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Opposing trends in the peak and low ozone concentrations in eastern China: anthropogenic and meteorological influences

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Figures:

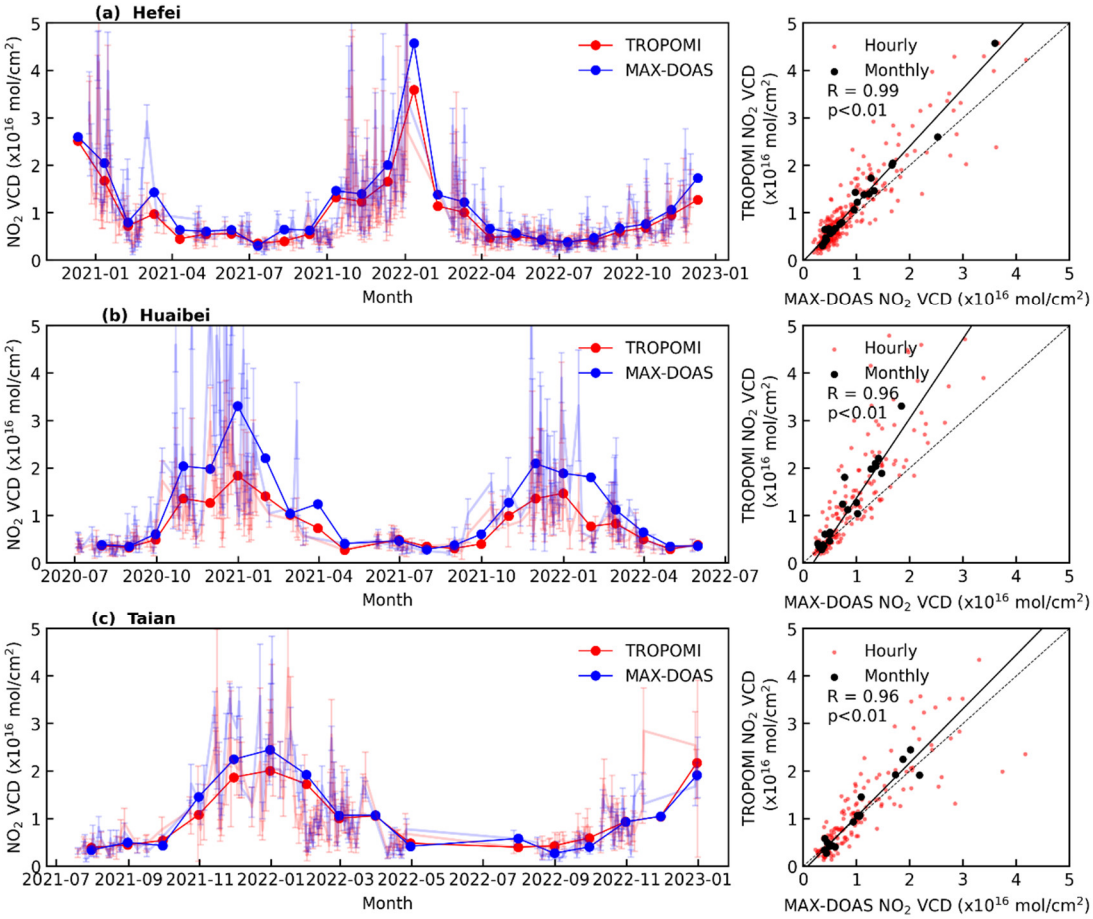

Fig.S1. Time series comparison (left panel) and scatter plot comparison (right panel) of monthly mean TROPOMI and MAX–DOAS NO_2 VCD during the whole observation period in (a) Hefei, (b) Huaibei, and (c) Tai'an, respectively. The light red and light blue dots in left panel represent the TROPOMI and MAX–DOAS observed hourly values, respectively, and the solid red and solid blue dots represent the TROPOMI and MAX–DOAS observed monthly mean values, respectively. The vertical bar in hourly values represents errors.

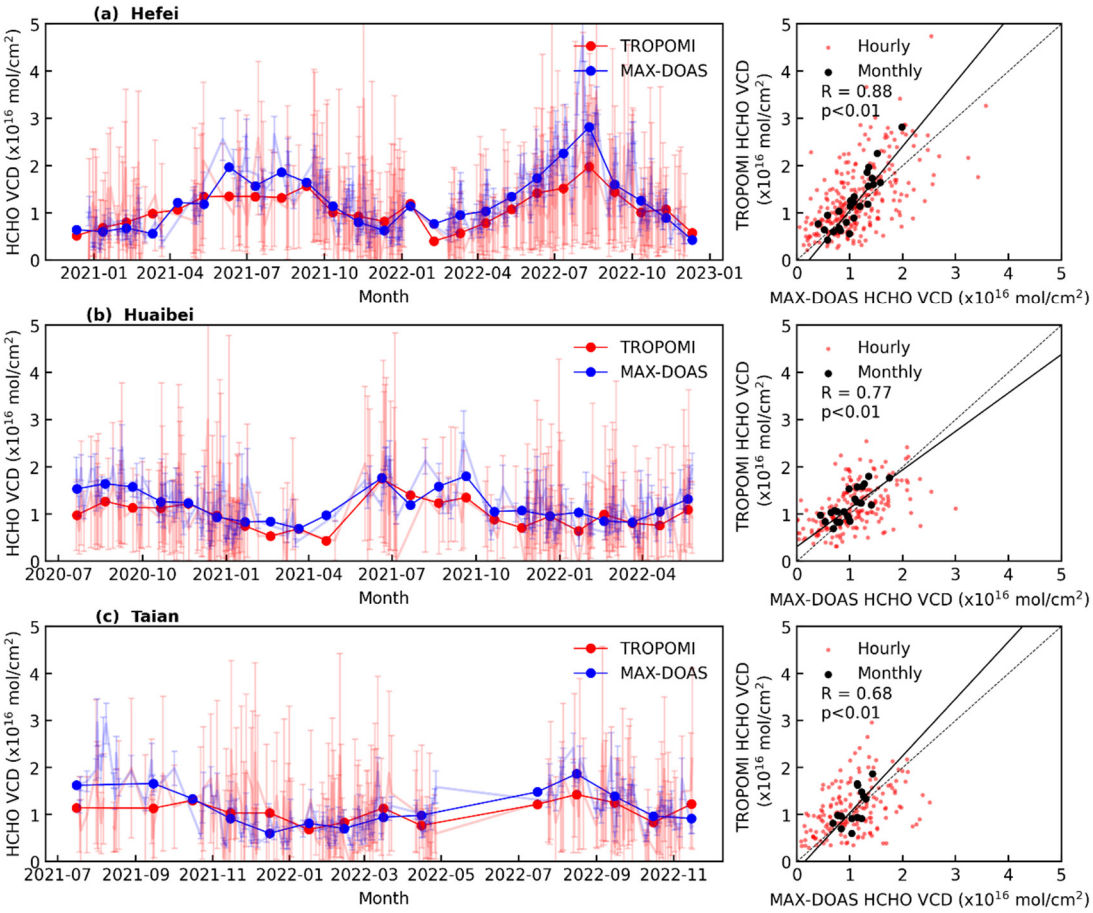

Fig.S2. The same as Fig.S1 but for HCHO VCD comparison.

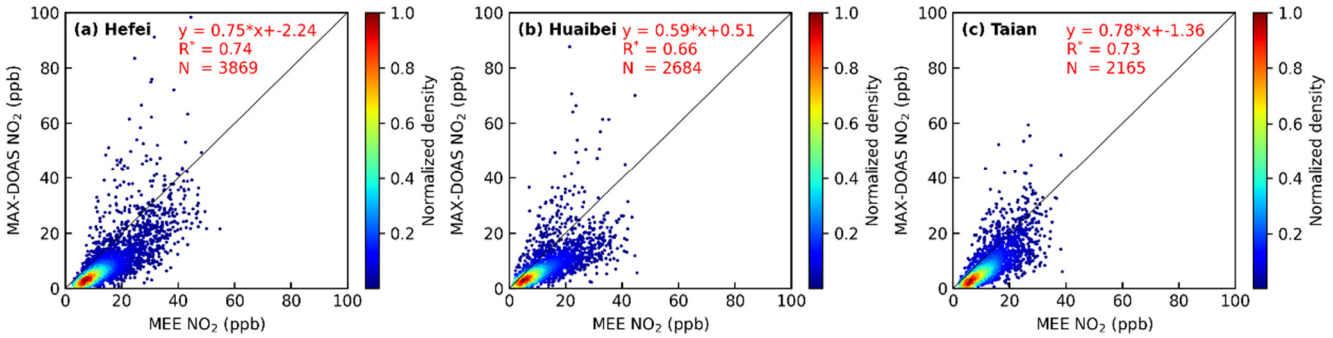

Fig.S3. Scatter plots show the correlation between the surface hourly NO_2 concentrations observed by Ministry of Ecology and Environment of China (MEE) and ground–based MAX–DOAS in (a) Hefei, (b) Huaibei, and (c) Tai'an during the whole observation period. The linear fitting function and correlation coefficient are show at the top of each panel, N=number of samples, and the superscript asterisk indicates P<0.01. Here, the color bar indicates the density.

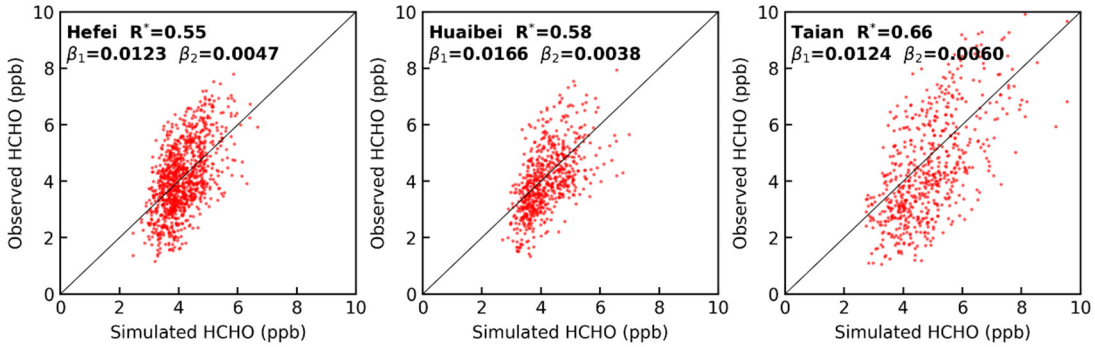

Fig.S4. Correlation analysis result of the simulated HCHO from the multi–linear regression model and measured HCHO, and the superscript asterisk indicates P<0.01.

Tables:

Table S1. Meteorological fields considered as possible 98% O_3 and 2% O_3 covariates

	Variables	Symbol	Average time (LT)	Units
98%	2–m temperature	T2	Maximum	K
	Surface relative humidity	RH	24 h	%
	Total cloud cover	TCC	08–18 h	0-1
	Total precipitation	TP	24 h	mm
	Mean sea level pressure	MSLP	24 h	Pa
	Wind speed	U, V	24 h	m/s
	Boundary layer height	BLH	08–18 h	m
	Vertical velocity at 850 hPa	V850	24 h	m/s
2%	2–m temperature	T2	Minimum	K
	Surface relative humidity	RH	19–07 h	%
	Total precipitation	TP	24 h	mm
	Mean sea level pressure	MSLP	24 h	Pa
	Wind speed	U, V	24 h	m/s
	Boundary layer height	BLH	19–07 h	m
	Vertical velocity at 850 hPa	V850	24 h	m/s

Table S2. Meteorological drivers of 2% O_3 percentile and Pearson correlation coefficient between observed and modeled 2% O_3 percentile in each city of eastern China during May–September 2017–2022

	Meteorological variable					Meteorological variable			
	1st	2st	3st	R		1st	2st	3st	R
Taian	T	RH	U	0.35	Beijing	U	RH	T	0.23
Puyang	T	BLH	RH	0.50	Tianjing	U	T	RH	0.32
Rizhao	U	V	T	0.46	Baoding	U	RH	TP	0.27
Jining	RH	T	V	0.54	Lanfang	U	T	V	0.23
Xinxiang	U	RH	V	0.41	Shijiazhuang	RH	BLH	U	0.27
Jiaozuo	T	RH	U	0.39	Handan	RH	V	BLH	0.20
Heze	RH	T	V	0.47	Qinghuangdao	V	U	RH	0.32
Linyi	RH	U	TP	0.40	Cangzhou	BLH	T	MSLP	0.28
Kaifeng	RH	U	T	0.49	Xingtai	RH	BLH	U	0.17
Zhengzhou	BLH	RH	U	0.47	Hengshui	T	V	RH	0.28
Luoyang	BLH	RH	V	0.16	Tangshan	U	V	RH	0.20
Zaozhuang	RH	T	U	0.46	Jinan	V	BLH	RH	0.59
Lianyungang	RH	V850	U	0.37	Qingdao	V	BLH	RH	0.26
Shangqiu	RH	T	V	0.48	Zibo	V	BLH	RH	0.59
Xuzhou	RH	BLH	V	0.48	Dongying	U	V	V850	0.36
Xuchang	BLH	RH	U	0.53	Yantai	V	BLH	U	0.33
Suqian	RH	T	MSLP	0.40	Weifang	BLH	T	U	0.34
Huaibei	RH	U	BLH	0.59	Weihai	RH	U	MSLP	0.36
Pingdingshan	BLH	RH	U	0.57	Dezhou	RH	V	BLH	0.40
Bozhou	RH	V	T	0.49	Liaocheng	BLH	V	RH	0.48
Zhoukou	RH	U	T	0.49	Binzhou	BLH	T	V	0.23
Luohe	RH	U	MSLP	0.45	Shaoxing	RH	BLH	T	0.59
Suzhou	RH	U	BLH	0.50	Jinhua	RH	TP	V	0.60
Huaian	RH	V	TP	0.42	Taizhou	V	RH	U	0.54
Yancheng	V	RH	BLH	0.37	Ningbo	RH	V	TP	0.48
Nanyang	RH	U	BLH	0.67	Wuhan	RH	V	BLH	0.61
Zhumadian	RH	TP	BLH	0.52	Changsha	RH	V	BLH	0.71
Fuyang	RH	V	U	0.64	Jinghzou	RH	V	BLH	0.55
Bengbu	RH	BLH	U	0.36	Yueyang	RH	BLH	V	0.60
Huainan	RH	BLH	U	0.56	Zhuzhou	RH	V	BLH	0.73
Xinyang	RH	TP	T	0.63	Xiangtan	RH	V	BLH	0.72
Suizhou	RH	BLH	U	0.63	Yichang	RH	U	V850	0.64
Shanghai	RH	V	TP	0.55	Yiyang	RH	V	BLH	0.67
Nanjing	V	RH	T	0.40	Changde	V	BLH	RH	0.59
Wuxi	RH	V	BLH	0.57	Jingmen	V	RH	U	0.63
Changzhou	V	RH	TP	0.49	Huangshi	RH	U	V850	0.72
Suzhou	RH	V	T	0.52	Huanggang	RH	U	V850	0.77
Nantong	V	RH	U	0.62	Xianning	RH	U	MSLP	0.74
Yangzhou	V	RH	T	0.52	Xiaogan	RH	V850	BLH	0.68
Zhenjiang	V	RH	T	0.55	Quzhou	V	RH	U	0.68
Taizhou	V	RH	T	0.59	Lishui	RH	V	T	0.70
Luan	RH	V	T	0.24	Wenzhou	RH	V	U	0.63
Hangzhou	RH	V	BLH	0.53	Jiujiang	V	RH	MSLP	0.58
Jiaxing	RH	V	T	0.45	Nanchang	V	RH	V850	0.67

Huzhou	V	RH	U	0.61	Jingdezhen	BLH	V850	T	0.59
Hefei	RH	TP	V	0.37	Shangrao	V850	BLH	RH	0.65
Wuhu	V	TP	U	0.46	Yingtan	BLH	V850	RH	0.64
Maanshan	V	U	TP	0.45	Yichun	V850	U	T	0.63
Tonglin	V	T	TP	0.50	Fuzhou	RH	V	BLH	0.72
Anqing	V	T	TP	0.56	Jian	BLH	U	RH	0.57
Chuzhou	RH	V	BLH	0.44	Xinyu	BLH	V	U	0.62
Chizhou	RH	V	BLH	0.47	Pingxiang	V850	BLH	T	0.61
Xuancheng	T	RH	U	0.27	-	-	-	-	-

Table S3. Meteorological drivers of 98% O_3 percentile and Pearson correlation coefficient between observed and modeled 98% O_3 percentile in each city of eastern China during May–September 2017–2022

	Meteorological variable					Meteorological variable			
	1st	2st	3st	R		1st	2st	3st	R
Taian	T	TP	TCC	0.71	Beijing	MSLP	BLH	V	0.30
Puyang	T	V850	TP	0.79	Tianjing	V	MSLP	BLH	0.27
Rizhao	T	U	TCC	0.67	Baoding	MSLP	V	BLH	0.28
Jining	T	TP	V850	0.77	Lanfang	MSLP	BLH	V	0.32
Xinxiang	T	TCC	BLH	0.74	Shijiazhuang	MSLP	BLH	V	0.24
Jiaozuo	T	TP	TCC	0.81	Handan	T	MSLP	U	0.31
Heze	T	V850	TP	0.78	Qinghuangdao	TCC	U	MSLP	0.36
Linyi	T	TP	TCC	0.73	Cangzhou	V	BLH	MSLP	0.35
Kaifeng	T	V850	TP	0.78	Xingtai	MSLP	BLH	V	0.25
Zhengzhou	T	V850	TP	0.78	Hengshui	V	MSLP	BLH	0.38
Luoyang	U	TCC	V	0.28	Tangshan	TCC	MSLP	T	0.27
Zaozhuang	T	TP	TCC	0.81	Jinan	T	TP	V850	0.77
Lianyungang	TCC	U	TP	0.68	Qingdao	U	BLH	RH	0.45
Shangqiu	T	TP	V850	0.71	Zibo	T	TP	V850	0.70
Xuzhou	T	TCC	TP	0.74	Dongying	T	RH	V	0.66
Xuchang	T	V850	TCC	0.70	Yantai	U	T	RH	0.44
Suqian	RH	TCC	TP	0.74	Weifang	T	TP	U	0.68
Huaibei	TCC	T	TP	0.74	Weihai	U	T	RH	0.44
Pingdingshan	T	V850	U	0.66	Dezhou	T	TP	V850	0.75
Bozhou	TCC	T	TP	0.67	Liaocheng	T	V850	TP	0.77
Zhoukou	T	TCC	RH	0.73	Binzhou	T	TP	V	0.66
Luohe	T	V850	RH	0.75	Shaoxing	T	V	TP	0.66
Suzhou	TCC	T	TP	0.71	Jinhua	T	V	TP	0.59
Huaian	T	TCC	TP	0.72	Taizhou	U	V	T	0.62
Yancheng	TP	V850	U	0.56	Ningbo	T	V	U	0.69
Nanyang	T	TCC	RH	0.74	Wuhan	TCC	RH	V850	0.75
Zhumadian	TCC	BLH	TP	0.67	Changsha	RH	TCC	V	0.76
Fuyang	RH	TCC	MSLP	0.74	Jinghzou	RH	V850	T	0.84
Bengbu	T	TCC	TP	0.72	Yueyang	RH	TCC	U	0.82
Huainan	TCC	RH	MSLP	0.68	Zhuzhou	RH	V	T	0.73
Xinyang	RH	TCC	U	0.74	Xiangtan	RH	V	TCC	0.78
Suizhou	RH	TCC	MSLP	0.75	Yichang	RH	TCC	V850	0.79
Shanghai	T	U	RH	0.72	Yiyang	RH	TCC	V850	0.80
Nanjing	TCC	V850	V	0.61	Changde	TCC	V850	T	0.74
Wuxi	TP	TCC	U	0.66	Jingmen	RH	V850	T	0.76
Changzhou	TCC	TP	BLH	0.60	Huangshi	RH	TCC	V	0.76
Suzhou	T	TP	U	0.63	Huanggang	TCC	RH	U	0.72
Nantong	T	RH	BLH	0.75	Xianning	RH	V850	T	0.80
Yangzhou	TCC	TP	V850	0.61	Xiaogan	RH	TCC	U	0.72
Zhenjiang	TCC	TP	MSLP	0.61	Quzhou	RH	V850	T	0.74
Taizhou	TCC	V850	U	0.61	Lishui	RH	U	V	0.65
Luan	TCC	MSLP	T	0.61	Wenzhou	U	RH	V	0.65
Hangzhou	TP	TCC	T	0.69	Jiujiang	TCC	V850	RH	0.80
Jiaxing	T	TP	U	0.70	Nanchang	RH	V850	T	0.72

Huzhou	TP	TCC	T	0.67	Jingdezhen	RH	V850	TCC	0.75
Hefei	TCC	TP	V	0.59	Shangrao	TCC	V850	T	0.76
Wuhu	TCC	TP	V	0.65	Yingtan	TCC	V850	T	0.78
Maanshan	TCC	TP	MSLP	0.66	Yichun	V850	TCC	T	0.75
Tonglin	TCC	MSLP	V	0.63	Fuzhou	V850	T	TCC	0.82
Anqing	TCC	V	TP	0.58	Jian	TCC	T	V	0.66
Chuzhou	TCC	TP	MSLP	0.58	Xinyu	V850	TCC	V	0.75
Chizhou	TCC	V	MSLP	0.63	Pingxiang	V850	TCC	V	0.75
Xuancheng	TCC	V	MSLP	0.58	-	-	-	-	-