# **User's Manual of ABaCAS-OE**

# **1** Introduction

Optimized Edition of Air Benefit and Control and Attainment Assessment System (ABaCAS-OE) is a system to develop optimized (least cost) control strategies for specified air quality goal. It integrates the five ABaCAS decision support tools (1) an international control cost estimate tool (ICET), (2) a real-time emissions control and air quality response tool (RSM-VAT), (3) a Least Cost Control Optimizer (LE-CO) tool, (4) an air quality attainment assessment tool (SMAT-CE), and (5) a health and economic benefit tool (BenMAP-CE), and provides a user-friendly framework for policy makers to conduct cost-efficient control strategy analysis.

### **1.1 Functional framework of ABaCAS-OE**

ABaCAS-OE links the five ABaCAS tools together to help users to get optimized control strategies for specified air quality attainment by running them with a master script. Fig. 1 shows the functional framework of ABaCAS-OE. Firstly, users set up the attainment goals (e.g.,  $35 \ \mu g \ m^{-3}$  for annual mean of PM<sub>2.5</sub> and 100 ppb for daily 1-hour maxima of O<sub>3</sub>). Secondly, the real-time responses of PM<sub>2.5</sub> and O<sub>3</sub> to emission reduction ratios will be calculated using SMAT-CE by combining with monitor data. Thirdly, the reduction ratios of different pollutants and regions will be input into control cost optimizer (iteration calculation among LECO, ICET and RSM-VAT) to find out optimized control cost strategies for meeting the environmental targets with minimal cost. Later, the optimized control cost strategies will be input into BenMAP-CE to estimate the health and economic benefits resulting from changes in air quality. Finally, it will output a cost/benefit ratio for these optimized emissions control strategies.



Fig. 1 Functional framework of ABaCAS-OE

# 1.2 Who Can Use ABaCAS-OE?

ABaCAS-OE can be used by a wide range of persons, including scientists, policy analysts, and decision makers. Most end users (policy makers) can directly use the ABaCAS-OE to select the optimal combination of controls that can not only meet air quality and health benefits standards but are also the most cost-efficient control strategy among all candidates.

In a word, ABaCAS-OE can be used in the following aspects:

### > Strategy design and assessment screening tool

### > Optimization

• Can be used to develop optimal combinations of controls to attain standards at minimum cost.

### ➤ "What If?" Analyses

• Provide real-time cost-benefit results for different attainment scenarios.

## **1.3 Computer Requirements**

ABaCAS-OE requires a computer with:

- ➢ .Net Framework Version 4.0 or higher.
- ➤ 32-bit or 64-bit Windows 7/Windows 8/Windows 10.
- $\geq$  2 GB RAM or greater.
- > 10 GB free disk space or greater.

# 1.4 Installing/Uninstalling ABaCAS-OE

# 1.4.1 Installing ABaCAS-OE

➢ Download ABaCAS-OE Software Package on the ABaCAS website. This tool and corresponding example data are available for registered users at this website: <u>http://www.abacas-dss.com/abacas/Software.aspx.</u>

> Double click ABaCAS-OE\_Setup.exe to install the program, it will appear the following figure.



Fig. 2 Setup Window

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Fig. 3 Choose Install Location

Click "Next" button, it will show the "Ready to Install" window as shown in ABaCAS-OE - InstallShield Wizard

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Fig. 4 Ready to Install

Click "Install" button and ABaCAS-OE will be installed.

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Fig. 4 Installation Complete

Click "**Finish**" button and installation complete.

# 1.4.2 Uninstalling ABaCAS-OE

➢ Go to Control Panel.

Select ABaCAS-OE and click Change/Remove, it will appear following figure.



Fig. 5 Uninstallation Processing

➤ After a few seconds, uninstallation will finish.

### **1.5 Contacts for Comments and Questions**

For comments and questions, please contact Prof. Yun (Dustin) Zhu at South China University of Technology, Environmental Simulation and Information Laboratory.

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Guangzhou Higher Education Mega Center, Guangzhou, P. R. China.

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Telephone: 020-39380017.

### **1.6 Sources for More Information**

#### For files that you can use in ABaCAS-OE:

Air Benefit and Cost and Attainment Assessment System (ABaCAS) website, available at: <u>http://www.abacas-dss.com/abacas/Software.aspx</u>.

# 2 Terminology and File Types

The first section of this chapter explains common terms used in this user's manual. Section 2.2 describes in detail the necessary format for externally-generated model and monitor data files that can be read into ABaCAS-OE.

## 2.1 Common Terms

ABaCAS-OE: Optimized Edition of Air Benefit and Cost and Attainment Assessment System.

# 2.2 File Types

➤ Base Year PM Monitor Data: A \*.csv file for PM concentration of each monitor site of base year. It contains each site's geographic location、 station name and PM concentration.

> Base Year O3 Monitor Data: A \*.csv file for O3 concentration of each monitor

site of base year. It contains each site's geographic location, station name and O3 concentration.

➤ Factors File: A \*.csv file for emission factor information. It contains each factor's attributes, size and source.

**RSM File**: A \*.rsm file created by RSM-VAT.

**Receptor Region File**: A separate \*.txt file which defines the grids of the analyzed cities.

➤ **Mapping File**: it is a simple text file (\*.csv), which is used to link the Region, Pollutant, Source in ICET with those in RSM. For example, "Shanghai" used in ICET will be instead of "SH" in RSM.

➤ **Control Input File**: it should be in the form of a simple text file (\*.csv). This file contains:(1) Unit control costs in various control factors under different emission reductions;(2) The default control level;(3) Unit of Emission and Cost;

Data Sources mainly come from those control strategy models (e.g., EMF/CoST, GCAM, TECAS, GAINS-Asia, LEAP, etc.) or research reports/references or field investigation of local factories in the areas/cities.

➤ **Pooled Grid Definition**: it is used to aggregate the grid value into the value of a target region level (e.g., county or state level). It is noted that this file should have overlaps with the grid definition file in SMAT-CE input options.

➤ CFG Configuration File: it is a configuration file (\*.cfgx), which is used for health impact assessment.

➤ APV Configuration File: it is a configuration file (\*.apvx or \*.apvrx), which is used for environmental benefit assessment.

Table 1 presents the above the different file types, their name and their file extension.

Filename	File Extension
Base Year PM Monitor Data	*.csv
Base Year O3 Monitor Data	*.csv
Factors file	*.csv
RSM file	*.rsm
Receptor Region file	*.txt
Mapping file	*.CSV

Table 1 File types generated by ABaCAS-OE

Control Input file	*.csv
Pooled Grid Definition	*.shp
CFG Configuration File	*.cfgx
APV Configuration File	*.apvx or *.apvrx

# **3 Main Interface**

The main interface of ABaCAS-OE can be shown in Fig. .



Fig. 8 Main interface of ABaCAS-OE

 $\succ$  Click **File** button on the toolbar of the main interface, there are six options that users can choose.

- 1) Go to file, click **Open Project** button, locate the \*.proj file and open it.
- 2) Click New Project button to create a new project.
- 3) Click **Save Project** button to save a created project.
- Click Example Cases button to use the configuration files of the relevant projects that have been configured without having to select and set each module one by one.
- 5) Click **Options** button to modify the executable path of each subsystem of ABaCAS-OE and data storage path.
- 6) Click **Exit** button to exit system.

Click Tool button to set and run related tools individually according to the needs of users, including ICET, RSM-VAT, SMAT-CE and BenMAP-CE. Click View button on the toolbar of the main interface, there are two options that users can choose.

1) Click Setting Viewer button to view the setting interface.

2) Click **Data Viewer** button to view the visual analysis interface.

Click Case button to view the existing case studies in China, the US or the other regions.

> Click About button to see the version and copyright information of ABaCAS-OE.

➢ In addition, there are three different input options for inputting different data or configurating the calculation parameters, including Attainment Assessment Option, Control Cost Optimizer Option and Health Benefit Input Option.

### **3.1 Attainment Assessment Option**

> The Attainment Assessment Option includes Attainment Goals, Base Year PM Monitor Data, Base Year O3 Monitor Data and Advanced Option, as shown in 错误!未找到引用源。.



Fig. 9 Attainment Assessment Option

> Attainment Goals: allows users to set the target concentration/percentage while selecting target pollutant. For example, users can choose  $PM_{2.5}$  or ozone, or both as target pollutant according to their needs. And then, users can set their target concentration/percentage.

**Base Year PM Monitor Data:** If users choose PM as target pollutant, they need to set the corresponding baseline monitor data. With these data, the rationality of the model prediction value can be guaranteed.

> Base Year O3 Monitor Data: If users choose  $O_3$  as target pollutant, they need to set the corresponding baseline monitor data. With these data, the rationality of the model prediction value can be guaranteed.

> Advanced Option: allows users to set more options. For example, users can check "eVNA" to interpolate monitor data to spatial field, gradient adjusted by model data, check "Output all attainment solutions" or not to output only one optimal attainment solution and check "Reduce regional transport (boundary conditions) contribution" to output attainment solutions if all the previous simulation solutions are not meet attainment goal.

### **3.2 Control Cost Optimizer Option**

➢ The Control Cost Optimizer Option includes LE-CO Calculation Input options, RSM Input Options and ICET Input Options, as shown in 错误!未找到引用源。.



Fig. 10 Control Cost Optimizer Option

# **3.2.1 LE-CO Calculation Input options**

➢ The LE-CO Calculation Input options include Factors File, Details and Use Genetic algorithm, as shown in 错误!未找到引用源。. In addition, user can choose whether or not to use LE-CO configuration file.



Fig. 11 LE-CO Calculation Input options

**Factors File:** allows users to set the factors of specific region.

> **Details:** allows users to determine the number of control scenarios by setting the step interval, minimum and maximum values.

➤ Use Genetic algorithm: allows users to use "Population Size" to set the number of original scenarios, use "Generation" to set the number of iterations and use "Cross Probability" or "Mutation Probability" to set the range of changing randomly for factors. These choosing of parameters depend on the numbers of factors. With the growing of iterations, the calculation will be convergent to an optimal solution.

# **3.2.2 RSM Input options**

➤ The RSM Input Options allow users to set RSM File based on different pollutants and select two pollutants simultaneously, as shown in 错误!未找到引用源。.



Fig. 12 RSM Input options

# **3.2.3 ICET Input options**

➤ The ICET Input Options allow users to set Mapping File and Control Input File.
And users can also select specific region for calculation and analysis, as shown in 错误:未找到引用源。.



Fig. 13 ICET Input options

# 3.3 Health Benefit Input Option

➢ The Health Benefit Input Option includes Pooled Grid Definition, CFG configuration file or result file, APV configuration file or result file and Audit Trail Report, as shown in 错误!未找到引用源。.



Fig. 14 Health Benefit Input Option

> Pooled Grid Definition: allows users to set the grid information of specific region.

> CFG configuration file or result file: includes a list of parameter information needed for a health impact assessment.

> APV configuration file or result file: includes a list of parameter information needed for an environmental benefit assessment.

> Audit Trail Report: allows users to view the detailed configuration information.

# **4 Run ABaCAS-OE**

After the input settings are complete, users need to click "Next" to start running ABaCAS-OE. And users can view the running messages through "Log/Msg", as shown in 错误!未找到引用源。.



Fig. 15 Running Messages

# **5** Operation Results

When the ABaCAS-OE is finished, the system provides various display ways for its four subsystems (SMAT-CE, LE-CO, RSM-VAT and BenMAP-CE) of visualized analysis, including MAP, GIS, Chart or Data, as shown in 错误!未找到引用源。.





## 5.1 The results of SMAT-CE

> In Chart module, users can view the comparison between the baseline and predicted values and their reductions of different regions/cities, including configurating plot according to their preferences, as shown in Fig. .



Fig. 17 Chart results and configuration options of SMAT-CE

### 5.2 The results of LE-CO

### **5.2.1** The results of Optimized Strategies

> In Map module, users are allowed to show the concentration distribution of different attainment scenarios. Users can also set specific plot type and perform different operations on map (e.g., zoom in or zoom out domain), as shown in Fig. 18.



Fig. 18 Map results and configuration options of Optimized Strategies

> In GIS module, it allows users to view the attainment results of different scenarios in each monitor site. It also provides a function for user to configurate legend as needed, as shown in Fig. .



Fig. 19 GIS results and configuration options of Optimized Strategies

➤ In Chart module, users can also view the results of different scenarios and monitoring sites, including configurating plot according to their preferences, as shown in Fig. .



Fig. 20 Chart results and configuration options of Optimized Strategies ➤ In Data module, it provides more details information for each attainment scenario, e.g., control cost, attainment concentration for each monitor sites and emission reduction and so on. Users can check their interest fields to show or export data for further study, as shown in Fig. .

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Fig. 21 Data detail results and configuration of Optimized Strategies

### **5.2.2** The results of ICET

> In Data module, it provides more details information about pollutant control strategies, e.g., total removal cost, removal cost of each pollutant, and baseline emission and so on. Users can check their interest fields to show or export data for further study, as shown in Fig. .

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Data	Chart .	uala uel			it, baseline	Data	Chart or	nission	and rom	ained e	mission
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otal Removal	Cost				^	Region	Pollutant	Baseline Er	missi Control Cost(F	MI Removed Er	missi Remained Er
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otal so2 Remo	wal Cost (Million Yu	an)		59.4		jinan	502	1,315.3	3,986,946.8	657.7	657.7
						jinan	nh3	4,709.1	35,276,535.6	3,296.4	1,412.7
tal nh3 Remo	wal Cost (Million Yu	ian)		208.8		jinan	voc	6,745.7	34,819,915.2	4,047.4	2,698.3
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tal pm25 Ren	noval Cost (Million	Yuan)		621.9		dezhou	so2	1,666.6	2,542,255.4	750.0	916.6
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seline pm2	5 Emission (Thou	sand Ton) 70.8	pm25 COST	per TON 16,981.4		dezhou	VOC	4,843.8	29,221,192.9	3,148.4	1,695.3
		16.4	(Yuan/Ton)	517		dezhou	pm25	10,734.4	42,357,754.5	5,367.2	5,367.2
125 Emission	n Removed (Thou	sand Ton) 36.6	pm25 Emis	ision Removed (%) 51.7		binzhou	nox	8,347.9	20,232,915.8	3,339.2	5,008.8
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isenne voc c	umasion (Thouse	40.5	(Yuan/Ton)	0,07.3.0		binzhou	nh3	5,272.9	7,693,620.4	1,581.9	3,691.1
c Emission F	Removed (Thousa	nd Ton) 21.1	voc Emissi	on Removed (%) 52.3		binzhou	voc	4,590.4	23,694,664.8	2,754.3	1,836.2
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nized Strat Data tem Outpu gion an an an an an an an an an an an an an	Removed (Thouse eggles) Chart t Regional Lev Pollutant nh3 so2 nh3 so2 nh3 so2 pm25 pm25 pm25 pm25 so2 nos so2 nh3 so2 nh3 so2 pm25 so2 nh3 so2 pm25 so2 nh3	end Ton) 22.0 CET Regional Co Source T R R dust inpc cb cb cb cb cb cb cb cb cb c	nh3 Emissi introl&Cost ESM Umit 0.30 0.35 0	Control Factor Show each of factor of sel regions	emission ected	Dottimized Strat Data System Output Region Jinan Jinan Jinan Jinan Jinan Jinan Jinan Jinan Jinan Jinan Jinan Jinan	egies Сhart t Regional Leve Sector 11 17 17 17 17 17 17 17	ECET  ECET ECET ECET  ECET ECE	Control Contro	ta detai mate an Control Facto ior Cost_statua ior Cost_statua	1000.
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h3 Emission mized Strat Data item Outpu gion an an an an an an an an an an an an an	Removed (Thouse egles Chart t Regional Lev Pollutant nos pm25 pm25 pm25 pm25 pm25 pm25 pm25 pm25	And Tony 22.8 CET Regional Coo R R R R R dust G G G Cher R R C R R R R R R R R R R R R R	nh3 Emissi Introl&Cost R3M Limit 0.30 0.30 0.40 0.40 0.40 0.40 0.40 0.55 0.35 0.45 0	Control Factor Show each of factor of sel regions Export the	emission ected	Coptimized Strat Coptimized Strat Data System Output Region Inan Jinan Jinan Jinan Jinan Jinan Jinan Jinan Jinan Jinan Jinan Jinan Jinan	egies Chart Chart Regional Leve Sector IT IT IT IT IT IT IT IT IT IT IT IT IT	ECET  ECET ECET  ECET  ECET  ECET  ECET ECET  ECET  ECET  ECET ECE	Show dat cost esti controls.com 245, 31228 245, 3128 245, 315, 315 245, 315, 315, 315, 315	ta detai mate ar control Facto control Facto control facto 5 20 25 25 20 25 20 25 25 20 25 20 25 25 20 25 25 20 25 20 25 25 20 25 25 20 25 25 20 25 25 20 25 25 20 25 25 20 25 25 20 25 25 25 20 25 25 25 25 25 25 25 25 25 25 25 25 25	1000.

Fig. 22 Data detail results and configuration of ICET

 $\succ$  In Chart module, users can also view the results of different pollutant control strategies, including configurating plot according to their preferences, as shown in Fig. .



Fig. 23 Chart results and configuration options of ICET

## 5.3 The results of RSM-VAT

> In Map module, users are allowed to show the concentration that responds in real time to the emission reduction control. Users can also set specific plot type and perform different operations on map (e.g., zoom in or zoom out domain), as shown in Fig. 24.



Fig. 24 Map results and configuration options of RSM-VAT

➢ In Data module, it provides more details information about concentration of selected pollutant e.g., baseline value, control value, and difference value and so on. Users can check their interest fields to show, as shown in Fig. .

Map B	Data	Chart O Delta	○ PM2.5 ● O3	(1	4 4   1	Expo data /264   > >	to local
	_ID	_TYPE	LAT	LONG	Season	03	^
•	1001		35.2	115.1	201707	202.3	
	2001		35.2	115.1	201707	201.4	
	3001		35.2	115.2	201707	198.5	
	4001		35.2	115.2	201707	197.8	
	5001		35.2	115.2	201707	195.5	
	6001		35.2	115.3	201707	198.0	
	7001		35.2	115.3	201707	198.0	
	8001		35.2	115.3	201707	200.4	
	9001		35.2	115.4	201707	196.3	
	10001		35.2	115.4	201707	196.6	
	11001		35.2	115.4	201707	198.0	
	12001		35.2	115.5	201707	204.9	
	13001		35.2	115.5	201707	204.7	
	14001		35.2	115.5	201707	206.9	
	15001		35.2	115.6	201707	207.0	
	16001		35.2	115.6	201707	207.4	
	17001		35.2	115.6	201707	205.4	
	18001		35.2	115.7	201707	201.5	
	19001		35.2	115.7	201707	200.8	
	20001		35.2	115.7	201707	201.2	
	21001		35.2	115.8	201707	196.8	~

Fig. 25 Data detail results and configuration of RSM-VAT

 $\succ$  In Chart module, users can also view the emission reduction effects of emission control, including configurating plot according to their preferences, as shown in Fig. .



Fig. 26 Chart results and configuration options of RSM-VAT

# 5.4 The results of BenMAP-CE

➢ In Map module, users are allowed to show the mortality and valuation results. Users can also confugurate legend as needed, as shown in Fig. 27.





> In Data module, it provides more details information about mortality and a range of benefits of each region e.g., low benefit, median benefit, high benefit and so on, as shown in Fig. .

Map Data	Chart					
Pollutant: PM2.	5 ~				/1   ▶ ▶	Output
Region	Benefit	Mortality	LowBenefit	MedianBenefit	HighBenefit	Export the output
other	3,015,783,872.0	1,417.6	1,900,293,990.0	2,075,780,852.0	11,994,156,824.0	
jinan	1,322,525,184.0	621.7	897,382,528.0	964,392,640.0	4,737,248,768.0	data to local path
binzhou	586,075,712.0	275.5	380,876,032.0	413,111,424.0	2,236,735,488.0	
taian	941,246,656.0	442.4	582,522,112.0	639,048,192.0	3,829,117,696.0	
zibo&laiwu	1,010,709,280.0	475.1	628,929,120.0	689,105,872.0	4,083,727,296.0	
liaocheng	861,934,272.0	405.2	563,530,368.0	610,417,664.0	3,261,921,024.0	
dezhou	924,848,896.0	434.7	596,129,088.0	647,800,896.0	3,569,496,320.0	
Total	8,663,123,872.0	4,072.2	5,549,663,238.0	6,039,657,540.0	33,712,403,416.0	

Fig. 28 Data detail results of BenMAP-CE

➤ In Chart module, users can also visually view the mortality and valuation results in different regions/cities, including configurating plot according to their preferences, as shown in Fig. .



Fig. 29 Chart results and configuration options of BenMAP-CE

# 6 Case Study in China

In order to better introduce how to use ABaCAS-OE, we will take a case study in China for example.

### 6.1 Create a new project

Click File button, and choose New Project option to create a new project.

### **6.2 Set input parameters**

> Choose PM<sub>2.5</sub> as target pollutant and set the target percentage to 30 %.

> Click the file button  $\swarrow$  which is the monitor data corresponding to PM<sub>2.5</sub> to select a **Base Year PM Monitor Data** and open it. The details of Base Year PM Monitor Data is shown Fig.30.

Quarter									
_ID	_TYPE	LAT	LONG	Quarter_I	PM25	LOCATION_	STATION_N.	AME	
1		36.6464	116.9472	201701	103.8616	Jinan	Ji chuange:	rchang	
2		36.7431	117.1509	201701	120.8155	Jinan	Jinanbaos	heng	
3		36.6861	116.9903	201701	85.66558	Jinan	Jinanhuag	ongchang	
4		36.6551	116.8104	201701	92.6089	Jinan	Jinanxich	engqu	
5		36.9719	117.1907	201701	99.87852	Jinan	Jiyangche	ngqu	
6		36.9858	117.155	201701	93.13418	Jinan	Jiyangkai	faqu	
7		36.6753	117.1851	201701	85.25469	Jinan	Jiangongx	ueyuan	
8		36.6303	117.1061	201701	86.95302	Jinan	Jinpingzh	ongxue	
9		36.6357	117.0669	201701	78.99095	Jinan	Jingjixue	yuan	
10		36.6772	117.1164	201701	81.9893	Jinan	Kaifaqu		
11		36.6116	116.9866	201701	87.99015	Jinan	Kegansuo		
12		36.7142	116.9483	201701	108.1632	Jinan	Lanxiangj	ixiao	
13		36.6653	116.9378	201701	88.94962	Jinan	Nongkesuo		
14		36.2833	116.4596	201701	107.5461	Jinan	Pingyinch	engqu	
15		36.2922	116.478	201701	104.3693	Jinan	Pingyinka	ifaqu	
16		36.5957	117.0204	201701	77.46541	Jinan	Shandongl	uneng	
17		37.3167	117.164	201701	94.37934	Jinan	Shanghech	engqu	
18		37.2642	117.1385	201701	94.60902	Jinan	Shangheka	ifaqu	
19		36.6368	117.2727	201701	74.70196	Jinan	Shangzhix	ueyuan	
20		36.6872	117.0619	201701	102.7154	Jinan	Shengzhon	gzicangku	L
21		36.6411	117.0276	201701	79.93753	Jinan	Gaoxinxue	xiao	
22		36.6627	117.0494	201701	90.9182	Jinan	Shijiance	zhan	
23		36.6871	117.5374	201701	99.95289	Jinan	Zhangqiuc	hengqu	
24		36.6763	117.5128	201701	95.19905	Jinan	Zhangqiuk	aifaqu	
25		36.5398	116.8059	201701	79.02929	Jinan	Changqing	daxuechen	ıg
26		36.5522	116.772	201701	85.45882	Jinan	Changqing	dangxiao	
27		36.6372	117.0365	201701	92.75034	Jinan	Shibowugu	an	
28		36.6612	117.0203	201701	83.52923	Jinan	Quancheng	guangchan	g
29		37.19109	116.8704	201701	81	Dezhou	Ertongley	uan	
30		37.34006	116.5708	201701	75.5	Dezhou	Jianlizha	n	
31		37.46083	116.3282	201701	61.75	Dezhou	Jiuququan	chunjings	hui chang
32		37.38424	117.9542	201701	81	Binzhou	Shihuanba	oju	
33		37.40531	117.9683	201701	75	Binzhou	Diershuid	hang	
34		37.70317	118.1537	201701	71.5	Binzhou	Beizhongx	inxiao	
35		36.41281	116.0065	201701	79.25	Liaocheng	Quzhengfu		
36		36.48508	115.9888	201701	75.75	Liaocheng	Dangxiao	_	
37		36.42711	116.0111	201701	79.25	Liaochens	Liaodadon	gxiao	
38		36.01747	117.1139	201701	61	Taian	Jiancezha	n	
39		36.2106	116.5809	201701	54.25	Taian	Renkouxue	xiao	
40		36.22791	117.1917	201701	67	Taian	Dianlixue	xiao	
41		36.81633	118.0552	201701	61	Zibo	Renmingon	gyuan	

Fig. 30 Base Year PM Monitor Data

≻ Check eVNA.

> Check the **Output all attainment solutions**.

> Check the **Reduce regional transport** (boundary conditions) contribution.

> Click Next button to enter the interface of Control Cost Optimizer Option, as shown in the Fig. .

File - Tool View - Case About				
Attainment Assessment Option Control Cost Optimizer Option Health Benefit Input Option				1
Attainment Assessment Option 0	)	🗟 SMAT-CE 🐝 LE-CO 🔹 RSM-VAT 🖲 BenMAP-CE Benefit/Cost 💿 Log/Msg		
Attainment Goals		Running messages		
O Concentration				
✓ PM2.5 30 %				
Ozone 0 %				
Base Year PM Monitor Data				
Jinan_PM25_Annual_Mass_Data.csv 🦻				
Base Year O3 Monitor Data				
Jinan_03_90_Annual_Mass_Data.csv 🂫				
Advanced Option	4			
Interpolate monitor data to spatial field,gradient adjusted by model data (eVNA)				
Output all attainment solutions				
Reduce regional transport (boundary conditions) contribution if attainment goals not meet				
Additional regional transport (BC) reduction (%): 20				
J				
Cancel des				
Back	-	Current	Setup:	China .::

Fig. 31 Set attainment goals

- > Choose No LE-CO configuration file.
- $\succ$  Click the file button  $\swarrow$  which is in the upper-right of the main interface to select
- a Factors File and open it. The details of Factors File is shown Fig.32.

A         NOX         TT         0.05         0         1           A         S02         TT         0.05         0         1           A         NH3         TT         0.05         0         1           A         VOC         TT         0.05         0         1           B         NOX         TT         0.05         0         1           B         NOX         TT         0.05         0         1           B         NOX         TT         0.05         0         1           B         VOC         TT         0.05         0         1           C         NOX         TT         0.05         0         1           C         NOX         TT         0.05         0         1           C         NOX         TT         0.05         0         1           D         NOX         TT         0.05         0         1           D         NOX         TT         0.05         0         1           D         NOX         TT         0.05         0         1           E         NOX         TT         0.05	Region	Pollutant	Source	Limit	Min	Max
A         SO2         TT         0.05         0         1           A         NH3         TT         0.05         0         1           A         VOC         TT         0.05         0         1           B         NOX         TT         0.05         0         1           B         NOX         TT         0.05         0         1           B         NH3         TT         0.05         0         1           B         NH3         TT         0.05         0         1           C         NOX         TT         0.05         0         1           D         NOX         TT         0.05         0         1           D         NOX         TT         0.05         0         1           D         NOX         TT         0.05         0         1           E         NOX         TT         0.05	A	NOX	TT	0.05	0	1
A         NH3         TT         0.05         0         1           A         YOC         TT         0.05         0         1           B         NOX         TT         0.05         0         1           B         NOX         TT         0.05         0         1           B         NOX         TT         0.05         0         1           B         VOC         TT         0.05         0         1           C         NOX         TT         0.05         0         1           D         NOX         TT         0.05         0         1           E         NOX         TT         0.05	A	S02	TT	0.05	0	1
A         VOC         TT         0.05         0         1           B         NOX         TT         0.05         0         1           B         SO2         TT         0.05         0         1           B         NH3         TT         0.05         0         1           B         NH3         TT         0.05         0         1           C         NOX         TT         0.05         0         1           D         NOX         TT         0.05         0         1           D         NOX         TT         0.05         0         1           E         NOX         TT         0.05         0         1           E         NOX         TT         0.05         0         1           F         NOX         TT         0.05	A	NH3	TT	0.05	0	1
B         NOX         TT         0.05         0         1           B         SO2         TT         0.05         0         1           B         NH3         TT         0.05         0         1           B         VOC         TT         0.05         0         1           C         NOX         TT         0.05         0         1           D         NOX         TT         0.05         0         1           D         NOX         TT         0.05         0         1           D         NOX         TT         0.05         0         1           E         NOX         TT         0.05         0         1           E         NOX         TT         0.05         0         1           F         NOX         TT         0.05	A	VOC	TT	0.05	0	1
B         SO2         TT         0.05         0         1           B         NH3         TT         0.05         0         1           B         VOC         TT         0.05         0         1           C         NOX         TT         0.05         0         1           D         NOX         TT         0.05         0         1           E         NOX         TT         0.05         0         1           E         NOX         TT         0.05         0         1           F         NOX         TT         0.05         0         1           F         NOX         TT         0.05	В	NOX	TT	0.05	0	1
B         NH3         TT         0.05         0         1           B         VOC         TT         0.05         0         1           C         NOX         TT         0.05         0         1           C         SO2         TT         0.05         0         1           C         NH3         TT         0.05         0         1           C         NH3         TT         0.05         0         1           D         NOX         TT         0.05         0         1           E         NOX         TT         0.05         0         1           E         NOX         TT         0.05         0         1           F         NOX         TT         0.05         0         1           F         NOX         TT         0.05         0         1           G         NOX         TT         0.05	В	S02	TT	0.05	0	1
B         VOC         TT         0.05         0         1           C         NOX         TT         0.05         0         1           C         SO2         TT         0.05         0         1           C         NH3         TT         0.05         0         1           C         NH3         TT         0.05         0         1           D         NOX         TT         0.05         0         1           D         VOC         TT         0.05         0         1           E         NOX         TT         0.05         0         1           E         NOX         TT         0.05         0         1           F         NOX         TT         0.05         0         1           F         NOX         TT         0.05         0         1           G         NOX         TT         0.05	В	NH3	TT	0.05	0	1
C         NOX         TT         0.05         0         1           C         S02         TT         0.05         0         1           C         NH3         TT         0.05         0         1           C         VOC         TT         0.05         0         1           D         NOX         TT         0.05         0         1           D         VOC         TT         0.05         0         1           E         NOX         TT         0.05         0         1           E         NOX         TT         0.05         0         1           F         NOX         TT         0.05         0         1           F         NOX         TT         0.05         0         1           F         NOX         TT         0.05         0         1           G         NOX         TT         0.05	В	VOC	TT	0.05	0	1
C         SO2         TT         0.05         0         1           C         NH3         TT         0.05         0         1           C         VOC         TT         0.05         0         1           D         NOX         TT         0.05         0         1           D         SO2         TT         0.05         0         1           D         NA3         TT         0.05         0         1           D         NA3         TT         0.05         0         1           D         VOC         TT         0.05         0         1           E         NOX         TT         0.05         0         1           E         NOX         TT         0.05         0         1           E         NOX         TT         0.05         0         1           F         NOX         TT         0.05         0         1           F         NOX         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         NOX         TT         0.05	С	NOX	TT	0.05	0	1
C         NH3         TT         0.05         0         1           C         VOC         TT         0.05         0         1           D         NOX         TT         0.05         0         1           D         SO2         TT         0.05         0         1           D         NH3         TT         0.05         0         1           D         VOC         TT         0.05         0         1           E         NOX         TT         0.05         0         1           F         NOX         TT         0.05         0         1           F         NOX         TT         0.05         0         1           F         NOX         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         NOX         TT         0.05	С	S02	TT	0.05	0	1
C         VOC         TT         0.05         0         1           D         NOX         TT         0.05         0         1           D         SO2         TT         0.05         0         1           D         NH3         TT         0.05         0         1           D         VOC         TT         0.05         0         1           E         NOX         TT         0.05         0         1           E         NOX         TT         0.05         0         1           E         SO2         TT         0.05         0         1           E         NOX         TT         0.05         0         1           F         NOX         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         NOX         TT         0.05	С	NH3	TT	0.05	0	1
D         NOX         TT         0.05         0         1           D         SO2         TT         0.05         0         1           D         NH3         TT         0.05         0         1           D         VOC         TT         0.05         0         1           E         NOX         TT         0.05         0         1           F         NOX         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         NOX         TT         0.05	С	VOC	TT	0.05	0	1
D         SO2         TT         0.05         0         1           D         NH3         TT         0.05         0         1           D         VOC         TT         0.05         0         1           E         NOX         TT         0.05         0         1           E         SO2         TT         0.05         0         1           E         NOX         TT         0.05         0         1           E         NOX         TT         0.05         0         1           E         NOX         TT         0.05         0         1           F         NOX         TT         0.05         0         1           F         SO2         TT         0.05         0         1           F         NOX         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         NOX         TT         0.05         0         1           A         PM25         DUST         0.05	D	NOX	TT	0.05	0	1
DNH3TT0.0501DVOCTT0.0501ENOXTT0.0501ESO2TT0.0501ENH3TT0.0501EVOCTT0.0501FNOXTT0.0501FSO2TT0.0501FSO2TT0.0501FNOXTT0.0501FVOCTT0.0501GNOXTT0.0501GSO2TT0.0501GNOXTT0.0501GNOXTT0.0501GNH3TT0.0501APM25DUST0.0501APM25TT0.0501APM25TT0.0501BPM25TT0.0501DPM25TT0.0501FPM25TT0.0501FPM25TT0.0501GPM25TT0.0501FPM25TT0.0501FPM25TT0.0501FPM25TT0.0501	D	S02	TT	0.05	0	1
DVOCTT0.0501ENOXTT0.0501ESO2TT0.0501ENH3TT0.0501EVOCTT0.0501FNOXTT0.0501FSO2TT0.0501FNOXTT0.0501FNOXTT0.0501FNH3TT0.0501GNOXTT0.0501GNOXTT0.0501GNOXTT0.0501GNOXTT0.0501GNOXTT0.0501GNOXTT0.0501APM25DUST0.0501APM25TT0.0501APM25TT0.0501DPM25TT0.0501FPM25TT0.0501FPM25TT0.0501GPM25TT0.0501GPM25TT0.0501GPM25TT0.0501GPM25TT0.0501CPM25TT0.0501	D	NH3	TT	0.05	0	1
E         NOX         TT         0.05         0         11           E         SO2         TT         0.05         0         11           E         NH3         TT         0.05         0         11           E         VOC         TT         0.05         0         11           E         VOC         TT         0.05         0         11           F         NOX         TT         0.05         0         11           F         SO2         TT         0.05         0         11           F         SO2         TT         0.05         0         11           F         NH3         TT         0.05         0         11           G         NOX         TT         0.05         0         11           A         PM25         DUST         0.05         0         11           A         PM25         FXCB         <	D	VOC	TT	0.05	0	1
E         SO2         TT         0.05         0         11           E         NH3         TT         0.05         0         11           E         VOC         TT         0.05         0         11           F         NOX         TT         0.05         0         11           F         NOX         TT         0.05         0         11           F         SO2         TT         0.05         0         11           F         NH3         TT         0.05         0         11           F         NH3         TT         0.05         0         11           G         NOX         TT         0.05         0         11           G         VOC         TT         0.05         0         11           A         PM25         DUST         0.05         0         11           A         PM25         TT <th< td=""><td>E</td><td>NOX</td><td>TT</td><td>0.05</td><td>0</td><td>1</td></th<>	E	NOX	TT	0.05	0	1
E         NH3         TT         0.05         0         11           E         VOC         TT         0.05         0         11           F         NOX         TT         0.05         0         11           F         NOX         TT         0.05         0         11           F         NOX         TT         0.05         0         11           F         NH3         TT         0.05         0         11           F         NH3         TT         0.05         0         11           G         NOX         TT         0.05         0         11           G         NH3         TT         0.05         0         11           A         PM25         DUST         0.05         0         11           A         PM25         FXCB         0.05         0         11           A         PM25         TT	E	S02	TT	0.05	0	1
E         VOC         TT         0.05         0         11           F         NOX         TT         0.05         0         11           F         SO2         TT         0.05         0         1           F         NH3         TT         0.05         0         1           F         VOC         TT         0.05         0         1           F         VOC         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         NH3         TT         0.05         0         1           G         NH3         TT         0.05         0         1           A         PM25         DUST         0.05         0         1           A         PM25         FXCB         0.05         0         1           A         PM25         TT         0.05         0         1           D         PM25         TT         0.05 <td>E</td> <td>NH3</td> <td>TT</td> <td>0.05</td> <td>0</td> <td>1</td>	E	NH3	TT	0.05	0	1
F         NOX         TT         0.05         0         11           F         SO2         TT         0.05         0         11           F         NH3         TT         0.05         0         1           F         VOC         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         SO2         TT         0.05         0         1           G         NH3         TT         0.05         0         1           G         NH3         TT         0.05         0         1           G         NH3         TT         0.05         0         1           G         VOC         TT         0.05         0         1           A         PM25         DUST         0.05         0         1           A         PM25         FXCB         0.05         0         1           A         PM25         TT         0.05         0         1           D         PM25         TT         0.05 <td>E</td> <td>VOC</td> <td>TT</td> <td>0.05</td> <td>0</td> <td>1</td>	E	VOC	TT	0.05	0	1
F         SO2         TT         0.05         0         1           F         NH3         TT         0.05         0         1           F         VOC         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         SO2         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         NH3         TT         0.05         0         1           G         VOC         TT         0.05         0         1           A         PM25         DUST         0.05         0         1           A         PM25         INPC         0.05         0         1           A         PM25         TT         0.05         0         1           B         PM25         TT         0.05         0         1           D         PM25         TT         0.05 <td>F</td> <td>NOX</td> <td>TT</td> <td>0.05</td> <td>0</td> <td>1</td>	F	NOX	TT	0.05	0	1
F         NH3         TT         0.05         0         1           F         VOC         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         NH3         TT         0.05         0         1           G         VOC         TT         0.05         0         1           A         PM25         DUST         0.05         0         1           A         PM25         INPC         0.05         0         1           A         PM25         FXCB         0.05         0         1           A         PM25         TT         0.05         0         1           D         PM25         TT         0.05         0         1           F         PM25         TT         0.05<	F	S02	TT	0.05	0	1
F         VOC         TT         0.05         0         1           G         NOX         TT         0.05         0         1           G         SO2         TT         0.05         0         1           G         NH3         TT         0.05         0         1           G         NH3         TT         0.05         0         1           G         VOC         TT         0.05         0         1           A         PM25         DUST         0.05         0         1           A         PM25         INPC         0.05         0         1           A         PM25         INPC         0.05         0         1           A         PM25         TT         0.05         0         1           A         PM25         TT         0.05         0         1           B         PM25         TT         0.05         0         1           C         PM25         TT         0.05         0         1           D         PM25         TT         0.05         0         1           F         PM25         TT         0.	F	NH3	TT	0.05	0	1
G         NOX         TT         0.05         0         11           G         SO2         TT         0.05         0         11           G         NH3         TT         0.05         0         1           G         VOC         TT         0.05         0         1           A         PM25         DUST         0.05         0         1           A         PM25         INPC         0.05         0         1           A         PM25         INPC         0.05         0         1           A         PM25         TCB         0.05         0         1           A         PM25         TTC         0.05         0         1           A         PM25         TT         0.05         0         1           B         PM25         TT         0.05         0         1           D         PM25         TT         0.05         0         1           E         PM25         TT         0.05         0         1           F         PM25         TT         0.05         0         1           G         PM25         TT	F	VOC	TT	0.05	0	1
G         SO2         TT         0.05         0         1           G         NH3         TT         0.05         0         1           G         VOC         TT         0.05         0         1           A         PM25         DUST         0.05         0         1           A         PM25         INPC         0.05         0         1           A         PM25         INPC         0.05         0         1           A         PM25         SCB         0.05         0         1           A         PM25         TT         0.05         0         1           A         PM25         TT         0.05         0         1           B         PM25         TT         0.05         0         1           C         PM25         TT         0.05         0         1           D         PM25         TT         0.05         0         1           E         PM25         TT         0.05         0         1           G         PM25         TT         0.05         0         1	G	NOX	TT	0.05	0	1
G         NH3         TT         0.05         0         1           G         VOC         TT         0.05         0         1           A         PM25         DUST         0.05         0         1           A         PM25         DUST         0.05         0         1           A         PM25         INPC         0.05         0         1           A         PM25         FXCB         0.05         0         1           A         PM25         FXCB         0.05         0         1           A         PM25         TT         0.05         0         1           B         PM25         TT         0.05         0         1           C         PM25         TT         0.05         0         1           D         PM25         TT         0.05         0         1           E         PM25         TT         0.05         0         1           F         PM25         TT         0.05         0         1           G         PM25         TT         0.05         0         1	G	S02	TT	0.05	0	1
G         VOC         TT         0.05         0         1           A         PM25         DUST         0.05         0         1           A         PM25         INPC         0.05         0         1           A         PM25         INPC         0.05         0         1           A         PM25         FXCB         0.05         0         1           A         PM25         OTHER         0.05         0         1           B         PM25         TT         0.05         0         1           C         PM25         TT         0.05         0         1           D         PM25         TT         0.05         0         1           E         PM25         TT         0.05         0         1           F         PM25         TT         0.05         0         1           G         PM25         TT         0.05         0         1	G	NH3	TT	0.05	0	1
A         PM25         DUST         0.05         0         1           A         PM25         INPC         0.05         0         1           A         PM25         FXCB         0.05         0         1           A         PM25         FXCB         0.05         0         1           A         PM25         FXCB         0.05         0         1           B         PM25         OTHER         0.05         0         1           C         PM25         TT         0.05         0         1           D         PM25         TT         0.05         0         1           E         PM25         TT         0.05         0         1           F         PM25         TT         0.05         0         1           G         PM25         TT         0.05         0         1	G	VOC	TT	0.05	0	1
A         PM25         INPC         0.05         0         1           A         PM25         FXCB         0.05         0         1           A         PM25         OTHER         0.05         0         1           B         PM25         TT         0.05         0         1           C         PM25         TT         0.05         0         1           D         PM25         TT         0.05         0         1           E         PM25         TT         0.05         0         1           F         PM25         TT         0.05         0         1           G         PM25         TT         0.05         0         1	A	PM25	DUST	0.05	0	1
A         PM25         FXCB         0.05         0         1           A         PM25         OTHER         0.05         0         1           B         PM25         TT         0.05         0         1           C         PM25         TT         0.05         0         1           D         PM25         TT         0.05         0         1           E         PM25         TT         0.05         0         1           F         PM25         TT         0.05         0         1           G         PM25         TT         0.05         0         1	A	PM25	INPC	0.05	0	1
A         PM25         OTHER         0.05         0         1           B         PM25         TT         0.05         0         1           C         PM25         TT         0.05         0         1           D         PM25         TT         0.05         0         1           E         PM25         TT         0.05         0         1           F         PM25         TT         0.05         0         1           G         PM25         TT         0.05         0         1	A	PM25	FXCB	0.05	0	1
B         PM25         TT         0.05         0         1           C         PM25         TT         0.05         0         1           D         PM25         TT         0.05         0         1           E         PM25         TT         0.05         0         1           F         PM25         TT         0.05         0         1           G         PM25         TT         0.05         0         1	A	PM25	OTHER	0.05	0	1
C         PM25         TT         0.05         0         1           D         PM25         TT         0.05         0         1           E         PM25         TT         0.05         0         1           F         PM25         TT         0.05         0         1           G         PM25         TT         0.05         0         1	В	PM25	TT	0.05	0	1
D         PM25         TT         0.05         0         1           E         PM25         TT         0.05         0         1           F         PM25         TT         0.05         0         1           G         PM25         TT         0.05         0         1	С	PM25	TT	0.05	0	1
E         PM25         TT         0.05         0         1           F         PM25         TT         0.05         0         1           G         PM25         TT         0.05         0         1	D	PM25	TT	0.05	0	1
F         PM25         TT         0.05         0         1           G         PM25         TT         0.05         0         1	E	PM25	TT	0.05	0	1
G PM25 TT 0.05 0 1	F	PM25	TT	0.05	0	1
	G	PM25	TT	0.05	0	1

Fig. 32 Factors File

Set the **Step Interval** to 0.05, the minimum value to 0 and maximum value to 1.

➤ Check Use Genetic algorithm to set the Population Size to 10, the Generation to 10, but the Cross Probability and the Mutation Probability take default values, as shown in the Fig. .

File Tool View Case About		
Attainment Assessment Option     Control Cost Optimizer Option     Health Benefit Input Option		
Control Cost Optimizer Option 📀 🕯	👷 SMAT-CE 🐝 LE-CO 📓 RSM-VAT SenMAP-CE Benefit/Cost 💿 Log/Msg	1
O Use LE-CO configuration file:	Running messages	
No LE-CO configuration file		
LE-CO Calculation Input options Set up details>>		
Factors File:		
FactorsInfo_JN.csv		
A/TT/NOX         Details           A/TT/N1502         Step Interval (0°-1):           A/TT/N0X         0.05           B/TT/NOX         Min:           B/TT/NOX         Min:           B/TT/NOX         Min:           B/TT/NOX         Min:           C/TT/NOX         Max:           C/TT/NOX         Save           C/TT/NOX         Save           D/TT/NOX         or set the step interval, D/TT/SO2		
Use Genetic algorithm		
Population Size: 10		
Generation: 10		
Cross Probability: 0		
Mutation Probability: 0.05		
· · · · · · · · · · · · · · · · ·		
Cancel Back Next	Currer	t Setup: China .::

Fig. 33 Set factor information

- $\triangleright$  Click the file button  $\bowtie$  to select a **RSM File** and open it.
- Set the Base Year to 2017, the Control Year to 2020 in PM settings area, as shown

in	the	Fig.	
----	-----	------	--

File <sup>*</sup> Tool View <sup>*</sup> Case About
Attainment Assessment Option
Health Benefit Input Option
Control Cost Optimizer Option 0 🐼 SMAT-CE 🐝 LE-CO 🗟 RSM-VAT SenMAP-CE Benefit/Cost Cost Og/Msg
RSM input Options Set up details>> A Running messages
PM RSM File:
JN_PM25_Annual.rsm
Base Year: 2017 Control Year: 2020
US RSM File:
JN_03_90_Annual.rsm
Base Year: 2017 Control Year: 2020
Receptor Region File:
Jinan_Region_Grid_Ratio_File_Model.txt 📔 _
ICET Input options Set up details>>
Mapping File:
Mapping_Factors_ICET2RSM_linan.csv 💫
Control Input File:
ICET_Config_China_Jinan_example_2017.
Available Regions: Selected Regions:
Jinan Jinan Dethou Dethou
Binzhou Binzhou Liaocheng
Taian Taian Tiho&laiwu
OTHER CONCERNENT V
Back Next Current Setup: China .:

Fig. 34 Set RSM information 33

➤ Click the file button it to select a Receptor Region File and open it. The details of Receptor Region File is shown in Fig.35.

1	34	32	8.794603934 A Jinan
1	35	32	5.385847419 A Jinan
1	36	32	6.775355024 A Jinan
1	37	32	6.455231211 A Jinan
1	34	33	69.1956159 A Jinan
1	35	33	90.98942958 A Jinan
1	36	33	92.83000316 A Jinan
1	37	33	60.99224907 A Jinan
1	38	33	8.620133975 A Jinan
1	41	33	22.05390712 A Jinan
1	34	34	81.25546341 A Jinan
1	35	34	100 A Jinan
1	36	34	100 A Jinan
1	37	34	100 A Jinan
1	38	34	76.82431281 A Jinan
1	39	34	7.822602685 A Jinan
1	40	34	77.70259154 A Jinan
1	41	34	99.70629765 A Jinan
1	42	34	89.31932517 A Jinan
1	43	34	70.52337193 A Jinan
1	44	34	7.788943883 A Jinan
1	34	35	78.92412029 A Jinan
1	35	35	IUU A Jinan
1	36	35	IUU A Jinan
1	37	35	IUU A Jinan
1	38	35	IUU A Jinan
1	39	35	IUU A Jinan
1	40	35	IUU A Jinan
1	41	35	IUU A Jinan
1	42	35	IUU A Jinan
1	43	35	IUU A Jinan
1	44	3D 96	40.72702402 A Jinan
1	34 2E	30	30.44026541 A Jinan
1	35	30	100 A Jinan
1	30	30	100 A Jinan
1	37	30	100 A Jinan
T	38	36	IUU A Jinan

Fig. 35 Receptor Region File

Click the file button it to select a Mapping File and open it. The details of Mapping File is shown in Fig.36.

Cost_Regi	RSM_Regio	Cost_Sect	RSM_Secto	Cost_Poll	RSM_Pollu	itant
Jinan	A	TT	TT	NOx	NOx	
Dezhou	В	DUST	DUST	PM25	PM25	
Binzhou	С	INPC	INPC	S02	S02	
Liaocheng	D	FXCB	FXCB	NH3	NH3	
Taian	E	OTHER	OTHER	VOC	VOC	
Zibo&Laiv	F					
OTHER	G					

Fig. 36 Mapping File

➢ Click the file button it to select a Control Input File and open it, as shown in the Fig. . And the details of Control Input File is shown in Fig.38.

File - Tool View - Case About		
Attainment Assessment Option     Control Cost Optimizer Option     Health Benefit Input Option		1
Control Cost Optimizer Option 3 SMAT-CE State LE-CO RSM-VAT BenMAP-CE Benefit/Cost	.og/Msg	1
Base Year: 2017 Control Year: 2020 A Running messages		
JN_05_99_Annual.rsm		
Receptor Region File: Jinan_Region_Grid_Ratio_File_Model.txt		
ICET Input options Set up details>>		
Mapping_Flet:		
ICET_Config_China_linan_example_2017.		
Available Regions: Selected Regions: Jinan Jinan		
Dezhou Dezhou Binzhou Binzhou Liaocheng Liaocheng		
Taian Taian Zibo&Laiwu Zibo&Laiwu OTHER CHARAN OTHER		
Cancel Back Next	Current Setup:	China .::

# Fig. 37 Mapping File and Control Input File

Region/Sector/Pollutant Contr		ontrol Set	trol Setup & Input:		Control Cost Setup & Input:						
	Currency	RMB	Emission	sTon							
Availabl	<pre>eControl_H</pre>	Control	_SControl_	FControl(%)	Region	Sector	Pollutan	tCurrent_I	Cost_Esti	Cost_Unit	t(\$/ton)
Jinan	Jinan	TT	NOx	58.42	Jinan	TT	NOx	7455.321	5	943.4752	
Dezhou		TT	S02	47.28		TT	NOx	7455.321	10	1886.95	
Binzhou		DUST	PM25	55.39		TT	NOx	7455.321	15	2830.426	
Liaochen	g	INPC	PM25	55.39		TT	NOx	7455.321	20	3773.901	
Taian		FXCB	PM25	55.39		TT	NOx	7455.321	25	4717.376	
Zibo&Lai	wu	OTHER	PM25	55.39		TT	NOx	7455.321	30	5660.851	
OTHER		TT	NH3	0		TT	NOx	7455.321	35	5860.061	
		TT	VOC	0		TT	NOx	7455.321	40	6059.27	
	Dezhou	TT	NOx	58.42		TT	NOx	7455.321	45	6258.48	
		TT	S02	47.28		TT	NOx	7455.321	50	6457.69	
		TT	PM25	55.39		TT	NOx	7455.321	55	8545.46	
		TT	NH3	0		TT	NOx	7455.321	60	10633.23	
		TT	VOC	0		TT	NOx	7455.321	65	12721	
	Binzhou	TT	NOx	58.42		TT	NOx	7455.321	70	16553.01	
		TT	S02	47.28		TT	NOx	7455.321	75	34801.42	
		TT	PM25	55.39		TT	NOx	7455.321	80	56917.73	
		TT	NH3	0		TT	NOx	7455.321	85	80473.57	
		TT	VOC	0		TT	NOx	7455.321	90	102350	
	Liaochens	TT	NOx	58.42		TT	NOx	7455.321	95	135262.8	
		TT	S02	47.28		TT	NOx	7455.321	100	181371.5	
		TT	PM25	55.39		TT	S02	1315.301	5	308.316	
		TT	NH3	0		TT	S02	1315.301	10	616.632	
		TT	VOC	0		TT	S02	1315.301	15	924.9479	
	Taian	TT	NOx	58.42		TT	S02	1315.301	20	1233.264	
		TT	S02	47.28		TT	S02	1315.301	25	1541.58	
		TT	PM25	55.39		TT	S02	1315.301	30	1849.896	
		TT	NH3	0		TT	S02	1315.301	35	2363.197	
		TT	VOC	0		TT	S02	1315.301	40	2876.497	
	Zibo&Laiv	TT	NOx	58.42		TT	S02	1315.301	45	3389.798	
		TT	S02	47.28		TT	S02	1315.301	50	6062.409	
		TT	PM25	55.39		TT	S02	1315.301	55	14274.26	
		TT	NH3	0		TT	S02	1315.301	60	23669.65	
		TT	VOC	0		TT	S02	1315.301	65	33065.04	
	OTHER	TT	NOx	58.42		TT	S02	1315.301	70	42460.43	
		TT	S02	47.28		TT	S02	1315.301	75	60435.91	
		TT	PM25	55.39		TT	S02	1315.301	80	78411.4	
		TT	NH3	0		TT	S02	1315.301	85	98786.12	
		TT	VOC	0		TT	S02	1315.301	90	114362.4	
						TT	S02	1315.301	95	129938.6	

Fig. 38 Control Input File

Select one or more of the seven options in the Available Regions column as shown in the Fig. , and the click button, the selected options will appear in the Selected Regions column which as shown in the Fig. .

File Tool View Case About			
Attainment Assessment Option     Ontrol Cost Optimizer Option     Health Benefit Input Option			1
Control Cost Optimizer Option	🔜 SMAT-CE 🐝 LE-CO 🕼 RSM-VAT SenMAP-CE Benefit/Cost 💿 Log/Msg		1
Base Year: 2017 Control Year: 2020	Running messages		
JN_03_90_Annual.rsm			
Receptor Region File: Jinan_Region_Grid_Ratio_File_Model.txt			
ICET Input options <u>Set up details&gt;&gt;</u> Mapping_File: Mapping_Factors_ICET2RSM_Jinan.csv Control Input File: ICET_Config_China_Jinan_example_2017.			
Available Regions: Jinan Dezhou Binzhou Liaocheng Taian Zibo&Laiwu OTHER			
Cancel Back Next	Curre	ent Setup	China .::

Fig. 39 Available Regions

File - Tool View - Case About		
Attainment Assessment Option     Control Cost Optimizer Option     Health Benefit Input Option		1
Control Cost Optimizer Option 2 SMAT-CE 5 LE-CO SRSM-VAT BenMAP-CE Benefit/Cost Cost Optimizer Option		
Base Year: 2017 Control Year: 2020		
US RSM File:		
Base Year: 2017 Control Year: 2020		
Receptor Region File:		
Jinan_Kegion_Grid_Katio_File_Model.txt		
ICET Input options Set up details>>>		
Mapping_Factors_ICET2RSM_Jinan.csv		
Control Input File:		
Available kegions: Selected kegions: Jinan Jinan		
Dezhou Dezhou Binzhou Binzhou		
Liaocheng Liaocheng Taian Taian Taian		
OTHER CITORCEINING OTHER		
Cancel des		
Back Next Current	Setup:	China .;;

Fig. 40 Selected Regions

Click Next button to enter the interface of Health Benefit Input Option, as shown in the Fig. .

➤ Click the file buttons is which correspond to Pooled Grid Definition, CFG configuration file and APV configuration file and then open them, as shown in the Fig. . And the details of Pooled Grid Definition is shown in Fig.42.



Fig. 41 Set health benefit information



Fig. 42 Pooled Grid Definition

Click Next button and Fig. will appear, choose yes to run the program.



Fig. 43 Save project and run

## 6.3 View Result

### 6.3.1 SMAT-CE

### 6.3.1.1 Chart results

> From the Fig. , we can directly view the comparison between the baseline and predicted values of different regions, which bases on the monitoring data. For example, the baseline value in Jinan is about 92% but its predicted value is about 64.4 %.



Fig. 44 Chart results of SMAT- CE

### 6.3.2 LE-CO

### 6.3.2.1 Optimized Strategies

#### 6.3.2.1.1 Map results

 $\succ$  From the Fig. , we can know that the maps show the concentration distribution of

PM<sub>2.5</sub> for five attainment scenarios and their minimum and maximum concentrations.



Fig. 45 Map results of Optimized Strategies

### 6.3.2.1.2 GIS results

> From the Fig. , we can know that the GIS shows the attainment results of five scenarios in each monitor site. And there are more than 10 red points which indicate no-attainment results in case 1.



Fig. 46 GIS results of Optimized Strategies

#### 6.3.2.1.3 Chart results

➢ From the Fig. , we can directly view the reduction between the baseline and predicted values of different scenarios and monitoring sites.



Fig. 47 Chart results of Optimized Strategies

#### 6.3.2.1.4 Data results

≻ From the Fig. , we can view more details information for each attainment scenario. Just take the summary information as an example, in case 1, the attainment ratio of PM<sub>2.5</sub> is about 100%, the total cost is about 1.99 billion yuan and the average concentration of PM<sub>2.5</sub> is about 59.06  $\mu$ g/m<sup>3</sup> and so on.

File • Tool View • Case About									
Attainment Assessment Option     Ontrol Cost Optimizer Option     Health Benefit Input Option		<u>Jinan_</u> I	PM25				I	- f	
Health Benefit Input Option	?	sm.	AT-CE 🐝	LE-CO	RSM	-VAT SenMAP	-CE Benefit/C	Cost 💿 Log/I	Msg
Set up details>>		Optim	ized Strategie	s	ICET				
Pooled Grid Definition: Jinan_City_WGS1984.s	1	MAP	GIS	Chart	Data				
PM2.5		Summ	ary information	Emissi	on Reduction	Monitor Data			
CFG configuration file or result file (*.cfgx)			iseID	^	Data Detail				
Jinan_China_PM.cfgx	1	✓ Ra ✓ PM	ank M_AttainmentRa 3 AttainmentRa	tio	CaseID	Rank	PM_AttainmentR	PM_AvgConc	Total Cost (Billion Yuan)
APV configuration file or result file (*.apvx or *.a	pvrx)	PN	 //AvgConc		1	0.08049158		59.05590346	1.9930427
Jinan_China_PM.apvx	<b>1</b>		3_AvgConc		2	0.08156307	1	59.01081345	2.01957385
Name	~		nan_Cost		3	0.08373817	1	58.64371098	2.07343108
⊟-benmap		iit 🖸	nan_BaseLine E	mise	4	0.08538276	1	58.43509771	2.11415275
—Aggregate, Pool & Value		ii 💟	nan_Emission R	emc	5	0.09056023	1	57.8461022	2.24235153
Letter Lead Munoads     IsRuninPointWodeFalse     Latin Hypercube Points20     Population Dataset.JJJ_Pop.JJ_Pop     Year2010     Threshold0     Indicence averagingAll     Baseline And Control Group0     Population     Name PMO 5			ezhou_Cost ezhou_BaseLine ezhou_Emissior ezhou_Emissior nzhou_Cost nzhou_BaseLin nzhou_Emissio nzhou_Emissio aocheng_Cost	e Em n Rer n Rer n Re n Re n Re	٤			Digits After De	-imal Point 8
Observation Type:Daily Season01月1日-3月31日	~	M AI	A	ррту				Digits Aiter De	
Cancel Back	Next								Export Current Setup: Chin

Fig. 48 Data results of Optimized Strategies

### 6.3.2.2 ICET

#### 6.3.2.2.1 Data results

From the Fig. , we can view more summary information which contains total removal cost, baseline emission and removal cost of each pollutant. For example, the total PM<sub>2.5</sub> removal cost in Jinan is about 970.8 million yuan, the baseline PM<sub>2.5</sub> emission is about 70.8 thousand ton and the removal cost of PM<sub>2.5</sub> is about 24201.4 yuan/ton and so on.

File • Tool View • Case About		
Attainment Assessment Option     Control Cost Optimizer Option     Health Benefit Input Option	Jinan_PM25	
Health Benefit Input Option	SMAT-CE 🥳 LE-CO 😂 RSM-VAT BenMAP-CE Benefit/Cost	Cog/Msg
Set up details>>	Optimized Strategies ICET	
Pooled Grid Definition: Jinan_City_WGS1984.s	Data Chart	
PM2.5 CFG configuration file or result file (*.cfgx)	System Output Regional Level Regional Control&Cost RSM Control Factor	
Jinan_China_PM.cfgx	Total nox Removal Cost (Million Yuan) 286.7	<u>^</u>
APV configuration file or result file (*.apvx or *.apv	Total so2 Removal Cost (Million Yuan) 227.9	
Jinan_China_PM.apvx	Total nh3 Removal Cost (Million Yuan) 264.7	
Name ⊟-benmap	Total voc Removal Cost (Million Yuan) 180.8	
—Aggregate, Pool & Value —Create Datetime:2018-12-12 21:11:58	Total pm25 Removal Cost (Million Yuan) 970.8	
Estimate.Health.Impads		
IsRuninPointModeFalse     Latin Hypercube Points20     Booulation Datacet III. Boo III. Boo	pm25 Emission Baseline pm25 Emission (Thousand Ton) 70.8 pm25 COST per TON 24,201. (Yuan/Ton)	-
-Year:2010	pm25 Emission Removed (Thousand Ton) 40.1 pm25 Emission Removed (%	56.7
-Incidence averagingAll -Incidence AveragingAll	VOC Emission Baseline voc Emission (Thousand Ton) 40.3 voc COST per TON 9,027.4 (Yuan/Ton)	
-Pollutant -Name:PM2.5	voc Emission Removed (Thousand Ton) 20.0 voc Emission Removed (%)	49.7
- Observation Type:Daily	nh3 Emission	
Seasor01月1日-3月31日	Baseline nh3 Emission (Thousand Ton) 40.2 nh3 COST per TON 12,301. (Yuan/Ton)	Ĺ
	nh3 Emission Removed (Thousand Ton) 21.5 nh3 Emission Removed (%)	53.5 🗸
Cancel Back N		Current Setup: China:

Fig. 49 Data results of ICET

### 6.3.2.2.2 Chart results

 $\succ$  From the Fig. , we can directly view the emissions or control cost comparison of different regions in different pollutants.



Fig. 50 Chart results of ICET

### 6.3.3 RSM-VAT

### 6.3.3.1 Map results

> From the Fig. , we can intuitively know that the maps show the  $PM_{2.5}$  concentration that responds in real time to the emission reduction control.



Fig. 51 Map results of RSM-VAT

### 6.3.3.2 Data results

 $\succ$  From the Fig. , we can view more details information about the emission reduction effects.

File - Tool View - Case About								
Attainment Assessment Option     Ontrol Cost Optimizer Option     Health Benefit Input Option	<u>Jinan_</u> P	<u>M25</u>				1	(	
Health Benefit Input Option	SMA 🥋	T-CE	> LE-CO	SM-VAT	BenMAP-CE	Benefit/Cost 🧯	Log/Msg	
Set up details>>	Map	Data	Chart					
Pooled Grid Definition: Jinan_City_WGS1984.s	Base		🔿 Delta			4 4   1 — J	/264   🕨 🔰	Output
PM2.5		_ID	_TYPE	LAT	LONG	Quarter	PM25	SO4 ^
CFG configuration file or result file (*.cfgx)	▶ 1	001		35.2	115.1	201701	73.0	0.0
Jinan_China_PM.cfgx	2	001		35.2	115.1	201701	73.0	0.0
APV configuration file or result file (* approver * approver)	3	001		35.2	115.2	201701	72.4	0.0
	4	001		35.2	115.2	201701	72.0	0.0
Jinan_China_PM.apvx	5	001		35.2	115.2	201701	71.7	0.0
Name	6	001		35.2	115.3	201701	71.8	0.0
🖃 benmap	7	001		35.2	115.3	201701	71.7	0.0
Aggregate, Pool & Value	8	001		35.2	115.3	201701	71.5	0.0
Create Datetime:2018-12-12 21:11:58	9	001		35.2	115.4	201701	71.3	0.0
IsRuninPointWode:False	1	0001		35.2	115.4	201701	71.0	0.0
Latin Hypercube Points20	1	1001		35.2	115.4	201701	71.3	0.0
Population Dataset:JJJ_Pop-JJJ_Pop	1	2001		35.2	115.5	201701	71.3	0.0
-Year:2010 Threshold0	1	3001		35.2	115.5	201701	70.6	0.0
-Incidence averagingAll	1	4001		35.2	115.5	201701	70.8	0.0
-Baseline.And.Control.Group0	1	5001		35.2	115.6	201701	70.7	0.0
⊖-Pollutant	1	6001		35.2	115.6	201701	70.9	0.0
- Name: PNI2:5 - Observation Type: Daily	1	7001		35.2	115.6	201701	71.2	0.0
Season01月1日-3月31日 V	1	8001		35.2	115.7	201701	70.6	0.0
< >>		9001		35.2	115.7	201701	70.5	0.0 ¥
	<		1				1.012	>
Cancel								
Back Next							Curren	t Setup: China 🤃

Fig. 52 Data results of RSM-VAT

### 6.3.3.3 Chart results

> From the Fig. , we can directly view the emission reduction effects of emission control. For example, the PM<sub>2.5</sub> reduction in Jinan is about 22.8  $\mu$ g/m<sup>3</sup>.



Fig. 53 Chart results of RSM-VAT

### 6.3.4 BenMAP-CE

#### 6.3.4.1 Map results

 $\succ$  From the Fig. , we can know that the maps show the mortality and valuation results of different regions.



Fig. 54 Map results of BenMAP-CE

### 6.3.4.2 Data results

> From the Fig. , we can view more details information which contains benefit, mortality, medianbenefit and so on. For example, the benefit in other is about 3273985054 yuan.

File • Tool View • Case About							
Attainment Assessment Option     Ontrol Cost Optimizer Option     Health Benefit Input Option	Jinan_PM2	5			1	(	
Attainment Assessment Option	SMAT-C	e 🐝 le-co	🈂 RSM-VAT	BenMAP-Cl	Benefit/Cos	a 💿 Log/Msg	
Attainment Goals	Map Da	ata Chart					
O Concentration   Percentage	Pollutant: PN	M2.5 ~	]			/1   ▶ ▶	Output
✓ PM2.5 30 %	Region	Benefit	Mortality	LowBenefit	MedianBenefit	HighBenefit	
Ozone 15 %	other	3,273,985,054.0	1,539.0	2,058,391,480.0	2,249,655,966.0	13,058,387,160.0	
Base Year PM Monitor Data	jinan	1,304,645,760.0	613.3	886,677,504.0	952,560,576.0	4,661,555,712.0	
Jinan_PM25_Annual_Mass_Data.csv	binzhou	674,982,592.0	317.3	435,633,184.0	473,244,288.0	2,600,622,592.0	
Base Year O3 Monitor Data	taian	913,487,936.0	429.4	566,231,936.0	620,938,880.0	3,709,016,576.0	
Jinan_03_90_Annual_Mass_Data.csv	zibo&laiwu	1,171,493,408.0	550.7	723,232,432.0	793,961,120.0	4,779,771,776.0	
	liaocheng	714,554,688.0	335.9	470,412,960.0	508,773,856.0	2,677,761,280.0	
Advanced Option	dezhou	945,842,304.0	444.6	608,697,280.0	661,699,520.0	3,658,343,936.0	
Interpolate monitor data to spatial field,gradient adjusted by model data (eVNA)	Total	8,998,991,742.0	4,230.1	5,749,276,776.0	6,260,834,206.0	35,145,459,032.0	
Output all attainment solutions							
Reduce regional transport (boundary conditions) contribution if attainment goals not meet							
Additional regional transport (BC) 20							
Cancel de							
Back Next						Currer	t Setup: China .::

Fig. 55 Data results of BenMAP-CE

### 6.3.4.3 Chart results

> From the Fig. , we can directly view the mortality and valuation results in different regions/cities. For example, the mortality in Jinan is about 6.13E+2.



Fig. 56 Chart results of BenMAP-CE

### 6.3.5 Benefit/Cost

#### 6.3.5.1 Chart results

> From the Fig. , we can directly view total benefit/cost ratio after taking effective measures is about 4.7.



Fig. 57 Chart results of Benefit/Cost

#### 6.3.5.2 Data results

➢ From the Fig. , we can view more details information which contains cost, benefit, benefit/cost and so on. For example, the benefit/cost ratio in Jinan is about 3.6.

File - Tool View - Case About											
Attainment Assessment Option     Ontrol Cost Optimizer Option     Health Benefit Input Option	Jinan_PM25										
Attainment Assessment Option 🧿 🗟 SMAT-CE 🐝 LE-CO 🗟 RSM-VAT BenMAP-CE Benefit/Cost Cost Cost Assessment Cost											
Attainment Goals	Chart	Data B	ar Chart								
O Concentration    Percentage	Province	Cost	Benefit	Low Benefit	Median Benefit	High Benefit	Benefit/Cost	ור			
PM2.5 30 %	other	241,593,666	3,273,985,054	2,058,391,480	2,249,655,966	13,058,387,160	13.6 (8.5~54.1)	- 11			
	jinan	367,352,682	1,304,645,760	886,677,504	952,560,576	4,661,555,712	3.6 (2.4~12.7)	- 1			
Ozone 15 %	binzhou	132,524,346	674,982,592	435,633,184	473,244,288	2,600,622,592	5.1 (3.3~19.6)	-11			
Base Year PM Monitor Data	taian	2/0,363,466	913,487,936	566,231,936	520,938,880	3,709,016,576	3.4 (2.1~13.7)	- 1			
Jinan_PM25_Annual_Mass_Data.csv	liaoche	176 201 768	714 554 688	470 412 960	508 773 856	2 677 761 280	4 1 (2 7~15 2)	- 11			
Baro Year O2 Monitor Data	dezhou	228,132,413	945.842.304	608,697,280	661,699,520	3,658,343,936	4.1 (2.7~16)				
base real OS MOINTOI Data	Total	1,931,029,823	8,998,991,742	5,749,276,776	6,260,834,206	35,145,459,032	4.7 (3~18.2)				
Jinan_03_90_Annual_Mass_Data.csv											
Advanced Option											
Interpolate monitor data to spatial field,gradient adjusted by model data (eVNA)								-			
Output all attainment solutions											
Reduce regional transport (boundary conditions) contribution if attainment goals not meet								-			
Additional regional transport (BC)											
reduction (%):											
								- 11			
								- 11			
								-11			
Back Next							Comment Cathorn China				
Dack Next							Current Setup: Chin	a .::			

Fig. 58 Data results of Benefit/Cost

## 6.3.5.3 Bar Chart results

 $\succ$  From the Fig. , we can view the benefit/cost ratios in different regions/cities more intuitively.



Fig.59 Bar Chart results of Benefit/Cost