

Supplement of

Quantitative impacts of vertical transport on long-term trend of nocturnal ozone increase over the Pearl River Delta region during 2006-2019

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Table S1. Details of air quality monitoring stations

City	Site	Area Type	Latitude	Longitude
Dongguan	Nanchengyuanling (NCYL)	urban	23.0	113.7
Foshan	Jinjuju (JJJ)	rural	22.8	113.3
	Huijingcheng (HJC)	urban	23.0	113.1
Guangzhou	Luhu (LH)	urban	23.2	113.3
	Wanqingsha (WQS)	urban	22.7	113.5
	Tianhu (TH)	rural	23.6	113.6
Hong Kong	Tap Mun (TM)	rural	22.5	114.4
	Tsuen Wan (TW)	urban	22.4	114.1
	Tung Chung (TC)	rural	22.3	113.9
Huizhou	Xiapu (XP)	urban	23.1	114.4
	Jinguowan (JGW)	urban	22.9	114.4
Jiangmen	Donghu (DH)	urban	22.6	113.1
Shenzhen	Liyuan (LY)	urban	22.5	114.1
Zhuhai	Tangjia (TJ)	urban	22.4	113.6
Zhaoqing	Chengzhong (CZ)	rural	23.1	112.5
Zhongshan	Zimaling (ZML)	urban	22.5	113.4

Table S2. Details of meteorological stations

City	Station	Latitude	Longitude
Dongguan	Dongguan(DG)	23.0	113.8
Foshan	Shunde(SD)	22.8	113.2
Guangzhou	Guangzhou(GZ)	23.1	113.3
Huizhou	Huiyang(HY)	23.0	114.2
Jiangmen	Taishan(TS)	22.2	112.5
Shenzhen	Shenzhen(SZ)	22.6	114.1
Zhuhai	Zhuhai(ZH)	22.2	113.3
Zhaoqing	Gaoyao(GY)	23.0	112.5
Zhongshan	Zhongshan(ZS)	22.6	113.4

Table S3. Statistical metrics of meteorological variables between observations and simulations in the PRD region during 8-14 September, 2017

Parameter	Site	SIM _{mean}	OBS _{mean}	MB	NMB (%)	NME (%)	r	RMSE	IoA
Wind speed (m s ⁻¹)	GZ	1.3	1.6	0.3	-23.5	42.3	0.5	0.9	0.9
	DG	1.3	2.0	0.7	-33.8	47.9	0.4	1.1	0.9
	HY	1.8	1.7	-0.1	6.5	52.3	0.4	1.1	0.9
	TS	2.7	1.8	-0.9	50.1	65.4	0.5	1.5	0.9
	SD	2.9	1.8	-1.1	60.5	76.3	0.3	1.8	0.9
	ZS	2.7	1.6	-1.1	70.8	84.1	0.5	1.6	0.9
	ZH	2.0	2.5	0.5	-21.4	44.6	0.4	1.4	0.9
	GY	2.2	1.9	-0.3	14.9	59.9	0.3	1.5	0.9
	SZ	2.3	1.5	-0.8	58.2	86.7	0.2	1.7	0.8
	Regional average	2.1	1.8	-0.3	16.1	29.0	0.7	0.7	1.0
Relative humidity (%)	GZ	81.8	86.3	4.5	-5.3	9.4	0.8	11.3	1.0
	DG	82.7	81.7	-1.0	1.2	10.8	0.8	10.8	1.0
	HY	87.1	84.2	-2.9	3.4	7.3	0.8	8.4	1.0
	TS	89.8	81.5	-8.3	10.2	11.9	0.7	12.4	1.0
	SD	84.0	77.5	-6.5	8.4	13.6	0.7	12.6	1.0
	ZS	86.7	81.5	-5.2	6.3	10.1	0.7	10.8	1.0
	ZH	86.4	77.7	-8.7	11.3	15.3	0.6	14.0	1.0
	GY	91.0	86.1	-4.9	5.7	10.0	0.6	12.5	1.0
	SZ	91.4	77.7	-13.7	17.6	17.8	0.7	15.8	1.0
	Regional average	83.7	77.6	-6.1	7.9	9.0	0.9	8.2	1.0
Temperature (°C)	GZ	27.7	27.9	0.2	-1.0	5.4	0.8	2.0	1.0
	DG	28.5	29.0	0.5	-3.2	5.4	0.8	1.9	1.0
	HY	27.6	28.3	0.7	-2.4	4.7	0.8	1.7	1.0
	TS	27.5	29.1	1.6	-5.7	7.0	0.7	2.5	1.0
	SD	28.7	29.9	1.2	-4.2	5.7	0.8	2.2	1.0
	ZS	28.1	28.9	0.8	-2.7	4.1	0.9	1.5	1.0
	ZH	27.7	29.0	1.3	-4.5	6.2	0.6	2.2	1.0
	GY	26.1	28.6	2.5	-8.8	9.0	0.7	3.1	1.0
	SZ	27.7	27.9	0.2	-5.4	5.8	0.7	2.1	1.0
	Regional average	27.7	29.1	1.4	-4.9	5.1	0.9	1.7	1.0

Table S4. Statistical metrics for O₃ between observations and simulations in the PRD region during 8-14 September, 2017

Site	SIM_{mean}	OBS_{mean}	MB	NMB (%)	NME (%)	r	RMSE	IoA
LH	33.2	39.2	6.1	-14.5	31.8	0.8	30.0	0.9
WQS	62.2	67.7	5.5	-8.1	36.8	0.8	37.7	0.9
TH	82.0	77.7	-4.3	5.5	25.2	0.7	27.6	1.0
LY	42.2	51.6	9.4	-18.3	39.7	0.8	29.9	0.9
JJJ	59.0	59.5	0.5	-0.9	13.6	0.9	14.0	1.0
HJC	65.7	78.7	13.0	-16.6	34.0	0.9	35.8	1.0
TJ	82.9	78.7	-4.2	5.3	26.6	0.9	25.9	1.0
DH	49.7	59.2	9.5	-16.0	32.8	0.9	26.2	1.0
CZ	87.9	79.7	-8.2	10.3	21.1	0.9	30.7	1.0
XP	50.1	55.3	5.2	-9.4	42.7	0.7	32.7	0.9
JGW	85.6	58.0	-27.6	37.6	44.7	0.6	44.5	0.9
ZML	57.8	70.4	12.7	-18.0	31.8	0.9	30.5	1.0
NCYL	56.6	61.0	4.4	-12.7	29.8	0.8	39.7	0.9
TM	88.9	86.4	-2.5	2.9	29.1	0.8	33.2	1.0
TW	92.8	64.0	-28.8	45.0	53.6	0.8	49.0	0.9
TC	93.0	65.4	-27.5	42.1	57.3	0.8	48.4	0.9
Regional average	75.8	79.7	3.9	-4.8	17.7	1.0	18.7	1.0

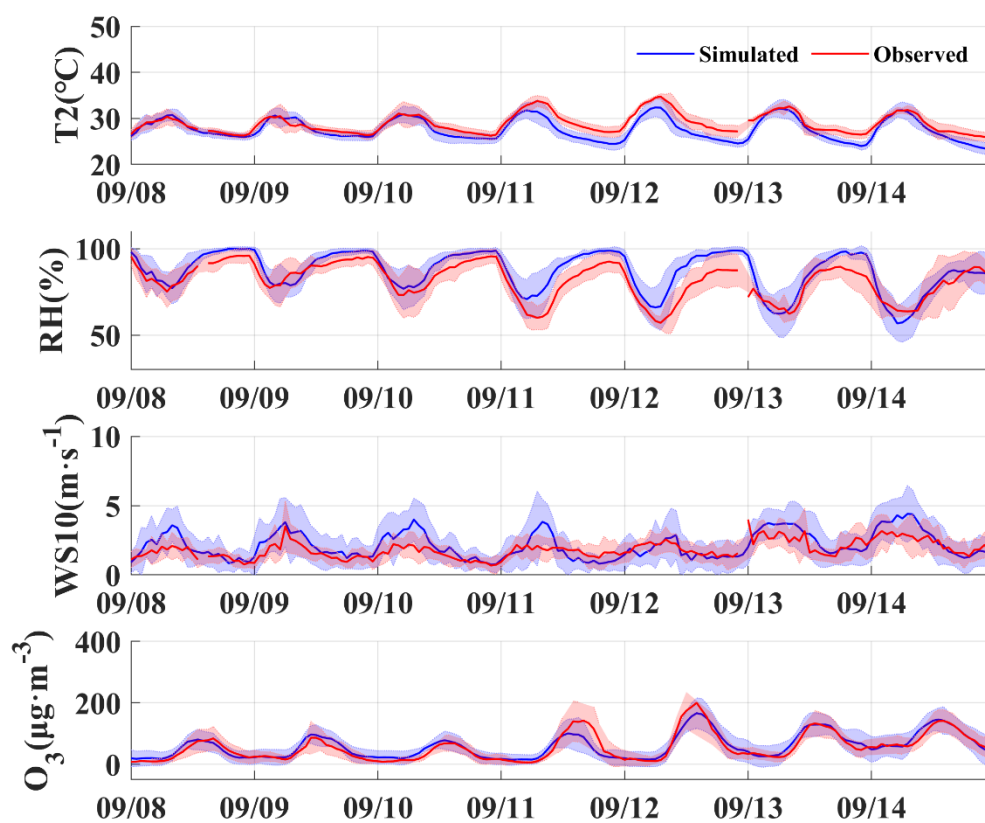


Figure S1: Time series of temperature (T), relative humidity (RH), wind speed (WS), and O_3 of PRD in the PRD region during 8-14 September, 2017.