

# Atmospheric Carbonyl Compounds in the Central Taklimakan Desert in Summertime: Ambient Levels, Composition and Sources

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**Table S1.** Correlation coefficients between carbonyls and meteorological factors at Tazhong in summer 2018. (1) Formaldehyde, (2) acetaldehyde, (3) acetone, (4) propionaldehyde, (5) crotonaldehyde, (6) butyraldehyde, (7) benzaldehyde, (8) isovaleraldehyde, (9) valeraldehyde, (10) o-tolualdehyde, (11) m-tolualdehyde, (12) p-tolualdehyde, (13) hexaldehyde, (14) 2,5-dimethoxybenzaldehyde, (15) methacrolein, (16) glyoxal, (17) methylglyoxal, (18) temperature, (19) RH, and (20) wind speed.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
(2)	0.71**																		
(3)	0.58**	0.72**																	
(4)	0.57**	0.90**	0.65**																
(5)	0.36**	0.43**	0.22*	0.32**															
(6)	0.83**	0.91**	0.67**	0.83**	0.38**														
(7)	0.63**	0.49**	0.44**	0.35**	0.28**	0.50**													
(8)	0.33**	0.48**	0.38**	0.57**	0.21*	0.49**	0.41**												
(9)	0.20*	0.06	0.18*	0.08	0.01	0.02	0.25**	-0.01											
(10)	-0.14	-0.31**	0.06	-0.20*	-0.11	-0.32**	-0.07	-0.25**	0.60**										
(11)	-0.15	-0.35**	0.01	-0.27**	-0.20*	-0.36**	-0.07	-0.28**	0.54**	0.85**									
(12)	0.55**	0.36**	0.18	0.28**	0.35**	0.36**	0.54**	0.30**	0.13	-0.17	-0.16								
(13)	0.74**	0.79**	0.56**	0.76**	0.41**	0.81**	0.59**	0.65**	0.05	-0.36**	-0.37**	0.60**							
(14)	0.17	0.13	0.14	0.20*	0.18	0.20*	0.21*	0.29**	-0.10	-0.08	-0.11	0.15	0.29**						
(15)	0.68**	0.68**	0.40**	0.61**	0.35**	0.77**	0.43**	0.38**	0.02	-0.33**	-0.45**	0.45**	0.67**	0.12					
(16)	0.35**	0.38**	0.37**	0.38**	0.06	0.32**	0.31**	0.21*	0.02	-0.04	0.07	0.32**	0.39**	0.12	0.21*				
(17)	0.43**	0.46**	0.62**	0.33**	0.17	0.37**	0.57**	0.33**	0.19*	0.04	0.15	0.26**	0.44**	0.05	0.23*	0.57**			
(18)	0.17	-0.12	0.18	-0.03	0.02	-0.05	0.13	-0.15	0.54**	0.69**	0.66**	-0.10	-0.13	0.01	-0.23*	0.05	0.13		
(19)	0.19*	0.11	-0.09	-0.01	0.11	0.14	0.29**	0.21*	-0.33**	-0.55**	-0.49**	0.61**	0.40**	0.10	0.27**	0.11	0.07	-0.63**	
(20)	-0.29**	-0.51**	-0.19*	-0.45**	-0.24**	-0.40*	-0.23*	-0.19*	-0.09	0.41**	0.38**	-0.33**	-0.40**	-0.03	-0.37**	-0.24**	-0.19*	0.20*	-0.13

\*\* Correlation significant at the 0.01 level. \* Correlation significant at the 0.05 level.

**Table S2.** The specific time period corresponding to each episode.

	Start Time	End Time	Temp. (°C)	RH (%)	WS (m/s)	Total OVOCs (ppbv)
Episode 1	2018/5/16 06:00	2018/5/20 23:00	22.16	28.71	5.02	7.66
Episode 2	2018/5/21 00:00	2018/5/26 16:00	18.13	24.78	3.64	8.61
Episode 3	2018/5/26 17:00	2018/6/01 14:00	22.19	19.47	2.21	12.32
Episode 4	2018/6/01 15:00	2018/6/03 15:00	25.15	14.75	3.45	14.85
Episode 5	2018/6/03 16:00	2018/6/05 09:00	27.06	15.75	3.05	18.49

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Episode 6	2018/6/05 10:00	2018/6/07 21:00	24.73	28.70	3.65	13.62
Episode 7	2018/6/07 22:00	2018/6/09 22:00	25.81	27.76	2.96	14.76
Episode 8	2018/6/09 23:00	2018/6/12 12:00	27.13	27.01	4.76	11.33
Episode 9	2018/6/12 13:00	2018/6/15 05:00	23.19	50.46	2.21	13.75

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**Table S3.** Detailed data summary of field observation of carbonyls related to areas or cities adopted in Figure 5, Figure 6 and Figure 7.

Area/City	Type	Concentration (ppbv)				Ratio		Time	Reference
		Formaldehyde	Acetaldehyde	Acetone	Others	C1/C2	C2/C3		
Shenyang	Urban	30.76	8.24	19.18	42.41	3.73	1.17	Aug.2014	[51]
Beijing	Urban	9.93	4.48	5.03	2.24	2.21	8.61	Aug. 2010; Jul.-Aug. 2008; Dec. 2004-Nov. 2005; Nov. 2017, Jul.-Aug. 2018; Jul. 2013, Jan.-Mar. 2014; Aug. 2005, Aug. 2006; Dec. 2016; Jul.-Oct. 2008; Jul.-Aug. 2008	[11,34,50,52–57]
Tianjin	Urban	12.91	8.68	10.71	-	1.49	-	Sep. 2007	[58]
Qingdao	Urban	8.14	3.91	2.43	1.39	2.09	9.82	Jul. 1998	[59]
Shanghai	Urban	14.00	8.59	4.01	4.14	1.63	6.88	Jan. & Mar. & Jul. & Oct. 2007	[5]
Hangzhou	Urban	17.50	3.44	7.50	1.05	5.09	5.63	Mar.-Apr. 2006	[60]
Hong Kong	Urban	4.61	1.21	0.69	0.26	3.66	7.47	Jan.-Dec. 2001	[61]
Guangzhou	Urban	5.30	4.36	4.96	4.85	1.21	8.39	Jul.-Sep. 2003; Jan. & Apr. & Jul. & Nov. 2005	[27,62]
Foshan	Urban	9.46	3.32	2.80	2.75	2.84	16.92	Dec. 2014, Jun.-Jul. 2015	[23]
Xi'an	Urban	5.46	4.38	3.32	2.76	1.25	12.17	Jun. 2009, Jan. 2010	[39]
Guiyang	Urban	3.70	2.99	2.03	-	1.24	-	Dec. 2008-Mar. 2009	[63]
Qinzhou	Urban	5.44	4.45	1.02	0.69	1.22	30.29	Oct. 2011, Jan. & Apr & Jul. 2012	[64]
Nanning	Urban	5.50	8.73	2.27	1.54	0.63	24.52	Oct. 2011-Jul. 2012	[65]
Chengdu	Urban	7.51	2.69	-	2.36	2.79	7.08	Aug. 2010, Jan. 2011	[52]
Wuhan	Urban	6.00	4.01	-	3.09	1.50	8.61	Aug. 2010, Jan. 2011	[52]
Xiamen	Urban	1.03	0.51	-	0.23	2.03	14.43	Aug. 2010, Jan. 2011	[52]
Yantai	Urban	2.54	1.65	-	0.90	1.54	11.00	Aug. 2010, Jan. 2011	[52]
Zhengzhou	Urban	8.39	4.65	5.64	1.59	1.81	10.08	Jan. & Aug. 2012	[66]
Kaohsiung	Urban	15.14	8.52	0.50	4.71	1.78	5.04	May-Dec. 2012	[67]
Bangkok	Urban	8.51	2.55	-	-	3.34	-	Sep. 2012, Mar. 2013	[68]
Fuji	Urban	2.06	2.64	0.74	0.73	0.78	8.02	Mar. & May & Nov. 2004	[69]
Seoul	Urban	4.48	2.17	3.71	3.83	2.06	9.86	2001-2003	[70]
Helsinki	Urban	0.61	0.16	0.47	0.2	3.76	5.85	Feb. & May 2004	[49]
Athens	Urban	11.13	7.45	4.17	4.11	1.49	10.04	Jun.-Dec. 2000	[48]

Rome	Urban	14.10	6.95	5.60	4.35	2.03	5.15	Jun.-Jul. 1994, Jan.-Mar. 1995	[71]
Los Angeles	Urban	5.30	4.00	1.60	11.18	1.33	5.06	Sep. 1993	[72]
Monterrey	Urban	27.35	9.55	9.33	7.60	2.86	6.26	May-Jun. & Oct.-Nov. 2011, Jun. & Oct. 2012	[28]
San Jose	Urban	2.00	1.31	0.75	0.39	1.53	24.34	Apr.-May & Sep.-Dec. 2009	[73]
Heredia	Urban	2.04	2.16	1.99	0.39	0.95	40.06	Apr.-May & Sep.-Dec. 2009	[73]
Tijuca	Urban	1.80	2.05	-	0.89	0.88	8.30	Winter 2017, Winter 2018	[74]
Santiago	Urban	3.90	3.00	2.40	5.01	1.30	6.52	Nov.-Dec. 2003	[75]
Perth	Urban	0.54	1.12	1.42	0.74	0.48	-	Dec. 2007-Mar. 2008	[76]
Sydney	Urban	1.69	0.24	0.41	0.14	7.04	-	Mar. 2007 (South)	[77]
Shiraz	Urban	9.88	3.41	-	-	2.90	-	Jun.-Jul. 2017, Dec. 2017-Jan. 2018	[78]
Beirut	Urban	4.55	1.90	3.85	0.90	2.39	2.11	Jul. 2003, Dec. 2003	[79]
Hong Kong	Suburban	1.99	0.58	-	0.43	3.41	7.95	Aug. 2011-May. 2012; 2013	[80-81]
WQS, Guangzhou	Suburban	7.03	4.63	-	=	1.52	-	Jul. 2006	[47]
Paris	Suburban	1.607	0.621	1.344	2.6215	2.59	7.31	Jul. 2009	[33]
Orléans	Suburban	2.25	0.85	1.84	1.23	2.65	4.24	Oct. 2010, Jan. & Apr. & Jun. 2011	[18]
Zürich	Suburban	1.05	0.52	1.55	0.68	2.02	5.91	Mar. 2005-Feb. 2006	[82]
DX, Beijing	Suburban	6.20	2.58	3.41	3.09	2.40	5.86	Aug. 2006	[54]
Durham	Suburban	-	0.37	1.02	0.60	-	-	Jul.-Aug. 2004, Jun. 2005-May 2008	[83]
Lhasa	Plateau	1.64	1.03	-	0.71	1.59	6.65	Aug. 2010, Jan. 2011	[52]
Waliguan	Plateau	4.16	4.25	2.02	6.20	0.98	-	Aug.-Sep. 2005	[30]
Bohai sea	Ocean	1.87	2.15	1.50	-	0.87	-	Nov. 2007	[58]
South China sea and sulu sea	Ocean	-	0.86	2.10	0.27	-	5.73	Nov. 2011	[84]
Calhau	Ocean	-	0.43	0.55	-	-	-	Jun. 2010	[85]
Georgia Candler County	Forest	2.55	0.65	1.75	0.51	3.92	-	Jul.-Aug. 1991, Jun. 1992	[32]
WZS, Guangzhou	Forest	3.07	1.88	-	4.91	1.63	4.88	Jul. 2004	[86]
Zhangjiajie	Forest	3.42	0.51	1.23	0.37	6.67	2.61	Aug. 2014-Jan. 2015	[18]
Hyytiälä	Forest	0.37	0.19	0.54	0.18	1.96	5.88	Mar.-Apr. 2003	[49]
Montseny	Forest	-	0.67	2.11	1.71	-	-	Feb.-Mar. & Jul.-Aug. 2009	[87]
Tijuca Forest	Forest	0.79	0.51	-	0.85	1.55	10.22	Winter 2017, Winter 2018	[74]
Mount Tai	Mountain	3.48	1.27	3.57	0.86	2.39	-	Jun.-Aug. 2014	[19]

Albany	Mountain	1.27	0.53	1.72	1.25	2.74	-	Jul. 1994	[88]
Alert Polar Night	Arctic	-	0.13	0.20	0.06	-	12.18	Feb.-Mar. 2000	[89]
Alert Polar Day	Arctic	-	0.17	0.87	0.07	-	15.09	Apr.-May 2000	[89]
Ny-Alesund, Svalbard	Arctic	0.339	0.061	0.477	0.11	5.56	1.11	Sep. 2004	[90]
Ouargla	Desert	-	-	4.08	1.57	-	-	Nov. 1999	[20]
Hassi Messaoud	Desert	-	-	6.37	2.69	-	-	Nov. 1999	[20]
Tazhong	Desert	6.08	1.68	2.52	1.51	3.74	16.80	May-Jun. 2018	This study
Dongying oil field	Oil field	9.99	7.18	7.29	9.76	1.39	8.50	Jun.-Jul. 2017	[35]

Note: ‘-’ means not detected or mentioned; C1/C2: formaldehyde/acetaldehyde, C2/C3: acetaldehyde/propionaldehyde; all data was converted to ppbv according to the temperature and atmospheric pressure data given in the studies. If these were absent, concentration data were converted according to standard values.

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