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Supplement of

Four-dimensional aircraft emission inventory dataset of the landing-and-takeoff cycle in China (2019–2023)

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S1. The modelling details of climb and approach time calculating model.

The relationship between height and time could be described as linear or quadratic functions. The general form of the functional relationships can be expressed in (S1).

$$H = aT^2 + bT + c\ (a \geq 0, T \geq 0) \quad \text{(S1)}$$

where H is aircraft height (m); T is duration of the aircraft traverse from ground to the given height (climb) or from that height to the ground (approach) (s); a, b and c are constants in the equation. For airports without AMDAR data, the functional relationship of the nearest airport was employed.

We assumed that the climb mode begins with the transition from takeoff to climb at 152m and continues until the aircraft ascends above the mixing layer height (MLH). The approach mode is that beginning with aircraft descent in the mixing layer until landing. The climb and approach time can be calculated using the following (S2) and (S3).

$$T_{climb} = T_{H_m} - T_{H_0} \quad \text{(S2)}$$

$$T_{approach} = T_{H_m} \quad \text{(S3)}$$

where T_{climb} is the climb time (s); $T_{approach}$ is the approach time (s); H_0 is 152 m; T_{H_0} is time from the ground to 152 m; H_m is MLH; T_{H_m} is the time from the ground to the top of the mixing layer or the reverse.

Table S1: The reference of the emission index (EI) for different pollutants.

Pollutant	Reference
HC	EEDB
CO	EEDB
NOx	EEDB
PM	EEDB; Wayson et al., 2009
SO_2	GB6537

Table S2: The proportion of flights with recorded taxi time.

Year	Taxi in mode	Taxi out mode
2019	47.9%	48.4%
2020	57.2%	57.8%
2021	53.8%	50.2%
2022	48.6%	51.5%
2023	59.3%	67.0%

Table S3: R^2 of between N and ΔT or T_0 of taxi in and out mode for different airports.

Airport type	Taxi out				Taxi in			
	ΔT		T_0		ΔT		T_0	
	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.
4F	0.86	0.09	0.58	0.19	0.59	0.20	0.74	0.15
4E	0.57	0.24	0.38	0.18	0.44	0.22	0.63	0.23
4D	0.41	0.20	0.35	0.11	0.34	0.17	0.45	0.21
4C	0.41	0.19	0.39	0.20	0.28	0.18	0.30	0.14

Table S4: The fitting parameters and performance between N and ΔT or T_0 at PEK in different years.

Year	Taxi out				Taxi in			
	ΔT		T_0		ΔT		T_0	
	Relationship	R^2	Relationship	R^2	Relationship	R^2	Relationship	R^2
2019	$\Delta T = 66.07e^{-0.027}$	0.96	$T_0 = 625.71e^{-0.011}$	0.59	$\Delta T = 21.01e^{-0.017}$	0.69	$T_0 = 418.49e^{-0.020}$	0.96
2020	$\Delta T = 49.43e^{-0.043}$	0.62	$T_0 = 710.86e^{-0.023}$	0.83	$\Delta T = 16.69e^{-0.015}$	0.39	$T_0 = 422.65e^{-0.022}$	0.82
2021	$\Delta T = 55.63e^{-0.049}$	0.89	$T_0 = 621.92e^{-0.031}$	0.84	$\Delta T = 25.88e^{-0.029}$	0.31	$T_0 = 363.97e^{-0.025}$	0.88
2022	$\Delta T = 36.58e^{-0.060}$	0.55	$T_0 = 576.79e^{-0.028}$	0.63	$\Delta T = 14.73e^{-0.023}$	0.19	$T_0 = 380.45e^{-0.022}$	0.94
2023	$\Delta T = 61.27e^{-0.039}$	0.78	$T_0 = 611.48e^{-0.020}$	0.80	$\Delta T = 18.39e^{-0.018}$	0.50	$T_0 = 417.40e^{-0.023}$	0.89

Table S5: The difference of LTO numbers before, during and after the epidemic compared with the same period in 2019.

Date	LTO number (10^4)	LTO number for the same period in 2019 (10^4)	LTO number change rate compared the same period in 2019
2020.1.20	1.71	1.56	9.2%
2020.2.13	0.24	1.61	-84.8%
2021.2.12	0.28	1.65	-83.1%
2021.8.12	0.67	1.70	-60.3%
2021.11.9	0.63	1.55	-59.5%
2022.4.4	0.19	1.57	-87.7%
2022.11.29	0.30	1.53	-80.4%
2023.4.6	1.45	1.45	-0.1%

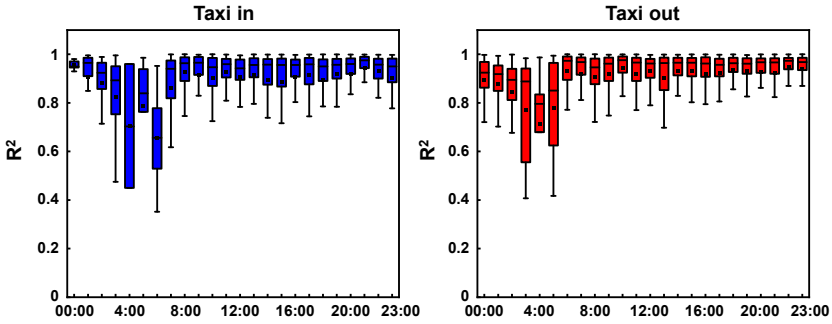

Figure S1: Hourly R^2 of taxi in and out time calculating model for different airports.

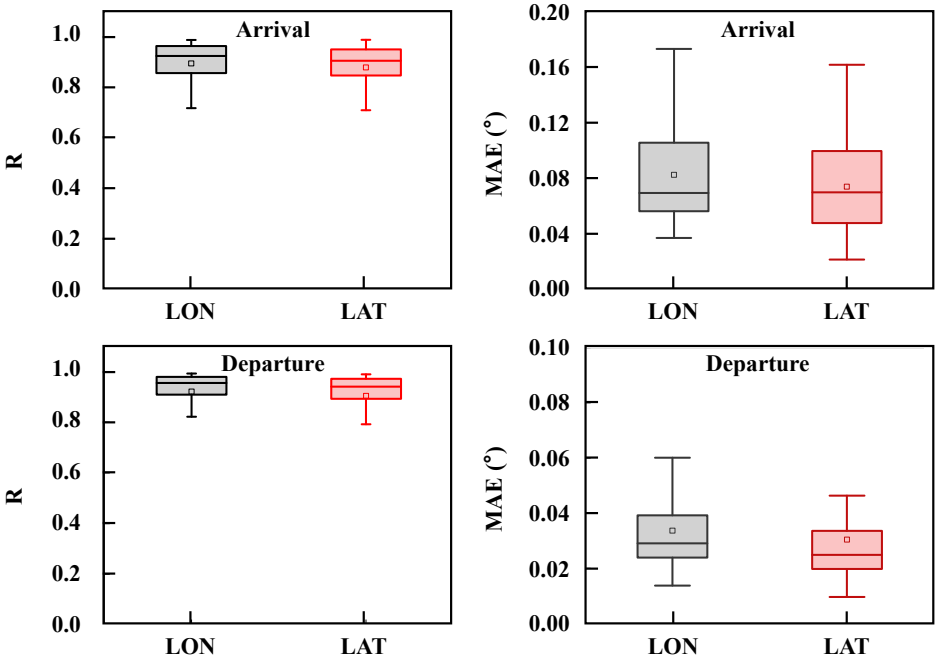

Figure S2: The R and MAE for flight trajectories at different airports.