

An improved TROPOMI tropospheric HCHO retrieval over China

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Table S1: The DOAS retrieval settings for MAX-DOAS HCHO SCD.

Fitting window	322.5-358 nm
polynomial	5rd order
Solar reference spectrum	(Chance and Kurucz, 2010)
HCHO cross sections	(Meller and Moortgat, 2000), 297K
O ₃ cross sections ^(a)	(Serdyuchenko et al., 2014), 223 and 243K
NO ₂ cross sections ^(b)	(Vandaele et al., 1998), 298K
BrO cross sections	(Fleischmann et al., 2004), 223K
O ₄ cross section	(Thalman and Volkamer, 2013), 293K
Molecular ring	

^(a) I_0 correction was applied using a SCD of 10^{20} molec cm⁻²

^(b) I_0 correction was applied using a SCD of 10^{17} molec cm⁻²

Table S2: The seasonal and annual average HCHO VCD in provincial-level administrative region of China (Unit: 1016 molec cm-2)

Provincial administrative regions of China	autumn 2018	winter 2018	spring 2019	summer 2019	annual average
Tianjin	1.32	1.16	1.26	2.10	1.46
Shandong	1.20	1.09	1.17	1.72	1.29
Beijing	1.11	0.98	1.14	1.91	1.29
Jiangsu	1.15	1.17	1.21	1.59	1.28
Anhui	1.14	1.22	1.16	1.51	1.26
Shanghai	1.22	1.20	1.19	1.34	1.24
Henan	1.11	1.15	1.12	1.56	1.23
Hong Kong	1.31	1.19	1.02	1.22	1.19
Hebei	1.05	0.96	1.06	1.62	1.17
Zhejiang	1.16	0.93	1.12	1.32	1.13
Hubei	0.96	1.09	1.06	1.34	1.12
Guangdong	1.08	1.06	1.04	1.21	1.10
Jiangxi	1.03	0.94	1.05	1.29	1.08
Hunan	0.98	0.98	1.06	1.25	1.06
Liaoning	0.97	0.83	1.01	1.43	1.06
Guangxi	0.96	1.00	1.14	1.14	1.06
Hainan	0.89	0.97	1.16	1.15	1.04
Macao	1.23	1.00	0.92	0.87	1.01
Chongqing	0.81	0.96	1.03	1.21	1.00
Shanxi	0.82	0.83	0.96	1.34	0.99
Fujian	0.95	0.91	0.96	1.13	0.99
Shaanxi	0.79	0.86	0.92	1.22	0.95
Jilin	0.88	0.77	0.96	1.16	0.94
Guizhou	0.70	0.94	1.09	0.94	0.92
Taiwan	0.85	0.87	0.91	0.94	0.89
Heilongjiang	0.83	0.76	0.83	1.00	0.85
Ningxia Hui	0.75	0.79	0.79	1.05	0.85
Yunnan	0.68	0.87	0.96	0.83	0.84
Sichuan	0.66	0.84	0.85	0.90	0.81

Nei Mongol	0.75	0.58	0.71	1.02	0.77
Xinjiang Uygur	0.72	0.58	0.67	0.85	0.71
Gansu	0.64	0.64	0.69	0.86	0.70
Tibet	0.52	0.46	0.54	0.62	0.53
Qinghai	0.45	0.48	0.52	0.65	0.53
National average	0.93	0.91	0.98	1.21	1.01