Supplement of Atmos. Chem. Phys., 24, 12861–12879, 2024
https://doi.org/10.5194/acp-24-12861-2024-supplement

Atmospheric Chemistry and Physics
Open Access

Supplement of

Review of source analyses of ambient volatile organic compounds considering reactive losses: methods of reducing loss effects, impacts of losses, and sources

Baoshuang Liu et al.

Correspondence to: Baoshuang Liu (lbsnankai@foxmail.com) and Yinchang Feng (fengyc@nankai.edu.cn)

Contents

Sect. S1 Estimation methods of the decay factors.

Method 1:

In 1981, Friedlander (1981) proposed treating an urban airshed as a continuous stirred tank reactor (CSTR) and relating the decay factor for a given species to its first-order reaction rate constant, k_i.

$$\alpha_i = (1 + k_i\theta)^{-1} \tag{1}$$

$$\theta = \frac{V}{q} \tag{2}$$

where α_i represents the decay factor of species i, θ represents the average residence time, V is the reactor volume, and q is the flow rate. This method considered only the first-order reaction of a given species, and there was high uncertainty in the average residence time.

Method 2:

In 1994, Lin and Milford (1994) first estimated the decay factor utilizing the reaction rate constants of VOC species and "aging coefficients". In 2007, Na and Pyo Kim (2007) also conducted a similar estimation utilizing this method. The specific estimation method of the decay factor (α_{ij}) was as follows:

$$\alpha_{ij} = \exp\,(-k_i\xi) \tag{3}$$

where k_i is the rate constant for the reaction of species i with the OH radical, and ξ is an empirically estimated "aging coefficient". To estimate ξ for a given sample, source contributions estimated with α_{ij} = 1.0 were used to calculate preliminary predicted concentrations, c^*_i. With the normalized residual (E_i) for species i defined as:

$$E_i = \frac{c_i^* - c_i}{c_i} \tag{4}$$

the linear expression:

$$\ln(E_i + 1) = -A + \xi k_i \tag{5}$$

where the ξ value can be estimated for each sample utilizing the linear regression. However, this method had two important limitations: First, for a given sample, the aging coefficient was assumed to be the same for all species and sources; second, rates of reaction of alkenes with NO_3 radicals and O_3 were neglected.

Table S1. Summary of sampling information and species concentration data from reviewed publications using PMF for VOC source analyses.

Literature	City/Region	Study period	Unit	TVOCs	PAMS	Alkanes	Alkenes	Aromatic hydrocarbons	Alkyne	OVOCs	Halohydrocarbons	Others
Ling et al. (2011)	PRD region	2007/10/23-2007/12/1	μgm^{-3}	81.01	81.01	27.84	5.08	43.53	4.56	-	-	-
Chen et al. (2019)	Taixi, Taiwan	2014	ppbv	11.19	11.19	6.28	2.11.	1.94	0.86	-	-	-
Chen et al. (2019)	Taixi, Taiwan	2015	ppbv	11.58	11.58	6.67	1.87	2.12	0.92	-	-	-
Chen et al. (2019)	Taixi, Taiwan	2016	ppbv	10.44	10.44	6.25	1.54	1.82	0.83	-	-	-
Zheng et al. (2018)	Junggar Basin	2014/9-2015/8	ppbv	145.83	145.83	129	9.52	4.28	3.03	-	-	-
Ling and Guo (2014)	Hong Kong	2010/9/6-2010/11/29	-	-	-	-	-	-	-	-	-	-
Tan et al. (2020)	Chengdu	2017/7/31-2017/8/6	ppbv	14.4	14.34	10	0.89	1.01	2.44	-	-	-
Tan et al. (2020)	Chengdu	2017/8/7-2017/8/31	ppbv	11.8	11.77	6.28	2.57	0.79	2.13	-	-	-
Tan et al. (2020)	Chengdu	2017/7/31-2017/8/6	ppbv	52.8	31.38	16.5	3.77	7.85	3.26	13.3	7.7	-
Tan et al. (2020)	Chengdu	2017/8/7-2017/8/31	ppbv	34.9	21.9	12.3	2.79	4.41	2.4	7.68	4.9	-
Tan et al. (2020)	Chengdu	2017/7/31-2017/8/6	ppbv	60.6	32.94	18.4	4.46	7.27	2.81	20.5	6.7	-
Tan et al. (2020)	Chengdu	2017/8/7-2017/8/31	ppbv	47.0	32.73	23.7	3.12	3.32	2.59	9.81	4.14	-
Brown et al. (2007)	Los Angeles	2001/7-9, 2002/7-9, 2003/7-9	ppbC	79	-	-	-	-	-	-	-	-
Brown et al. (2007)	Los Angeles	2001/7-9, 2002/7-9, 2003/7-9	ppbC	237	-	-	-	-	-	-	-	-
Zhang et al. (2013)	Guangzhou	2009/11/8-2009/12/7	ppbv	-	-	-	-	9.26	-	-	-	-
Zhang et al. (2013)	Guangzhou	2009/11/8-2009/12/7	ppbv	-	-	-	-	6.4	-	-	-	-
Zhang et al. (2013)	Zengcheng	2009/11/8-2009/12/7	ppbv	-	-	-	-	2.5	-	-	-	-
Zhang et al. (2013)	Wanqingsha	2009/11/8-2009/12/7	ppbv	-	-	-	-	10.4	-	-	-	-

Guo et al. (2011)	PRD center	2007/10-2007/12	ppbv	42	-	-	-	-	-	-	-	-
Guo et al. (2011)	Hong Kong	2007/10-2007/13	ppbv	34	-	-	-	-	-	-	-	-
Shao et al. (2016)	Nanjing	2013/5/15-2013/8/31	ppbv	34.4	34.4	14.98	7.35	9.06	3.01	-	-	-
Liu et al. (2023a)	Tianjin	2020/4/15-2020/8/31	ppbv	19.35	19.35	11.3	5.32	1.6	1.13	-	-	-
Hui et al. (2019)	Wuhan	2016/10/15-2016/10/20	ppbv	58.33	32.07	18.84	5.9	4.89	2.44	20.67	5.11	0.48
Hui et al. (2019)	Wuhan	2016/11/2-2016/11/6	ppbv	45.84	32.75	19.79	5.12	4.81	3.03	7.26	5.38	0.45
Hui et al. (2019)	Wuhan	2016/11/11-2016/11/16	ppbv	57.73	43.87	26.56	7.58	5.65	4.08	7.08	6.24	0.54
Liu et al. (2020)	Beijing	2016/4; 2016/7; 2016/10	ppbv	44	27.96	16.2	5.24	3.39	3.13	11	4.76	0.3
Xiong et al. (2021)	Chengdu	2018/6	ppbv	26.8	22.3	11.9	3.76	3.18	3.46	-	4.47	-
Xiong et al. (2021)	Chengdu	2019/1	ppbv	53.3	49.67	29.2	6.55	5.46	8.46	-	3.62	-
Zhu et al. (2017)	Mt. Tai	2014/6/4-2014/7/4	pptv	8040	7947	4464	906	1179	1398	-	-	94
Yang et al. (2019)	Xianghe	2017/11/6-2018/1/29	ppbv	61.04	48.44	23.66	12.27	8.27	4.24	5.18	8.47	0.32
Li et al. (2019)	Zhengzhou	2017/5	ppbv	37.6	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/6	ppbv	34	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/7	ppbv	16	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/8	ppbv	21.5	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/9	ppbv	26.2	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/5	ppbv	29.3	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/6	ppbv	30.3	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/7	ppbv	20.7	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/8	ppbv	24.4	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/9	ppbv	34.2	-	-	-	-	-	-	-	-

Li et al. (2019)	Zhengzhou	2017/5	ppbv	31.7	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/6	ppbv	39.3	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/7	ppbv	19.6	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/8	ppbv	20.5	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/9	ppbv	30.4	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/5	ppbv	30.1	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/6	ppbv	28.3	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/7	ppbv	15.9	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/8	ppbv	26.1	-	-	-	-	-	-	-	-
Li et al. (2019)	Zhengzhou	2017/9	ppbv	32.6	-	-	-	-	-	-	-	-
Liu et al. (2016)	Tianjin	2015/3	ppbv	19.6	19.7	14.2	4.2	1.3	-	-	-	-
Liu et al. (2016)	Tianjin	2015/4	ppbv	22.6	22.5	15.9	4.3	2.3	-	-	-	-
Liu et al. (2016)	Tianjin	2015/5	ppbv	14.4	14.4	11.1	2.4	0.9	-	-	-	-
Liu et al. (2016)	Tianjin	2015/6	ppbv	10.4	10.5	7.4	2.3	0.8	-	-	-	-
Liu et al. (2016)	Tianjin	2015/7	ppbv	34.5	34.5	20.1	4.4	10	-	-	-	-
Liu et al. (2016)	Tianjin	2015/8	ppbv	48.9	49	21.3	5.9	21.8	-	-	-	-
Liu et al. (2016)	Tianjin	2015/9	ppbv	44.8	45	30	5.3	9.7	-	-	-	-
Liu et al. (2016)	Tianjin	2015/1	ppbv	31.8	31.9	19.7	5.3	6.9	-	-	-	-
Liu et al. (2016)	Tianjin	2014/11	ppbv	30	30	20.5	5.7	3.8	-	-	-	-
Liu et al. (2016)	Tianjin	2014/12	ppbv	26.9	27	18.2	6.4	2.4	-	-	-	-
Liu et al. (2016)	Tianjin	2015/1	ppbv	39.4	39.4	26.3	10.2	2.9	-	-	-	-
Liu et al. (2016)	Tianjin	2015/2	ppbv	20.9	20.9	14.3	5.6	1	-	-	-	-

Guan et al. (2020)	Shijiazhuang	2018/7/6-2018/7/15	ppbv	-	-	-	-	-	-	-	-	-
Gao et al. (2020)	Yuncheng	2018/1/20-2018/1/24	μgm^{-3}	87.7	84.92	53.5	8.8	20.02	2.6	-	-	-
Hui et al. (2020)	Wuhan	2017/4/26-2017/6/6	ppbv	28.92	21.74	14.79	2.9	2.25	1.8	3.8	3.16	0.22
Huang and Hsieh (2020)	Taipei	2017	μgm^{-3}	76.0	76.0	40.9	7.3	24.7	3.1	-	-	-
Huang and Hsieh (2020)	Taipei	2017	μgm^{-3}	65.0	65.0	34.8	4.8	24.5	1.0	-	-	-
Huang and Hsieh (2020)	Taichung	2017	μgm^{-3}	64.9	64.9	30.2	5.5	27.5	1.8	-	-	-
Huang and Hsieh (2020)	Tainan	2017	μgm^{-3}	65.2	65.2	32.2	5.9	26.3	0.8	-	-	-
Huang and Hsieh (2020)	Kaohsiung	2017	μgm^{-3}	53.4	53.4	26.8	5.8	19.9	1.0	-	-	-
Huang and Hsieh (2020)	Kaohsiung	2017	μgm^{-3}	58.2	58.2	31.3	6.7	18.9	1.5	-	-	-
Huang and Hsieh (2020)	Yunlin	2017	μgm^{-3}	21.7	21.7	11.8	3.0	6.0	0.7	-	-	-
Huang and Hsieh (2020)	Chiayi	2017	μgm^{-3}	40.1	40.1	22.1	4.4	13.0	0.5	-	-	-
Huang and Hsieh (2020)	Pingtung	2017	μgm^{-3}	34.9	34.9	18.1	3.9	11.0	1.9	-	-	-
Zhao et al. (2020)	Nanjing	2016	ppbv	25.7	25.7	13.6	3.2	4.4	4.5	-	-	-
Hui et al. (2021)	Weinan	2019/7/1-2019/9/19	ppbv	30.42	22.91	14.94	3.3	2.42	2.25	4.36	3.02	0.13
Zhou et al. (2022)	Beijing	2020/11/5-2020/11/14	ppbv	19.43	11.21	6.84	1.46	2.05	0.86	5.52	2.65	-
Zhou et al. (2022)	Beijing	2020/11/15-2020/11/26	ppbv	16.25	9.35	5.66	1.36	1.43	0.9	4.56	2.31	-
Gu et al. (2022)	Tianjin	2019/11/1-2020/3/31	ppbv	27.6	27.6	18.6	4.3	2.5	2.2	-	-	-
Yang et al. (2022)	Tianjin	2020/12/1-2021/3/15	ppbv	24.2	24.13	16.5	3.99	2.18	1.46	-	-	-
Yu et al. (2023)	Hefei	2020/8/18-2020/9/2	ppbv	42.26	13.22	8.99	2.62	1.61	-	22.13	5.63	1.3
Cao et al. (2023)	Hainan	2019/1-2019/12	ppbv	11.4	11.39	8.15	1.32	1.03	0.89	-	-	-
Wang et al. (2023a)	Taiyuan	2021/7/16-2022/1/4	ppbv	21.97	21.97	13.42	5	1.57	1.98	-	-	-
Wu et al. (2023b)	Qingdao	2020/3/11-2020/5/31	μgm^{-3}	57.4	57.45	37.1	5.96	13.8	0.59	-	-	-

Liu et al. (2023b)	Beijing	2019/8/1-2019/8/28	ppbv	94.26	86.6	53.51	2.53	29.88	0.68	7.34	-	-
Liu et al. (2023b)	Beijing	2019/8/1-2019/8/28	ppbv	20.69	12.27	8.31	1.21	2.36	0.39	8.12	-	-
Tan et al. (2021)	Hong Kong	2018/8/27-2018/10/10	ppbv	9.38	1.27	-	0.47	0.8	-	7.91	-	0.2
Cui et al. (2024a)	Shijiazhuang	2022/6/1-2022/8/31	ppbv	23.2	15.91	10.2	2.78	1.94	1.01	5.49	1.8	-
He et al. (2024)	Guangzhou	2022/3-2022/5	ppbv	26.88	26.88	17.7	2.38	4.65	2.19	-	-	-
Liu et al. (2025)	Shijiazhuang	2021/5/15-2021/9/30	ppbv	34.4	22.05	14.2	3.00	3.39	1.46	7.00	5.00	0.33
Liu et al. (2023c)	Jinan	2022/8/17-2022/8/31	ppbv	12.0	12.0	7.2	2.3	0.98	1.5	-	-	-
Wang et al. (2024a)	Zhengzhou	2019/5/23-2019/7/8	ppbv	23.74	17.33	10.42	2.37	2.33	2.21	2.42	3.92	0.07
Zhang et al. (2024a)	Langfang	2018/8/25-2018/10/18	μgm^{-3}	227.4	128.48	97.1	6.37	25.01	-	23.2	73.5	-
Ren et al. (2024)	Shanghai	2020/4/1-2020/10/31	ppbv	53.1	-	16.9	-	-	-	11.6	-	-
Wang et al. (2024b)	Zibo	2022/5-2022/9	ppbv	36.1	18.8	11.6	0.7	3.6	2.9	9.4	7.6	-
Li et al. (2020)	Hong Kong	2013/1-2014/12	ppbv	41.6	41.6	28.3	6.66	3.33	3.62	-	-	-
Jain et al. (2022)	Delhi	2019/1-2019/12	ppbv	143.9	-	-	-	-	-	-	-	-

The data from the same city at different or same times were derived mainly from multiple sampling sites.

Table S2. Summary of methods for reducing reactive loss impacts in the VOC source analyses.

Literature	Models	Reduce reactive loss impact methods
Ling et al. (2011)	PMF	Input low reactivity species
Chen et al. (2019)	PMF	Input low reactivity species
Zheng et al. (2018)	PMF	Input low reactivity species
Ling and Guo (2014)	PMF	Input low reactivity species
Tan et al. (2020)	PMF	Input low reactivity species
Brown et al. (2007)	PMF	Input low reactivity species
Zhang et al. (2013)	PMF	Input low reactivity species
Guo et al. (2011)	PMF	Input low reactivity species
Shao et al. (2016)	PMF	Input low reactivity species
Liu et al. (2023a)	PMF	Input low reactivity species and calculate initial concentrations
Hui et al. (2019)	PMF	Input low reactivity species
Liu et al. (2020)	PMF	Input low reactivity species
Xiong et al. (2021)	PMF	Input low reactivity species
Zhu et al. (2017)	PMF	Input low reactivity species
Yang et al. (2019)	PMF	Input low reactivity species
Li et al. (2019)	PMF	Input low reactivity species
Liu et al. (2016)	PMF	Input low reactivity species
Guan et al. (2020)	PMF	Input low reactivity species
Gao et al. (2020)	PMF	Input low reactivity species

Hui et al. (2020)	PMF	Input low reactivity species
Huang and Hsieh (2020)	PMF	Input low reactivity species
Zhao et al. (2020)	PMF	Input low reactivity species
Hui et al. (2021)	PMF	Input low reactivity species
Zhou et al. (2022)	PMF	Input low reactivity species
Gu et al. (2022)	PMF	Input low reactivity species
Yang et al. (2022)	PMF	Input low reactivity species and calculate initial concentrations
Yu et al. (2023)	PMF	Input low reactivity species
Cao et al. (2023)	PMF	Input low reactivity species
Wang et al. (2023a)	PMF	Input low reactivity species
Buzcu and Fraser (2006)	PMF	Input nighttime data
BuzcuGuven and Fraser (2008)	PMF	Input nighttime data
Lin and Milford (1994)	CMB	Decay factor method
Friedlander (1981)	CMB	Decay factor method
Na and Pyo Kim (2007)	CMB	Decay factor method
He et al. (2019)	PMF	Calculate initial concentration
Wang et al. (2023b)	PMF	Calculate initial concentration
Sun et al. (2016)	PMF	Calculate initial concentration
Zou et al. (2023)	PMF	Calculate initial concentration
Wu et al. (2023a)	PMF	Calculate initial concentration
Wu et al. (2023b)	PMF	Input low reactivity species and calculate initial concentrations
Cui et al. (2024a)	PMF	Input low reactivity species and calculate initial concentrations
Ren et al. (2024)	PMF	Calculate initial concentration
Chen et al. (2023)	PMF	Calculate initial concentration

Hua et al. (2023)	PMF	Calculate initial concentration
He et al. (2024)	PMF	Calculate initial concentration
Liu et al. (2023c)	PMF	Calculate initial concentration
Wang et al. (2024a)	PMF	Calculate initial concentration
Zhang et al. (2024a)	PMF	Calculate initial concentration
Borlaza-Lacoste et al. (2024)	PMF	Calculate initial concentration
Cui et al. (2024b)	MLR, PAPM, and PMF	Calculate initial concentration
Zhu et al. (2021)	PAPM	/
de Gouw et al. (2005)	PAPM	/
Huang et al. (2020)	PAPM	/
Yuan et al. (2012)	PAPM	/
Wang et al. (2016)	PAPM	/
Han et al. (2019)	PAPM	/
Wu et al. (2020)	PAPM	/
de Gouw et al. (2017)	PAPM	Calculate initial concentration
de Gouw et al. (2018)	PAPM	Calculate initial concentration

PMF represents positive matrix factorization, CMB represents chemical mass balance, PAPM represents photochemical age-based parameterization method, and MLR represents multiple linear regression.

Table S3. The type and quantity of input species in PMF for VOC source apportionment in the publications.

Literature	Input Species	PAMS	Alkanes	Alkenes	Aromatic hydrocarbons	Alkyne	OVOCs	Halohydrocarbons	Others
Ling et al. (2011)	22	22	10	3	8	1	0	0	0
Chen et al. (2019)	27	27	17	3	6	1	0	0	0
Zheng et al. (2018)	20	20	14	1	4	1	0	0	0
Ling and Guo (2014)	25	25	12	3	9	1	0	0	0
Tan et al. (2020)	82	54	29	8	16	1	14	14	0
Brown et al. (2007)	31	31	19	2	9	1	0	0	0
Zhang et al. (2013)	33	33	13	6	13	1	0	0	0
Guo et al. (2011)	16	16	9	1	5	1	0	0	0
Shao et al. (2016)	33	33	15	6	11	1	0	0	0
Liu et al. (2023a)	32	32	17	5	9	1	0	0	0
Hui et al. (2019)	43	35	18	6	10	1	0	7	1
Liu et al. (2020)	39	31	15	6	9	1	5	2	1
Xiong et al. (2021)	30	26	14	3	8	1	3	1	0
Zhu et al. (2021)	28	28	14	4	9	1	0	0	0
Yang et al. (2019)	48	25	9	5	10	1	7	15	1
Li et al. (2019)	30	30	15	8	6	1	0	0	0
Liu et al. (2016)	31	31	17	5	9	0	0	0	0
Guan et al. (2020)	35	15	6	4	4	1	12	7	1
Gao et al. (2020)	37	37	19	7	10	1	0	0	0
Hui et al. (2020)	41	32	16	4	11	1	2	7	1
Huang and Hsieh (2020)	15	15	7	2	5	1	0	0	0
Zhao et al. (2020)	25	25	11	6	7	1	0	0	0

Hui et al. (2021)	30	24	13	5	5	1	1	4	1
Zhou et al. (2022)	38	19	10	3	5	1	9	9	1
Gu et al. (2022)	30	30	16	5	8	1	0	0	0
Yang et al. (2022)	30	30	17	5	7	1	0	0	0
Yu et al. (2023)	27	17	8	4	5	0	4	6	0
Cao et al. (2023)	34	34	16	8	9	1	0	0	0
Wang et al. (2023a)	35	34	16	9	8	1	1	0	0
Wu et al. (2023b)	27	27	14	6	6	1	0	0	0
Li et al. (2023)	34	30	18	2	9	1	4	0	0
Li et al. (2023)	24	20	14	2	4	0	4	0	0
Liu et al. (2023b)	29	26	14	4	7	1	3	0	0
Tan et al. (2021)	16	4	0	1	3	0	7	0	5
He et al. (2024)	26	26	14	3	8	1	0	0	0
Zhang et al. (2024a)	35	29	16	5	7	1	4	2	0
Wang et al. (2024a)	28	24	14	1	8	1	1	3	0
Cui et al. (2024a)	37	30	16	5	8	1	7	0	0
Ren et al. (2024)	58	36	20	4	11	1	11	11	0
Chen et al. (2023)	31	31	16	6	8	1	0	0	0
He et al. (2019)	49	47	27	6	13	1	2	0	0
Hua et al. (2023)	25	21	11	4	6	0	3	0	1
Mishra et al. (2023)	24	24	13	4	6	1	0	0	0
Liu et al. (2025)	30	30	17	5	7	1	0	0	0
Liu et al. (2023c)	26	26	14	3	8	1	0	0	0
Zhao et al. (2004)	13	9	0	2	7	0	3	0	1
Li et al. (2020)	20	19	8	4	6	1	0	0	1
Borlaza-Lacoste et al. (2024)	54	54	28	9	16	1	0	0	0

Table S4. Summary of k_{OH} values of PAMS species used in the publications.

Species	k_{OH} (Carter, 2010) (cm^3 molecule^{-1} s^{-1})	k_{OH} (Atkinson and Arey, 2003)	Species	k_{OH} (Carter, 2010) (cm^3 molecule^{-1} s^{-1})	k_{OH} (Atkinson and Arey, 2003)
Temperature	300ºK	298ºK	Temperature	300ºK	298ºK
	Alkanes			**Alkenes**	
Ethane	2.54E-13	2.48E-13	Ethylene	8.15E-12	8.52E-12
Propane	1.11E-12	1.09E-12	Propene	2.60E-11	2.63E-11
i-Butane	2.14E-12	-	trans-2-Butene	6.32E-11	6.40E-11
n-Butane	2.38E-12	2.36E-12	1-Butene	3.11E-11	3.14E-11
2,2-Dimethylbutane	2.27E-12	2.23E-12	cis-2-Butene	5.58E-11	5.64E-11
2,3-Dimethylbutane	5.79E-12	5.78E-12	1-Pentene	3.14E-11	3.14E-11
n-Pentane	3.84E-12	3.80E-12	trans-2-Pentene	6.70E-11	6.70E-11
i-Pentane	3.60E-12	-	cis-2-Pentene	6.50E-11	6.50E-11
Cyclopentane	5.02E-12	4.97E-12	Isoprene	9.96E-11	10.0E-11
Methylcyclopentane	5.68E-12	-	1-Hexene	3.70E-11	3.70E-11
2-Methylpentane	5.20E-12	5.20E-12		**Aromatic hydrocarbons**	
3-Methylpentane	5.20E-12	5.20E-12	Benzene	1.22E-12	1.22E-12
2,4-Dimethylpentane	4.77E-12	4.77E-12	Toluene	5.58E-12	5.63E-12
2,3-Dimethylpentane	7.15E-12	-	Ethylbenzene	7.00E-12	7.00E-12
2,3,4-Trimethylpentane	6.60E-12	6.60E-12	o-Xylene	1.36E-11	1.36E-11
2,2,4-Trimethylpentane	3.38E-12	3.34E-12	i-Propylbenzene	6.30E-12	6.30E-12
n-Hexane	5.25E-12	5.20E-12	n-Propylbenzene	5.80E-12	5.80E-12
3-Methylhexane	7.17E-12	-	m-Ethyltoluene	1.86E-11	1.86E-11

Methylcyclohexane	9.64E-12	9.64E-12
Cyclohexane	7.02E-12	6.97E-12
2-Methylhexane	6.89E-12	-
n-Heptane	6.81E-12	6.76E-12
2-Methylheptane	8.31E-12	-
3-Methylheptane	8.59E-12	-
n-Octane	8.16E-12	8.11E-12
n-Nonane	9.75E-12	9.70E-12
n-Decane	1.10E-11	1.10E-11
	Alkyne	
Acetylene	7.56E-13	-
p-Ethyltoluene	1.18E-11	1.18E-11
o-Ethyltoluene	1.19E-11	1.19E-11
1,3,5-Trimethylbenzene	5.67E-11	5.67E-11
1,2,4-Trimethylbenzene	3.25E-11	3.25E-11
1,2,3-Trimethylbenzene	3.27E-11	3.27E-11
m-Diethylbenzene	-	-
p-Diethylbenzene	-	-
Styrene	5.80E-11	5.80E-11
m-Xylene	2.31E-11	2.31E-11
p-Xylene	1.43E-11	1.43E-11

Table S5. Summary of estimation methods for calculating photochemical age (reaction time, Δt) in the publications.

Number	Study city or area	Δt calculation method	Publication Year	Literature
1	Sydney	Species ratio method	1983	Nelson and Quigley (1983)
2	Nashville	Sequential reaction model	2001	Stroud et al. (2001)
3	Boston	Species ratio and sequential reaction model	2005	de Gouw et al. (2005)
4	NOAA aircraft data	Species ratio method	2007	Parrish et al. (2007)
5	NOAA aircraft data	Species ratio and sequential reaction model	2007	Warneke et al. (2007)
6	Beijing	Sequential reaction model	2008	Xie et al. (2008)
7	Beijing	Species ratio method	2011	Shao et al. (2011)
8	Beijing	Species ratio method	2012	Yuan et al. (2012)
9	Shanghai	Species ratio method	2013	Wang et al. (2013)
10	Heshan (PRD)	Species ratio method	2016	Wang et al. (2016)
11	Beijing	Species ratio method	2016	Sun et al. (2016)
12	Beijing	Species ratio method	2018	Gao et al. (2018)
13	Heshan (PRD)	Species ratio method	2019	He et al. (2019)
14	Shenzhen	Species ratio method	2019	Huang et al. (2019)
15	Beijing	Species ratio method	2021	Zhan et al. (2021)
16	Guangzhou	Species ratio method	2021	Fang et al. (2021)
17	Tianjin	Species ratio method	2022	Yang et al. (2022)
18	Beijing	Species ratio and sequential reaction model	2023	Wu et al. (2023a)
19	Handan	Species ratio method	2022	Wei et al. (2022)
20	Pune	Species ratio method	2022	Kalbande et al. (2022)
21	Tianjin	Species ratio method	2023	Liu et al. (2023a)
22	Tianjin and Guangzhou	Local parameter method	2023	Wang et al. (2023b)
23	Wuhan	Species ratio method	2021	Zheng et al. (2021)
24	Tianjin	Local parameter method	2022	Wang et al. (2022)

25	Jiaozhou	Species ratio method	2023	Wu et al. (2023b)
26	-	Isotopic hydrocarbon clock method	2000	Rudolph and Czuba (2000)
27	East Asia	Isotopic hydrocarbon clock method	2009	Saito et al. (2009)
28	Toronto	Isotopic hydrocarbon clock method	2016	Kornilova et al. (2016)
29	Guangzhou	Species ratio method	2023	Zou et al. (2023)
30	Guangzhou	Species ratio method	2024	He et al. (2024)
31	Langfang	Species ratio and sequential reaction model	2024	Zhang et al. (2024a)
32	Zhengzhou	Species ratio method	2024	Wang et al. (2024a)
33	Shijiazhuang	Species ratio and sequential reaction model	2024	Cui et al. (2024a)
34	PRD region (petroleum refinery)	Species ratio method	2024	Zhang et al. (2024b)
35	Beijing	Species ratio method	2022	Ma et al. (2022)
36	Wuhan	Species ratio method	2023	Xu et al. (2023)
37	Shanghai	Species ratio method	2024	Ren et al. (2024)
38	Zibo	Species ratio method	2024	Wang et al. (2024b)
39	Da Wan Shan Island (PRE)	Species ratio method	2024	Sun et al. (2024)
40	Taipei	Species ratio method	2023	Chen et al. (2023)
41	Taiyuan	Species ratio method	2024	Cui et al. (2024b)
42	Changdao Island	Species ratio method	2013	Yuan et al. (2013)
43	Taiyuan	Species ratio method	2023	Hua et al. (2023)
44	Jinan	Species ratio method	2023	Liu et al. (2023c)
45	Pasadena	Species ratio method	2017	de Gouw et al. (2017)
46	Pasadena	Species ratio method	2018	de Gouw et al. (2018)
47	Bronx, New York City	Species ratio method	2024	Borlaza-Lacoste et al. (2024)

"Local parameter method" was defined that Δt was estimated based on the distributions of emission sources and wind directions around the receptor measure site. PRD represents Pearl River Delta, PRE represents Pearl River Estuary.

Table S6. Primary initial ratios of reference species used in different publications.

Literature	T/B[a]	X/B[b]	E/X[c]	X/E[d]	E/O[e]	O/E[f]	iB/P[g]	B/124T[h]	Methods	Time (LT)
de Gouw et al. (2005)	3.7	-	-	-	-	-	-	-	Based on observed data	-
Warneke et al. (2007)	4.25	-	-	-	-	-	-	-	Based on observed data	-
Yuan et al. (2012)	-	2.2	-	-	-	-	-	-	Based on observed data	00:00-05:00
Wang et al. (2013)	-	-	0.5	-	-	-	-	-	Based on emission inventory	-
Wang et al. (2016)	-	-	-	2.0	-	-	-	-	Based on source profiles	-
Sun et al. (2016)	-	-	-	1.8	-	-	-	-	Based on observed data	00:00-05:00
Gao et al. (2018)	-	-	0.39	-	1.32	-	-	-	Based on observed data	-
He et al. (2019)	-	-	0.62	-	-	-	-	-	Based on observed data	00:00-05:00
Han et al. (2020)	-	-	-	1.04	-	-	-	-	Based on observed data	00:00-06:00
Fang et al. (2021)	-	-	0.5	-	-	-	-	-	Based on observed data	00:00-04:00
Yang et al. (2022)	3.14	-	-	-	-	-	-	-	Based on observed data	20:00-05:00
Wu et al. (2023a)	-	-	-	2.47	-	-	-	-	Based on observed data	
Liu et al. (2023a)	-	-	0.22	-	-	-	-	-	Based on observed data	00:00-05:00
Kong et al. (2023a)	-	-	0.23	-	-	-	-	-	Based on observed data	21:00-02:00
Li et al. (2021)	-	-	0.75	-	-	-	-	-	Based on observed data	03:00-07:00
Zou et al. (2021)	-	-	0.50	-	1.30	-	-	-	Based on observed data	19:00-06:00
Shao et al. (2011)	-	-	-	-	-	-	-	-	Based on observed NOx/NOy >80% data	-
Zou et al. (2023)	-	-	-	2.0	-	-	-	-	Based on summer observed data	20:00-06:00
Zou et al. (2023)	-	-	-	1.8	-	-	-	-	Based on autumn observed data	20:00-06:00
He et al. (2024)	-	-	-	1.8	-	-	-	-	Based on spring observed data	19:00-06:00
Zhang et al. (2024a)	-	-	-	2.83	-	-	-	-	Based on observed data	01:00-06:00
Wang et al. (2024a)	-	-	-	-	-	-	-	1.7	Based on emission inventory	-
Cui et al. (2024a)	4.48	-	-	-	-	-	-	-	Based on summer observed data	23:00-03:00
Sun et al. (2024)	-	-	0.62	-	-		-	-	Based on observed data	05:00

Chen et al. (2023)	-	-	-	3.47	-		-	-	Based on observed data	0:00-05:00
Cui et al. (2024b)	-	-	-	-	-	1.19	-	-	Based on observed data	-
Cui et al. (2024b)	-	-	-	-	-	1.22	-	-	Based on observed data	-
Cui et al. (2024b)	-	-	-	-	-	1.26	-	-	Based on observed data	-
Cui et al. (2024b)	-	-	-	-	-	1.24	-	-	Based on observed data	-
Yuan et al. (2013)	-	-	-	2.2	-	-	-	-	Based on observed data	0:00-06:00
Hua et al. (2023)	-	-	-	-	-	3.14	-	-	Based on observed data	19:00-08:00
Liu et al. (2023c)	-	-	-	4.42	-	-	-	-	Based on observed data	-
de Gouw et al. (2017)	-	-	-	-	-	-	-	1.75	Based on observed data	-
Borlaza-Lacoste et al. (2024)	-	-	0.23	-	-	-	-	-	Based on observed data	0:00-05:00

[a]denotes Toluene/Benzene; [b]denotes m,p-Xylene/Benzene; [c]denotes Ethylbenzene/m,p-Xylene; [d]denotes m,p-Xylene/Ethylbenzene; [e]denotes Ethylbenzene/o-Xylene; [f]denotes o-Xylene/Ethylbenzene; [g]denotes i-Butene/Propene; [h]denotes Benzene/1,2,4-Trimethylbenzene; LT denotes local time.

Table S7. Summary of relevant parameters for source analyses of OVOCs using the photochemical-age parameter method in publications.

City	Tracer species	Methods to determine parameters	Literature
Shenzhen	Benzene	linear least-squares fits	Zhu et al. (2021)
NEAQS data	Acetylene	linear least-squares fit	de Gouw et al. (2005)
Beijing and Shenzhen	Benzene	least-squares fit	Huang et al. (2020)
Beijing	Acetylene	least-squares fit	Yuan et al. (2012)
Heshan	CO	least-squares fit	Wang et al. (2016)
Wangdu	Benzene	linear least-squares fits	Han et al. (2019)
Guangzhou	Acetylene	linear least-squares fits	Wu et al. (2020)

Table S8. Summary of parameter values obtained utilizing a least-squares linear fit in the photochemical-age parameter method.

	ER_{ovoc}	$ER_{precursor}$	k_{ovoc}	$k_{precursor}$	$ER_{biogenic}$	[background]
	ppbv [ppbv Tracer]$^{-1}$		10^{-12} cm^{3}molecule^{-1}s^{-1}		ppbv [ppbv isoprene]$^{-1}$	ppbv or pptv
Beijing (Huang et al., 2020)						
Methanol	16.95	3.04	0.94	3.12	1.92	3.95
Formaldehyde	3.14	9.39	9.7	8.15	1.34	1.25
Acetaldehyde	1.85	6.89	15	4.45	0.69	0.48
Acetone	1.09	4.26	0.17	4.76	0.63	1.36
MEK	0.72	3.89	1.22	1.26	0.14	0.08
Shenzhen (Huang et al., 2020)						
Methanol	16.43	8.42	0.94	7.96	1.24	1.01
Formaldehyde	1.14	15.69	9.7	8.63	0.80	0.24
Acetaldehyde	0.71	14.12	15	14.74	0.53	0.10
Acetone	1.51	13.31	0.17	14.51	0.64	0.81
MEK	1.16	8.97	1.22	9.51	0.14	0.06
NEAQS data (de Gouw et al., 2005)						
Acetaldehyde	0.83 ± 0.07	6.9 ± 0.9	15	2.3 ± 0.4	0.063 ± 0.004	150 ± 10
Propanal	0.24 ± 0.02	3 ± 1	20	1.3 ± 0.4	0.010 ± 0.001	22 ± 5
Acetone	1.2 ± 0.2	1.6 ± 0.5	0.17	4 ± 3	0.23 ± 0.01	960 ± 40
MEK	0.26 ± 0.02	1 ± 2	1.22	7 ± 2	0.031 ± 0.001	31 ± 5
Methanol	2.3 ± 0.2	0	0.94	0	0.44 ± 0.02	1280 ± 70
Ethanol	0.96 ± 0.04	0	3.2	0	0.022 ± 0.005	90 ± 10
Formic acid	0	2.1 ± 0.5	0.4	6 ± 3	0.26 ± 0.03	150 ± 90
Acetic acid	0.0 ± 0.4	1.8 ± 0.4	0.8	7 ± 4	0.19 ± 0.02	90 ± 70
Beijing (Yuan et al., 2012)						

Formaldehyde	0.72 ± 0.11	6.40	9.4	2.87	0.98 ± 0.07	0.94 ± 0.21
Acetaldehyde	0.72 ± 0.05	3.45	15	2.41	0.17 ± 0.03	0.29 ± 0.10
Propanal	0.02 ± 0.02	2.04	20	2.45	0.14 ± 0.01	0.31 ± 0.03
n-Butanal	0.002 ± 0.005	1.66	24	0.58	0.04 ± 0.00	0.10 ± 0.01
Acetone	0.57 ± 0.05	1.47	0.17	1.05	0.18 ± 0.03	1.98 ± 0.09
MEK	0.31 ± 0.01	0	1.22	0	0.07 ± 0.01	0.06 ± 0.04
Methanol	3.43 ± 0.11	0	0.94	0	0.02 ± 0.11	5.76 ± 0.37

Units of ER_{OVOC} and $ER_{precursor}$ are ppbv [ppbv Benzene]$^{-1}$ of Huang et al. (2020); units of ER_{OVOC} and $ER_{precursor}$ are ppbv [ppbv C_2H_2]$^{-1}$ of de Gouw et al. (2005) and Yuan et al. (2012); unit of [background] is ppbv for Huang et al. (2020) and Yuan et al. (2012); unit of [background] is pptv for de Gouw et al. (2005).

Table S9. Summary of publications on estimation methods of consumed VOCs (i.e., CVOCs) and models used for their source analyses.

Literature	Publication year	Calculation methods	Apportionment methods
Ma et al. (2022)	2022	Difference method	-
Gao et al. (2018)	2018	Difference method	-
Gu et al. (2023)	2023	Difference method	PMF
Zhan et al. (2021)	2021	Difference method	-
Chen et al. (2023)	2023	Difference method	-
Wang et al. (2013)	2013	Difference method	-
Liu et al. (2023a)	2023	Difference method	PMF
Wang et al. (2023b)	2023	Difference method	PMF/ME2-SR
Xie et al. (2008)	2008	Isoprene loss reference method	-
Wang et al. (2022)	2022	Difference method	PMF/ME2-SR
Wiedinmyer et al. (2001)	2001	Isoprene loss reference method	-
Kong et al. (2023b)	2023	Difference method	PMF
He et al. (2024)	2024	Difference method	PMF

Zhang et al. (2024a)	2024	Difference method	PMF
Wang et al. (2024a)	2024	Difference method	PMF/ME2-SR
Cui et al. (2024a)	2024	Difference method	PMF

PMF/ME2-SR denotes Positive Matrix Factorization/Multilinear Engine 2-Species Ratio.

Table S10. Summary of information related to VOC measured and initial concentrations, and chemical losses in the reviewed publications.

City (literature)	Study period	Season/year	Initial concentration calculated time (LT)	Numbers of species	TVOC conc. (ppbv)			CL rate [d] (%)
					OC [a]	IC [b]	CL [c]	
Beijing (Gao et al., 2018)	2013/03-2013/04	Spring	08:30-09:00 and 13:30-14:00	90	64.9	72.6	7.72	10.6
Qingdao (Gu et al., 2023)	2022/06-2022/08	Summer	06:00-19:00	89	20.2	65.3	45.1	69.1
Beijing (Zhan et al., 2021)	2019/08	Summer	-	51	11.2	14.6	3.40	23.3
Taipei (Chen et al., 2023)	2020/03-2020/05	Spring	07:00-17:00	54	27.6	31.8	4.21	13.2
Taipei (Chen et al., 2023)	2020/06-2020/08	Summer	07:00-17:00	54	22.0	30.3	8.29	27.3
Taipei (Chen et al., 2023)	2020/09-2020/11	Autumn	07:00-17:00	54	20.6	22.1	1.48	6.71
Taipei (Chen et al., 2023)	2020/12-2021/02	Winter	07:00-17:00	54	24.8	25.6	0.76	2.97
Tianjin (Liu et al., 2023a)	2020/04-2020/08	Spring-Summer	06:00-23:00	54	19.4	-	17.8	56.5
Beijing (Ma et al., 2022)	2019/01-2019/12	Year	00:00-23:00	56	18.6	24.5	6.90	28.2
Tianjin (Wang et al., 2023b)	2018	Year	-	-	21.4	24.3	2.90	11.9
Guangzhou (Wang et al., 2023b)	2020	Year	-	-	29.6	34.8	5.20	14.9
Shanghai (Wang et al., 2013)	2009	Year	08:00-18:00	-	26.4	35.4	9.00	25.4
Shanghai (Wang et al., 2013)	2010	Year	08:00-18:00	-	24.5	34.1	9.60	28.2
Chengdu (Kong et al., 2023b)	2019	Spring	00:00-23:00	56	19.4	26.0	6.60	25.4
Chengdu (Kong et al., 2023b)	2019	Summer	00:00-23:00	56	19.3	25.1	5.90	23.5
Chengdu (Kong et al., 2023b)	2019	Autumn	00:00-23:00	56	23.5	26.6	3.10	11.7

Chengdu (Kong et al., 2023b)	2019	Winter	00:00-23:00	56	33.6	35.9	2.30	6.41
Guangzhou (He et al., 2024)	2022	Spring	07:00-18:00	56	22.78	26.88	4.10	15.3
Langfang (Zhang et al., 2024a)	2018/08-2018/10	-	06:00-19:00	99	227.4[e]	244.8[e]	17.4[e]	7.11
Zhengzhou (Wang et al., 2024a)	2019/05-2019/07	Spring-Summer	-	106	23.74	33.89	10.15	29.9
Shijiazhuang (Cui et al., 2024a)	2022/06-2022/08	Summer	05:00-19:00	110	23.2	56.4	33.2	58.9
Wuhan (Xu et al., 2023)	2020/01-2020/04	-	08:00-18:00	91	23.9	47.6	23.7	49.8
Shanghai (Ren et al., 2024)	2020/04-2020/10	O_3 polluted days	08:00-18:00	106	47.1	61.1	14.1	23.1
Zibo (Wang et al., 2024b)	2022/05-2022/09	-	05:00-18:00	114	36.1	42.9	6.8	15.9
Jinan (Liu et al., 2023c)	2022/08	Summer	06:00-20:00	56	12.0	16.0	4.0	25.0
Borlaza-Lacoste et al. (2024)	2000-2021	-	06:00-23:00	54	9.74	19.58	9.84	50.2

[a] denotes observation concentrations; [b] denotes initial concentrations; [c] denotes chemical loss; [d] denotes the chemical loss rate (i.e., chemical loss×100/initial concentration); [e] denotes that unit is μg m^{-3}.

Table S11. Summary of concentrations and percentages of the consumed VOC species in the reviewed publications.

City (literature)	Studying period	Season	Alkanes		Alkenes		Aromatic hydrocarbons		Alkyne		OVOCs		Halo-hydrocarbons	
			Conc. [a] (ppbv)	Per. [b] (%)	Conc. (ppbv)	Per. (%)	Conc. (ppbv)	Per. (%)	Conc. (ppbv)	Per. (%)	Conc. (ppbv)	Per. (%)	Conc. (ppbv)	Per. (%)
Beijing (Gao et al., 2018)	2013/03-2013/04	Spring	0.83	10.7	5.26	68.0	1.51	19.5	0.13	1.68	-	-	-	-
Qingdao (Gu et al., 2023)	2022/06-2022/08	Summer	1.05	2.33	42.1	93.3	1.72	3.81	0.02	0.04	0.21	0.5	0.04	0.1
Beijing (Zhan et al., 2021)	2019/08	Summer	0.21	6.18	2.74	80.6	0.45	13.2	0.00	0.00	-	-	-	-
Taipei (Chen et al., 2023)	2020/03-2020/05	Spring	0.53	12.8	2.52	61.2	1.03	25.1	0.04	0.85	-	-	-	-
Taipei (Chen et al., 2023)	2020/06-2020/08	Summer	0.55	6.61	6.51	78.6	1.20	14.5	0.03	0.30	-	-	-	-
Taipei (Chen et al., 2023)	2020/09-2020/11	Autumn	0.19	12.5	0.91	61.0	0.39	25.8	0.01	0.67	-	-	-	-
Taipei (Chen et al., 2023)	2020/12-2021/02	Winter	0.12	15.7	0.42	55.4	0.21	27.5	0.01	1.33	-	-	-	-
Tianjin (Liu et al., 2023a)	2020/04-2020/08	Spring/Summer	1.43	8.04	15.6	87.8	0.75	4.21	0.03	0.17	-	-	-	-
Chengdu (Kong et al., 2023b)	2019/01-2019/12	Spring	0.60	9.23	5.00	76.9	0.90	13.8	0.00	0.00	-	-	-	-
Chengdu (Kong et al., 2023b)	2019/01-2019/12	Summer	0.70	11.9	3.40	57.6	1.80	30.5	0.00	0.00	-	-	-	-
Chengdu (Kong et al., 2023b)	2019/01-2019/12	Autumn	0.50	16.1	1.40	45.2	1.20	38.7	0.00	0.00	-	-	-	-
Chengdu (Kong et al., 2023b)	2019/01-2019/12	Winter	0.50	22.7	1.30	59.1	0.40	18.2	0.00	0.00	-	-	-	-
Zhengzhou (Wang et al., 2024a)	2019/05-2019/07	Spring/Summer	1.10	11.1	6.61	65.4	2.20	21.5	-	-	0.20	2.0	-	-
Shijiazhuang (Cui et al., 2024a)	2022/06-2022/08	Summer	4.50	13.6	12.2	36.7	6.82	20.5	0.20	0.60	9.08	27.4	0.39	1.17
Jinan (Liu et al., 2023c)	2022/08	Summer	0.44	11.1	3.23	80.5	0.28	6.90	0.06	1.40	-	-	-	-
NYC (Borlaza-Lacoste et al., 2024)	2000-2021	-	0.57	5.80	7.94	80.9	1.30	13.2	0.01	0.10	-	-	-	-

[a] denotes consumed concentrations; [b] denotes percentages of consumed concentrations of different species in total consumed concentrations. NYC represents New York City.

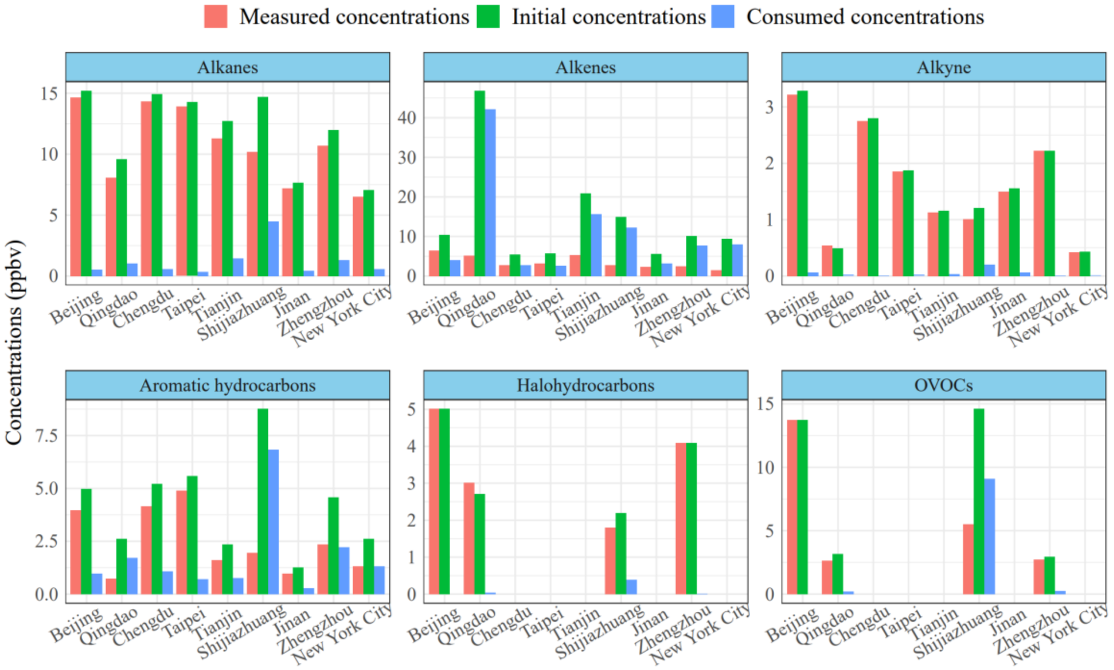

Figure S1. The measured and initial concentrations of VOC groups, and their consumed concentrations in Beijing (Gao et al., 2018; Zhan et al., 2021), Qingdao (Gu et al., 2023), Tianjin (Liu et al., 2023a), Chengdu (Kong et al., 2023b), Taipei (Chen et al., 2023), Shijiazhuang (Cui et al., 2024a), Jinan (Liu et al., 2023c), Zhengzhou (Wang et al., 2024a), and New York City (Borlaza-Lacoste et al., 2024) in the reviewed publications. The data of Beijing was the average value from the two publications.

References

Atkinson, R. and Arey, J.: Atmospheric degradation of volatile organic compounds, Chem. Rev., 103, 4605-4638, https://doi.org/10.1002/chin.200410285, 2003.

Borlaza-Lacoste, L., Bari, M. A., Lu, C. H., and Hopke, P. K.: Long-term contributions of VOC sources and their link to ozone pollution in Bronx, New York City, Environ. Int., 191, 108993, https://doi.org/10.1016/j.envint.2024.108993, 2024.

Brown, S. G., Frankel, A., and Hafner, H. R.: Source apportionment of VOCs in the Los Angeles area using positive matrix factorization, Atmos. Environ., 41, 227-237, https://doi.org/10.1016/j.atmosenv.2006.08.021, 2007.

Buzcu, B. and Fraser, M. P.: Source identification and apportionment of volatile organic compounds in Houston, TX, Atmos. Environ., 40, 2385-2400, https://doi.org/10.1016/j.atmosenv.2005.12.020, 2006.

Buzcu-Guven, B. and Fraser, M. P.: Comparison of VOC emissions inventory data with source apportionment results for Houston, TX, Atmos. Environ., 42, 5032-5043, https://doi.org/10.1016/j.atmosenv.2008.02.025, 2008.

Cao, X. C., Xing, Q., Hu, S. H., Xu, W. S., Xie, R. F., Xian, A. D., Xie, W. J., Yang, Z. H., and Wu, X. C.: Characterization, reactivity, source apportionment, and potential source areas of ambient volatile organic compounds in a typical tropical city, J. Environ. Sci., 123, 417-429, https://doi.org/10.1016/j.jes.2022.08.005, 2023.

Carter, W. P. L.: Development of the SAPRC-07 chemical mechanism, Atmos. Environ., 44, 5324-5335, https://doi.org/10.1016/j.atmosenv.2010.01.026, 2010.

Chen, C., Chuang, Y., Hsieh, C., and Lee, C.: VOC characteristics and source apportionment at a PAMS site near an industrial complex in central Taiwan, Atmos. Pollut. Res., 10, 1060-1074, https://doi.org/10.1016/j.apr.2019.01.014, 2019.

Chen, Z.-W., Ting, Y.-C., Huang, C.-H., and Ciou, Z.-J.: Sources-oriented contributions to ozone and secondary organic aerosol formation potential based on initial VOCs in an urban area of Eastern Asia, Sci. Total Environ., 892, 164392, https://doi.org/10.1016/j.scitotenv.2023.164392, 2023.

Cui, Y. Q., Liu, B. S., Yang, Y. F., Kang, S. C., Wang, F. Q., Xu, M., Wang, W., Feng, Y. C., and Hopke, P. K.: Primary and oxidative source analyses of consumed VOCs in the atmosphere, J. Hazard. Mater., 476, 134894, https://doi.org/10.1016/j.jhazmat.2024.134894, 2024a.

Cui, Y., Hua, J. Y., He, Q. S., Guo, L. L., Wang, Y. H., and Wang, X. M.: Comparison of three source apportionment methods based on observed and initial HCHO in Taiyuan, China, Sci. Total Environ., 926, 171828, https://doi.org/10.1016/j.scitotenv.2024.171828, 2024b.

de Gouw, J. A., Gilman, J. B., Kim, S. W., Alvarez, S. L., Dusanter, S., Graus, M., Griffith, S. M., Isaacman-VanWertz, G., Kuster, W. C., Lefer, B. L., Lerner, B. M., McDonald, B. C., Rappenglück, B., Roberts, J. M., Stevens, P. S., Stutz, J., Thalman, R., Veres, P. R., Volkamer, R., Warneke, C., Washenfelder, R. A., and Young, C. J.: Chemistry of volatile organic compounds in the Los Angeles Basin: Formation of oxygenated compounds and determination of emission ratios, J. Geophys. Res. Atmos., 123, 2298-2319, https://doi.org/10.1002/2017JD027976, 2018.

de Gouw, J. A., Gilman, J. B., Kim, S.-W., Lerner, B. M., Isaacman-VanWertz, G., McDonald, B. C., Warneke, C., Kuster, W. C., Lefer, B. L., Griffith, S. M., Dusanter, S., Stevens, P. S., and Stutz, J.: Chemistry of volatile organic compounds in the Los Angeles Basin: Nighttime removal of alkenes and determination of emission ratios, J. Geophys. Res., 122, 11843-11861, https://doi.org/10.1002/2017JD027459, 2017.

de Gouw, J. A., Middlebrook, A. M., Warneke, C., Goldan, P. D., Kuster, W. C., Roberts, J. M., Fehsenfeld, F. C., Worsnop, D. R., Canagaratna, M. R., Pszenny, A. A. P., Keene, W. C., Marchewka, M., Bertman, S. B., and Bates, T. S.: Budget of organic carbon in a polluted atmosphere: Results from the New England Air Quality Study in 2002, J. Geophys. Res., 110, D16305, https://doi.org/10.1029/2004JD005623, 2005.

Fang, H., Luo, S. L., Huang, X. Q., Fu, X. W., Xiao, S. X., Zeng, J. Q., Wang, J., Zhang, Y. L., and Wang, X. M.: Ambient naphthalene and methylnaphthalenes observed at an urban site in the Pearl River Delta region: Sources and contributions to secondary organic aerosol, Atmos. Environ., 252, 118295, https://doi.org/10.1016/j.atmosenv.2021.118295, 2021.

Friedlander, S. K.: New Developments in Receptor Modeling Theory. In Atmospheric Aerosol: Source/Air Quality Relationships, Macias, E. S., Hopke, P. K., Eds., ACS Symposium Series No. 167, American Chemical Society: Washington, 1-19, 1981.

Gao, J., Zhang, J., Li, H., Li, L., Xu, L. H., Zhang, Y. J., Wang, Z. S., Wang, X. Z., Zhang, W. Q., Chen, Y. Z., Cheng, X., Zhang, H., Peng, L., Chai, F. H., and Wei, Y. J.: Comparative study of volatile organic compounds in ambient air using observed mixing ratios and initial mixing ratios taking chemical loss into account - A case study in a typical urban area in Beijing, Sci. Total Environ., 628-629, 791-804, https://doi.org/10.1016/j.scitotenv.2018.01.175, 2018.

Gao, Q. Z., Yan, Y. L., Li, R. M., Xu, Y., Niu, Y. Y., Liu, C. L., Xie, K., Chang, Z. W., Hu, D. M., Li, Z. Y., and Peng, L.: Characteristics of volatile organic compounds during different pollution periods in winter in Yuncheng, a typical city in north China, Aerosol Air Qual. Res., 20, 97-107, https://doi.org/10.4209/aaqr.2019.08.0402, 2020.

Gu, Y., Liu, B. S., Dai, Q. L., Zhang, Y. F., Zhou, M., Feng, Y. C., and Hopke, P. K.: Multiply improved positive matrix factorization for source apportionment of volatile organic compounds during the COVID-19 shutdown in Tianjin, China, Environ. Int., 158, 106979, https://doi.org/10.1016/j.envint.2021.106979, 2022.

Gu, Y., Liu, B. S., Meng, H., Song, S. J., Dai, Q. L., Shi, L. Y., Feng, Y. C., and Hopke, P. K.: Source apportionment of consumed volatile organic compounds in the atmosphere, J. Haz. Mat., 459, 132138, https://doi.org/10.1016/j.jhazmat.2023.132138, 2023.

Guan, Y. N., Wang, L., Wang, S. J., Zhang, Y. H., Xiao, J. Y., Wang, X. L., Duan, E. H., and Hou, L. A.: Temporal variations and source apportionment of volatile organic compounds at an urban site in Shijiazhuang, China, J. Environ. Sci., 97, 25-34, https://doi.org/10.1016/j.jes.2020.04.022, 2020.

Guo, H., Cheng, H. R., Ling, Z. H., Louie, P. K. K., and Ayoko, G. A.: Which emission sources are responsible for the volatile organic compounds in the atmosphere of Pearl River Delta?, J. Haz. Mat., 188, 116-124, https://doi.org/10.1016/j.jhazmat.2011.01.081, 2011.

Han, T., Li, Y., Qiu, Y., He, D., Wang, G., and Ma, Z.: Characteristics of VOCs and their roles in ozone formation at a regional background site in Beijing, China, Environ. Sci. (in Chinese), 41, 2586-2595, https://doi.org/10.13227/j.hjkx.201912032, 2020.

Han, Y., Huang, X. F., Wang, C., Zhu, B., and He, L. Y.: Characterizing oxygenated volatile organic compounds and their sources in rural atmospheres in China, J. Environ. Sci., 81, 148-155, https://doi.org/10.1016/j.jes.2019.01.017, 2019.

He, Z. R., Wang, X. M., Ling, Z. H., Zhao, J., Guo, H., Shao, M., and Wang, Z.: Contributions of different anthropogenic volatile organic compound sources to ozone formation at a receptor site in the Pearl River Delta region and its policy implications, Atmos. Chem. Phys., 19, 8801-8816, https://doi.org/10.5194/acp-19-8801-2019, 2019.

He, C. Q., Zou, Y., Lv, S. J., Flores, R. M., Yan, X. L., Deng, T., and Deng, X. J.: The importance of photochemical loss to source analysis and ozone formation potential: Implications from in-situ observations of volatile organic compounds (VOCs) in Guangzhou, China, Atmos. Environ., 320, 120320, https://doi.org/10.1016/j.atmosenv.2023.120320, 2024.

Hua, J. Y., Cui, Y., Guo, L. L., Li, H. Y., Fan, J., Li, Y. N., Wang, Y. H., Liu, K. K., He, Q. S., and Wang, X. M.: Spatial characterization of HCHO and reapportionment of its secondary sources considering photochemical loss in Taiyuan, China, Sci. Total Environ., 865, 161069, https://doi.org/10.1016/j.scitotenv.2022.161069, 2023.

Huang, X.-F., Wang, C., Zhu, B., Lin, L.-L., and He, L.-Y.: Exploration of sources of OVOCs in various atmospheres in southern China, Environ. Pollut., 249, 831-842, https://doi.org/10.1016/j.envpol.2019.03.106, 2019.

Huang, X.-F., Zhang, B., Xia, S.-Y., Han, Y., Wang, C., Yu, G.-H., and Feng, N.: Sources of oxygenated volatile organic compounds (OVOCs) in urban atmospheres in North and South China, Environ. Pollut., 261, 114152, https://doi.org/10.1016/j.envpol.2020.114152, 2020.

Huang, Y. S. and Hsieh, C. C.: VOC characteristics and sources at nine photochemical assessment monitoring stations in western Taiwan, Atmos. Environ., 240, 117741, https://doi.org/10.1016/j.atmosenv.2020.117741, 2020.

Hui, L., Liu, X., Tan, Q., Feng, M., An, J., Qu, Y., Zhang, Y., Deng, Y., Zhai, R., and Wang, Z.: VOC characteristics, chemical reactivity and sources in urban Wuhan, central China, Atmos. Environ., 224, 117340, https://doi.org/10.1016/j.atmosenv.2020.117340, 2020.

Hui, L., Ma, T., Gao, Z., Gao, J., Wang, Z., Xue, L., Liu, H., and Liu, J.: Characteristics and sources of volatile organic compounds during high ozone episodes: A case study at a site in the eastern Guanzhong Plain, China, Chemosphere, 265, 129072, https://doi.org/10.1016/j.chemosphere.2020.129072, 2021.

Hui, L. R., Liu, X. G., Tan, Q. W., Feng, M., An, J. L., Qu, Y., Zhang, Y. H., and Cheng, N. L.: VOC characteristics, sources and contributions to SOA formation during haze events in Wuhan, Central China, Sci. Total Environ., 650, 2624-2639, https://doi.org/10.1016/j.scitotenv.2018.10.029, 2019.

Jain, V., Tripathi, S. N., Tripathi, N., Sahu, L. K., Gaddamidi, S., Shukla, A. K., Bhattu, D., and Ganguly, D.: Seasonal variability and source apportionment of non-methane VOCs using PTR-TOF-MS measurements in Delhi, India, Atmos. Environ., 283, 119163, https://doi.org/10.1016/j.atmosenv.2022.119163, 2022.

Kalbande, R., Yadav, R., Maji, S., Rathore, D. S., and Beig, G.: Characteristics of VOCs and their contribution to O_3 and SOA formation across seasons over a metropolitan region in India, Atmos. Pollut. Res., 13, 101515, https://doi.org/10.1016/j.apr.2022.101515, 2022.

Kong, C. L., Wu, Y. T., Gu, Y., Song, J. B., Meng, H., Shi, L. Y., and Liu, B. S.: Source apportionment of ambient VOCs in Qingdao based on photochemical losses correction, Environ. Sci. (in Chinese), 44, 6551-6563, https://doi.org/10.13227/j.hjkx.202212008, 2023a.

Kong, L., Zhou, L., Chen, D. Y., Luo, L., Xiao, K., Chen, Y., Liu, H. F., Tan, Q. W., and Yang, F. M.: Atmospheric oxidation capacity and secondary pollutant formation potentials based on photochemical loss of VOCs in a megacity of the Sichuan Basin, China, Sci. Total Environ., 901, 166259, https://doi.org/10.1016/j.scitotenv.2023.166259, 2023b.

Kornilova, A., Huang, L., Saccon, M., and Rudolph, J.: Stable carbon isotope ratios of ambient aromatic volatile organic compounds, Atmos. Chem. Phys., 16, 11755-11772, https://doi.org/10.5194/acp-16-11755-2016, 2016.

Li, B. W., Ho, S. S. H., Gong, S. L., Ni, J. W., Li, H. R., Han, L. Y., Yang, Y., Qi, Y. J., and Zhao, D. X.: Characterization of VOCs and their related atmospheric processes in a central Chinese city during severe ozone pollution periods, Atmos. Chem. Phys., 19, 617-638, https://doi.org/10.5194/acp-19-617-2019, 2019.

Li, B. W., Yu, S. C., Shao, M., Li, X. H., Ho, S. S. H., Hu, X. Y., Wang, H. L., Feng, R., and Fang, X. K.: New insights into photochemical initial concentrations of VOCs and their source implications, Atmos. Environ., 298, 119616, https://doi.org/10.1016/j.atmosenv.2023.119616, 2023.

Li, R., Yan, Y., Wang, C., Xu, Y., Li, Y., and Peng, L.: Source apportionment of VOCs and its contribution to O_3 production during summertime in urban area of Taiyuan, China Environ. Sci. (in Chinese), 41, 2515-2525, https://doi.org/10.19674/j.cnki.issn1000-6923.2021.0263, 2021.

Li, Z. Y., Ho, K. F., and Yim, S. H. L.: Source apportionment of hourly-resolved ambient volatile organic compounds: Influence of temporal resolution, Sci. Total Environ., 725, 138243, https://doi.org/10.1016/j.scitotenv.2020.138243, 2020.

Lin, C. and Milford, D. B.: Decay-adjusted chemical mass balance receptor modeling for volatile organic compounds, Atmos. Environ., 28, 3261-3276, https://doi.org/10.1016/1352-2310(94)00163-F, 1994.

Ling, Z. H., Guo, H., Cheng, H. R., and Yu, Y. F.: Sources of ambient volatile organic compounds and their contributions to photochemical ozone formation at a site in the Pearl River Delta, southern China, Environ. Pollut., 159, 2310-2319, https://doi.org/10.1016/j.envpol.2011.05.001, 2011.

Ling, Z. H. and Guo, H.: Contribution of VOC sources to photochemical ozone formation and its control policy implication in Hong Kong, Environ. Sci. Policy, 38, 180-191, https://doi.org/10.1016/j.envsci.2013.12.004, 2014.

Liu, B. S., Liang, D. N., Yang, J. M., Dai, Q. L., Bi, X. H., Feng, Y. C., Yuan, J., Xiao, Z. M., Zhang, Y. F., and Xu, H.: Characterization and source apportionment of volatile organic compounds based on 1-year of observational data in Tianjin, China, Environ. Pollut., 218, 757-769, https://doi.org/10.1016/j.envpol.2016.07.072, 2016.

Liu, B. S., Yang, Y., Yang, T., Dai, Q. L., Zhang, Y. F., Feng, Y. C., and Hopke, P. K.: Effect of photochemical losses of ambient volatile organic compounds on their source apportionment, Environ. Int., 172, 107766, https://doi.org/10.1016/j.envint.2023.107766, 2023a.

Liu, B. S., Yang, T., Kang, S. C., Wang, F. Q., Zhang, H. X., Xu, M., Wang, W., Bai, J. R., Song, S. J., Dai, Q. L., Feng, Y. C., and Hopke, P. K.: Changes in factor profiles deriving from photochemical losses of volatile organic compounds: Insight from daytime and nighttime positive matrix factorization analyses, J. Environ. Sci., 151, 627-639, https://doi.org/10.1016/j.jes.2024.04.032, 2025.

Liu, C. T., Xin, Y. Y., Zhang, C. L., Liu, J. F., Liu, P. F., He, X. W., and Mu, Y. J.: Ambient volatile organic compounds in urban and industrial regions in Beijing: Characteristics, source apportionment, secondary transformation and health risk assessment, Sci. Total Environ., 855, 158873, https://doi.org/10.1016/j.scitotenv.2022.158873, 2023b.

Liu, Z. G., Wang, B. L., Wang, C., Sun, Y. C., Zhu, C. Y., Sun, L., Yang, N., Fan, G. L., Sun, X. Y., Xia, Z. Y., Pan, G., Zhu, C. T., Gai, Y. C., Wang, X. Y., Xiao, Y., Yan, G. H., and Xu, C. Q.: Characterization of photochemical losses of volatile organic compounds and their implications for ozone formation potential and source apportionment during summer in suburban Jinan, China, Environ. Res., 238, 117158, https://doi.org/10.1016/j.envres.2023.117158, 2023c.

Liu, Y. F., Song, M. D., Liu, X. G., Zhang, Y. P., Hui, L. R., Kong, L. W., Zhang, Y. Y., Zhang, C., Qu, Y., An, J. L., Ma, D. P., Tan, Q. W., and Feng, M.: Characterization and sources of volatile organic compounds (VOCs) and their related changes during ozone pollution days in 2016 in Beijing, China, Environ. Pollut., 257, 113599, https://doi.org/10.1016/j.envpol.2019.113599, 2020.

Ma, W., Feng, Z. M., Zhan, J. L., Liu, Y. C., Liu, P. F., Liu, C. T., Ma, Q. X., Yang, K., Wang, Y. F., He, H., Kulmala, M., Mu, Y. J., and Liu, J. F.: Influence of photochemical loss of volatile organic compounds on understanding ozone formation mechanism, Atmos. Chem. Phys., 22, 4841-4851, https://doi.org/10.5194/acp-22-4841-2022, 2022.

Mishra, M., Chen, P. H., Bisquera Jr., W., Lin, G. Y., Le, T. C., Dejchanchaiwong, R., Tekasakul, P., Jhang, C. W., Wu, C. J., and Tsai, C. J.: Source-apportionment and spatial distribution analysis of VOCs and their role in ozone formation using machine learning in central-west Taiwan. Environ. Res., 232, 116329, https://doi.org/10.1016/j.envres.2023.116329, 2023.

Na, K. and Pyo Kim, Y.: Chemical mass balance receptor model applied to ambient C_2–C_9 VOC concentration in Seoul, Korea: Effect of chemical reaction losses, Atmos. Environ., 41, 6715-6728, https://doi.org/10.1016/j.atmosenv.2007.04.054, 2007.

Nelson, P. F. and Quigley, S. M.: The m,p-xylenes:ethylbenzene ratio. A technique for estimating hydrocarbon age in ambient atmospheres, Atmos. Environ., 17, 659-662, https://doi.org/10.1016/0004-6981(83)90141-5, 1983.

Parrish, D. D., Stohl, A., Forster, C., Atlas, E. L., Blake, D. R., Goldan, P. D., Kuster, W. C., and de Gouw, J. A.: Effects of mixing on evolution of hydrocarbon ratios in the troposphere, J. Geophys. Res. Atmos., 112, D10S34, https://doi.org/10.1029/2006jd007583, 2007.

Ren, H. R., Xia, Z. Y., Yao, L. B., Qin, G. M., Zhang, Y., Xu, H., Wang, Z., and Cheng, J. P.: Investigation on ozone formation mechanism and control strategy of VOCs in petrochemical region: Insights from chemical reactivity and photochemical loss, Sci. Total Environ., 914, 169891, https://doi.org/10.1016/j.scitotenv.2024.169891, 2024.

Rudolph, J. and Czuba, E.: On the use of isotopic composition measurements of volatile organic compounds to determine the "photochemical age" of an air mass, Geophys. Res. Lett., 27, 3865-3868, https://doi.org/10.1029/2000gl011385, 2000.

Saito, T., Kawamura, K., Tsunogai, U., Chen, T. Y., Matsueda, H., Nakatsuka, T., Gamo, T., Uematsu, M., and Huebert, B. J.: Photochemical histories of nonmethane hydrocarbons inferred from their stable carbon isotope ratio measurements over east Asia, J. Geophys. Res., 114, D11303, https://doi.org/10.1029/2008jd011388, 2009.

Shao, M., Wang, B., Lu, S. H., Yuan, B., and Wang, M.: Effects of Beijing Olympics control measures on reducing reactive hydrocarbon species, Environ. Sci. Technol., 45, 514-519, https://doi.org/10.1021/es102357t, 2011.

Shao, P., An, J. L., Xin, J. Y., Wu, F. K., Wang, J. X., Ji, D. S., and Wang, Y. S.: Source apportionment of VOCs and the contribution to photochemical ozone formation during summer in the typical industrial area in the Yangtze River Delta, China, Atmos. Res., 176-177, 64-74, https://doi.org/10.1016/j.atmosres.2016.02.015, 2016.

Stroud, C. A., Roberts, J. M., Goldan, P. D., Kuster, W. C., Murphy, P. C., Williams, E. J., Hereid, D., Parrish, D., Sueper, D., Trainer, M., Fehsenfeld, F. C., Apel, E. C., Riemer, D., Wert, B., Henry, B., Fried, A., Martinez-Harder, M., Harder, H., Brune, W. H., Li, G., Xie, H., and Young, V. L.: Isoprene and its oxidation products, methacrolein and methylvinyl ketone, at an urban forested site during the 1999 Southern Oxidants Study, J. Geophys. Res., 106, 8035-8046, https://doi.org/10.1029/2000JD900628, 2001.

Sun, J., Wu, F. K., Hu, B., Tang, G. Q., Zhang, J. K., and Wang, Y. S.: VOC characteristics, emissions and contributions to SOA formation during hazy episodes, Atmos. Environ., 141, 560-570, https://doi.org/10.1016/j.atmosenv.2016.06.060, 2016.

Sun, J. Y., Yu, X. Y., Ling, Z. H., Fang, G. Z., Ming, L. L., Zhao, J., Zou, S. C., Guan, H. T., Wang, H. C., Wang, X. M., Wang, Z., Gao, Y., Tham, Y. J., Guo, H., and Zhang, Y. L.: Roles of photochemical consumption of VOCs on regional background O_3 concentration and atmospheric reactivity over the pearl river estuary, Southern China, Sci. Total Environ., 928, 172321, https://doi.org/10.1016/j.scitotenv.2024.172321, 2024.

Tan, Q. W., Zhou, L., Liu, H. F., Feng, M., Qiu, Y., Yang, F. M., Jiang, W. J., and Wei, F. S.: Observation-based summer O_3 control effect evaluation: A case study in Chengdu, a megacity in Sichuan Basin, China, Atmosphere, 11, 1278, https://doi.org/10.3390/atmos11121278, 2020.

Tan, Y., Han, S. W., Chen, Y., Zhang, Z. Z., Li, H. W., Li, W. Q., Yuan, Q., Li, X. W., Wang, T., and Lee, S. C.: Characteristics and source apportionment of volatile organic compounds (VOCs) at a coastal site in Hong Kong, Sci. Total Environ., 777, 146241, https://doi.org/10.1016/j.scitotenv.2021.146241, 2021.

Wang, B. L., Liu, Y., Shao, M., Lu, S. H., Wang, M., Yuan, B., Gong, Z. H., He, L. Y., Zeng, L. M., Hu, M., and Zhang, Y. H.: The contributions of biomass burning to primary and secondary organics: A case study in Pearl River Delta (PRD), China, Sci. Total Environ., 569, 548-556, https://doi.org/10.1016/j.scitotenv.2016.06.153, 2016.

Wang, H. L., Chen, C. H., Wang, Q., Huang, C., Su, L. Y., Huang, H. Y., Lou, S. R., Zhou, M., Li, L., Qiao, L. P., and Wang, Y. H.: Chemical loss of volatile organic compounds and its impact on the source analysis through a two-year continuous measurement, Atmos. Environ., 80, 488-498, https://doi.org/10.1016/j.atmosenv.2013.08.040, 2013.

Wang, T. T., Tao, J., Li, Z., Lu, X., Liu, Y. L., Zhang, X. R., Wang, B., Zhang, D., and Yin, S. S.: Characteristic, source apportionment and effect of photochemical loss of ambient VOCs in an emerging megacity of Central China, Atmos. Res., 305, 107429, https://doi.org/10.1016/j.atmosres.2024.107429, 2024a.

Wang, W. T., Zheng, Z. S., Liu, Y. H., Xu, B., Yang, W., Wang, X. L., Geng, C. M., and Bai, Z. P.: Quantification for photochemical loss of volatile organic compounds upon ozone formation chemistry at an industrial city (Zibo) in North China Plain, Environ. Res., 256, 119088, https://doi.org/10.1016/j.envres.2024.119088, 2024b.

Wang, Y., Cui, Y., He, Q. S., Fan, J., Li, Y. A., Liu, K. K., Guo, L. L., and Wang, X. M.: Significant impact of VOCs emission from coking and coal/biomass combustion on O_3 and SOA formation in taiyuan, China, Atmos. Pollut. Res., 14, 101671, https://doi.org/10.1016/j.apr.2023.101671, 2023a.

Wang, Z. Y., Shi, Z. B., Wang, F., Liang, W. Q., Shi, G. L., Wang, W. C., Chen, D., Liang, D. N., Feng, Y. C., and Russell, A. G.: Implications for ozone control by understanding the survivor bias in observed ozone-volatile organic compounds system, npj Clim. Atmos. Sci., 5, 39, https://doi.org/10.1038/s41612-022-00261-7, 2022.

Wang, Z. Y., Tian, X., Li, J., Wang, F., Liang, W. Q., Zhao, H., Huang, B., Wang, Z. H., Feng, Y. C., and Shi, G. L.: Quantitative evidence from VOCs source apportionment reveals O_3 control strategies in northern and southern China, Environ. Int., 172, 107786, https://doi.org/10.1016/j.envint.2023.107786, 2023b.

Warneke, C., McKeen, S. A., de Gouw, J. A., Goldan, P. D., Kuster, W. C., Holloway, J. S., Williams, E. J., Lerner, B. M., Parrish, D. D., Trainer, M., Fehsenfeld, F. C., Kato, S., Atlas, E. L., Baker, A., and Blake, D. R.: Determination of urban volatile organic compound emission ratios and comparison with an emissions database, J. Geophys. Res., 112, D10S47, https://doi.org/10.1029/2006JD007930, 2007.

Wei, W., Chen, S. S., Wang, Y., Cheng, L., Wang, X. Q., and Cheng, S. Y.: The impacts of VOCs on $PM_{2.5}$ increasing via their chemical losses estimates: A case study in a typical industrial city of China, Atmos. Environ., 273, 118978, https://doi.org/10.1016/j.atmosenv.2022.118978, 2022.

Wiedinmyer, C., Friedfeld, S., Baugh, W., Greenberg, J., Guenther, A., Fraser, M., and Allen, D.: Measurement and analysis of atmospheric concentrations of isoprene and its reaction products in central Texas, Atmos. Environ., 35, 1001-1013, https://doi.org/10.1016/s1352-2310(00)00406-4, 2001.

Wu, C. H., Wang, C. M., Wang, S. H., Wang, W. J., Yuan, B., Qi, J. P., Wang, B. L., Wang, H. L., Wang, C., Song, W., Wang, X. M., Hu, W. W., Lou, S. R., Ye, C. S., Peng, Y. W., Wang, Z. L., Huangfu, Y. B., Xie, Y., Zhu, M. N., Zheng, J. Y., Wang, X. M., Jiang, B., Zhang, Z. Y., and Shao, M.: Measurement report: Important contributions of oxygenated compounds to emissions and chemistry of volatile organic compounds in urban air, Atmos. Chem. Phys., 20, 14769-14785, https://doi.org/10.5194/acp-20-14769-2020, 2020.

Wu, Y. J., Fan, X. L., Liu, Y., Zhang, J. Q., Wang, H., Sun, L. A., Fang, T. E., Mao, H. J., Hu, J., Wu, L., Peng, J. F., and Wang, S. L.: Source apportionment of VOCs based on photochemical loss in summer at a suburban site in Beijing, Atmos. Environ., 293, 119459, https://doi.org/10.1016/j.atmosenv.2022.119459, 2023a.

Wu, Y. T., Liu, B. S., Meng, H., Dai, Q. L., Shi, L. Y., Song, S. J., Feng, Y. C., and Hopke, P. K.: Changes in source apportioned VOCs during high O_3 periods using initial VOC-concentration-dispersion normalized PMF, Sci. Total Environ., 896, 165182, https://doi.org/10.1016/j.scitotenv.2023.165182, 2023b.

Xie, X., Shao, M., Liu, Y., Lu, S. H., Chang, C.-C., and Chen, Z.-M.: Estimate of initial isoprene contribution to ozone formation potential in Beijing, China, Atmos. Environ., 42, 6000-6010, https://doi.org/10.1016/j.atmosenv.2008.03.035, 2008.

Xiong, C., Wang, N., Zhou, L., Yang, F. M., Qiu, Y., Chen, J. H., Han, L., and Li, J. J.: Component characteristics and source apportionment of volatile organic compounds during summer and winter in downtown Chengdu, southwest China, Atmos. Environ., 258, 118485, https://doi.org/10.1016/j.atmosenv.2021.118485, 2021.

Xu, K., Liu, Y. F., Li, F., Li, C. L., Zhang, C., Zhang, H., Liu, X. G., Li, Q. J., and Xiong, M.: A retrospect of ozone formation mechanisms during the COVID-19 lockdown: The potential role of isoprene, Environ. Pollut., 317, 120728, https://doi.org/10.1016/j.envpol.2022.120728, 2023.

Yang, T., Liu, B. S., Yang, Y., Dai, Q. L., Zhang, Y. F., Feng, Y. C., and Hopke, P. K.: Improved positive matrix factorization for source apportionment of volatile organic compounds in vehicular emissions during the Spring Festival in Tianjin, China, Environ. Pollut., 303, 119122, https://doi.org/10.1016/j.envpol.2022.119122, 2022.

Yang, Y., Ji, D. S., Sun, J., Wang, Y. H., Yao, D., Zhao, S., Yu, X. N., Zeng, L. M., Zhang, R. J., Zhang, H., Wang, Y. H., and Wang, Y. S.: Ambient volatile organic compounds in a suburban site between Beijing and Tianjin: Concentration levels, source apportionment and health risk assessment, Sci. Total Environ., 695, 133889, https://doi.org/10.1016/j.scitotenv.2019.133889, 2019.

Yu, H., Liu, Q. Q., Wei, N. A., Hu, M. F., Xu, X. Z., Wang, S., Zhou, J. C., Zhao, W. X., and Zhang, W. J.: Investigation of summertime ozone formation and sources of volatile organic compounds in the suburb area of Hefei: A case study of 2020, Atmosphere, 14, 740, https://doi.org/10.3390/atmos14040740, 2023.

Yuan, B., Shao, M., de Gouw, J., Parrish, D. D., Lu, S., Wang, M., Zeng, L., Zhang, Q., Song, Y., Zhang, J., and Hu, M.: Volatile organic compounds (VOCs) in urban air: How chemistry affects the interpretation of positive matrix factorization (PMF) analysis, J. Geophys. Res., 117, D24302, https://doi.org/10.1029/2012jd018236, 2012.

Yuan, B., Hu, W. W., Shao, M., Wang, M., Chen, W. T., Lu, S. H., Zeng, L. M., and Hu, M.: VOC emissions, evolutions and contributions to SOA formation at a receptor site in eastern China, Atmos. Chem. Phys., 13, 8815-8832, https://doi.org/10.5194/acp-13-8815-2013, 2013.

Zhan, J. L., Feng, Z. M., Liu, P. F., He, X. W., He, Z. M., Chen, T. Z., Wang, Y. F., He, H., Mu, Y. J., and Liu, Y. C.: Ozone and SOA formation potential based on photochemical loss of VOCs during the Beijing summer, Environ. Pollut., 285, 117444, https://doi.org/10.1016/j.envpol.2021.117444, 2021.

Zhang, J. Q., Liu, Z., Wu, Y. J., Zhu, Y., Cao, T., Ling, D. Y., Wang, H., and Wang, S. L.: The impacts of photochemical loss on the source apportionment of ambient volatile organic compounds: A case study in Northern China, Atmos. Environ., 333, 120671, https://doi.org/10.1016/j.atmosenv.2024.120671, 2024a.

Zhang, L. L., Xu, T., Wu, G. C., Zhang, C. L., Li, Y., Wang, H., Gong, D. C., Li, Q. Q., and Wang, B. G.: Photochemical loss with consequential underestimation in active VOCs and corresponding secondary pollutions in a petrochemical refinery, China, Sci. Total Environ., 918, 170613, https://doi.org/10.1016/j.scitotenv.2024.170613, 2024b.

Zhang, Y. L., Wang, X. M., Barletta, B., Simpson, I. J., Blake, D. R., Fu, X. X., Zhang, Z., He, Q. F., Liu, T. Y., Zhao, X. Y., and Ding, X.: Source attributions of hazardous aromatic hydrocarbons in urban, suburban and rural areas in the Pearl River Delta (PRD) region, J. Haz. Mat., 250, 403-411, https://doi.org/10.1016/j.jhazmat.2013.02.023, 2013.

Zhao, Q. Y., Bi, J., Liu, Q., Ling, Z. H., Shen, G. F., Chen, F., Qiao, Y. Z., Li, C. Y., and Ma, Z. W.: Sources of volatile organic compounds and policy implications for regional ozone pollution control in an urban location of Nanjing, east China, Atmos. Chem. Phys., 20, 3905-3919, https://doi.org/10.5194/acp-20-3905-2020, 2020.

Zhao, W., Hopke, P. K., and Karl, T.: Source identification of volatile organic compounds in Houston, Texas, Environ. Sci. Technol., 38, 1338-1347, https://doi.org/10.1021/es034999c, 2004.

Zheng, H., Kong, S., Xing, X., Mao, Y., Hu, T., Ding, Y., Li, G., Liu, D., Li, S., and Qi, S.: Monitoring of volatile organic compounds (VOCs) from an oil and gas station in northwest China for 1 year, Atmos. Chem. Phys., 18, 4567-4595, https://doi.org/10.5194/acp-18-4567-2018, 2018.

Zheng, H., Kong, S., Chen, N., Niu, Z., Zhang, Y., Jiang, S., Yan, Y., and Qi, S.: Source apportionment of volatile organic compounds: Implications to reactivity, ozone formation, and secondary organic aerosol potential, Atmos. Res., 249, 105344, https://doi.org/10.1016/j.atmosres.2020.105344, 2021.

Zhou, B. A., Zhao, T. Y., Ma, J., Zhang, Y. X., Zhang, L. J., Huo, P., and Zhang, Y.: Characterization of VOCs during nonheating and heating periods in the typical suburban area of Beijing, China: Sources and health assessment, Atmosphere, 13, 560, https://doi.org/10.3390/atmos13040560, 2022.

Zhu, B., Huang, X. F., Xia, S. Y., Lin, L. L., Cheng, Y., and He, L. Y.: Biomass-burning emissions could significantly enhance the atmospheric oxidizing capacity in continental air pollution, Environ. Pollut., 285, 117523, https://doi.org/10.1016/j.envpol.2021.117523, 2021.

Zhu, Y. H., Yang, L. X., Kawamura, K., Chen, J. M., Ono, K. R., Wang, X. F., Xue, L. K., and Wang, W. X.: Contributions and source identification of biogenic and anthropogenic hydrocarbons to secondary organic aerosols at Mt. Tai in 2014, Environ. Pollut., 220, 863-872, https://doi.org/10.1016/j.envpol.2016.10.070, 2017.

Zou, Y., Charlesworth, E., Wang, N., Flores, R. M., Liu, Q. Q., Li, F., Deng, T., and Deng, X. J.: Characterization and ozone formation potential (OFP) of non-methane hydrocarbons under the condition of chemical loss in Guangzhou, China, Atmos. Environ., 262, 118630, https://doi.org/10.1016/j.atmosenv.2021.118630, 2021.

Zou, Y., Yan, X., Flores, R. M., Zhang, L. Y., Yang, S., Fan, L. Y., Deng, T., Deng, X., and Ye, D.: Source apportionment and ozone formation mechanism of VOCs considering photochemical loss in Guangzhou, China, Sci. Total Environ., 903, 166191, https://doi.org/10.1016/j.scitotenv.2023.166191, 2023.