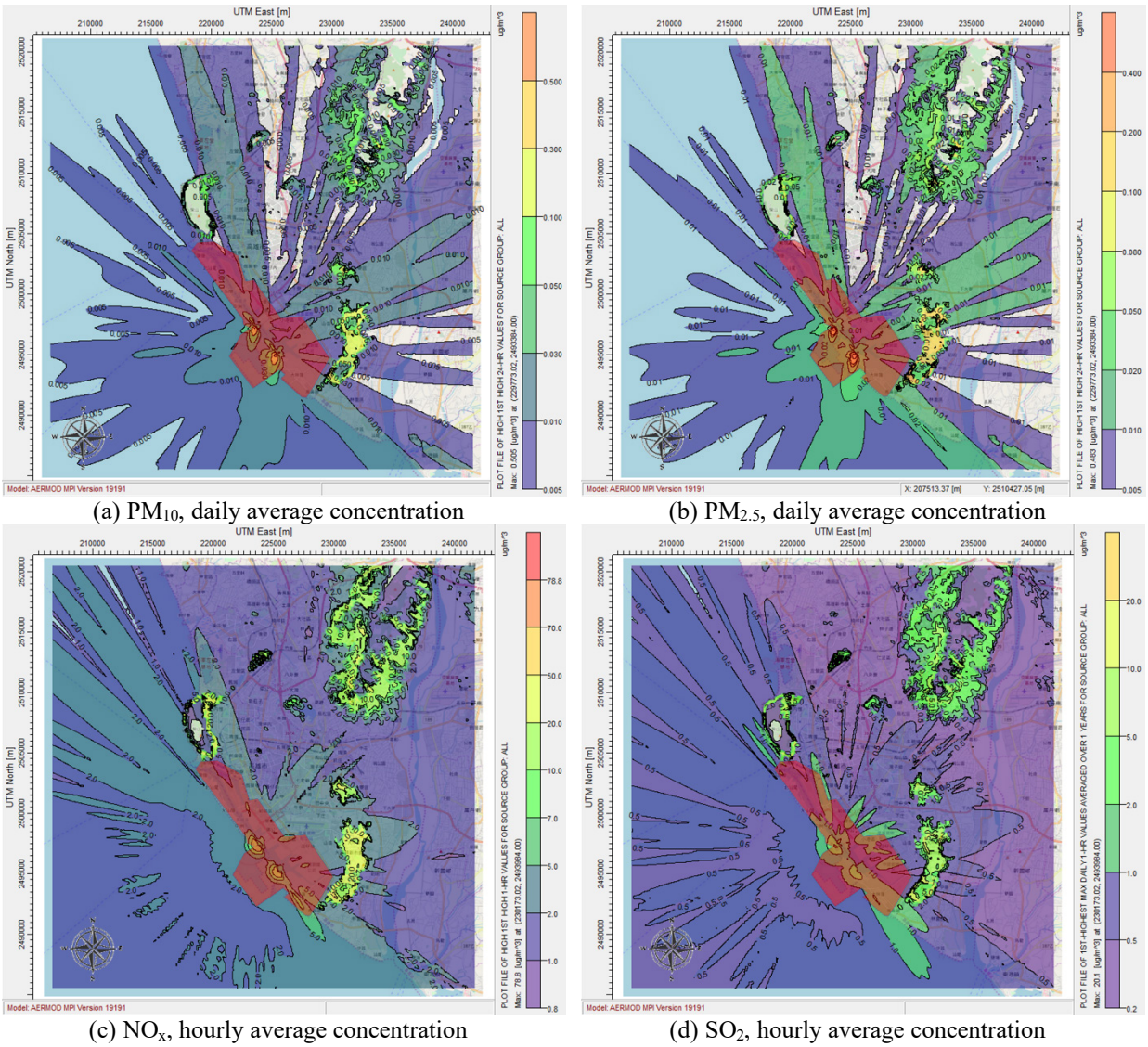

(a) PM_{10}, daily average concentration

(b) $PM_{2.5}$, daily average concentration

(c) NO_x, hourly average concentration

(d) SO_2, hourly average concentration

Fig. S1. The simulated dispersion of the daily average concentration of (a) PM_{10} and (b) $PM_{2.5}$; and hourly average concentration of (c) NO_x and (d) SO_2 for the S1 scenario. The contour levels depict the ground concentration of the pollutants, and the average concentrations are shown on each contour line. The orange-colored contours have the highest concentrations, while the purple-colored contours have the lowest concentrations. The red transparent shape is the Port of Kaohsiung area.

Table S1. The emission factor of ship auxiliary engines (g kWh^{-1}).

Fuel	Engine category	International Maritime Organization (IMO) Tier	Factory year	PM_{10}	$PM_{2.5}$	NO_x	SO_2
Heavy fuel oil (HFO) 2.7%-sulfur	Medium speed auxiliary	Tier 0	≦1999	1.5	1.2	14.7	12.3
	Medium speed auxiliary	Tier I	2000 - 2011	1.5	1.2	13	12.3
	Medium speed auxiliary	Tier II	2011 - 2016	1.5	1.2	11.2	12.3
	Medium speed auxiliary	Tier III	≧2016	1.5	1.2	2.8	12.3
	High speed auxiliary	Tier 0	≦1999	1.5	1.2	11.6	12.3
	High speed auxiliary	Tier I	2000 - 2011	1.5	1.2	10.4	12.3
	High speed auxiliary	Tier II	2011 - 2016	1.5	1.2	8.2	12.3
	High speed auxiliary	Tier III	≧2016	1.5	1.2	2.1	12.3

Table S2. Fuel correction factor values for the four pollutants.

Standard fuel (S % m/m)	Actual fuel (S % m/m)	PM_{10}	$PM_{2.5}$	NO_x	SO_2
HFO (2.7%-sulfur)	HFO (2.7%-sulfur)	1	1	1	1
HFO (2.7%-sulfur)	Marine gas oil (MGO) (0.5%-sulfur)	0.25	0.29	0.94	0.185

Table S3. Preset values of the load power (kW) for auxiliary engines of ocean-going vessels.

Vessel Type	Transit	Maneuvering	Berth hoteling	Anchorage hoteling
Auto Carrier	1,079	2,391	1,284	622
Bulk	313	822	210	253
Bulk - Heavy Load	462	1,223	272	253
Bulk - Self Discharging	305	807	179	305
Container - 1000	957	2,245	720	1,000
Container - 2000	985	2,188	1,039	1,012
Container - 3000	747	2,562	641	694
Container - 4000	1,403	2,472	1,136	1,200
Container - 5000	1,333	4,487	1,107	967
Container - 6000	1,248	2,567	832	1,645
Container - 7000	1,220	2,721	845	1,000
Container - 8000	1,457	3,249	1,008	986
Container - 9000	1,458	2,323	924	968
Container – 10000	1,318	1,791	981	1,129
Container – 11000	1,618	3,210	1,500	2,000
Container – 12000	2,500	4,500	2,000	2,000
Container – 13000	2,246	4,254	1,317	1,015
Container – 17000	1,500	1,750	1,000	1,000
Cruise	5,445	8,711	5,445	7,782
General Cargo	421	1,060	572	180
Miscellaneous	793	2,100	467	200
Reefer	630	1,889	1,091	630
RoRo	132	396	229	132
Tanker - Aframax	576	719	724	474
Tanker - Chemical	611	833	967	402
Tanker - Handysize	559	768	605	560
Tanker - Panamax	596	801	679	379
Tanker - Suezmax	860	1,288	2,509	773
Tanker - ULCC	1,080	1,486	1,171	1,080
Tanker - VLCC	1,080	1,486	1,171	1,080

Table S4. Average docking time at each container terminal of the Port of Kaohsiung.

Container Terminals	2017	2018	2019
APL	9.1	8.1	9.1
Port of Kaohsiung self-operated	17.6	17.9	25.2
OOCL	14.2	12.4	14.3
Changrong	20.0	20.8	21.6
Gaoming	16.0	15.5	15.0
Han Xin	12.5	13.8	12.2
Lianhai	12.8	18.3	12.2
Wan Hai	13.2	12.1	12.8
Hong Ming	8.6	11.0	9.6
Total average (h)	14.4	14.6	14.7

Table S5. Surface parameters for the study area.

Type	Land	Sea
Albedo	0.16	0.1
Bowen ratio	0.8	0.2
Roughness	1.2	0.0001

Table S6. Kaohsiung emission inventories (tons yr^{-1}) in 2020.

Sector	PM_{10}	$PM_{2.5}$	NO_X	SO_2
Industry	5,498.98	4,176.44	33,004.85	21,807.44
Vehicle	2,391.77	1,928.80	22,255.09	15.18
Off-road Transportation	543.70	441.38	6531.97	2164.95
Business	490.10	339.68	408.58	307.82
Construction/Road Dust	8,493.34	1,842.19	0.00	0.00
Open Burning	280.56	263.27	189.95	8.70
Other	158.38	140.31	1,832.52	191.46
Total emissions	18,130.70	9,351.52	64,276.07	30,485.08

Note: The data are based on Taiwan Emission Data System (TEDS) in 2016 baseline

Table S7. The concentrations of the four pollutants (μg m^{-3}) from the air quality monitoring stations in the Kaohsiung Metropolitan area in 2019.

Station	PM_{10} (daily average)	$PM_{2.5}$ (daily average)	NO_x (hourly average)	SO_2 (hourly average)
E1	45.72	22.98	59.21	12.62
E2	47.12	20.74	83.27	15.52
E3	45.37	20.86	93.19	22.22
Taiwan air quality standard	100	35	100	75