

- 1 [Interactive comment on “An updated emission inventory of vehicular](#)
- 2 [VOCs/IVOCs in China” by Huan Liu et al.](#)
- 3

4 Anonymous Referee #2

5 Received and published: 16 August 2017

6 General Comments: This work developed an updated speciated emission inventory of
7 VOCs and IVOCs from vehicles in China for the year of 2015 based on a set of state-
8 of-the-art methodologies and a mass of local measurement data. The strength of this
9 inventory is that massive GPS records and questionnaire analysis are collected to better
10 characterize the activity level. In addition, in terms of the method, this work improved
11 the emission estimation by including evaporative emission calculation and applying
12 road emission intensity based approach. This well-written and well-structured paper is
13 potentially important and will be valuable in the future for modelling the formation of
14 fine particles and ozone pollution in China. There are a few comments that need to be
15 addressed to improve the paper and make it more accessible to the wide audience of
16 users of the information presented.

17 **Response:** Thank you for the comments. We try our best to improve the manuscript
18 based on your comments. The point-by-point response is provided.

19 Specific Comments:

20 In the first place, the information need to be made available, for example through the
21 journal with a doi, or through the website of the author's institute.

22 **Response:** Accepted. Firstly, instead of providing figures and percentages, we have
23 revised and added several tables to provide the raw data and the emission data. Due to
24 the length limitation, the additional dataset are available upon request.

25 **Author's changes in manuscript:**

26 Table 1 to table 5 and table S1 to table S9 were added to provide information as detail
27 as possible.

28 Table 1 Population of different types of vehicles in China in 2015

29

- 30 Table 2 Provincial annual average VKT of LDPVs in China
- 31 Table 3 Average annual VKT of trucks in China (Km/year)
- 32 Table 4 VOC tailpipe emissions by vehicle type and by control technology in China in 2015 (Gg)
- 33 Table 5 IVOC tailpipe emissions by vehicle type and by control technology in China in 2015 (Gg)
- 34 Table S1. Previous studies on emission inventory of VOCs from vehicles in China.
- 35 Table S2. Mapping from vehicles in US to China certification level (Gasoline).
- 36 Table S3. Mapping from vehicles in US to China certification level (Diesel).

Table S4. VOCs tailpipe emission factors used in this study (g/km).

Table S5. IVOCs tailpipe emission factors used in this study (g/km).

Table S6. Evaporation emission factors used in this study.

Table S7. Characteristics of probability distribution functions for selected key model parameters and input variables included in the uncertainty analysis.

Table S8. Assignments from Real Compounds to Carbon Bond 05 (CB05) Model Species for diesel exhaust, gasoline exhaust and evaporation in China (Gmol).

Table S9. Uncertainty range of emission inventories.

A second recommendation is that speciated emission inventory of VOCs and IVOCs based on prevailing lumped chemical mechanisms like CB05 and SAPRC are suggested to be provided since that this emission database will be mainly used in chemical transport models.

Response: Accepted. A table and discussions were added.

Author's changes in manuscript:

Table S8. Assignments from Real Compounds to Carbon Bond 05 (CB05) Model Species for diesel exhaust, gasoline exhaust and evaporation in China (Gmol).

	Diesel exhaust	Gasoline exhaust	Evaporation
PAR	7.179	39.017	72.452
OLE	0.371	0.994	1.380
TOL	0.217	2.389	0.507
XYL	0.222	1.035	0.189
FORM	4.425	2.700	0.215
ALD2	1.219	1.071	0.095
ETH	0.837	N.D.	0.017
ISOP	N.D.	N.D.	0.012
MEOH	N.D.	N.D.	N.D.
ETOH	N.D.	N.D.	N.D.
ETHA	N.D.	0.882	0.158
IOLE	N.D.	N.D.	2.046
ALDX	0.6852	1.309	0.128
TERP	N.D.	N.D.	N.D.
UNR	1.773	8.276	5.762

There still large uncertainty lies in activity level, emission factor and the estimation method itself. Another recommendation is that uncertainty analysis ought to be conducted and more quantitative results should be provided in Section 3.3.

Response: Accepted.

Author's changes in manuscript:

The uncertainty for emission inventory is assessed using a Monte Carlo method. The probability distributions of key model parameters were established with our experimental data, investigation data and literature review (Table S7). Using these assumptions, a Monte Carlo model was run 10000 times to produce the estimate.

Inevitable uncertainties are present in VOCs emission inventories due to the use of different input data, including activity characteristics, emission factors and VOCs emission profiles. Total vehicle emissions of VOCs are 4.21 Tg yr⁻¹ with a 95% confidence interval ranges from 2.90-6.54 Tg. The overall uncertainties in this inventory are estimated at -28.53 to 61.35% for total VOC emissions. The uncertainties of detailed categories were listed in Table S9. These confidence ranges are comparable to other bottom-up emission inventories.

Table S7. Characteristics of probability distribution functions for selected key model parameters and input variables included in the uncertainty analysis.

Parameter or variable			Distribution	Standard division	The 95% confidence interval		
					2.5% percentile	50 % percentile	97.5% percentile
Evaporative emission factors	Diurnal	1-24hour	Log-Normal	0.065	0.023	0.077	0.264
	emissions (g/hour)	24-48hour	Log-Normal	0.100	0.107	0.229	0.493
		>48hour	Log-Normal	0.085	0.204	0.331	0.536
	Hot Soak	(g/hour)	Log-Normal	0.014	0.059	0.082	0.114
	Base Refuelling	(g/L)	Log-Normal	0.077	0.707	0.843	1.009
	Running loss	(g/hour)	Log-Normal	4.689	5.072	10.712	22.938
	GMs	(g/Km)	Log-Normal	0.550	0.086	0.415	1.945
Parking duration per day in Beijing (hour)			Extreme Value	1.1365	19.4652	22.3486	23.8540
Parking duration per day in other provinces (hour)			Extreme Value	0.9919	19.7238	22.2438	23.5538
Percentage of parking events in Beijing	0-1hour		Log-Normal	0.100	0.320	0.475	0.712
	1-24hour		Log-Normal	0.099	0.306	0.460	0.688
	24-48hour		Log-Normal	0.006	0.018	0.027	0.041
	48-72hour		Log-Normal	0.002	0.004	0.007	0.012
	72-119.5hour		Log-Normal	0.002	0.002	0.005	0.010
	>119.5hour		Log-Normal	0.000	0.004	0.004	0.005
Percentage of parking	0-1hour		Log-Normal	0.124	0.352	0.539	0.834
	1-24hour		Log-Normal	0.079	0.290	0.420	0.605

events	in	24-48hour		Log-Normal	0.002	0.007	0.010	0.015
other		48-72hour		Log-Normal	0.000	0.002	0.003	0.004
provinces		72-119.5hour		Log-Normal	0.002	0.000	0.002	0.007
		>119.5hour		Log-Normal	0.004	0.000	0.001	0.010
Percentage		0-1hour		Log-Normal	0.006	0.020	0.029	0.043
of parking		1-24hour		Log-Normal	0.099	0.316	0.471	0.703
duration in		24-48hour		Log-Normal	0.040	0.101	0.162	0.260
Beijing		48-72hour		Log-Normal	0.014	0.048	0.071	0.103
		72-119.5hour		Log-Normal	0.020	0.050	0.080	0.127
		>119.5hour		Log-Normal	0.040	0.103	0.163	0.255
Percentage		0-1hour		Log-Normal	0.020	0.024	0.049	0.101
of parking		1-24hour		Log-Normal	0.121	0.433	0.628	0.902
duration in		24-48hour		Log-Normal	0.184	0.004	0.043	0.468
other		48-72hour		Log-Normal	0.010	0.030	0.046	0.069
provinces		72-119.5hour		Log-Normal	0.020	0.022	0.047	0.098
		>119.5hour		Log-Normal	0.020	0.084	0.117	0.161
Tailpipe		GMs		Log-Normal	0.56	0.52	1.16	2.64
Emission		LDGTAs	China0	Log-Normal	1.694	1.550	3.519	8.045
factors of			China1	Log-Normal	0.599	0.558	1.255	2.839
passenger			China2	Log-Normal	0.418	0.392	0.891	1.968
vehicles			China3	Log-Normal	0.200	0.184	0.416	0.957
(g/Km)			China4	Log-Normal	0.121	0.112	0.254	0.582
			China5	Log-Normal	0.114	0.104	0.236	0.543
		LDDTAs	China0	Log-Normal	0.337	0.311	0.726	1.608
			China1	Log-Normal	0.031	0.028	0.065	0.150
			China2	Log-Normal	0.020	0.019	0.042	0.096
			China3	Log-Normal	0.010	0.010	0.022	0.050
			China4	Log-Normal	0.007	0.006	0.015	0.033
			China5	Log-Normal	0.007	0.006	0.015	0.033
		LDDATAs	China0	Log-Normal	1.649	1.516	3.471	7.828
			China1	Log-Normal	0.187	0.174	0.396	0.884
			China2	Log-Normal	0.176	0.159	0.367	0.829
			China3	Log-Normal	0.050	0.046	0.105	0.241
			China4	Log-Normal	0.029	0.027	0.060	0.139
			China5	Log-Normal	0.127	0.118	0.270	0.608
		LDGPVs	China0	Log-Normal	1.181	1.105	2.473	5.687
			China1	Log-Normal	0.293	0.269	0.608	1.385
			China2	Log-Normal	0.140	0.127	0.287	0.654
			China3	Log-Normal	0.083	0.077	0.174	0.395
			China4	Log-Normal	0.033	0.031	0.069	0.158

	China5	Log-Normal	0.025	0.023	0.052	0.115
LDDPVs	China0	Log-Normal	0.337	0.311	0.726	1.608
	China1	Log-Normal	0.031	0.028	0.065	0.150
	China2	Log-Normal	0.020	0.019	0.042	0.096
	China3	Log-Normal	0.010	0.010	0.022	0.050
	China4	Log-Normal	0.007	0.006	0.015	0.033
	China5	Log-Normal	0.007	0.006	0.015	0.033
LDAPVs	China0	Log-Normal	0.977	0.900	2.071	4.581
	China1	Log-Normal	0.104	0.095	0.217	0.486
	China2	Log-Normal	0.073	0.067	0.151	0.347
	China3	Log-Normal	0.065	0.023	0.077	0.264
	China4	Log-Normal	0.027	0.025	0.056	0.127
	China5	Log-Normal	0.039	0.037	0.084	0.186
MDGBUs	China0	Log-Normal	2.223	2.100	4.741	10.559
	China1	Log-Normal	2.306	2.142	4.859	10.957
	China2	Log-Normal	0.852	0.788	1.805	4.030
	China3	Log-Normal	0.383	0.346	0.791	1.838
	China4	Log-Normal	0.184	0.167	0.380	0.872
	China5	Log-Normal	0.184	0.167	0.380	0.872
MDDBUs	China0	Log-Normal	1.184	1.068	2.424	5.614
	China1	Log-Normal	0.254	0.234	0.532	1.211
	China2	Log-Normal	0.153	0.141	0.323	0.728
	China3	Log-Normal	0.122	0.114	0.260	0.583
	China4	Log-Normal	0.047	0.042	0.098	0.220
	China5	Log-Normal	0.024	0.021	0.050	0.112
MDABUs	China0	Log-Normal	1.694	1.550	3.519	8.045
	China1	Log-Normal	1.415	1.299	2.945	6.765
	China2	Log-Normal	1.256	1.146	2.609	5.943
	China3	Log-Normal	0.745	0.697	1.555	3.567
	China4	Log-Normal	0.517	0.484	1.100	2.460
	China5	Log-Normal	0.517	0.484	1.100	2.460
MDGPVs	China0	Log-Normal	1.623	1.482	3.364	7.725
	China1	Log-Normal	1.123	1.043	2.351	5.301
	China2	Log-Normal	0.628	0.587	1.324	2.993
	China3	Log-Normal	0.165	0.150	0.338	0.779
	China4	Log-Normal	0.047	0.042	0.098	0.220
	China5	Log-Normal	0.047	0.042	0.098	0.220
MDDPVs	China0	Log-Normal	0.663	0.602	1.373	3.165
	China1	Log-Normal	0.612	0.576	1.301	2.933
	China2	Log-Normal	0.185	0.172	0.391	0.873

	China3	Log-Normal	0.160	0.146	0.335	0.764
	China4	Log-Normal	0.166	0.155	0.348	0.797
	China5	Log-Normal	0.166	0.155	0.348	0.797
MDAPVs	China0	Log-Normal	0.834	0.763	1.753	4.002
	China1	Log-Normal	0.704	0.650	1.479	3.335
	China2	Log-Normal	0.628	0.571	1.305	2.985
	China3	Log-Normal	0.376	0.347	0.780	1.797
	China4	Log-Normal	0.259	0.246	0.550	1.245
	China5	Log-Normal	0.259	0.246	0.550	1.245
MDGBUs	China0	Log-Normal	2.223	2.100	4.741	10.559
	China1	Log-Normal	2.306	2.142	4.859	10.957
	China2	Log-Normal	0.852	0.788	1.805	4.030
	China3	Log-Normal	0.383	0.346	0.791	1.838
	China4	Log-Normal	0.184	0.167	0.380	0.872
	China5	Log-Normal	0.184	0.167	0.380	0.872
HDDBUs	China0	Log-Normal	1.184	1.068	2.424	5.614
	China1	Log-Normal	0.254	0.234	0.532	1.211
	China2	Log-Normal	0.153	0.141	0.323	0.728
	China3	Log-Normal	0.122	0.114	0.260	0.583
	China4	Log-Normal	0.047	0.042	0.098	0.220
	China5	Log-Normal	0.024	0.021	0.050	0.112
HDABUs	China0	Log-Normal	1.694	1.550	3.519	8.045
	China1	Log-Normal	1.415	1.299	2.945	6.765
	China2	Log-Normal	1.256	1.146	2.609	5.943
	China3	Log-Normal	0.745	0.697	1.555	3.567
	China4	Log-Normal	0.517	0.484	1.100	2.460
	China5	Log-Normal	0.517	0.484	1.100	2.460
HDGPVs	China0	Log-Normal	2.223	2.100	4.741	10.559
	China1	Log-Normal	2.306	2.142	4.859	10.957
	China2	Log-Normal	0.852	0.788	1.805	4.030
	China3	Log-Normal	0.383	0.346	0.791	1.838
	China4	Log-Normal	0.184	0.167	0.380	0.872
	China5	Log-Normal	0.184	0.167	0.380	0.872
HDDPVs	China0	Log-Normal	1.184	1.068	2.424	5.614
	China1	Log-Normal	0.254	0.234	0.532	1.211
	China2	Log-Normal	0.153	0.141	0.323	0.728
	China3	Log-Normal	0.122	0.114	0.260	0.583
	China4	Log-Normal	0.047	0.042	0.098	0.220
	China5	Log-Normal	0.024	0.021	0.050	0.112
HDAPVs	China0	Log-Normal	1.694	1.550	3.519	8.045

			China1	Log-Normal	1.415	1.299	2.945	6.765
			China2	Log-Normal	1.256	1.146	2.609	5.943
			China3	Log-Normal	0.745	0.697	1.555	3.567
			China4	Log-Normal	0.517	0.484	1.100	2.460
			China5	Log-Normal	0.517	0.484	1.100	2.460
VKT of passenger vehicles in Beijing (Km)	LDGTAs	China0	Log-Normal	78550	38951	113204	330220	
	LDDTAs	China0	Log-Normal	78550	38951	113204	330220	
	LDATAs	China0	Log-Normal	78550	38951	113204	330220	
	LDGPVs	China0	Log-Normal	7841	3973	11362	33524	
	LDDPVs	China0	Log-Normal	7841	3973	11362	33524	
	LDAPVs	China0	Log-Normal	7841	3973	11362	33524	
	MDGBUs	China0	Log-Normal	4991	40260	50093	59910	
	MDDBUs	China0	Log-Normal	4991	40260	50093	59910	
	MDABUs	China0	Log-Normal	4991	40260	50093	59910	
	MDGPVs	China0	Log-Normal	3143	25009	31310	37380	
	MDDPVs	China0	Log-Normal	3143	25009	31310	37380	
	MDAPVs	China0	Log-Normal	3143	25009	31310	37380	
	HDGBUs	China0	Log-Normal	4991	40260	50093	59910	
	HDDBUs	China0	Log-Normal	4991	40260	50093	59910	
	HDABUs	China0	Log-Normal	4991	40260	50093	59910	
	HDGPVs	China0	Log-Normal	11401	92557	114757	136940	
	HDDPVs	China0	Log-Normal	11401	92557	114757	136940	
	HDAPVs	China0	Log-Normal	11401	92557	114757	136940	
	VKT of passenger vehicles in other provinces (Km)	LDGTAs	China0	Log-Normal	78325	43077	120437	342273
		LDDTAs	China0	Log-Normal	78325	43077	120437	342273
LDATAs		China0	Log-Normal	78325	43077	120437	342273	
LDGPVs		China0	Log-Normal	10796	6013	16571	46419	
LDDPVs		China0	Log-Normal	10796	6013	16571	46419	
LDAPVs		China0	Log-Normal	10796	6013	16571	46419	
MDGBUs		China0	Log-Normal	4991	40260	50093	59910	
MDDBUs		China0	Log-Normal	4991	40260	50093	59910	
MDABUs		China0	Log-Normal	4991	40260	50093	59910	
MDGPVs		China0	Log-Normal	3143	25009	31310	37380	
MDDPVs		China0	Log-Normal	3143	25009	31310	37380	
MDAPVs		China0	Log-Normal	3143	25009	31310	37380	
HDGBUs		China0	Log-Normal	4991	40260	50093	59910	
HDDBUs		China0	Log-Normal	4991	40260	50093	59910	
HDABUs		China0	Log-Normal	4991	40260	50093	59910	
HDGPVs		China0	Log-Normal	11401	92557	114757	136940	
HDDPVs		China0	Log-Normal	11401	92557	114757	136940	

	HDAPVs	China0	Log-Normal	11401	92557	114757	136940
Emission factors on Urban road (g/Km)	LDGTs	China0	Normal	2.331	2.172	4.895	10.942
		China1	Normal	1.604	1.454	3.301	7.527
		China2	Normal	1.049	0.962	2.195	5.010
		China3	Normal	0.279	0.259	0.583	1.323
		China4	Normal	0.078	0.070	0.160	0.367
		China5	Normal	0.078	0.070	0.160	0.367
	MDGTs	China0	Normal	3.305	3.014	6.799	15.521
		China1	Normal	3.223	2.942	6.688	15.221
		China2	Normal	1.436	1.319	3.012	6.806
		China3	Normal	0.643	0.601	1.361	3.042
		China4	Normal	0.275	0.249	0.561	1.307
		China5	Normal	0.275	0.249	0.561	1.307
	HDGTs	China0	Normal	3.200	2.955	6.680	15.063
		China1	Normal	3.148	2.944	6.678	14.911
		China2	Normal	1.393	1.346	2.989	6.689
		China3	Normal	0.639	0.588	1.333	3.062
		China4	Normal	0.261	0.245	0.550	1.242
		China5	Normal	0.259	0.242	0.549	1.237
	LDGTs	China0	Normal	1.774	1.657	3.728	8.432
		China1	Normal	1.182	1.107	2.497	5.675
China2		Normal	0.802	0.754	1.699	3.831	
China3		Normal	0.233	0.218	0.481	1.120	
China4		Normal	0.064	0.059	0.134	0.302	
China5		Normal	0.064	0.059	0.134	0.302	
Emission factors on Provincial road (g/Km)	MDGTs	China0	Normal	0.559	4.572	5.555	6.775
		China1	Normal	2.399	2.225	5.036	11.250
		China2	Normal	1.053	0.997	2.232	5.023
		China3	Normal	0.486	0.453	1.025	2.268
		China4	Normal	0.200	0.190	0.422	0.962
		China5	Normal	0.200	0.190	0.422	0.962
Emission factors on	HDGTs	China0	Normal	2.402	2.198	4.985	11.389
		China1	Normal	2.359	2.185	5.015	11.257
		China2	Normal	1.099	0.983	2.252	5.223
		China3	Normal	0.470	0.446	0.997	2.254
		China4	Normal	0.045	0.368	0.447	0.543
		China5	Normal	0.202	0.181	0.414	0.947
Emission factors on	LDGTs	China0	Normal	1.902	1.789	3.988	9.089
		China1	Normal	1.268	1.181	2.697	6.060
		China2	Normal	0.846	0.775	1.764	3.999

National road (g/Km)		China3	Normal	0.245	0.219	0.500	1.159
		China4	Normal	0.066	0.062	0.138	0.317
		China5	Normal	0.066	0.062	0.138	0.317
	MDGTs	China0	Normal	2.612	2.461	5.547	12.615
		China1	Normal	2.630	2.403	5.400	12.396
		China2	Normal	1.150	1.070	2.424	5.444
		China3	Normal	0.521	0.482	1.100	2.456
		China4	Normal	0.218	0.201	0.461	1.031
		China5	Normal	0.218	0.201	0.461	1.031
	HDGTs	China0	Normal	2.575	2.427	5.430	12.302
		China1	Normal	2.639	2.391	5.387	12.523
		China2	Normal	1.140	1.072	2.415	5.435
		China3	Normal	0.513	0.484	1.088	2.454
		China4	Normal	0.215	0.199	0.446	1.020
		China5	Normal	0.211	0.198	0.449	0.997
Emission factors on Freeway (g/Km)	LDGTs	China0	Normal	1.801	1.691	3.760	8.437
		China1	Normal	1.219	1.121	2.542	5.812
		China2	Normal	0.808	0.746	1.688	3.817
	MDGTs	China3	Normal	0.237	0.214	0.487	1.117
		China4	Normal	0.065	0.059	0.136	0.309
		China5	Normal	0.065	0.059	0.136	0.309
		China0	Normal	2.525	2.249	5.277	11.911
		China1	Normal	2.418	2.264	5.101	11.534
		China2	Normal	1.086	1.003	2.296	5.215
	HDGTs	China3	Normal	0.487	0.457	1.048	2.313
		China4	Normal	0.207	0.188	0.431	0.993
		China5	Normal	0.207	0.188	0.431	0.993
		China0	Normal	2.410	2.242	5.132	11.470
		China1	Normal	2.430	2.327	5.150	11.495
		China2	Normal	1.089	0.992	2.282	5.249
Emission factors on other type roads (g/Km)	LDGTs	China3	Normal	0.485	0.456	1.029	2.318
		China4	Normal	0.203	0.182	0.420	0.968
		China5	Normal	0.198	0.187	0.418	0.941
	MDGTs	China0	Normal	3.066	2.829	6.411	14.780
		China1	Normal	1.994	1.857	4.246	9.496
		China2	Normal	1.370	1.238	2.848	6.525
		China3	Normal	0.352	0.320	0.734	1.679
		China4	Normal	0.094	0.089	0.204	0.452
		China5	Normal	0.094	0.089	0.204	0.452

		China1	Normal	4.122	3.823	8.777	19.875
		China2	Normal	1.900	1.707	3.882	9.052
		China3	Normal	0.839	0.781	1.759	3.984
		China4	Normal	0.357	0.325	0.738	1.709
		China5	Normal	0.357	0.325	0.738	1.709
	HDGTs	China0	Normal	4.102	3.794	8.706	19.494
		China1	Normal	4.055	3.828	8.734	19.229
		China2	Normal	1.847	1.712	3.882	8.921
		China3	Normal	0.843	0.771	1.744	3.988
		China4	Normal	0.336	0.322	0.715	1.600
		China5	Normal	0.344	0.317	0.720	1.632
Emission factors on urban road (g/Km)	LDDTs	China0	Normal	0.990	0.932	2.093	4.717
		China1	Normal	0.966	0.894	2.008	4.547
		China2	Normal	0.615	0.569	1.300	2.913
		China3	Normal	0.168	0.158	0.351	0.787
		China4	Normal	0.085	0.078	0.178	0.406
		China5	Normal	0.085	0.078	0.178	0.406
	MDDTs	China0	Normal	2.125	1.942	4.434	10.110
		China1	Normal	0.772	0.701	1.596	3.656
		China2	Normal	0.200	0.185	0.414	0.940
		China3	Normal	0.096	0.089	0.199	0.457
		China4	Normal	0.048	0.045	0.103	0.233
		China5	Normal	0.048	0.045	0.103	0.233
	HDDTs	China0	Normal	1.900	1.775	4.023	9.117
		China1	Normal	0.417	0.388	0.887	2.006
		China2	Normal	0.245	0.228	0.516	1.154
		China3	Normal	0.121	0.113	0.252	0.576
		China4	Normal	0.060	0.055	0.127	0.286
		China5	Normal	0.060	0.055	0.127	0.286
Emission factors on provincial road (g/Km)	LDDTs	China0	Normal	0.745	0.668	1.552	3.518
		China1	Normal	0.719	0.667	1.515	3.409
		China2	Normal	0.487	0.444	0.998	2.317
		China3	Normal	0.138	0.130	0.294	0.658
		China4	Normal	0.072	0.065	0.148	0.339
		China5	Normal	0.072	0.065	0.148	0.339
	MDDTs	China0	Normal	1.596	1.477	3.328	7.576
		China1	Normal	0.575	0.521	1.211	2.727
		China2	Normal	0.149	0.135	0.311	0.704
		China3	Normal	0.072	0.067	0.151	0.343
		China4	Normal	0.036	0.034	0.077	0.173

		China5	Normal	0.036	0.034	0.077	0.173
	HDDTs	China0	Normal	1.465	1.322	3.030	6.879
		China1	Normal	0.319	0.290	0.665	1.514
		China2	Normal	0.188	0.170	0.385	0.890
		China3	Normal	0.090	0.083	0.190	0.424
		China4	Normal	0.046	0.042	0.096	0.217
		China5	Normal	0.046	0.042	0.096	0.217
Emission factors on national road (g/Km)	LDDTs	China0	Normal	0.810	0.736	1.698	3.816
		China1	Normal	0.765	0.722	1.644	3.692
		China2	Normal	0.494	0.454	1.034	2.351
		China3	Normal	0.143	0.134	0.300	0.693
		China4	Normal	0.074	0.067	0.154	0.352
		China5	Normal	0.074	0.067	0.154	0.352
	MDDTs	China0	Normal	1.730	1.585	3.640	8.182
		China1	Normal	0.611	0.571	1.299	2.923
		China2	Normal	0.161	0.150	0.337	0.764
		China3	Normal	0.078	0.071	0.162	0.369
		China4	Normal	0.040	0.036	0.083	0.190
		China5	Normal	0.040	0.036	0.083	0.190
	HDDTs	China0	Normal	1.570	1.431	3.270	7.502
		China1	Normal	0.345	0.321	0.722	1.635
		China2	Normal	0.202	0.183	0.419	0.953
		China3	Normal	0.099	0.092	0.205	0.465
		China4	Normal	0.050	0.046	0.104	0.236
		China5	Normal	0.050	0.046	0.104	0.236
Emission factors on freeway (g/Km)	LDDTs	China0	Normal	0.757	0.696	1.593	3.582
		China1	Normal	0.715	0.699	1.555	3.487
		China2	Normal	0.480	0.433	0.983	2.249
		China3	Normal	0.141	0.132	0.297	0.677
		China4	Normal	0.071	0.066	0.148	0.336
		China5	Normal	0.071	0.066	0.148	0.336
	MDDTs	China0	Normal	1.639	1.506	3.402	7.777
		China1	Normal	0.582	0.529	1.221	2.748
		China2	Normal	0.153	0.141	0.322	0.724
		China3	Normal	0.073	0.067	0.154	0.345
		China4	Normal	0.037	0.034	0.078	0.175
		China5	Normal	0.037	0.034	0.078	0.175
	HDDTs	China0	Normal	1.456	1.328	3.075	6.925
		China1	Normal	0.324	0.301	0.682	1.522
		China2	Normal	0.187	0.175	0.394	0.892

		China3	Normal	0.021	0.173	0.210	0.255
		China4	Normal	0.046	0.044	0.097	0.219
		China5	Normal	0.046	0.044	0.097	0.219
Emission factors on other type roads (g/Km)	MDDTs	China0	Normal	1.286	1.182	2.694	6.171
		China1	Normal	1.214	1.176	2.635	5.828
		China2	Normal	0.793	0.732	1.667	3.801
		China3	Normal	0.208	0.192	0.439	0.992
		China4	Normal	0.105	0.100	0.224	0.506
		China5	Normal	0.105	0.100	0.224	0.506
	MDDTs	China0	Normal	2.701	2.537	5.734	12.858
		China1	Normal	0.972	0.928	2.080	4.628
		China2	Normal	0.259	0.238	0.546	1.232
		China3	Normal	0.126	0.115	0.260	0.594
		China4	Normal	0.063	0.057	0.134	0.296
		China5	Normal	0.063	0.057	0.134	0.296
	HDDTs	China0	Normal	2.497	2.292	5.314	11.801
		China1	Normal	0.561	0.517	1.170	2.649
		China2	Normal	0.320	0.299	0.675	1.527
China3		Normal	0.156	0.149	0.328	0.749	
China4		Normal	0.079	0.072	0.165	0.374	
China5		Normal	0.079	0.072	0.165	0.374	
VKT of freight trucks (Km)	LDGTs	China0	Normal	2231	17804	22144	26459
		China1	Normal	2231	17804	22144	26459
		China2	Normal	2613	21212	26282	31510
		China3	Normal	2962	23701	29470	35296
		China4	Normal	3412	27517	34137	40880
		China5	Normal	3412	27517	34137	40880
	LDDTs	China0	Normal	1936	15457	19261	23046
		China1	Normal	1936	15457	19261	23046
		China2	Normal	2698	21680	26977	32181
		China3	Normal	3642	29375	36624	43686
		China4	Normal	4564	36264	45280	54401
		China5	Normal	4564	36264	45280	54401
	MDGTs	China0	Normal	3523	28361	35216	42199
		China1	Normal	3523	28361	35216	42199
		China2	Normal	4003	32747	40789	48541
China3		Normal	4801	38505	47870	57236	
China4		Normal	5273	43193	53491	63709	
China5		Normal	5273	43193	53491	63709	
MDDTs	China0	Normal	2126	17035	21228	25407	

		China1	Normal	2126	17035	21228	25407	
		China2	Normal	2833	22651	28170	33692	
		China3	Normal	3616	29244	36345	43352	
		China4	Normal	5998	48661	60346	72179	
		China5	Normal	5998	48661	60346	72179	
	HDGTs	China0	Normal	2747	22236	27753	33098	
		China1	Normal	2747	22236	27753	33098	
		China2	Normal	3343	26601	33215	39661	
		China3	Normal	4031	32340	40265	48241	
		China4	Normal	4524	36913	45806	54752	
		China5	Normal	4524	36913	45806	54752	
	HDDTs	China0	Normal	2430	19566	24330	29119	
		China1	Normal	2430	19566	24330	29119	
		China2	Normal	3814	31028	38551	46017	
		China3	Normal	6316	51858	64083	76300	
		China4	Normal	9863	78952	98396	117258	
		China5	Normal	9863	78952	98396	117258	
Percentage of driving distance on different type roads	MDG(D)Ts	Urban road	Normal	0.010	0.219	0.239	0.258	
		Provincial road	Normal	0.020	0.303	0.342	0.381	
		National road	Normal	0.007	0.124	0.137	0.151	
		Freeway	Normal	0.014	0.247	0.274	0.301	
		others	Normal	0.000	0.007	0.008	0.009	
		LDG(D)Ts	Urban road	Normal	0.020	0.314	0.353	0.392
		Provincial road	Normal	0.009	0.167	0.185	0.203	
		National road	Normal	0.011	0.196	0.218	0.239	
		Freeway	Normal	0.010	0.195	0.215	0.234	
		others	Normal	0.001	0.028	0.031	0.034	
		HDG(D)Ts	Urban road	Normal	0.007	0.128	0.142	0.155
			Provincial road	Normal	0.010	0.173	0.192	0.212
			National road	Normal	0.010	0.226	0.246	0.265
			Freeway	Normal	0.020	0.352	0.391	0.429
			others	Normal	0.002	0.027	0.030	0.033

Table S9. Uncertainty range of emission inventories.

		Unit	Mean	Standard division	C.V	The 95% confidence interval		
						2.5% percentile	50 % percentile	97.5% percentile
Tailpipe emissions	Passenger vehicles tailpipe emissions	Gg	1279.12	252.51	0.20	902.39	1237.21	1891.96
	Trucks tailpipe emissions	Gg	720.89	45.20	0.06	636.52	718.39	816.43
	Motorcycles tailpipe emissions	Gg	562.54	349.17	0.62	158.61	476.40	1444.66
Evaporative emissions	Diurnal emissions (excluding motorcycles)	Gg	138.99	75.27	0.54	56.22	124.26	312.78
	Hot Soak emissions (excluding motorcycles)	Gg	15.75	3.71	0.24	9.70	15.33	24.26
	Refueling emissions	Gg	109.38	7.46	0.07	95.82	108.94	124.92
	Running loss	Gg	1146.18	768.92	0.67	229.90	963.11	3132.67
	Motorcycles evaporation	Gg	251.30	278.70	1.11	29.31	170.14	954.21
	Ratio of evaporative emissions versus tailpipe emissions of passenger cars		1.14	0.67	0.5828	0.36	0.98	2.89
Total emissions		Gg	4224.14	943.21	0.22	2897.14	4053.82	6540.95

Technical Corrections:

Section 3.2.2-3.2.4 are too short to be an individual section. I personally think that this part of discussion is not necessarily to be divided into three sections.

Response: Accepted. The original Sect. 3.2.1-3.2.4 were combined to Sect. 3.2. No sub-section was divided.

Supporting Information, Table S4: Some abbreviations of vehicle types (LDGTAs, LDDTAs) ought to be specified.

Response: Corrected. We have modified Sect. 2.1. Now the vehicle classification and abbreviations are consistent through the whole manuscript.

Some in-text citations are missing in the reference list, e.g., MOVES, 2010; ICCT, 2012.

Response: Corrected.