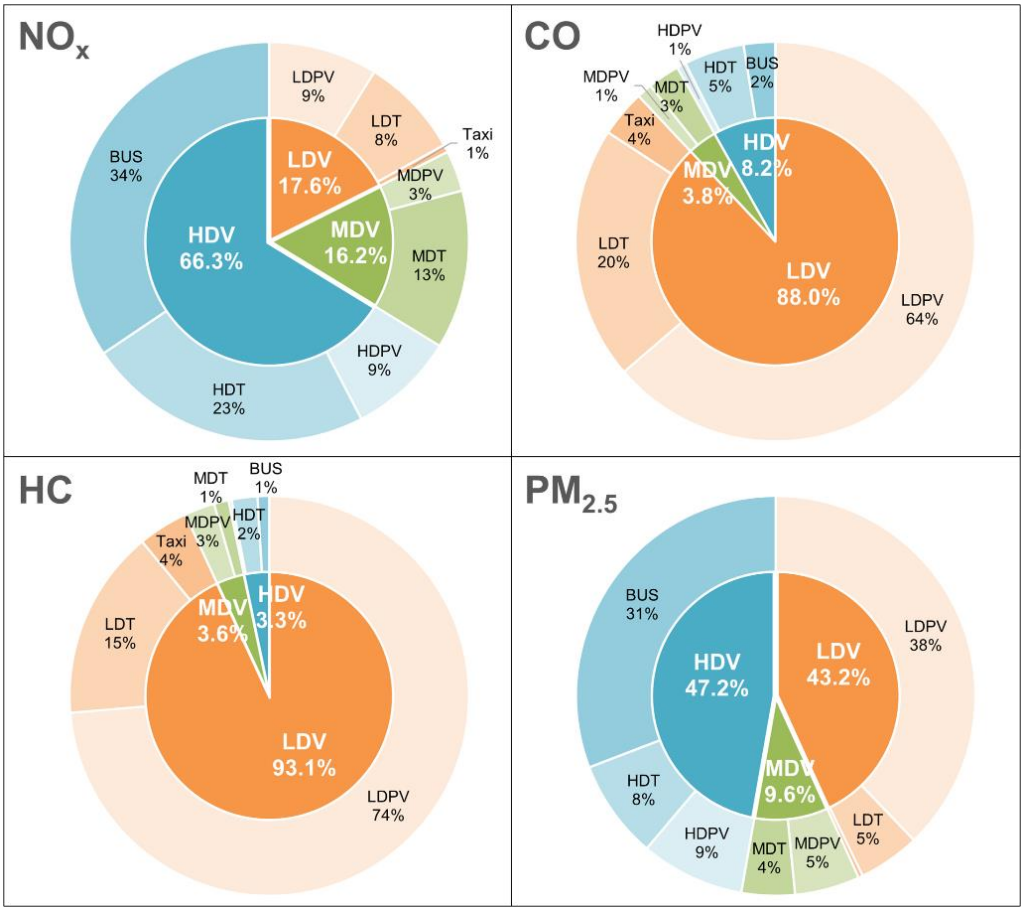

Figure S4. Emissions contribution of different vehicle types.

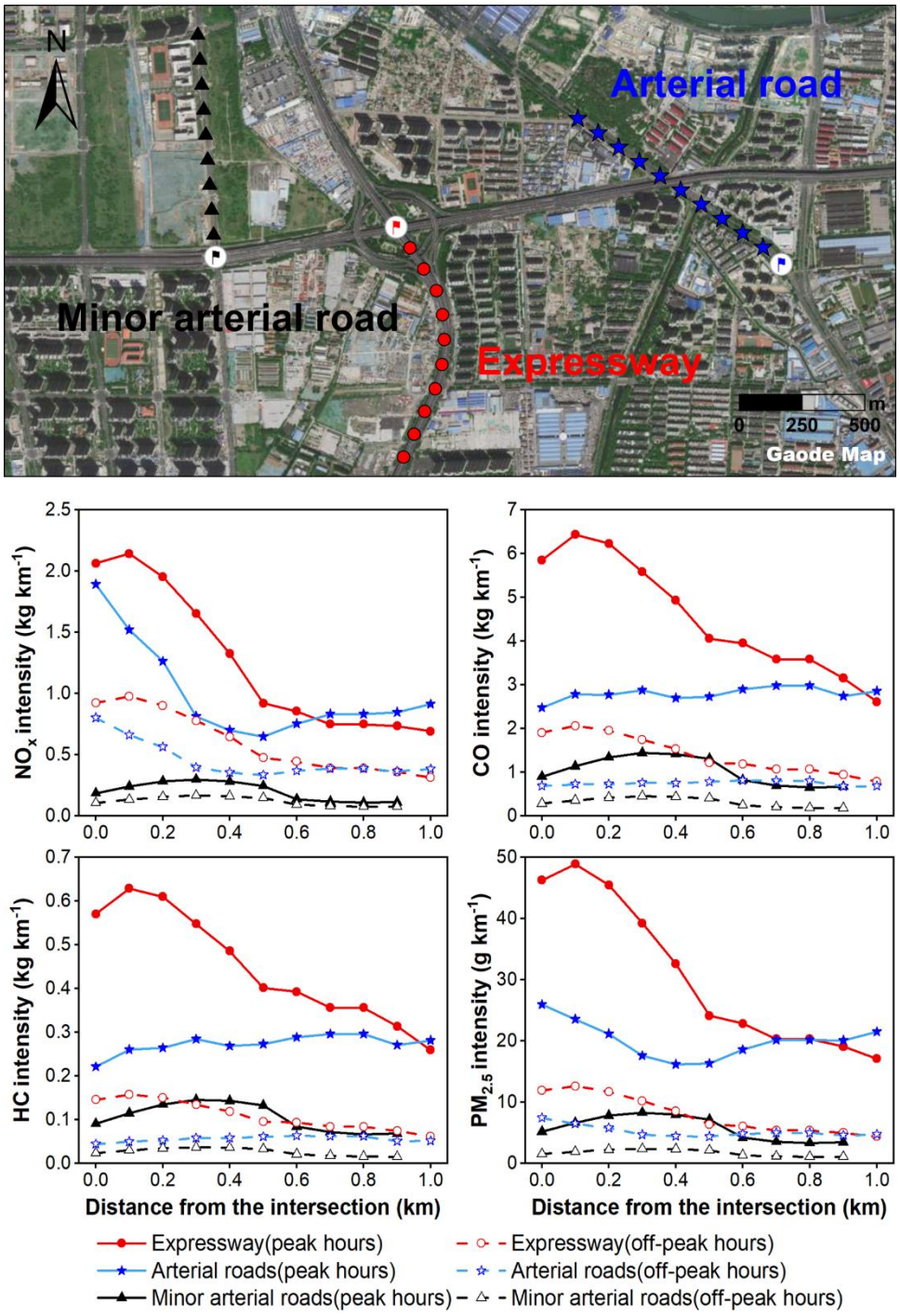

Figure S5. Emission variations at the intersections of expressways (i.e., Second Ring West Elevated Road), arterial roads (i.e., Jiqi Road) and minor arterial roads (i.e., Binzhou Road). Emission intensities are plotted as a function of cumulative distance from the intersections. Map data © 2024, Gaode Map.

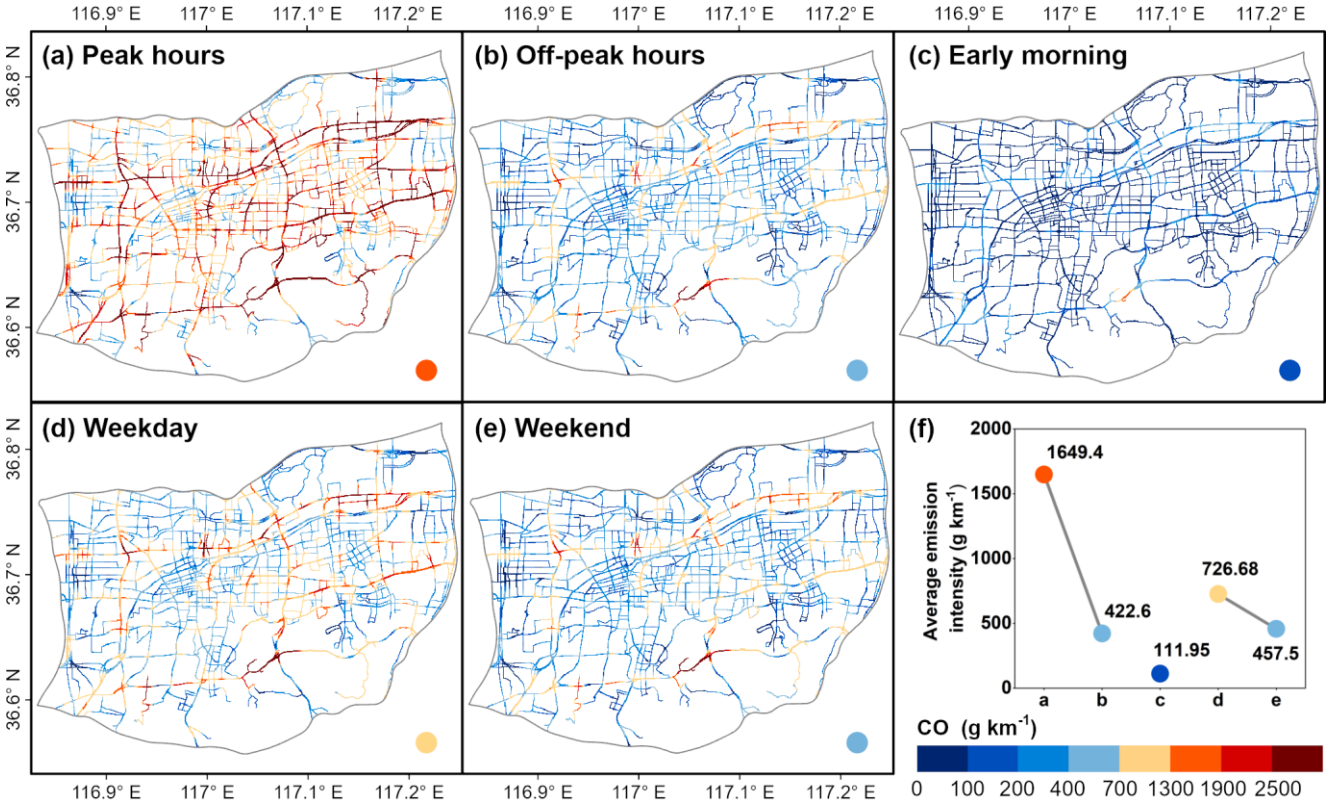

Figure S6. High-resolution mapping of on-road vehicle CO emissions during (a) peak hours, (b) off-peak hours, (c) early morning, (d) weekday, and (e) weekend and (f) average emission intensities of CO during each time period.

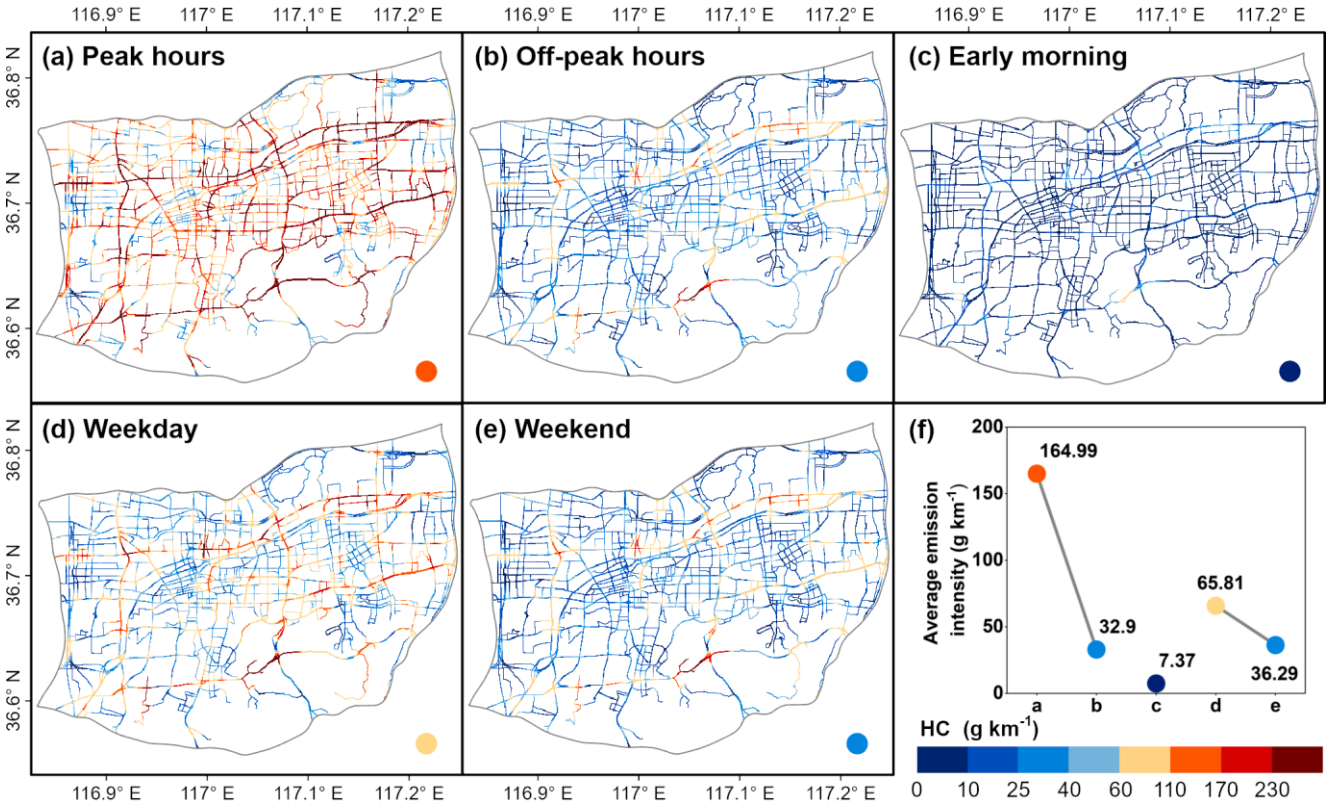

Figure S7. High-resolution mapping of on-road vehicle HC emissions during (a) peak hours, (b) off-peak hours, (c) early morning, (d) weekday, and (e) weekend and (f) average emission intensities of HC during each time period.

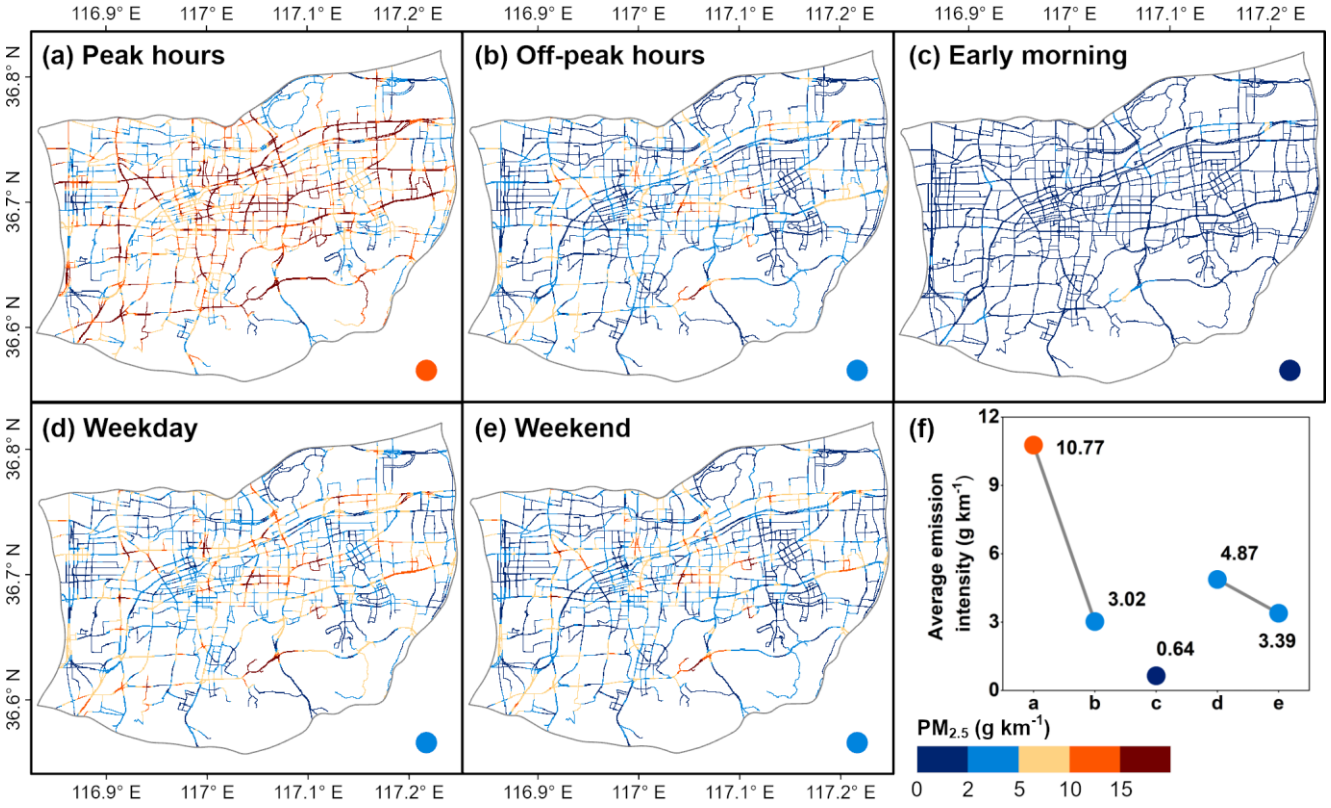

Figure S8. High-resolution mapping of on-road vehicle $PM_{2.5}$ emissions during (a) peak hours, (b) off-peak hours, (c) early morning, (d) weekday, and (e) weekend and (f) average emission intensities of PM2.5 during each time period.

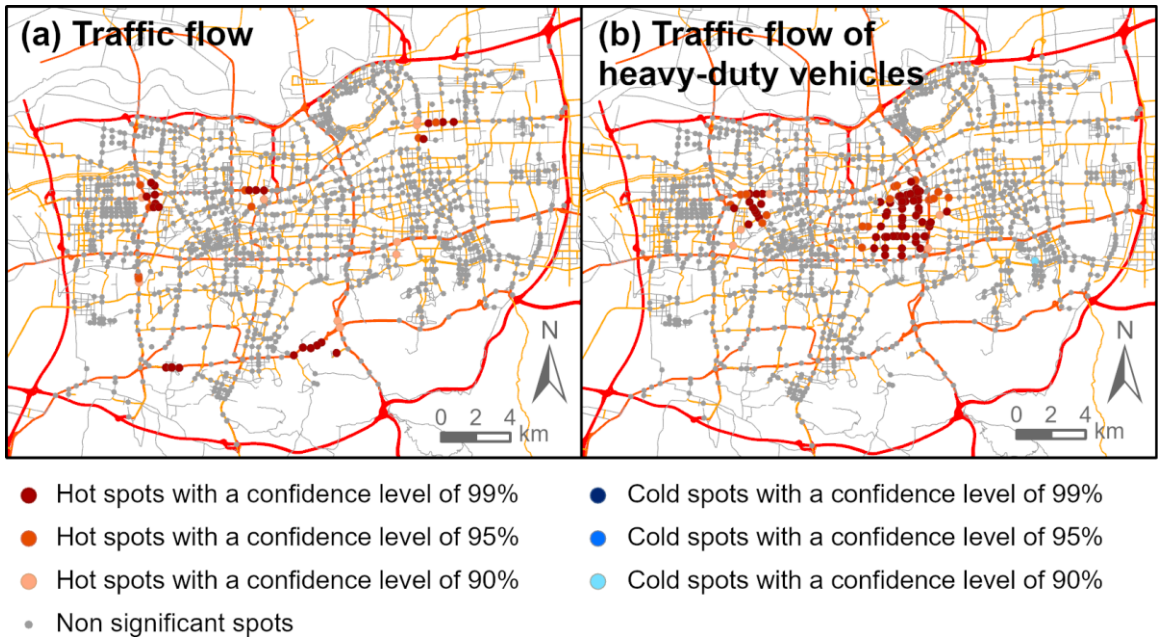

Figure S9. Spatial distributions of hot and cold spots of traffic flows for (a) total vehicles and (b) heavy-duty vehicles.

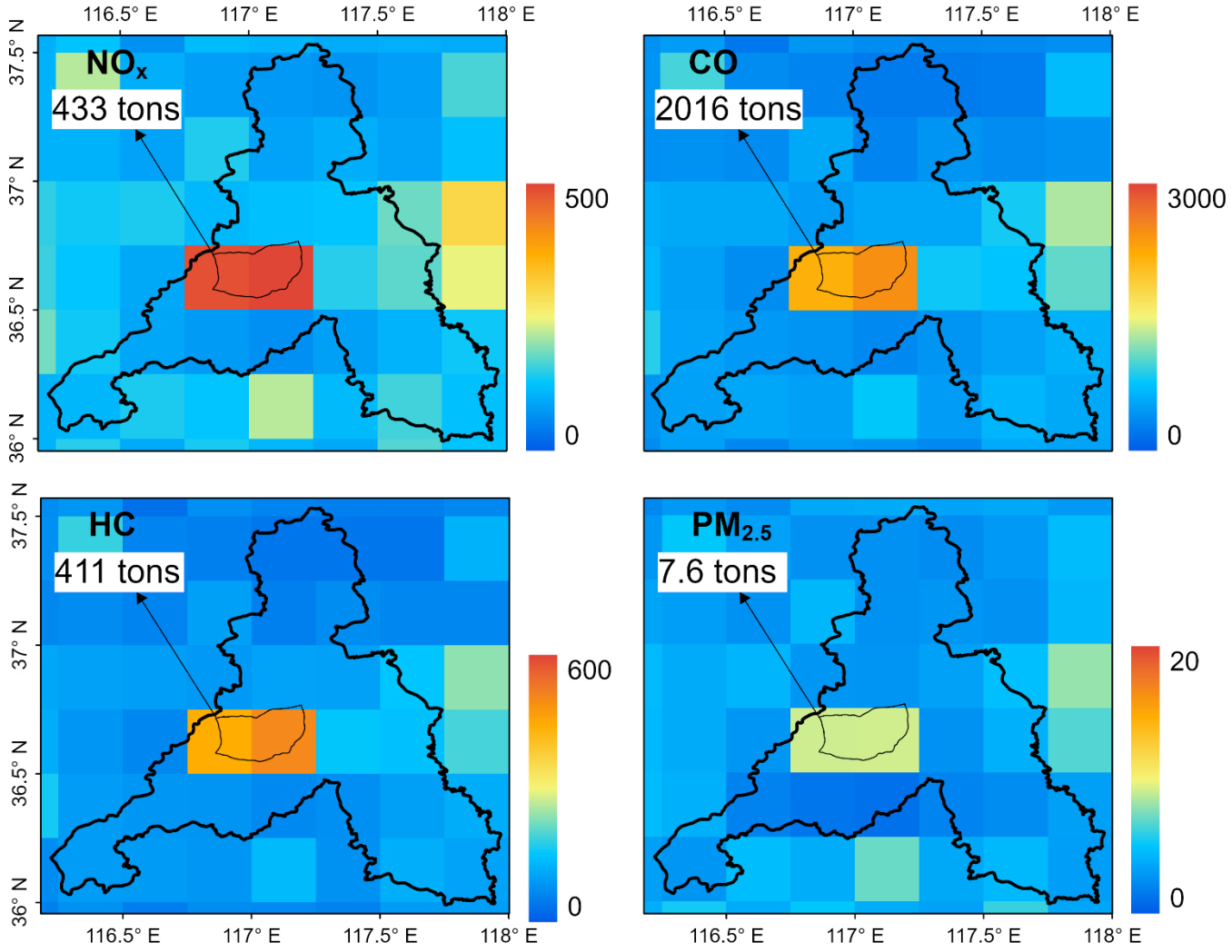

Figure S10. Spatial distributions of monthly gasoline and diesel vehicle emissions in Jinan in MEICv1.4. The numbers marked within the white box represent the emissions within the study area from the MEICv1.4. Based on the proportions of gasoline and diesel vehicles in transportation emissions in Shandong Province in MEICv1.4, the gasoline and diesel vehicle emissions in MEICv1.4 in the study area were estimated.

Table S1. Definition and abbreviation of vehicle types.

Vehicle classification	Abbreviation	Description
Light-duty passenger vehicle	LDPV	VC [a] < 6 m and PC [b] ≤ 9
Medium-duty passenger vehicle	MDPV	VC < 6 m and 9 < PC < 20
Heavy-duty passenger vehicle	HDPV	VC ≥ 6 m and PC ≥ 20
Light-Duty Truck	LDT	VC < 6 m and GVW [c] < 4500 kg
Middle-Duty Truck	MDT	VC ≥ 6 m or 4500 kg ≤ GVW < 12 t
Heavy-Duty Truck	HDT	GVW ≥ 12t
Public bus	Bus	
Taxi	Taxi	

Notes: [a] Vehicle commander, [b] Passenger capacity; [c] Gross vehicle weight.

Table S2. Hourly vehicle category distribution coefficients obtained from field surveys.

Time	Distribution coefficients of LDVs					Distribution coefficients of HDVs		
	LDPVs	LDTs	Taxis	MDPVs	MDTs	HDPVs	HDTs	Buses
0:00	0.847	0.072	0.026	0.001	0.054	0.002	0.998	0.000
1:00	0.773	0.144	0.025	0.005	0.053	0.005	0.995	0.000
2:00	0.718	0.204	0.013	0.003	0.062	0.000	1.000	0.000
3:00	0.637	0.252	0.024	0.000	0.088	0.000	1.000	0.000
4:00	0.616	0.325	0.010	0.002	0.047	0.010	0.990	0.000
5:00	0.679	0.269	0.011	0.007	0.034	0.063	0.841	0.095
6:00	0.846	0.104	0.014	0.020	0.016	0.446	0.321	0.233
7:00	0.932	0.051	0.006	0.009	0.002	0.541	0.041	0.418
8:00	0.922	0.064	0.008	0.004	0.002	0.145	0.093	0.762
9:00	0.918	0.057	0.010	0.003	0.011	0.093	0.620	0.287
10:00	0.913	0.062	0.010	0.004	0.011	0.028	0.575	0.398
11:00	0.920	0.060	0.012	0.001	0.007	0.028	0.671	0.302
12:00	0.913	0.066	0.007	0.004	0.010	0.035	0.682	0.283
13:00	0.924	0.057	0.008	0.002	0.009	0.035	0.651	0.314
14:00	0.916	0.060	0.008	0.002	0.014	0.040	0.634	0.326
15:00	0.929	0.051	0.010	0.002	0.008	0.035	0.641	0.323
16:00	0.938	0.042	0.011	0.005	0.004	0.066	0.602	0.332
17:00	0.958	0.028	0.006	0.007	0.000	0.398	0.109	0.493
18:00	0.957	0.030	0.006	0.006	0.001	0.451	0.056	0.493
19:00	0.959	0.026	0.010	0.004	0.002	0.139	0.450	0.412
20:00	0.948	0.028	0.012	0.003	0.010	0.045	0.846	0.109
21:00	0.952	0.024	0.009	0.000	0.014	0.044	0.881	0.075
22:00	0.937	0.031	0.014	0.000	0.017	0.007	0.964	0.030
23:00	0.911	0.052	0.012	0.001	0.025	0.004	0.996	0.000

Table S3. Temperature correction coefficients for gasoline vehicles.

Pollutants	Low temperature (<10°C)	High temperature (>25°C)
CO	1.36	1.23
HC	1.47	1.08
NO_x	1.15	1.31

Table S4. Temperature correction coefficients for diesel vehicles.

Pollutants	Vehicle classification	Low temperature (<10°C)	High temperature (>25°C)
CO	LDPV	1.00	1.33
	LDT	1.00	1.33
	MDPV, HDPV, Bus, MDT, HDT	1.00	1.30
HC	LDPV	1.00	1.07
	LDT	1.00	1.06
	MDPV, HDPV, Bus, MDT, HDT	1.00	1.06
NO_x	LDPV	1.06	1.17
	LDT	1.05	1.17
	MDPV, HDPV, Bus, MDT, HDT	1.06	1.15
$PM_{2.5}$	LDPV	1.87	0.68
	LDT	1.27	0.90
	MDPV, HDPV, Bus, MDT, HDT	1.70	0.74

Table S5. Humidity correction coefficients for gasoline vehicles.

Pollutants	Temperature	Low humidity (<50%)	High humidity (>50%)
CO	>24°C	0.97	1.04
HC	>24°C	0.99	1.01
NO_x	>24°C	1.13	0.87
	<24°C	1.06	0.92

Table S6. Humidity correction coefficients for diesel vehicles.

Pollutants	Temperature	Low humidity (<50%)	High humidity (>50%)
NO_x	>24°C	1.12	0.88
	<24°C	1.04	0.94

Table S7. Correction coefficients for average traveling speed for gasoline vehicles.

Pollutants	Speed intervals (km/h)				
	<20	20-30	30-40	40-80	>80
CO	1.69	1.26	0.79	0.39	0.62
HC	1.68	1.25	0.78	0.32	0.59
NO_x	1.38	1.13	0.90	0.86	0.96
$PM_{2.5}$	1.68	1.25	0.78	0.32	0.59

Table S8. Correction coefficients for average traveling speed for diesel vehicles.

Pollutants	Speed intervals (km/h)				
	<20	20-30	30-40	40-80	>80
CO	1.29	1.10	0.93	0.70	0.61
HC	1.38	1.12	0.91	0.64	0.48
NO_x	1.39	1.12	0.91	0.60	0.28
$PM_{2.5}$	1.36	1.12	0.91	0.65	0.48

Notes: Buses are usually corrected for <20 km/h.

Table S9. Speed ranges for different types of roads during peak and off-peak hours.

Time period	Design speed (km h^{-1})				
	Highways	Expressways	Arterial roads	Minor arterial roads	Branch ways
Off-peak hours	＞80	60-80	40-60	30-40	20-30
Peak hours	40-80	30-40	20-30	20-30	20-30

Notes: Speed ranges during off-peak hours are set to the design speeds for each road type. Speed ranges during peak hours are adjusted based on the different congestion states (smooth, slow, congested, severely congested) for different road types in Gaode Maps (https://www.amap.com/).