Supplementary Materials

Impact of the '13th Five-Year Plan' policy on air quality in Pearl River Delta, China: A case study of Haizhu district in Guangzhou city using WRF-Chem

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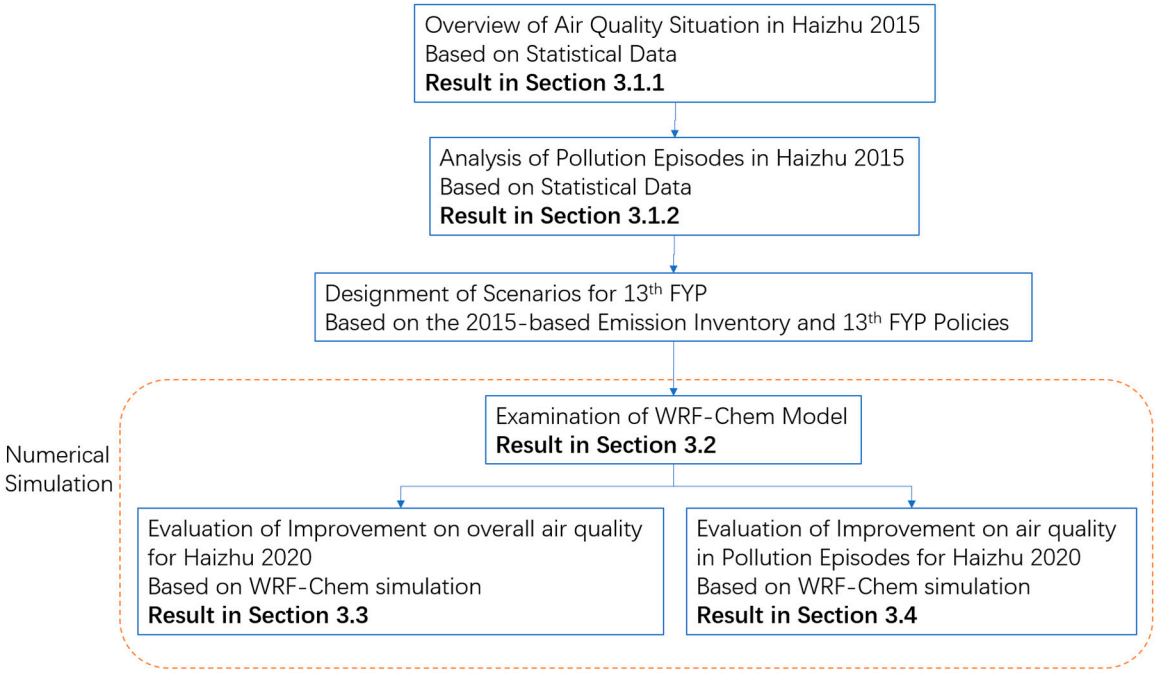

Figure S1. Research framework.

Table S1. Emission sectors, corresponding inventory technical guidelines and special allocation rules.

Emission sectors	Technical guidelines	Spatial allocation rules [1]
Industry (Industries)	Technical Guidelines for the Primary Source Emission Inventory of Atmospheric Fine Particles (Trial) [2]; Technical Guidelines for the Emission Inventory of Atmospheric Volatile Organic Compounds (Trial) [2]; Technical Guidelines for the Primary Source Emission Inventory of Inhalable Particulate Matter (Trial) [3].	According to the sources' location information (latitude and longitude).
Residential (residential cooking and fuel)	Technical Guidelines for the Emission Inventory of Atmospheric Volatile Organic Compounds (Trial) [2]; Technical Guidelines for the Primary Source Emission Inventory of Atmospheric Fine Particles (Trial) [2]; Technical Guidelines for the Primary Source Emission Inventory of Inhalable Particulate Matter (Trial) [3].	As area sources, and the spatial allocation is based on the population density and activity area information (location and acreage).
Transport (on-road vehicles source)	Technical Guidelines for the Air Pollutant Emission Inventory for Road Vehicles (Trial) [3].	Based on the road network information (road level, length and location).
Others (dust, non-road mobile source, sewage treatment source, commercial solvent use, etc.)	Technical Guidelines for the Air Pollutant Emission Inventory of Non-road Mobile Source (Trial) [3]; Technical Guidelines for the Emission Inventory of Dust Particles Discharge (Trial) [3]; Technical Guidelines for the Emission Inventory of Atmospheric Volatile Organic Compounds (Trial) [2].	As area sources, and the spatial allocation is based on the population density and activity area information (location and acreage).

Table S2. Description of emission control scenarios.

Scenarios	Emission Control Policy	
	Haizhu district	Other districts of Guangzhou
2020A	Follow the 2015 emission control policy tendency.	Follow the 2015 emission control policy tendency.
2020B	13th FYP emission control policy (comprehensive control).	Follow the 2015 emission control policy tendency.
2020C	13th FYP emission control policy (comprehensive control).	13th FYP emission control policy (comprehensive control).
2020D	13th FYP emission control policy (vehicle sector); Follow the 2015 emission control policy tendency(other sectors).	Follow the 2015 emission control policy tendency.

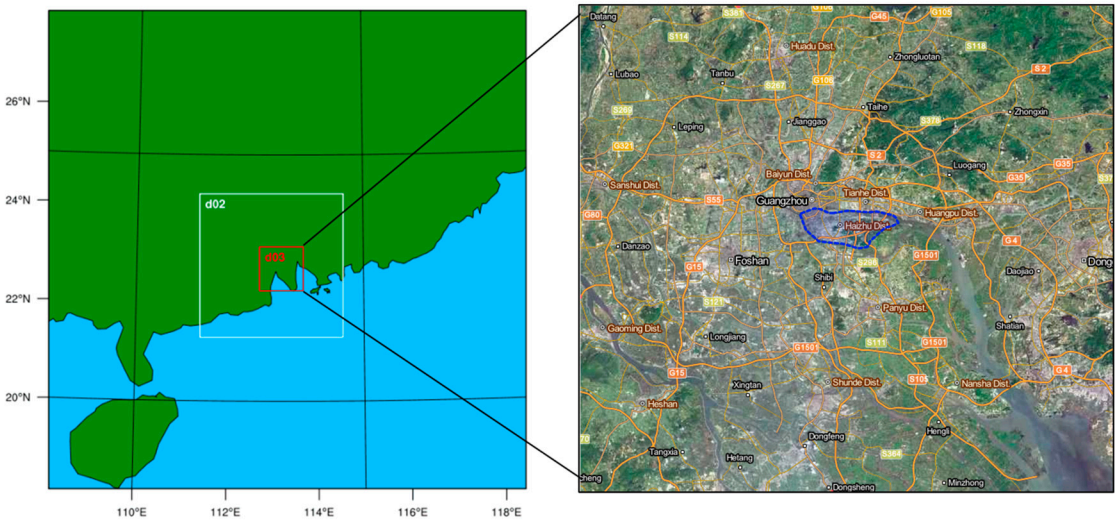

Figure S2. WRF-Chem simulation domain [4].

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93 **Table S3. Detailed information for pollution episodes observed in Haizhu monitoring stations, 2015.**

Station	Season	Event Frequency (Units)	Description (Date, primary pollutant, pollution level)
Baogang	Spring	5	March 8th -9th:$PM_{2.5}$, light pollution; March 14th: NO_2, light pollition; April 15th- 16th: O_3, moderate pollution; April 25th-27th: $PM_{2.5}$, O_3, light pollution; May 24th-25th: NO_2, $PM_{2.5}$, light pollution.
	Summer	4	July 12th-15th: O_3, moderate pollution; August 4th-6th: O_3, **heavy pollution**; August 19th: O_3, light pollution; August 24th-27th: O_3, light pollution;
	Autumn	3	September 8th-11th: O_3, moderate pollution; October 13th-16th: NO_2, $PM_{2.5}$, O_3, moderate pollution; Novenber 18th-19th: NO_2, light pollution.
	Winter	9	January 3rd-6th: $PM_{2.5}$, NO_2, light pollution; January 18th: $PM_{2.5}$, light pollution; January 20th-21st: $PM_{2.5}$, moderate pollution; January 24th-27th: $PM_{2.5}$, light pollution; February 3rd: $PM_{2.5}$, light pollution; February 6th-7th: $PM_{2.5}$, light pollution; February 10th-15th: $PM_{2.5}$, NO_2, moderate pollution; December 13th: $PM_{2.5}$, light pollution; December 19th-23rd: $PM_{2.5}$, moderate pollution.
Chisha	Spring	4	March 8th -9th:$PM_{2.5}$, light pollution; April 15th- 16th: O_3, moderate pollution; April 25th: $PM_{2.5}$, light pollution; May 24th: NO_2, light pollution.
	Summer	4	July 12th-15th: O_3, moderate pollution; August 4th-6th: O_3, **heavy pollution**; August 19th: O_3, light pollution; August 24th-27th: O_3, moderate pollution;
	Autumn	3	September 8th-11th: O_3, moderate pollution; October 13th-17th: NO_2, light pollution; Novenber 4th: NO_2, light pollution.

	Winter	7	January 3rd-6th: $PM_{2.5}$, light pollution; January 18th: $PM_{2.5}$, light pollution; January 20th-26th: $PM_{2.5}$, NO_2, moderate pollution; February 3rd: $PM_{2.5}$, light pollution; February 6th-7th: $PM_{2.5}$, light pollution; February 10th-15th: $PM_{2.5}$, NO_2, light pollution; December 19th-23rd: $PM_{2.5}$, NO_2, light pollution.
Shayuan	Spring	7	March 8th -9th:$PM_{2.5}$, moderate pollution; March 14th: $PM_{2.5}$, light pollition; April 13th: $PM_{2.5}$, light pollition; April 15th-16th:O_3, moderate pollution; April 25th-27th: $PM_{2.5}$, O_3, moderate pollution; April 29th:O_3, light pollution; May 25th: $PM_{2.5}$, light pollution.
	Summer	5	July 12th-15th: O_3, light pollution; August 4th-7th: O_3, **heavy pollution**; August 19th: O_3, light pollution; August 24th: O_3, light pollution; August 26th-27th: O_3, light pollution.
	Autumn	12	September 8th-11th: O_3, moderate pollution; September 17th-18th: O_3, light pollution; September 23th: O_3, light pollution; September 25th: O_3, light pollution; September 30th: O_3, light pollution. October 6th: O_3, light pollution; October 13th-17th: NO_2, O_3, $PM_{2.5}$, moderate pollution; October 23th-24th: NO_2, light pollution; October 28th: NO_2, light pollution; November 3th-4th: NO_2, light pollution; November 19th: $PM_{2.5}$, light pollution; November 29th: $PM_{2.5}$, light pollution.
	Winter	7	January 2nd-6th: $PM_{2.5}$, NO_2, moderate pollution; January 15th-27th: $PM_{2.5}$, NO_2, **heavy pollution**; January 29th: NO_2, light pollution; February 2nd-3rd: NO_2, light pollution; February 7th-16th: $PM_{2.5}$, NO_2, moderate pollution; December 13th: $PM_{2.5}$, light pollution; December 19th-23rd: $PM_{2.5}$, NO_2, moderate pollution.

Haizhuhu	Spring	6	March 8th -9th:$PM_{2.5}$, light pollution; March 14th: NO_2, light pollition; April 13th: $PM_{2.5}$, light pollition; April 15th-16th:O_3, moderate pollution; April 24th-25th: NO_2, $PM_{2.5}$, light pollution; May 24th: NO_2, light pollution
	Summer	3	July 2nd: O_3, light pollution; August 24th: O_3, light pollution; August 26th-27th: O_3, light pollution.
	Autumn	10	September 8th-11th: O_3, moderate pollution; September 17th-19th: O_3, moderate pollution; September 23rd: O_3, light pollution; September 25th: O_3, light pollution; September 30th: O_3, light pollution; October 14th-15th: O_3, moderate pollution; October 28th: O_3, light pollution; November 4th-5th: NO_2, O_3, light pollution; November 18th-20th: NO_2, light pollution; November 28th-29th: NO_2, light pollution;
	Winter	12	January 3rd-4th: $PM_{2.5}$, NO_2, light pollution; January 6th: NO_2, light pollution; January 18th: $PM_{2.5}$, light pollution; January 20th-21st: $PM_{2.5}$, moderate pollution; January 24th: NO_2, light pollution; January 26th: $PM_{2.5}$, light pollution; February 3rd: $PM_{2.5}$, light pollution; February 6th-7th: $PM_{2.5}$, light pollution; February 9th-13th: $PM_{2.5}$, O_3, NO_2, light pollution; February 15th: $PM_{2.5}$, light pollution; December 13th: NO_2, light pollution; December 19th-23rd: $PM_{2.5}$, NO_2, light pollution.

97 **Table S4. Statistical data for heavy pollution episode in Haizhu district during January 14–28, 2015.**

Date January	Primary pollutant	AQI	Air quality	Wind speed (m/s)	Relative Humidity (%)	Temperature (℃)	Surface pressure (hPa)
14th	NO_2	71	Good	2.9	72	11.4	1014.7
15th	NO_2	105	Light pollution	2.4	74	10.3	1015.1
16th	NO_2	116	Light pollution	2.4	72	12.2	1014.5
17th	NO_2	102	Light pollution	2.1	67	12.8	1016.1
18th	$PM_{2.5}$	120	Light pollution	2.3	67	12.2	1015.7
19th	$PM_{2.5}$	113	Light pollution	2.5	52	12.7	1014.5
20th	**$PM_{2.5}$**	**221**	**Heavy pollution**	**1.5**	**77**	**11.7**	**1012.3**
21st	**$PM_{2.5}$**	**217**	**Heavy pollution**	**2.4**	**73**	**14.9**	**1012.6**
22nd	NO_2	122	Light pollution	2	65	13.2	1013.2
23rd	NO_2	115	Light pollution	2.6	73	12.0	1011.8
24th	NO_2	118	Light pollution	1.5	82	14.4	1010.5
25th	$PM_{2.5}$	121	Light pollution	1.7	82	18.0	1010.0
26th	$PM_{2.5}$	129	Light pollution	1.4	85	17.7	1009.9
27th	$PM_{2.5}$	118	Light pollution	1.1	85	17.0	1009.1
28th	$PM_{2.5}$	80	Good	1.4	76	17.3	1009.4

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Table S5. Statistical data for heavy pollution episode in Haizhu district during August 3–8, 2015.

Date August	Primary pollutant	AQI	Air quality	Wind speed (m/s)	Relative Humidity (%)	Temperature (℃)	Surface pressure (hPa)
3rd	O_3	80	Good	1.1	76	27.6	1002.4
4th	O_3	119	Light pollution	1.3	74	28.5	1000.2
5th	O_3	161	Moderate pollution	1.3	75	28.5	997.9
6th	**O_3**	**201**	**Heavy pollution**	**1.4**	**76**	**29.2**	**997.2**
7th	O_3	115	Light pollution	3.9	69	29.6	996.2
8th	O_3	79	Good	4.4	65	30.3	991.7

Table S6. Performance statistics for meteorological simulation (hourly statistical data in October, 2015).

	Temperature (℃)	RH(%)	Wind speed (m/s)
Mean observation	23.72	74.98	2.26
Mean simulation	23.32	79.80	4.67
MB	-0.40	4.81	2.40
MAE	1.31	9.86	2.26
RMSE	1.65	12.24	3.15
R	0.90	0.69	0.45

MAE: Mean Absolute Error; R: Correlation Coefficient.

Table S7. Statistical comparison of model evaluation in this paper and previous study.

	CO	NO_2	$PM_{2.5}$	PM_{10}	SO_2	O_3	Temperature	RH	Wind speed	Reference
Mean observation	0.89	49.37	46.07	74.13	12.13	97.13#	23.72	74.98	2.26	This paper
Mean simulation	0.58	72.89	37.26	74.97	13.59	88.76#	23.32	79.80	4.67	This paper
MB	-0.32	24.34	-8.07	1.84	1.66	-6.92#	-0.40	4.81	2.40	This paper
RMSE	0.43	48.35	26.61	36.30	9.81	37.10#	1.31	9.86	2.26	This paper
MAE	0.38	35.65	20.62	27.72	7.07	30.26#	1.65	12.24	3.15	This paper
Mean observation	--	68.5	75.5	--	23.9	27.9#	16.5	63.5	2.4	[5]
Mean simulation	--	61.3	43.9	--	19.5	36.6#	16.8	61.8	4.0	[5]
MB	--	-7.2	-31.6	--	-4.4	8.7#	0.4	-1.7	1.6	[5]
RMSE	--	20.1	47.5	--	16.6	16.2#	1.3	5.6	1.7	[5]
MAE	--	16.0	35.4	--	10.5	12.4#	1.0	4.1	1.6	[5]
Mean observation	--	53.9*	61.9	--	--	29.2*	20.5	60.7	1.7	[6]
Mean simulation	--	40.0*	50.2	--	--	28.6*	19.4	63.2	4.2	[6]
MB	--	13.9*	11.7	--	--	0.6*	1.1	-2.5	-2.5	[6]
RMSE	--	33.3*	28.5	--	--	13.7*	2.3	11.5	2.8	[6]
MAE	--	--	--	--	--	--	1.8	9.2	2.5	[6]

Mean observation	--	--	--	--	--	--	--	--	--	[7]
Mean simulation	--	--	--	--	--	--	--	--	--	[7]
MB	--	--	--	--	--	--	-0.55	7.04	0.95	[7]
RMSE	--	--	--	--	--	--	2.21	12.84	2.30	[7]
MAE	--	--	--	--	--	--	--	--	--	[7]
Mean observation	--	--	--	79.5	--	--	18.7	--	1.9	[8]
Mean simulation	--	--	--	67.8	--	--	17.8	--	2.9	[8]
MB	--	--	--	-11.7	--	--	-0.9	--	1.0	[8]
RMSE	--	--	--	70.4	--	--	3.1	--	1.3	[8]
MAE	--	--	--	--	--	--	--	--	--	[8]
Mean observation	--	--	--	--	--	--	--	--	--	[9]
Mean simulation	--	--	--	--	--	--	--	--	--	[9]
MB	--	--	--	--	--	-5.77*	-0.71	--	0.63	[9]
RMSE	--	--	--	--	--	21.81*	2.13	--	1.23	[9]
MAE	--	--	--	--	--	--	--	--	--	[9]

CO concentration unit: mg/m^3; other pollutants concentration unit: $\mu g/m^3$; Temperature unit: ℃; RH unit: %; Wind speed unit: m/s.

*: pollutant concentration unit is ppbv; #: concentration of O_3-8h.

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