Supplementary Materials:

The Study of Emission Inventory on Anthropogenic Air Pollutants and Source Apportionment of $PM_{2.5}$ in the Changzhutan Urban Agglomeration, China

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Table S1. Classification of air pollutant emission sources.

Primary Pollution Source	Primary Classification	Secondary Classification	Tertiary Classification	Quaternary
Stationary fuel combustion source	Power plant Heat generation and supply Residential combustion	Fuel types	Technological process types	Control technology
Process source	Iron and steel smelting Metallurgy Petrochemicals	Product types	Technological process types	Control technology
Mobile source	On-road transportation Non-road transportation	Fuel types Product types	Emission standard types Power types	/
Solvent source	Printing and dyeing Surface coatings Building coatings Motor vehicle manufacturing Pesticide use	Product types	Technological process types	Control technology
Agricultural source	Nitrogen (N) fertilizer application Livestock and poultry breeding	Fertilizers types Populations	/	/
Dust source	Soil fugitive dust Road fugitive dust Construction fugitive dust	Main types	Emission characteristics	Control technology
Biomass combustion source	Biomass boilers Household biomass stoves Open biomass burning	Fuel types	Technological process types	/
Storage and transportation sources	Oil and gas storage and transportation	types	/	/

Table S1 (continued)

Primary Pollution Source	Primary Classification	Secondary Classification	Tertiary Classification	Quaternary
Waste treatment source	Wastewater treatment Solid waste treatment Flue gas denitration	Pollutant types	Technological process types	/
Other source	Catering industry	/	/	/

Table S2. Detailed information of various models.

Model	Version Information	Author	Source URL
Chemical Mass Balance model	Version 1.0	School of Environmental Science and Engineering, Nankai University	https://env.nankai.edu.cn/air/2019/0627/c15333a182888/page.psp
Positive Matrix Factorization model	Version 5.0.12	The United States Environmental Protection Agency	https://geometrictools.com
Airflow HYSPLIT4	Version 4.9	National Oceanic and Atmospheric Administration	https://ready.arl.noaa.gov/HYSPLIT.php
MeteoInfo	Version 1.4.6	Yaqiang Wang	http://meteothink.org/

Table S3. Data sources used to derive the parameters needed for the CZT inventory[1].

Database	Statistics level	Date year	Date type	Description
Hunan Statistical Yearbook	City	2015	Activity rates(Fuel use and industrial product)	Cover almost all industry plants with detailed statistics for each boiler and kiln. Updated every years.
China Energy Statistics Yearbook	Province	2015	Activity rates, energy balance table	Cover almost all industry plants. Updated every year.
China Traffic Statistics Yearbook	Province	2015	Vehicle numbers	Cover all vehicle types. Updated every years
Road motor vehicle emission inventory of air pollutants preparation of Technical Guidelines (Trial)	City	2015	VKT, average mileage	Cover all vehicle types. Implemented first year.
China Chemical Industry Yearbook	Factory	2015	Chemical raw material production	Cover almost all chemical raw materials, Coatings, inks, fibers, resins, rubber. Updated every year.
China Business Intelligence Network	City	2015	Ink usage, paper product output	Cover almost all types of inks and pulp used. Updated annually but lags 2-3 years.
Hunan Rural Statistical Yearbook	Factory	2015	Pesticide use numbers, livestock and poultry numbers	Cover almost all farms and agricultural areas. Updated every years.
Hunan Provincial Environmental Statistics Database	Factory	2015	Activity rates	Cover almost sewage treatment plants and cement production enterprises. Updated every year.

[1] These datasets are unpublished and collected from local agencies, with the exception of those estimated at the province level.

Table S4. Content of the main chemical components of $PM_{2.5}$ in different cities of Changsha, Zhuzhou and Xiangtan ($\mu g/m^3$).

Component	Region			Average concentration
	Changsha	Zhuzhou	Xiangtan	
OC	8.47	8.33	OC	8.47
EC	3.61	3.72	EC	3.61
Cl^-	0.79	0.88	Cl^-	0.79
NO^{3-}	5.83	4.52	NO^{3-}	5.83
SO_4^{2-}	11.60	14.13	SO_4^{2-}	11.60
NH_4^+	4.32	4.91	NH_4^+	4.32
Na	1.32	1.64	Na	1.32
Mg	0.36	0.38	Mg	0.36

Al	1.10	1.03	Al	1.10
Si	1.62	2.68	Si	1.62
K	0.74	0.85	K	0.74
Ca	1.44	1.09	Ca	1.44
Fe	1.46	1.77	Fe	1.46
Ti	0.01	0.01	Ti	0.01
V	0.05	0.03	V	0.05
Cr	0.06	0.05	Cr	0.06
Mn	0.03	0.03	Mn	0.03
Ni	0.01	0.01	Ni	0.01
Cu	0.04	0.09	Cu	0.04
Zn	0.18	0.42	Zn	0.18
Pb	0.10	0.21	Pb	0.10
As	0.04	0.08	As	0.04
Cd	0.00	0.01	Cd	0.00

Table S5. Uncertainty assessment of major emission sources in the Changzhutan urban agglomerations.

Types of pollution sources	**SO_2**	**NOx**	**CO**	**NH_3**	**VOCs**	**PM_{10}**	**$PM_{2.5}$**
Livestock and poultry Breeding	-	-	-	-51%~42%			
Waste treatment	-	-	-	-67%~74%	-78%~98%	-	-
Chemical production	-	-	-	-32%~151%	-	-	-
Motor vehicle	-	-25%~32%	-15%~17%	-48%~66%	-23%~41%	-31%~46%	-32%~38%
Human faeces	-	-	-	-42%~59%	-	-	-
Ecological farmland	-	-	-	-43%~47%	-	-	-
Biomass combustion	-	-	-	-82%~125%	-38%~43%	-	-
Construction Machinery	-	-37%~51%	-38%~50%	-	-69%~91%	-51%~67%	-48%~68%
Inland waterway vessels	-	-99%~99%	-90%~106%	-	-99%~169%	-88%~97%	-80%~111%
Agricultural machinery	-	-58%~99%	-60%~102%	-	-81%~178%	-80%~111%	-74%~117%
Railway	-79%~68%	-40%~40%	-40%~40%	-	-40%~42%	-40%~40%	-40%~42%
Plane		-50%~51%	-49%~51%	-	-50%~50%	-50%~51%	-49%~52%
Burning source of residents ' life	-54%~105%	-46%~63%	-	-	-88%~129%	-57%~93%	-72%~103%
Soil dust	-	-	-	-	-	-60%~121%	-60%~121%
Building dust	-	-	-	-	-	-31%~36%	-28%~33%
Pesticide use	-	-	-	-	-58%~109%	-	-

Architectural Coatings	-	-	-	-	-47%~79%	-	-
Automotive Spraying	-	-	-	-	-35%~41%	-	-
Surface Coating	-	-	-	-	-53%~39%	-	-
Dyeing process	-	-	-	-	-46%~57%	-	-
Other	-	-	-	-	-31%~33%	-	-
Industrial and commercial consumption	-	-	-	-	-69%~66%	-	-
Thermal Power generation	-	-	-	-	-42%~58%	-	-
Heating	-	-	-	-	-40%~38%	-	-
Residents ' living consumption	-	-	-	-	-73%~96%	-	-

Table S5 (continued)

Types of pollution sources	**SO_2**	**NOx**	**CO**	**NH_3**	**VOCs**	**PM_{10}**	**$PM_{2.5}$**
Gasoline	-	-	-	-	-17%~15%	-	-
Diesel	-	-			-14%~14%	-	-
Process Source	-35%~42%	-30%~31%	-	-	-35%~41%	-31%~36%	-34%~35%
Fixed combustion source	-22%~17%	-30%~19%	-	-	-32%~33%	-26%~30%	-30%~35%
Total	-20%~42%	-34%~58%	-36%~61%	-42%~89%	-46%~73%	-42%~67%	-38%~69%