User's Manual of ABaCAS-SE

1 Introduction

ABaCAS-SE (Air Benefit/Cost and Assessment System: Streamlined Edition) is an integrated system to connect six individual ABaCAS tools (ICET, RSM-VAT, SMAT-CE, BenMAP-CE, Data Fusion and Model-VAT) to provide policy makers with a user-friendly framework for conducting integrated assessments of emissions control cost and their associated health and economic benefits and air quality attainment.

1.1 Functional framework of ABaCAS-SE

ABaCAS-SE will call and run the five modules sequentially in the background using a master script. ICET will estimate the emission costs associated with future-year control strategies. RSM-VAT/CMAQ will take the emissions reduction from ICET to provide a real-time air quality response of emissions change. Then SMAT-CE combines the monitoring data as well as the air quality data from RSM-VAT/CMAQ and to assess if the air quality goal or attainment has been reached. Subsequently, BenMAP-CE uses the air quality surface generated from SMAT-CE to estimate the health and economic benefits resulting from changes in air quality. And then, Data Fusion superimposes the optimized assessment results of relevant emission reduction measures with localized data like remote sensing, population, monitoring and so on. Finally, ABaCAS-SE will integrate the results from these five modules to provide assessments of emissions control cost and their associated air quality, health and economic benefits as well as estimate the cost/benefit ratio ($$ benefit per $$ cost). A user-friendly graphical user interface (GUI) together with graphical and tabular functions is also provided for users to easily visualize and analyze these assessment results.

1.2 Who Can Use ABaCAS-SE?

ABaCAS-SE 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-SE to analyze the pollution situation under the existing control scenarios and then adjust control measures based on these analyzed results.

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

- **Strategy design and assessment screening tool**

➢ **"What If?" Analyses**

- Provide real-time cost-benefit results for real scenarios.

1.3 Computer Requirements

Recommend screen resolution: 1024 by 768 pixels; Font size: normal.

Minimum System Environment:	
CPU	Intel, Duo-Core, 1.6GHz
Memory (RAM)	2GB
Free Disk Space	10GB
Operation System	32-Bit Windows XP
Recommend System Environment:	
CPU	Intel, Quad-Core, 3GHz
Memory (RAM)	6GB
Free Disk Space	10GB
Operation System	64-Bit Windows 7

1.4 Installing/Uninstalling ABaCAS-SE

1.4.1 Installing ABaCAS-SE

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

➢ Double click ABaCAS-SE_Setup.exe to install the program, it will appear the following figure.

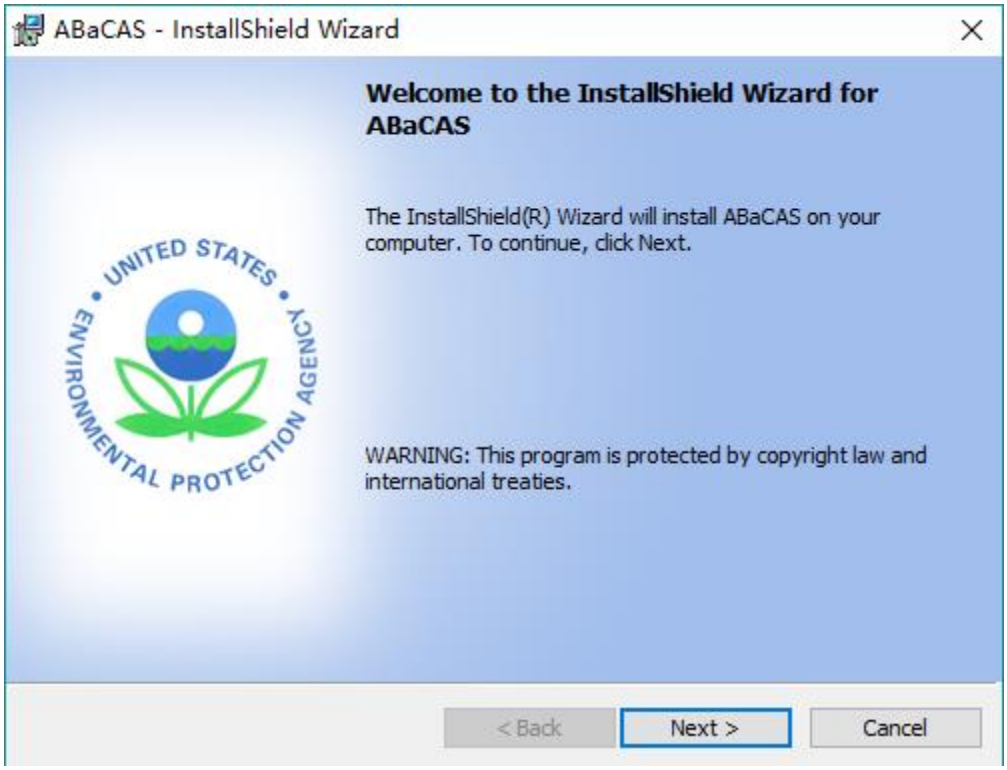


Fig. 1 Setup Window

➢ Click "**Next**" button, users should choose install location in Fig.

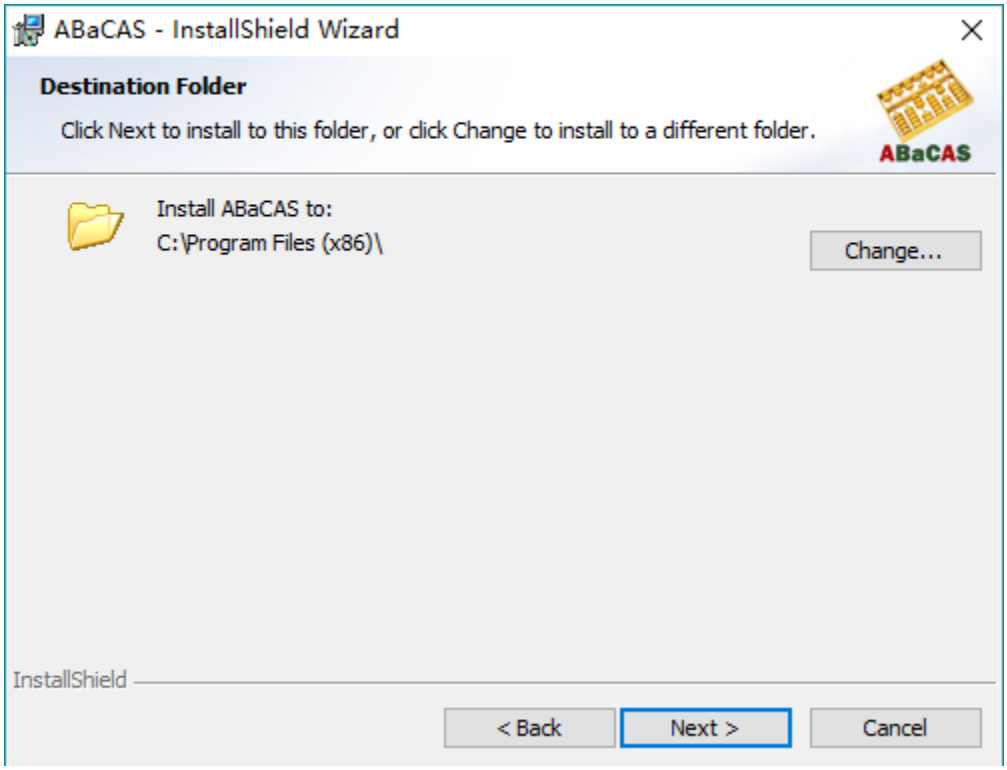


Fig. 2 Choose Install Location

➢ Click "**Next**" button, it will show the "Ready to Install" window as shown in Fig. .

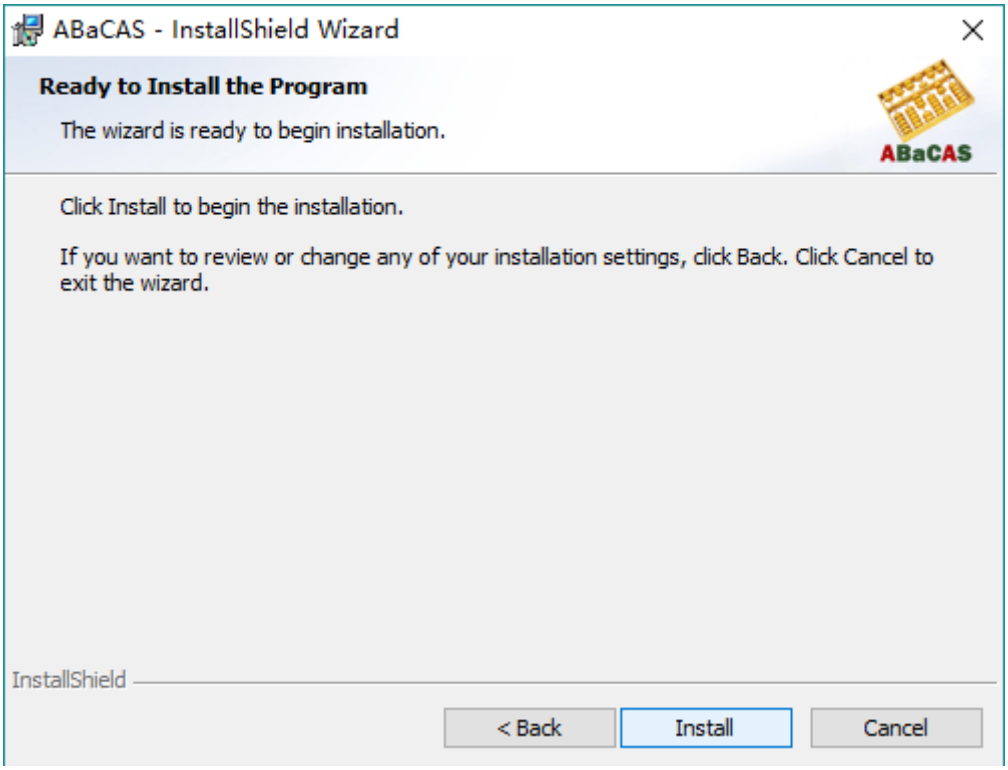


Fig. 3 Ready to Install

➢ Click "**Install**" button and ABaCAS-SE will be installed.

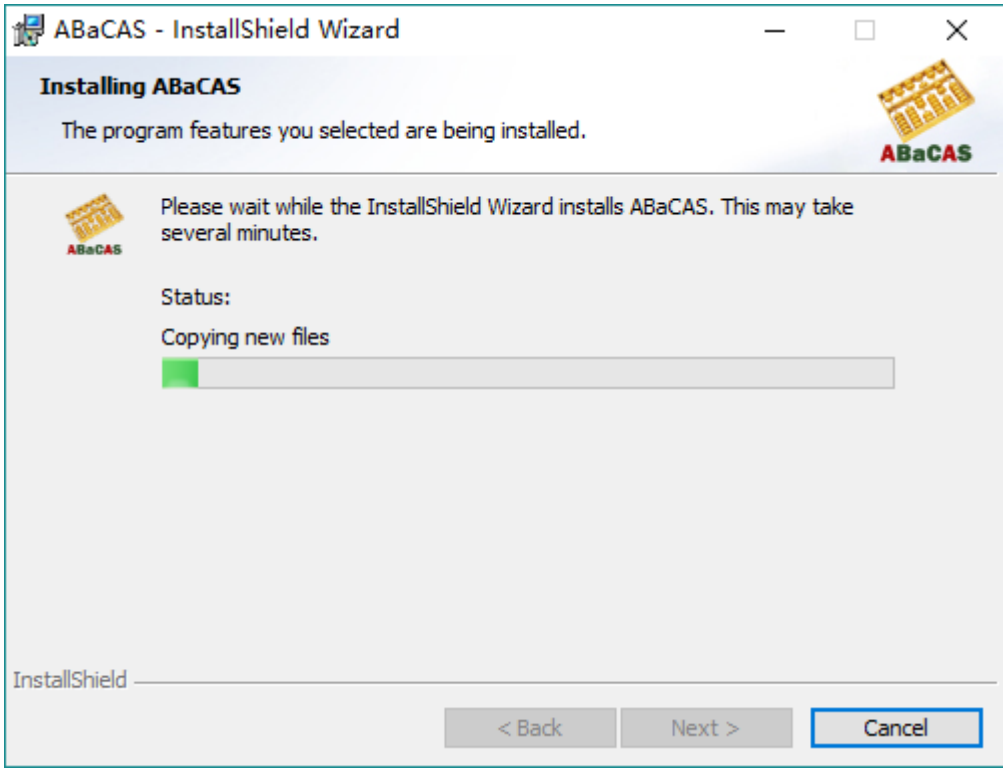


Fig. 4 Installation Processing

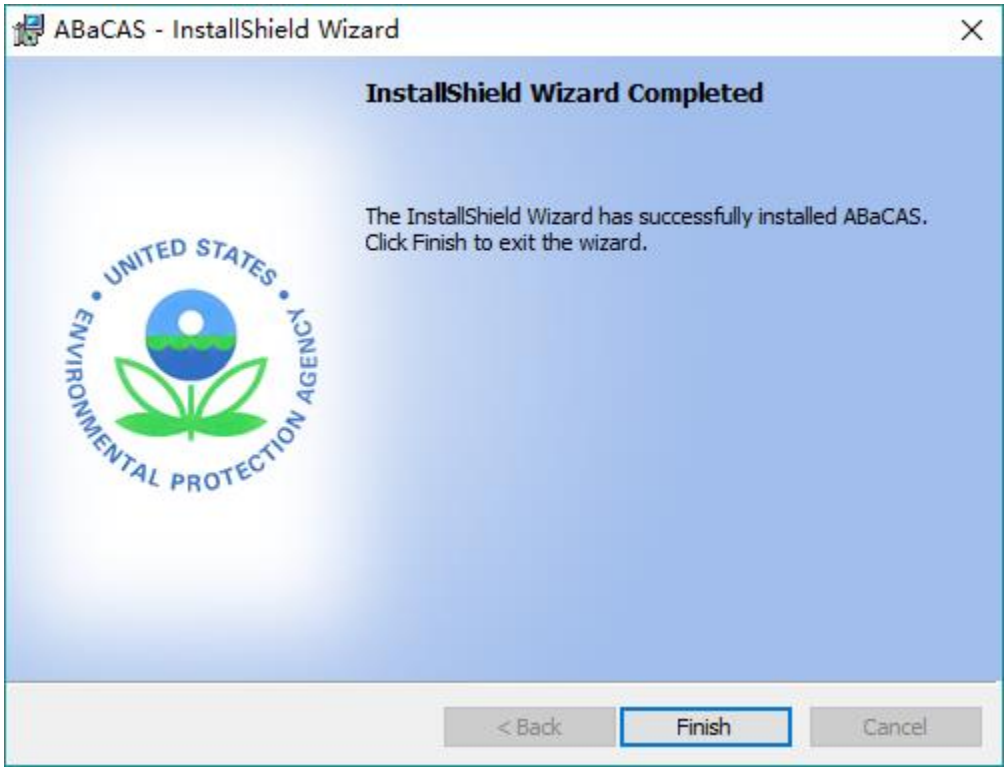


Fig. 5 Installation Complete

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

➢ After finished installation, please download the corresponding ABaCAS-SE input data and unzip it to My Documents directory under **\My Documents\My ABaCAS-SE Files\Data*** to replace the old **Data** folder. These data and tool are available at: http://abacas-dss.com/abacas/Software.aspx.

1.4.2 Uninstalling ABaCAS-SE

➢ Go to Control Panel.

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

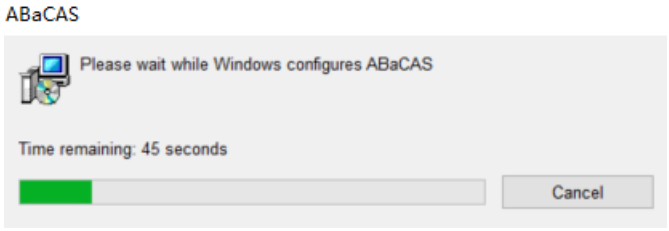


Fig. 6 Uninstallation Processing

➢ 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.

Address: School of Environment and Energy, South China University of Technology, Guangzhou Higher Education Mega Center, Guangzhou, P. R. China.

Email: zhuyun@scut.edu.cn

Telephone: 020-39380017.

1.6 Sources for More Information

For files that you can use in ABaCAS-SE:

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

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-SE.

2.1 Common Terms

- **ABaCAS-SE: Air Benefit/Cost and Assessment System: Streamlined Edition.**

2.2 File Types

- **ABaCAS-SE Project File:** An existing ABaCAS-SE project file**.**
- **ICET Project File:** An existing ICET project file**.**
- **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.

- **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.
- **RSM configuration Files**: Those existing pre-processed RSM format files (*.rcfg).
- **Region Grid Ratio File**: A *.txt file defines the grid ratio of the analyzed cities, which represents the percentage of the grid covered by those analyzed cities.
- **CMAQ output Files**: Those existing pre-processed CMAQ output files.
- **Grid Shape File**: A *.csv file defines a sequence of points for each state or county,

or any other contour, in terms of X, Y coordinates.

- **$PM_{2.5}$ Monitor Data**: A *.csv file for $PM_{2.5}$ concentration of each monitor site. It contains each site's geographic location、station name and $PM_{2.5}$ concentration.
- **O3 Monitor Data**: A *.csv file for O3 concentration of each monitor site. It contains each site's geographic location、station name and O3 concentration.
- **Species Fraction Data**: A *.csv file which uses to calculate the concentration of each component in the corresponding monitoring point and space area.
- **Grid Definition File**: A *.txt or *.shp file contains a series of information of a total number of columns and rows, column index, row index and so on.
- **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.

Table 1 File types generated by ABaCAS-SE

Filename	File Extension
ABaCAS-SE Project File	*.projx
ICET Project File	*.projx
Control Input File	*.csv
Mapping File	*.txt
RSM configuration Files	*.rcfg
Region Grid Ratio File	*.txt
CMAQ output Files	*.csv
Grid Shape File	*.csv
$PM_{2.5}$ Monitor Data	*.csv
O3 Monitor Data	*.csv
Species Fraction Data	*.csv
Grid Definition File	*.txt or *.shp

Pooled Grid Definition	*.shp
CFG Configuration File	*.cfgx
APV Configuration File	*.apvx or *.apvrx

3 Main Interface

The main interface of ABaCAS is shown in Fig. .

On the left-hand of the main interface, it's four standalone ABaCAS tool buttons (ICET, RSM-VAT, SMAT-CE, and BenMAP-CE). You can click any one of the four buttons to run the standalone tool according to your own demand.

Fig. 7 The interface of ABaCAS

➢To start ABaCAS-SE, you can click **ABaCAS-SE** button and the main window of ABaCAS-SE will appear, as shown in **错误!未找到引用源。**.

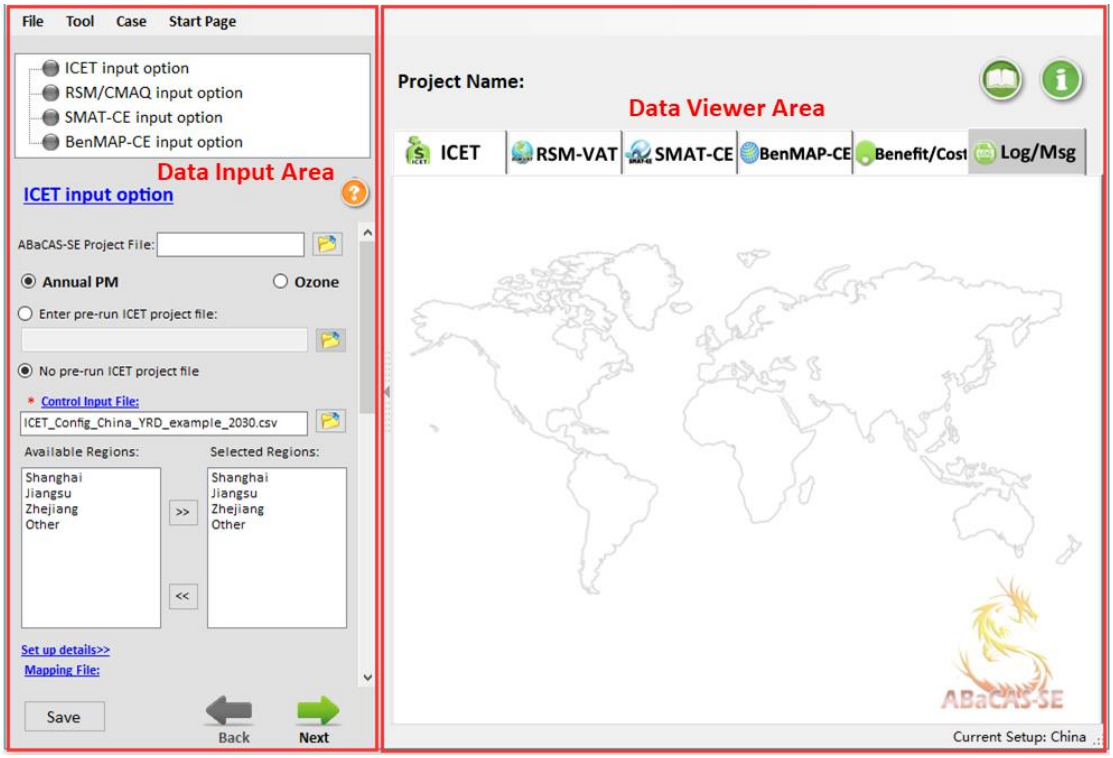


Fig. 8 Main interface of ABaCAS-SE

➢ Click **File** button on the toolbar of the main interface, there are seven options that users can choose.

1) Go to file, click **New Project** button to create a new project.
2) Click **Open Projec**t button, locate the *.proj file and open it.
3) Click **Save Project** button to save a created project.
4) Click **Example Cases** button to choose and open the existing example cases that have been successfully run.
5) Click **Options** button to modify the executable path of each subsystem of ABaCAS-SE and data storage path.
6) Click **Case Settings** 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.
7) 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, BenMAP-CE, Model-VAT and Data Fusion Tool.

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

➢ Click **Start Page** button to open the main interface of ABaCAS.

➢ In addition, there are four different input options for inputting different data or configurating the calculation parameters, including ICET input option, RSM/CMAQ input option, SMAT-CE input option and BenMAP-CE input option.

3.1 ICET Input Option

➢ The ICET Input Option allows users to set **Control Input File** and **Mapping File**. And users can also select specific region for calculation and analysis, as shown in 错误!未找到引用源。.

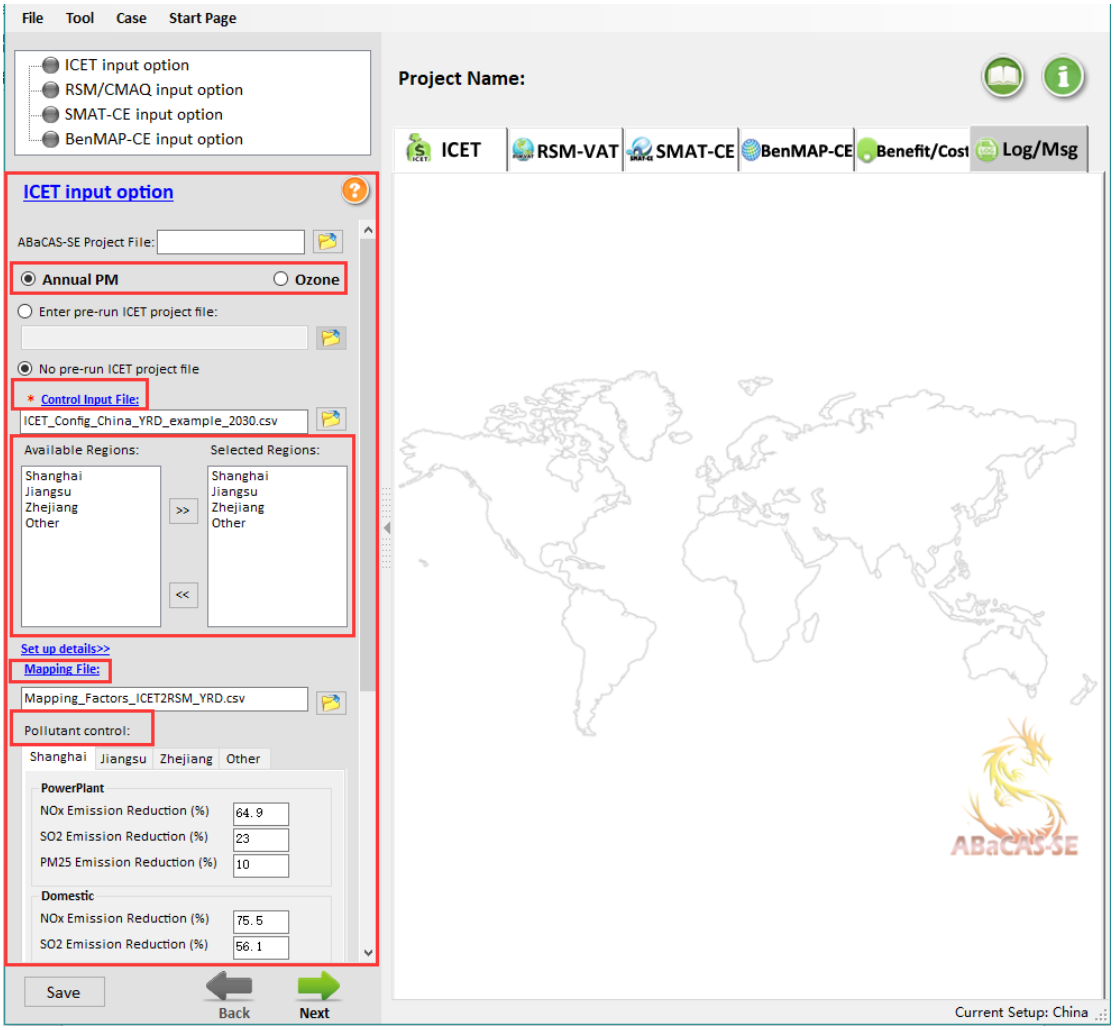


Fig. 9 ICET Input Option

➢ **Annual PM/Ozone:** allow users to choose the analyzed pollutant according to their needs.

➢ **Pollutant control:** allows users to set emission reduction ratios of different pollutants of various sectors in different regions/cities, which base on their data sources like control strategy models or research reports/references or field

investigation of local factories in the areas/cities. With these data, the rationality of the model prediction value can be guaranteed.

3.2 RSM/CMAQ Input Option

➢ The RSM/CMAQ Input Option includes **RSM Input option** and **CMAQ Input Option**. Users can choose one of them to calculate and analyze, as shown in 错误!未找到引用源。.

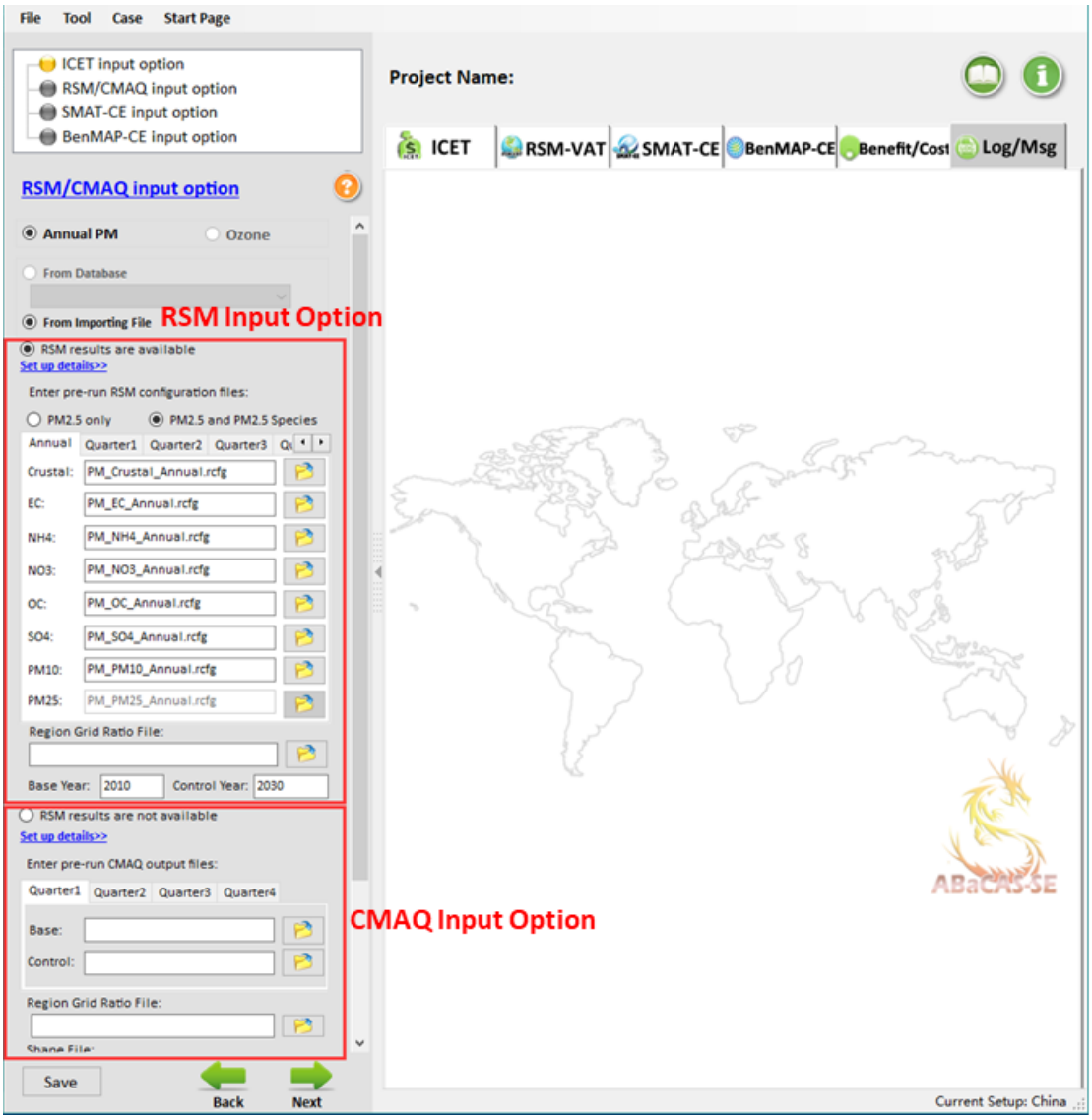


Fig. 10 RSM/CMAQ Input Option

3.2.1 RSM Input Option

➢ The RSM Input option allows users to enter **pre-run RSM configuration files** and set the base year and control year according to their needs, as shown in 错误!未找到引用源。. In addition, the Region Grid Ratio File is not necessary here.

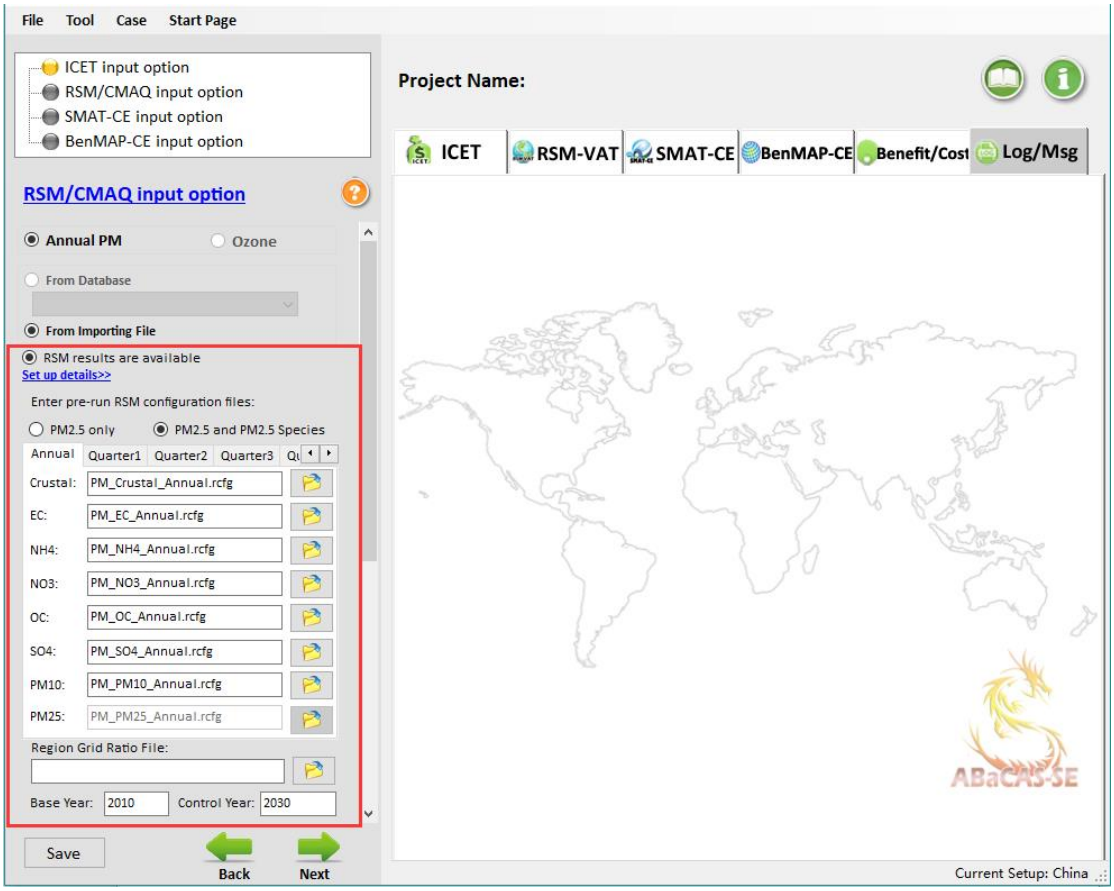


Fig. 11 RSM Input option

3.2.2 CMAQ Input Option

➢ The CMAQ Input Option allows users to enter **pre-run CMAQ output files** and set the base year and control year according to their needs, as shown in 错误!未找到引用源。. In addition, the Region Grid Ratio File and Shape File are necessary here. And it's noted that when users choose pre-run CMAQ output files as input files, the result can't be displayed in the form of Chart.

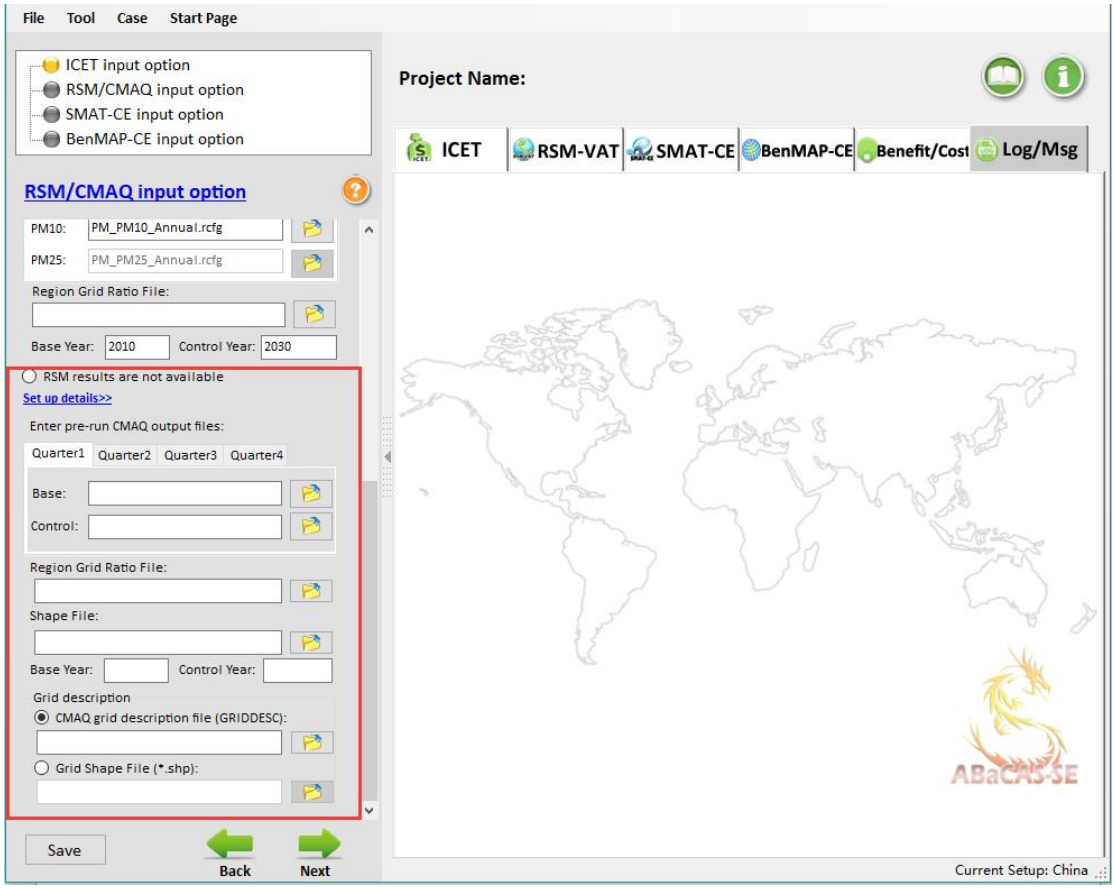


Fig. 12 CMAQ Input option

3.3 SMAT-CE Input Option

➢ The SMAT-CE Input Option includes **Monitor Data**, **Monitor Data Year**, **Spatial Field Option**, **Species Data** and **Grid Definition File**, as shown in **错误!未找到引用源。.**

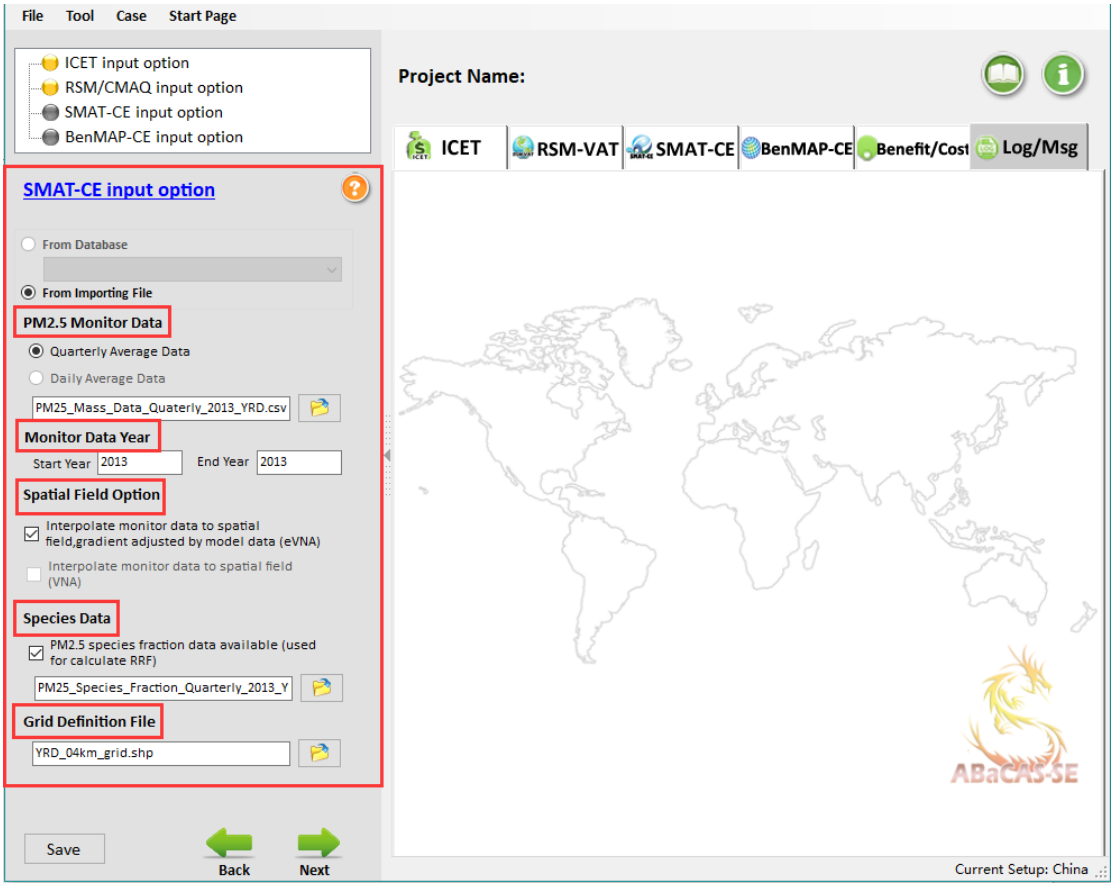


Fig. 13 SMAT-CE Input Option

➢ **Monitor Data:** allows users to choose Quarterly Average Data or Daily Average Data. It's noted that the calculation speed and output files are related to the type and size of monitoring data.

➢ **Monitor Data Year:** allows users to set the monitor data year according to different monitoring data.

➢ **Spatial Field Option:** allows users to choose interpolation methods. For example, users can check eVNA to interpolate monitor data to spatial field, gradient adjusted by model data and check VNA to interpolate monitor data to spatial field. Through this option, the result files can be used to analyze health benefits.

➢ **Species Data:** this option is available only when users choose PM as analyzed pollutant. It allows users to calculate the concentration of each component in the corresponding monitoring point and space area.

➢ **Grid Definition File:** allows users to set the grid information of specific region.

3.4 BenMAP-CE Input Option

➢ The BenMAP-CE 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。.

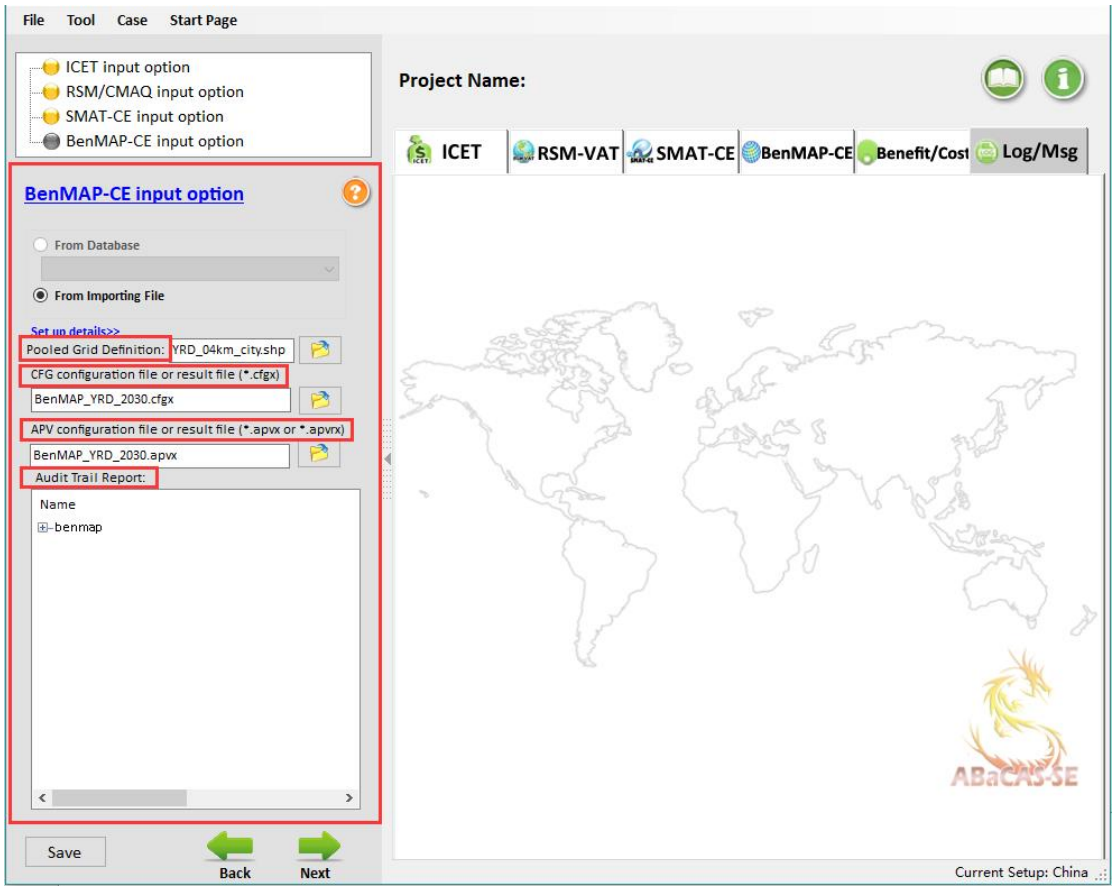


Fig. 14 BenMAP-CE Input Option

➢ **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-SE

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

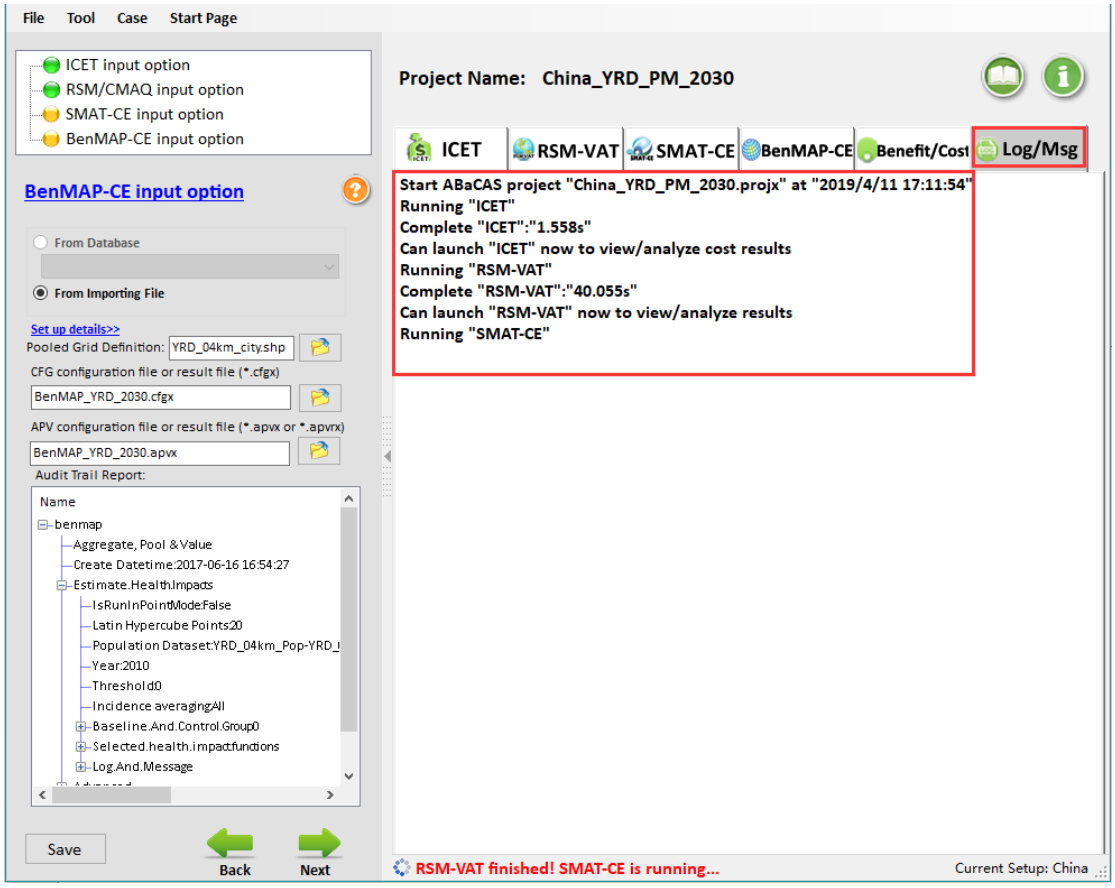


Fig. 15 Running Messages

5 Operation Results

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

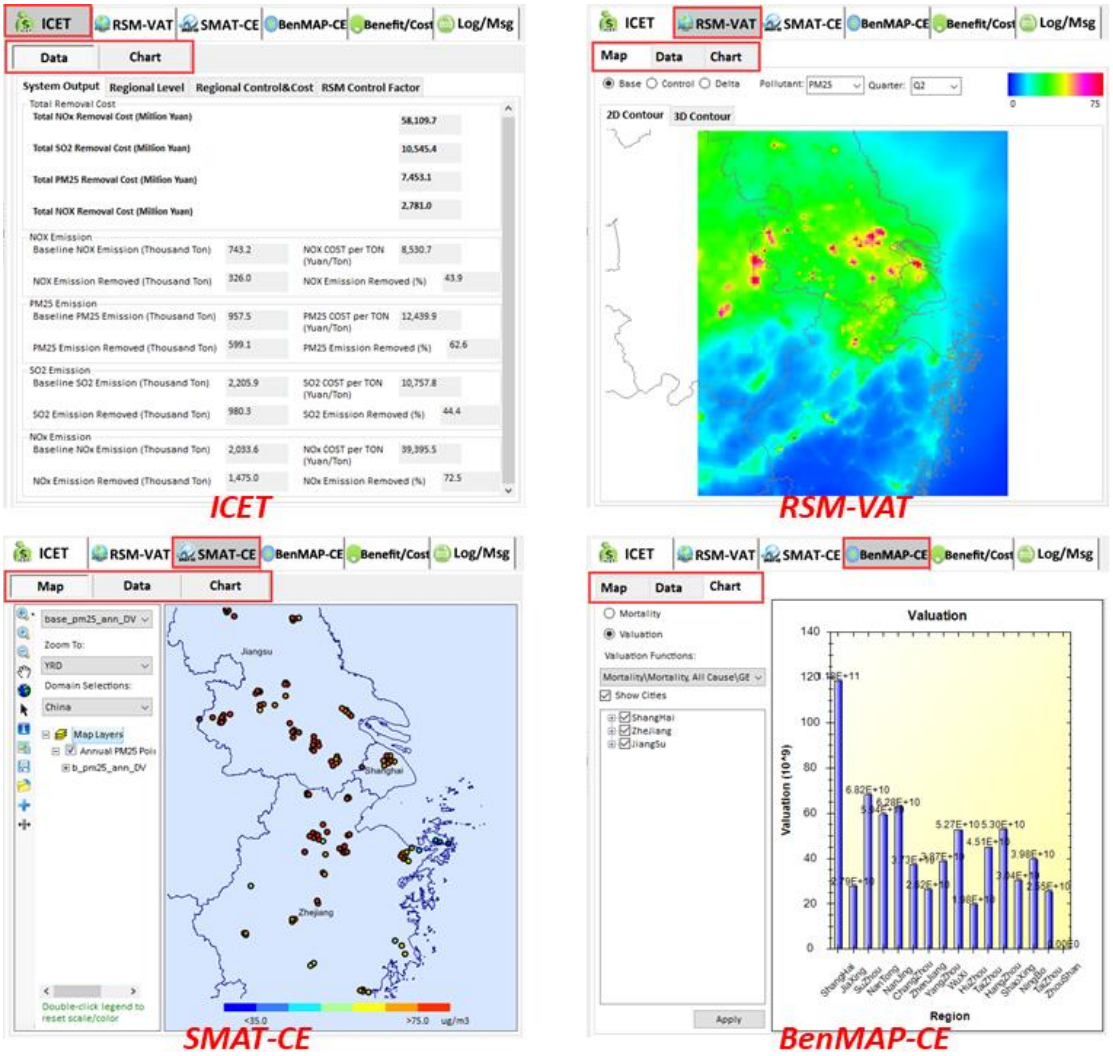


Fig. 16 Data Viewer of ABaCAS-SE results

5.1 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 **错误!未找到引用源。**.

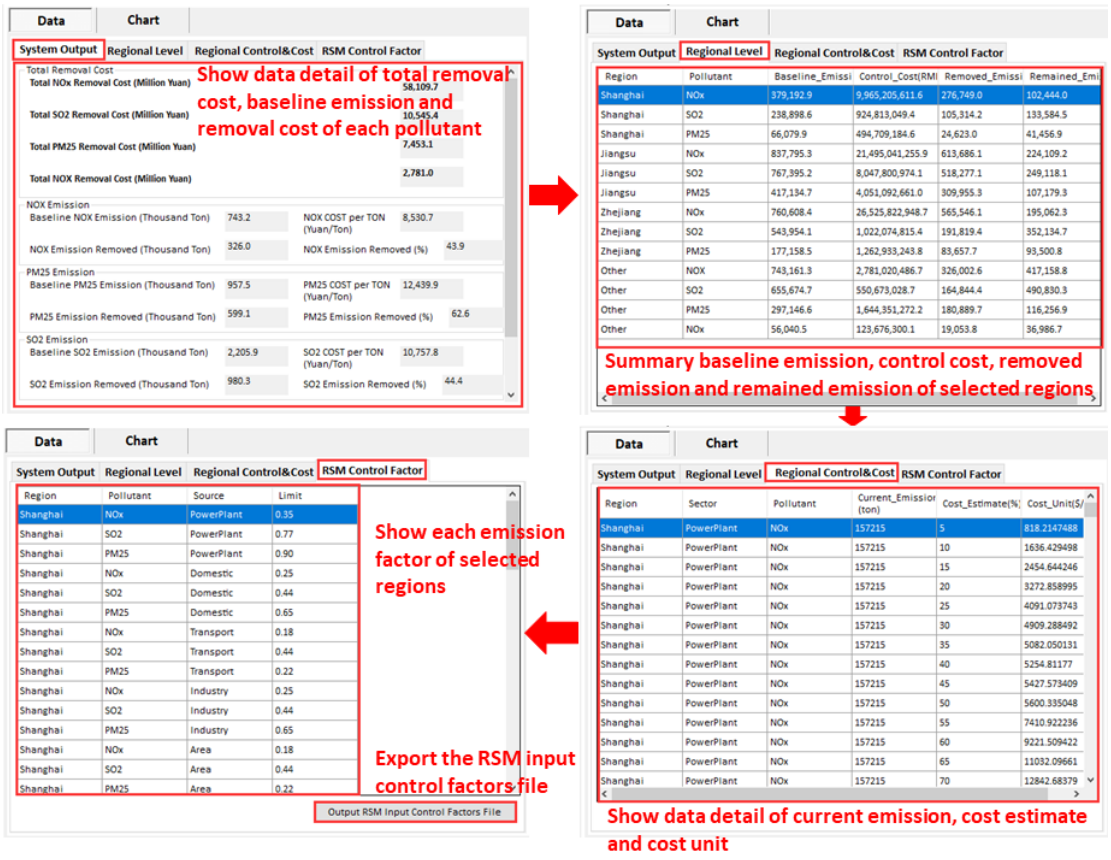


Fig. 17 Data detail results and configuration of ICET

➢ In Chart module, users can also view the results of different pollutant control strategies, including configurating plot according to their preferences, as shown in 错误!未找到引用源。.

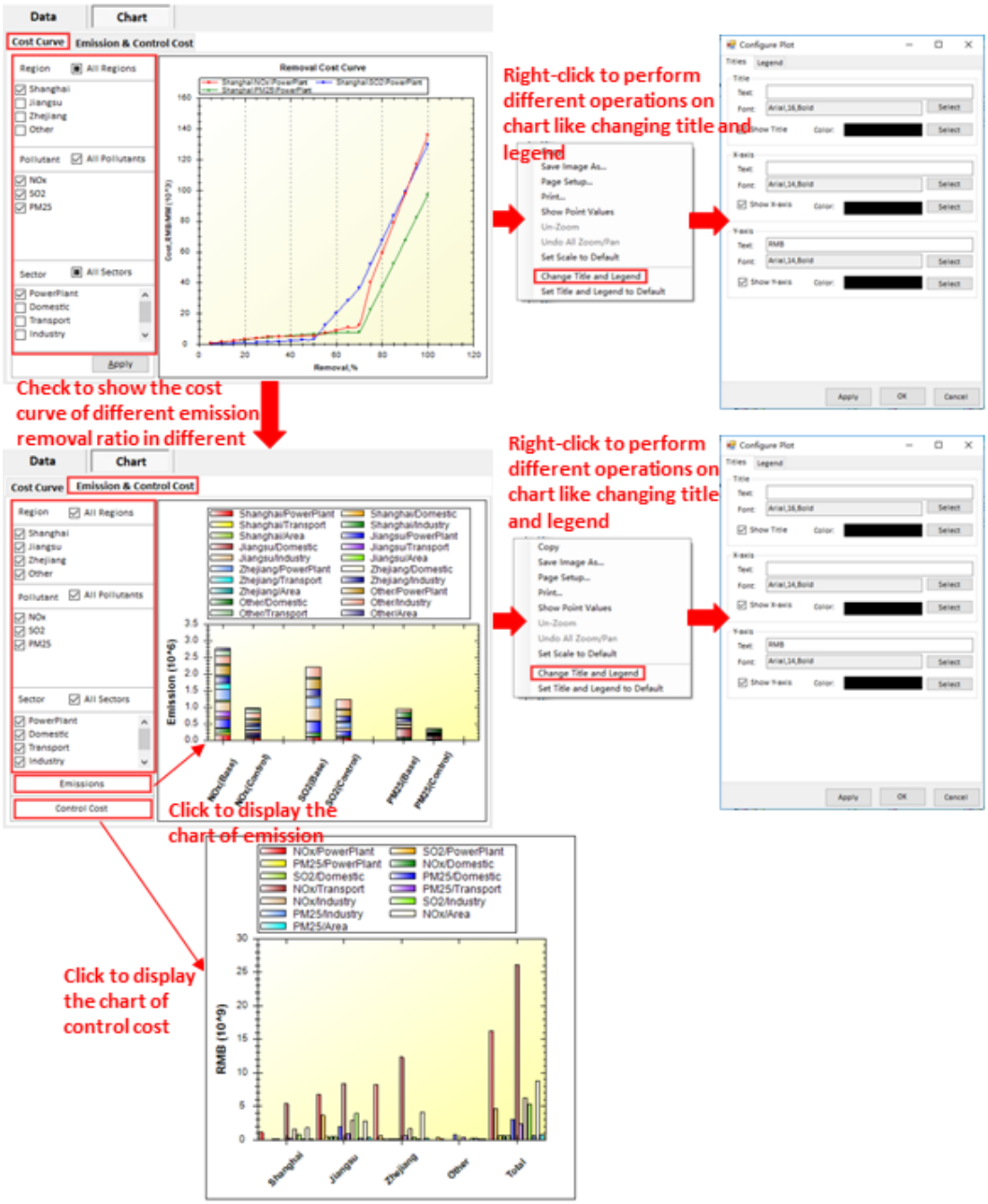


Fig. 18 Chart results and configuration options of ICET

5.2 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 perform different operations on map (e.g., save image as… or save data as CMAQ), as shown in 错误!未找到引用源。19.

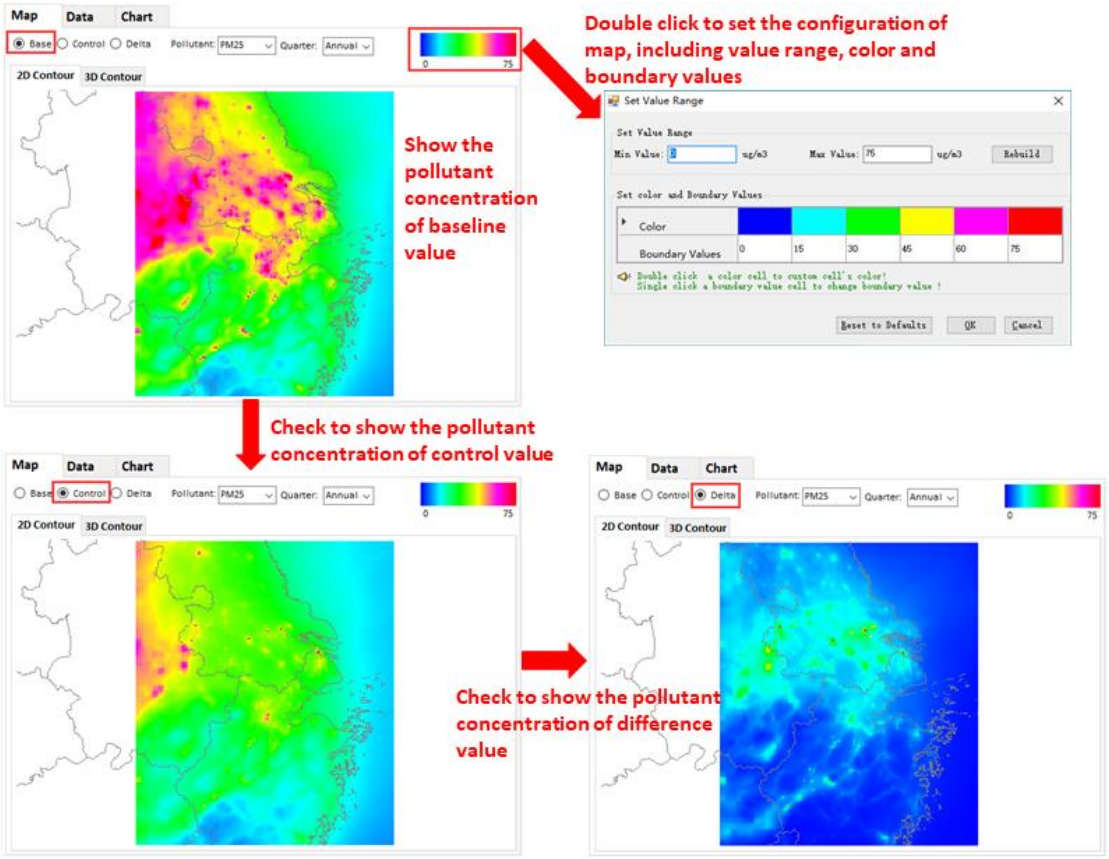
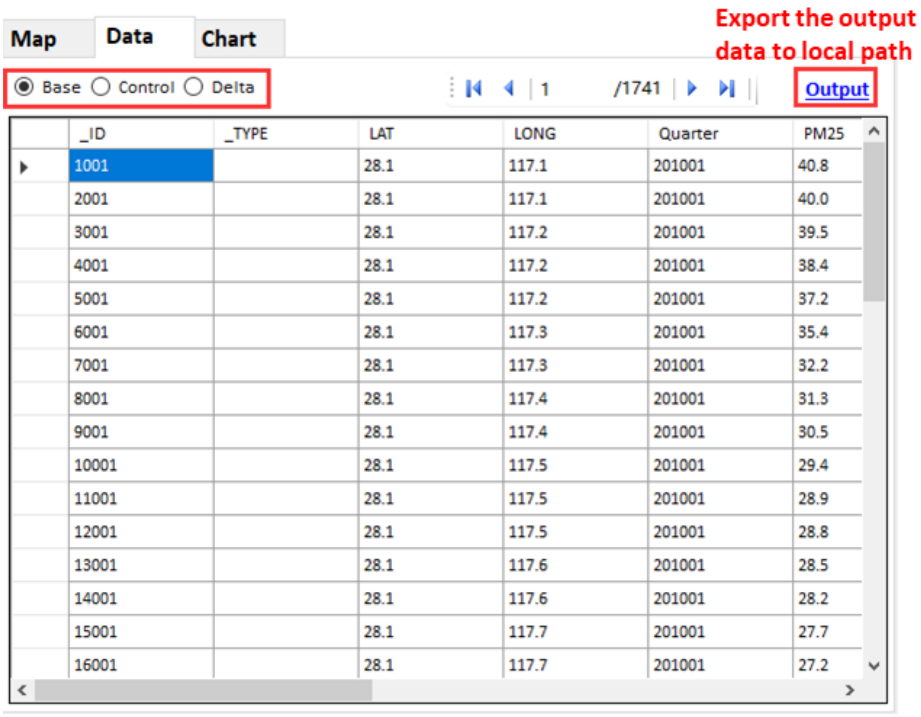


Fig. 19 Map results and configuration options of RSM-VAT

➢ 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 错误!未找到引用源。.



_ID	_TYPE	LAT	LONG	Quarter	PM25
1001		28.1	117.1	201001	40.8
2001		28.1	117.1	201001	40.0
3001		28.1	117.2	201001	39.5
4001		28.1	117.2	201001	38.4
5001		28.1	117.2	201001	37.2
6001		28.1	117.3	201001	35.4
7001		28.1	117.3	201001	32.2
8001		28.1	117.4	201001	31.3
9001		28.1	117.4	201001	30.5
10001		28.1	117.5	201001	29.4
11001		28.1	117.5	201001	28.9
12001		28.1	117.5	201001	28.8
13001		28.1	117.6	201001	28.5
14001		28.1	117.6	201001	28.2
15001		28.1	117.7	201001	27.7
16001		28.1	117.7	201001	27.2

Fig. 20 Data detail results and configuration of RSM-VAT

➢ In Chart module, users can also view the emission reduction effects of emission control, including configurating plot according to their preferences, as shown in **错误! 未找到引用源。**.

Fig. 21 Chart results and configuration options of RSM-VAT

5.3 The results of SMAT-CE

➢ In Map module, users are allowed to show the analysis results of monitoring sites in the selected model area. Users can also configurate legend as needed, as shown in 错误!未找到引用源。22.

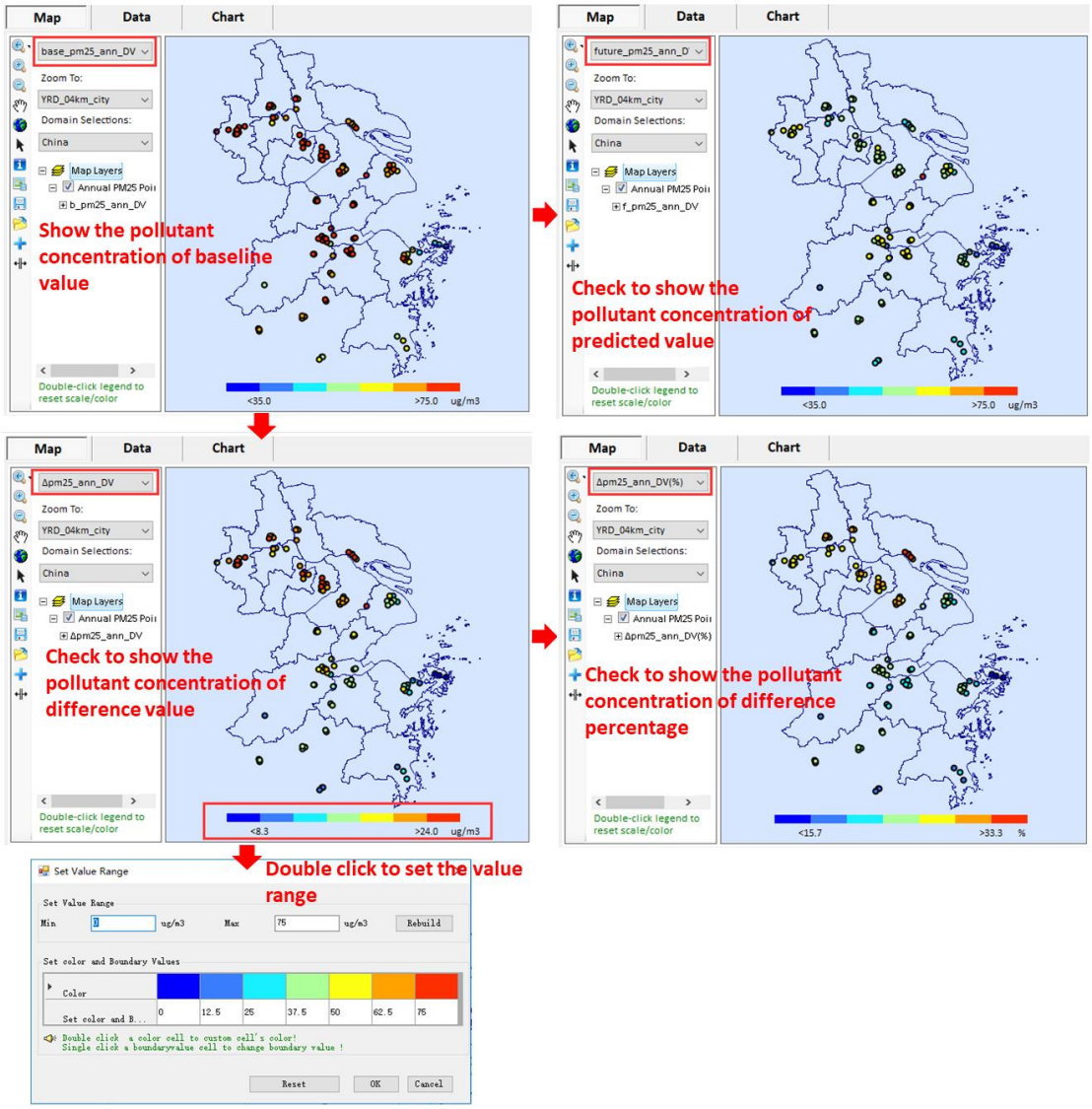


Fig. 22 Map results and configuration options of SMAT-CE

➢ In Data module, it provides more details information about pollutant concentration of each monitor site e.g., baseline value, predicted value and so on. Users can check their interest fields to show, as shown in 错误!未找到引用源。.

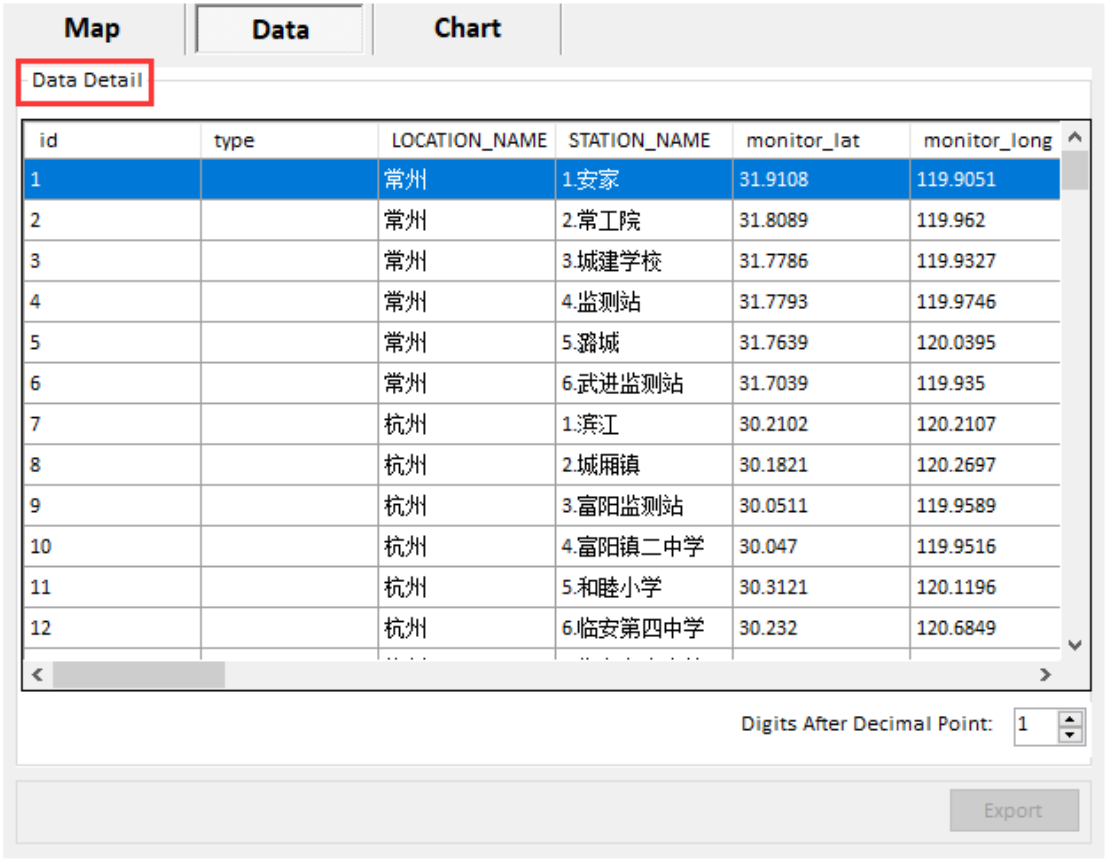


Fig. 23 Data detail results and configuration of SMAT-CE

➢ In Chart module, users can also view the comparison between the baseline and predicted values of different regions/cities, including configurating plot according to their preferences, as shown in 错误!未找到引用源。.

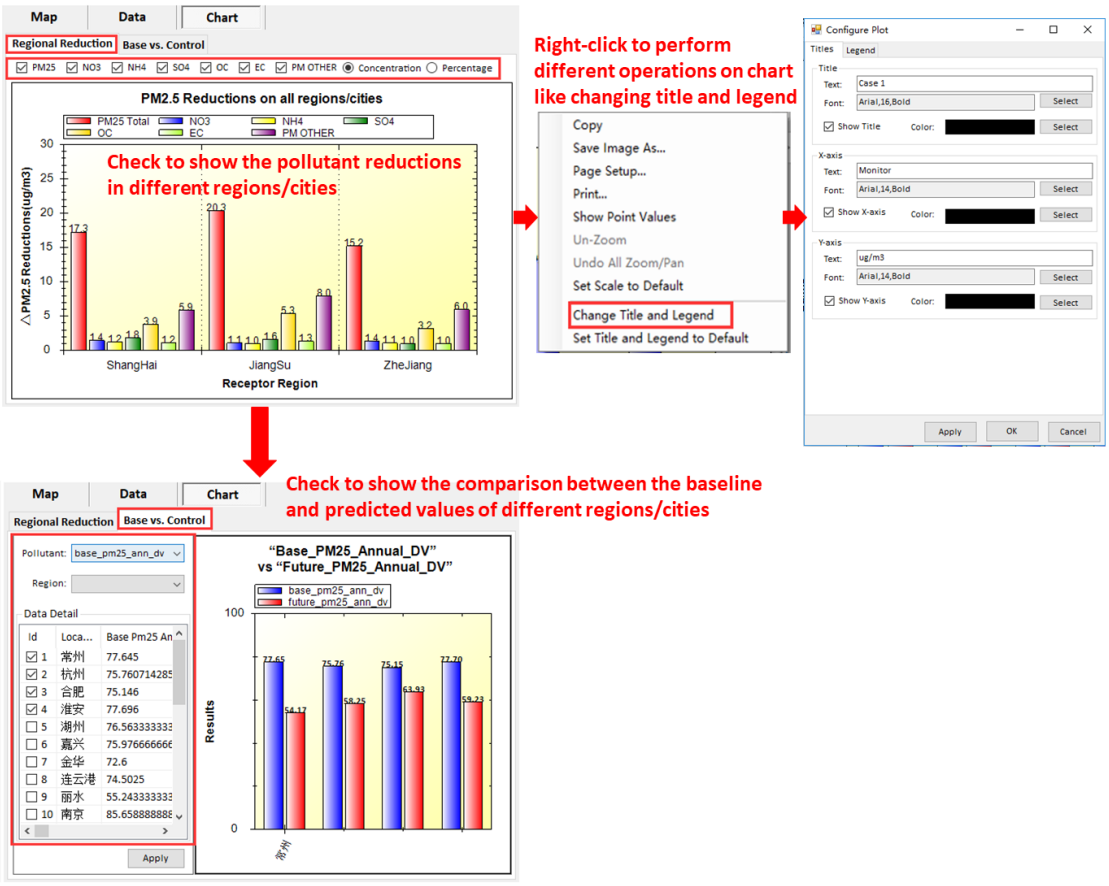


Fig. 24 Chart results and configuration options of SMAT-CE

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 错误!未找到引用源。25.

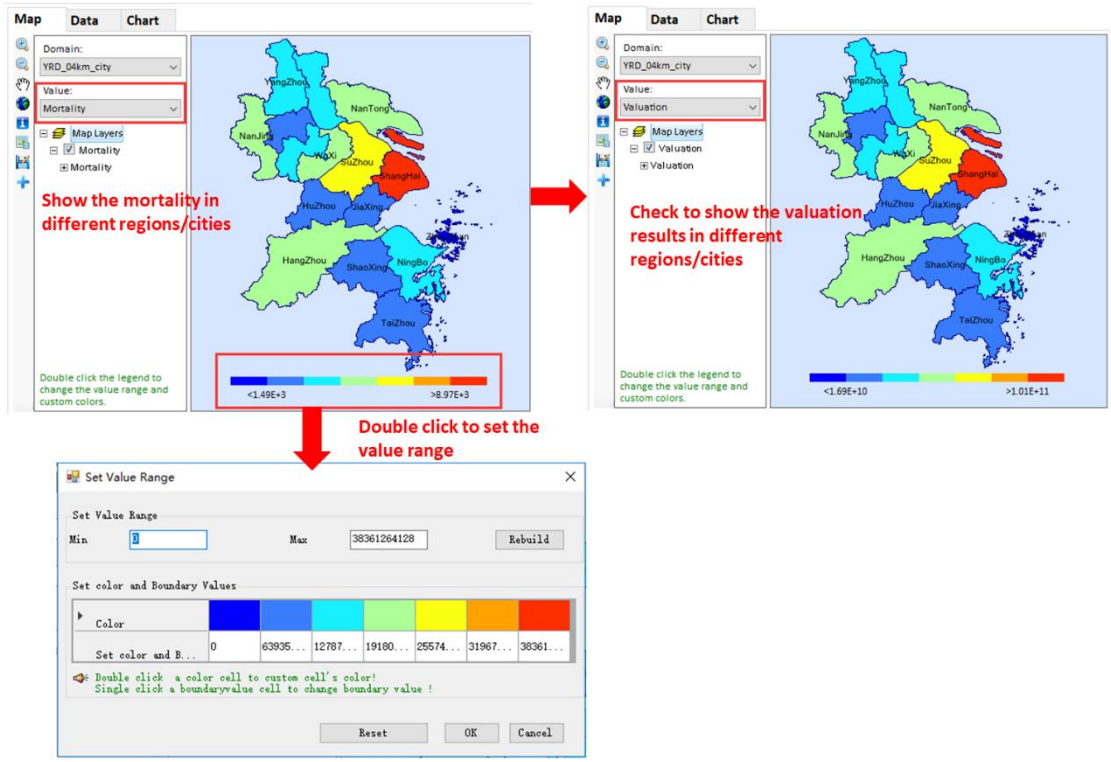
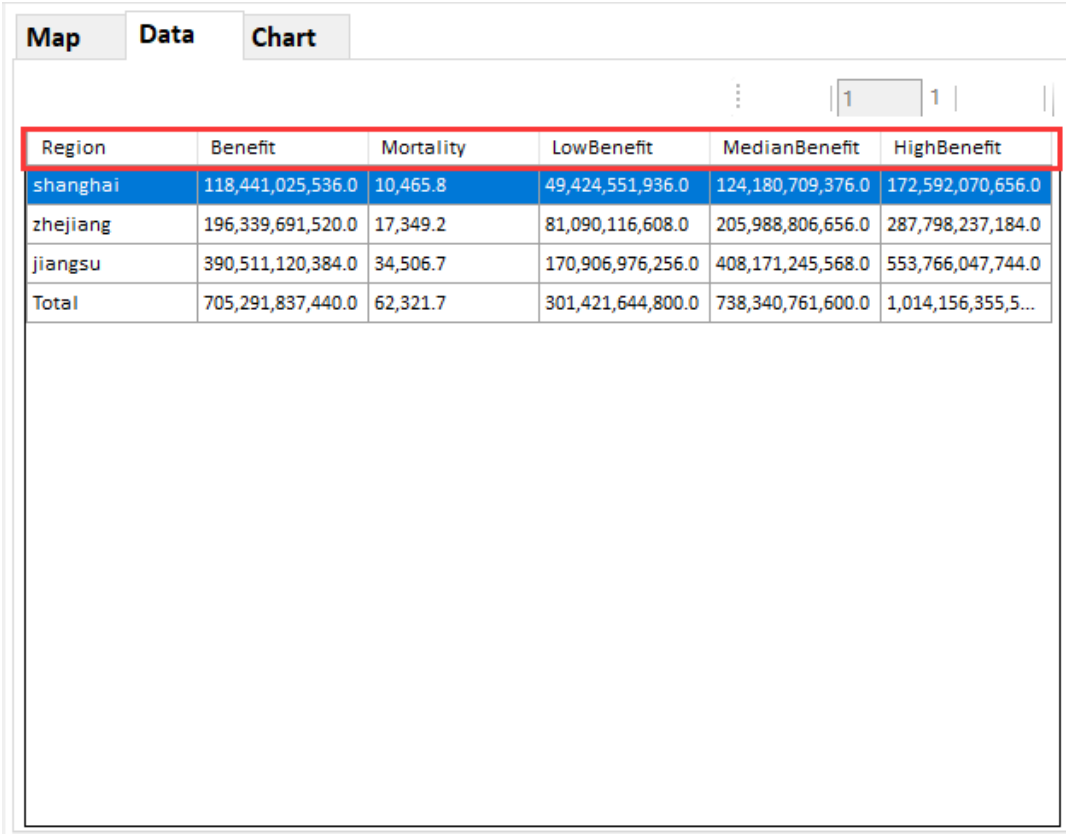


Fig. 25 Map results and configuration options of BenMAP-CE

➢ 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 **错误!未找到引用源。**.



Region	Benefit	Mortality	LowBenefit	MedianBenefit	HighBenefit
shanghai	118,441,025,536.0	10,465.8	49,424,551,936.0	124,180,709,376.0	172,592,070,656.0
zhejiang	196,339,691,520.0	17,349.2	81,090,116,608.0	205,988,806,656.0	287,798,237,184.0
jiangsu	390,511,120,384.0	34,506.7	170,906,976,256.0	408,171,245,568.0	553,766,047,744.0
Total	705,291,837,440.0	62,321.7	301,421,644,800.0	738,340,761,600.0	1,014,156,355,5...

Fig. 26 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 **错误!未找到引用源。**.

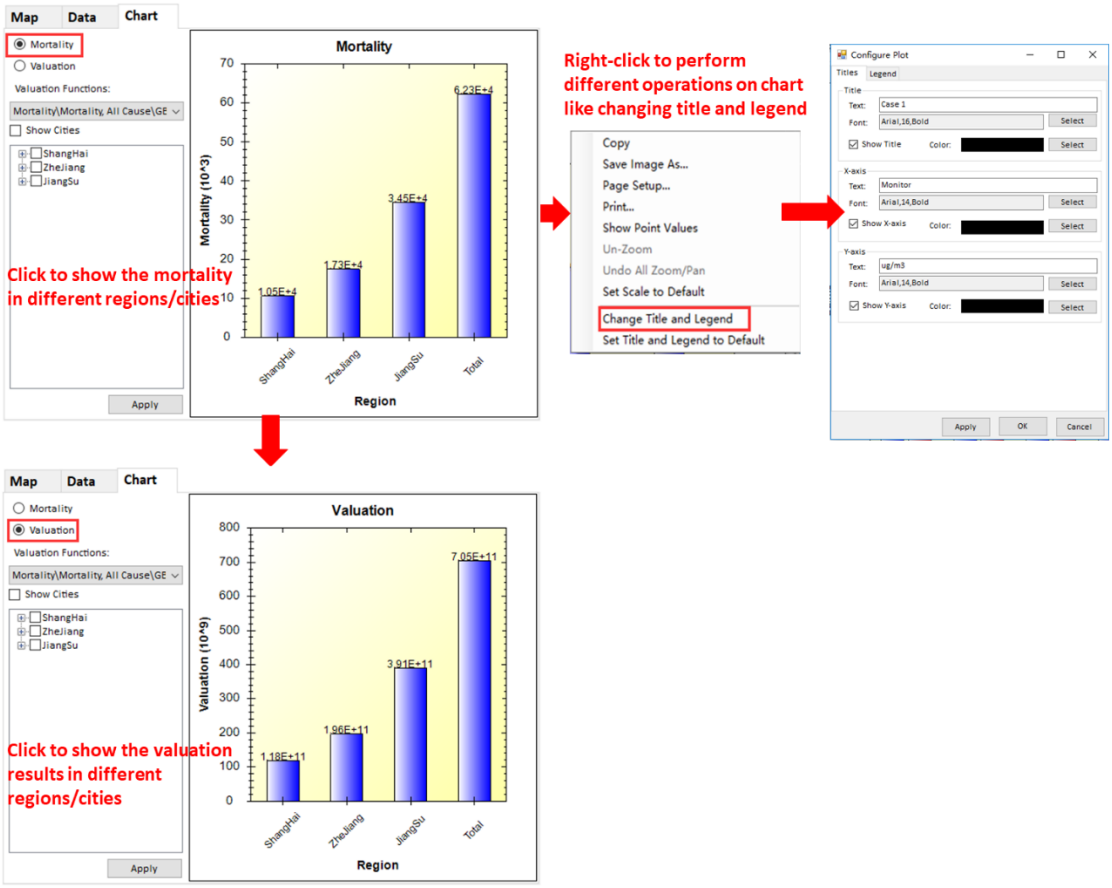


Fig. 27 Chart results and configuration options of BenMAP-CE

6 Case Study in China

In order to better introduce how to use ABaCAS-SE, 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 **Annual PM** as analyzed pollutant.

➢ Choose **No pre-run ICET project file**.

➢ Click the file button  to select a **Control Input File** and open it. The details of Control Input File is shown in Fig.28.

Region/Sector/Pollutant Control Setup & Input:						Control Cost Setup & Input:					
	Currency	RMB	Emission:	Ton							
Available	Control_I	Control_S	Control_I	Control(%)		Region	Sector	Pollutan	Current_I	Cost_Est:	Cost_Unit ($/ton)
Shanghai	Shanghai	PowerPla	NOx	64.9		Shanghai	PowerPla	NOx	157215	5	818.2147
Jiangsu		PowerPla	SO2	23			PowerPla	NOx	157215	10	1636.429
Zhejiang		PowerPla	PM25	10			PowerPla	NOx	157215	15	2454.644
Other		Domestic	NOx	75.5			PowerPla	NOx	157215	20	3272.859
		Domestic	SO2	56.1			PowerPla	NOx	157215	25	4091.074
		Domestic	PM25	35			PowerPla	NOx	157215	30	4909.288
		Transport	NOx	82.2			PowerPla	NOx	157215	35	5082.05
		Transport	SO2	56.1			PowerPla	NOx	157215	40	5254.812
		Transport	PM25	77.6			PowerPla	NOx	157215	45	5427.573
		Industry	NOx	75.5			PowerPla	NOx	157215	50	5600.335
		Industry	SO2	56.1			PowerPla	NOx	157215	55	7410.922
		Industry	PM25	35			PowerPla	NOx	157215	60	9221.509
		Area	NOx	82.2			PowerPla	NOx	157215	65	11032.1
		Area	SO2	56.1			PowerPla	NOx	157215	70	12842.68
		Area	PM25	77.6			PowerPla	NOx	157215	75	40584.51
	Jiangsu	PowerPla	NOx	75.9			PowerPla	NOx	157215	80	59764.55
		PowerPla	SO2	58.4			PowerPla	NOx	157215	85	78944.58
		PowerPla	PM25	78.4			PowerPla	NOx	157215	90	98124.62
		Domestic	NOx	69.5			PowerPla	NOx	157215	95	117304.7
		Domestic	SO2	74.5			PowerPla	NOx	157215	100	136484.7
		Domestic	PM25	73.5			PowerPla	SO2	86731	5	267.3824
		Transport	NOx	75.7			PowerPla	SO2	86731	10	534.7649
		Transport	SO2	74.5			PowerPla	SO2	86731	15	802.1473
		Transport	PM25	86			PowerPla	SO2	86731	20	1069.53
		Industry	NOx	69.5			PowerPla	SO2	86731	25	1336.912
		Industry	SO2	74.5			PowerPla	SO2	86731	30	1604.295
		Industry	PM25	73.5			PowerPla	SO2	86731	35	2049.447
		Area	NOx	75.7			PowerPla	SO2	86731	40	2494.599
		Area	SO2	74.5			PowerPla	SO2	86731	45	2939.752
		Area	PM25	86			PowerPla	SO2	86731	50	3384.904
	Zhejiang	PowerPla	NOx	73.3			PowerPla	SO2	86731	55	12379.14
		PowerPla	SO2	44.9			PowerPla	SO2	86731	60	20527.15
		PowerPla	PM25	45			PowerPla	SO2	86731	65	28675.16
		Domestic	NOx	70.5			PowerPla	SO2	86731	70	36823.17
		Domestic	SO2	24.9			PowerPla	SO2	86731	75	52412.14
		Domestic	PM25	45			PowerPla	SO2	86731	80	68001.11
		Transport	NOx	80.8			PowerPla	SO2	86731	85	83590.08

Fig. 28 Control Input File

➢ Select one or more of the four options in the **Available Regions** column as shown in the **错误!未找到引用源。** , and the click >> button, the selected options will appear in the **Selected Regions** column which as shown in the **错误!未找到引用源。**.

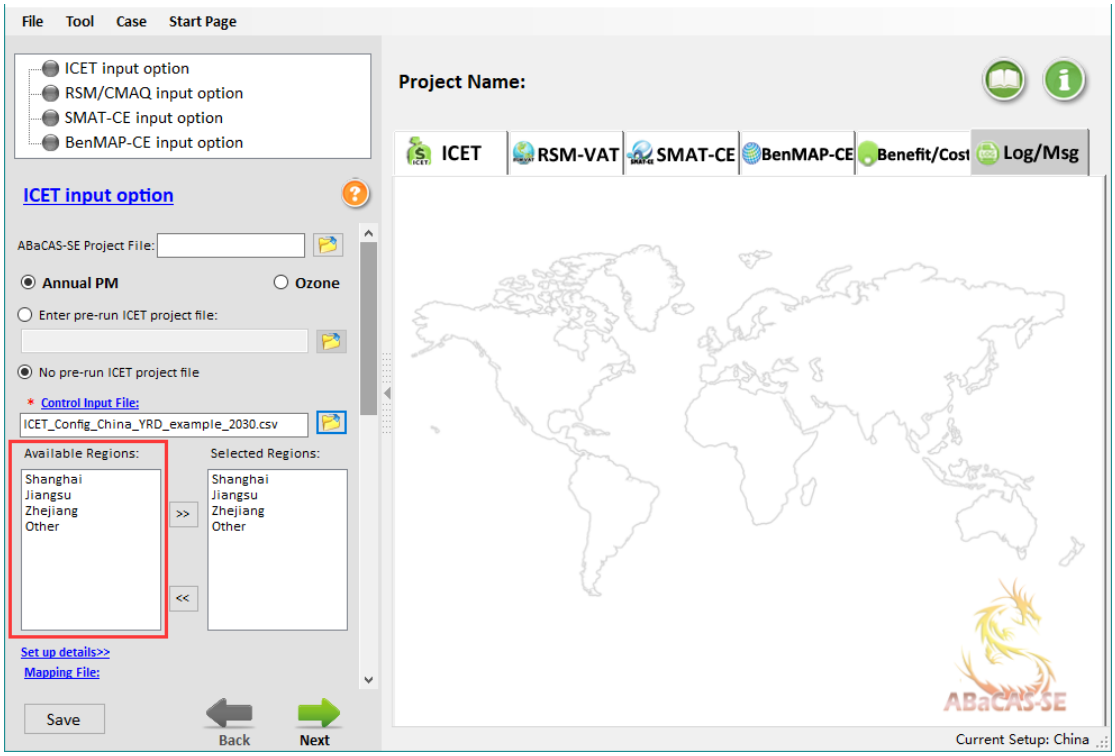


Fig. 29 Available Regions

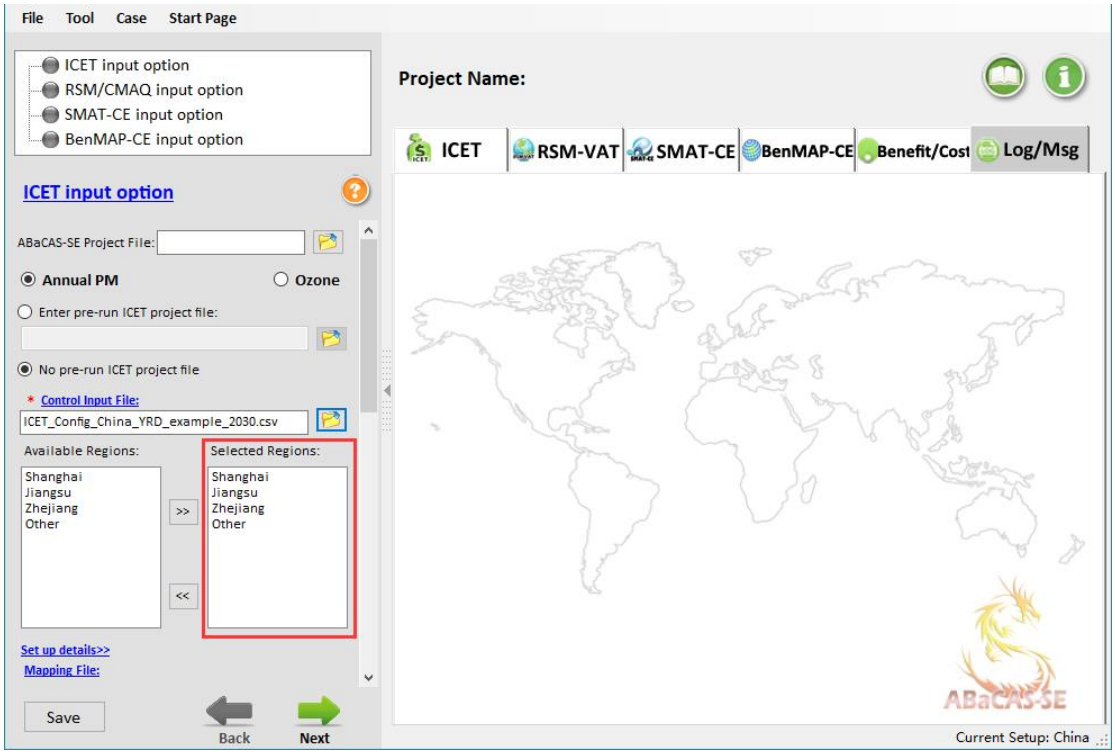


Fig. 30 Selected Regions

➢ Click the file button  to select a **Mapping File** and open it. The details of Mapping File is shown in Fig.31.

Cost_Reg	RSM_Regi	Cost_Sec	RSM_Sect	Cost_Pol	RSM_Pollutant
Shanghai	SH	PowerPla	PP	NOx	NOx
Jiangsu	JS	Industry	IN&DO	PM25	PM25
Zhejiang	ZJ	Domestic	IN&DO	SO2	SO2
Other	OTH	Transport	TR&AR	NH3	NH3
		Area	TR&AR	VOC	VOC
				PMC	PMC

Fig. 31 Mapping File

➢ Click **Next** button to enter the interface of **RSM/CMAQ Input Option,** as shown in the 错误!未找到引用源。.

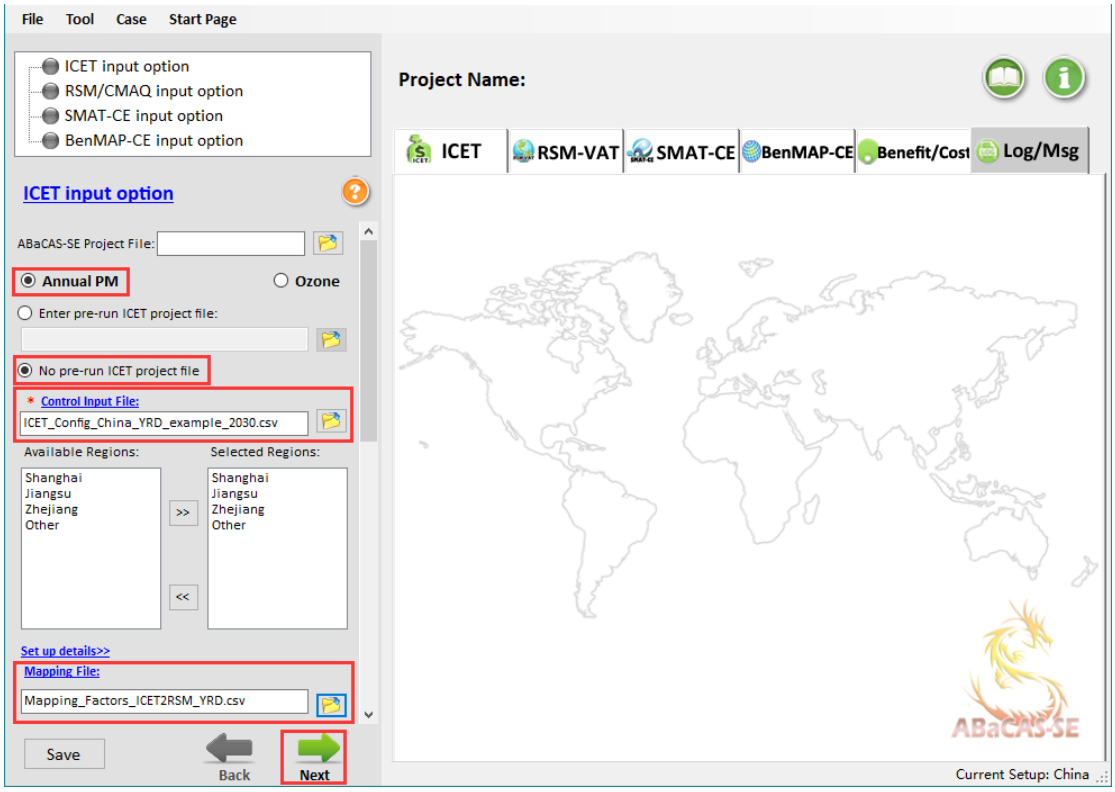


Fig. 32 ICET Input Option

➢ Choose **From Importing File** and **RSM results are available**.

➢ Choose **PM2.5 and PM2.5 Species**, and then click the file buttons  which are the pre-run RSM configuration files corresponding to $PM_{2.5}$ and $PM_{2.5}$ species and open them.

➢ Set the **Base Year** to 2010, the **Control Year** to 2030.

➢ Click **Next** button to enter the interface of **SMAT-CE Input Option,** as shown in the 错误!未找到引用源。.

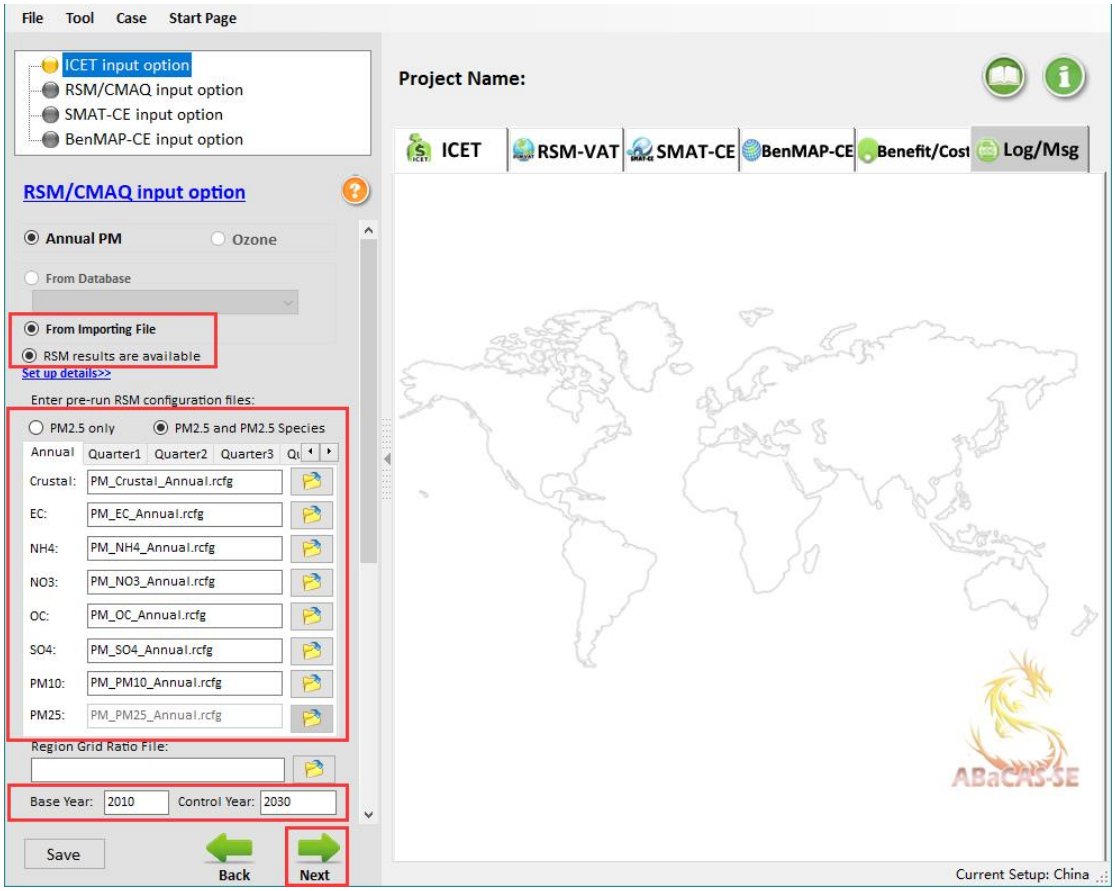


Fig. 33 RSM/CMAQ Input Option

➢ Choose **From Importing File**.

➢ Choose **Quarterly Average Data,** and then click the file button  to select a corresponding file and open it. The details of Quarterly Average Data is shown Fig.34.

Quarter_ID	_TYPE	LAT	LONG	Quarter_I	PM25	LOCATION	STATION_NAME
1		31.9108	119.9051	201301	112.9662	常州	1.安家
1		31.9108	119.9051	201304	67.84835	常州	1.安家
1		31.9108	119.9051	201307	34.60286	常州	1.安家
1		31.9108	119.9051	201310	92.37324	常州	1.安家
2		31.8089	119.962	201301	115.4451	常州	2.常工院
2		31.8089	119.962	201304	69.33719	常州	2.常工院
2		31.8089	119.962	201307	35.36217	常州	2.常工院
2		31.8089	119.962	201310	94.40024	常州	2.常工院
3		31.7786	119.9327	201301	115.4451	常州	3.城建学校
3		31.7786	119.9327	201304	69.33719	常州	3.城建学校
3		31.7786	119.9327	201307	35.36217	常州	3.城建学校
3		31.7786	119.9327	201310	94.40024	常州	3.城建学校
4		31.7793	119.9746	201301	109.2479	常州	4.监测站
4		31.7793	119.9746	201304	65.6151	常州	4.监测站
4		31.7793	119.9746	201307	33.46389	常州	4.监测站
4		31.7793	119.9746	201310	89.33274	常州	4.监测站
5		31.7639	120.0395	201301	118.5437	常州	5.潞城
5		31.7639	120.0395	201304	71.19823	常州	5.潞城
5		31.7639	120.0395	201307	36.31131	常州	5.潞城
5		31.7639	120.0395	201310	96.93398	常州	5.潞城
6		31.7039	119.935	201301	112.3465	常州	6.武进监测站
6		31.7039	119.935	201304	67.47614	常州	6.武进监测站
6		31.7039	119.935	201307	34.41303	常州	6.武进监测站
6		31.7039	119.935	201310	91.86649	常州	6.武进监测站
7		30.2102	120.2107	201301	100.7155	杭州	1.滨江
7		30.2102	120.2107	201304	71.44604	杭州	1.滨江
7		30.2102	120.2107	201307	46.48453	杭州	1.滨江
7		30.2102	120.2107	201310	101.3038	杭州	1.滨江
8		30.1821	120.2697	201301	66.71082	杭州	2.城厢镇
8		30.1821	120.2697	201304	47.32365	杭州	2.城厢镇
8		30.1821	120.2697	201307	30.78992	杭州	2.城厢镇
8		30.1821	120.2697	201310	67.10047	杭州	2.城厢镇
9		30.0511	119.9589	201301	98.44309	杭州	3.富阳监测站
9		30.0511	119.9589	201304	69.83404	杭州	3.富阳监测站
9		30.0511	119.9589	201307	45.43573	杭州	3.富阳监测站
9		30.0511	119.9589	201310	99.01809	杭州	3.富阳监测站
10		30.047	119.9516	201301	99.01119	杭州	4.富阳镇二中学
10		30.047	119.9516	201304	70.23704	杭州	4.富阳镇二中学
10		30.047	119.9516	201307	45.69793	杭州	4.富阳镇二中学

Fig. 34 Quarterly Average Data

- Set the **Start Year** to 2013, the **End Year** to 2013.
- Check **eVNA**.
- Check **PM2.5 species fraction data available**, and then click the file button  to select a species data file corresponding to $PM_{2.5}$ and open it. The details of Species Data is shown Fig.35.

Quarter_ID	_TYPE	LAT	LONG	Quarter_I	SO4	NO3	NH4	OC	EC	CRUSTAL	H2O	OTHER	LOCATION_	STATION_NAME
21024		28.88179	117.9729	201301	5.327441	1.233222	1.876913	2.456423	0.550741	3.471466	0.908408	0.908408		Station1
21024		28.88179	117.9729	201307	4.028065	0.932436	1.41913	1.857295	0.416414	2.624767	0.686845	0.686845		Station1
21024		28.88179	117.9729	201304	3.04561	0.705012	1.073	1.404296	0.31485	1.98458	0.519322	0.519322		Station1
21024		28.88179	117.9729	201310	2.302778	0.533058	0.811293	1.061785	0.238057	1.500536	0.392658	0.392658		Station1
22058		30.11118	118.1211	201301	7.769868	1.798606	2.737406	3.582598	0.803235	5.063	1.324877	1.324877		Station2
22058		30.11118	118.1211	201307	5.874778	1.359922	2.069746	2.708793	0.607324	3.828122	1.001737	1.001737		Station2
22058		30.11118	118.1211	201304	4.441905	1.028234	1.56493	2.048112	0.459196	2.894434	0.757411	0.757411		Station2
22058		30.11118	118.1211	201310	3.358514	0.777445	1.18324	1.548573	0.347197	2.188474	0.572676	0.572676		Station2
25094		31.40813	118.3645	201301	15.75283	3.646542	5.549889	7.263453	1.6285	10.26486	2.686091	2.686091		Station3
25094		31.40813	118.3645	201307	11.91068	2.757141	4.196257	5.491879	1.231305	7.761234	2.030947	2.030947		Station3
25094		31.40813	118.3645	201304	9.005635	2.084668	3.17278	4.152396	0.930986	5.86825	1.535594	1.535594		Station3
25094		31.40813	118.3645	201310	6.809139	1.576212	2.398931	3.139617	0.703917	4.43697	1.161059	1.161059		Station3
43016		28.529	118.8502	201301	4.606187	1.066262	1.622808	2.123861	0.476179	3.001483	0.785423	0.785423		Station4
43016		28.529	118.8502	201307	3.482727	0.806198	1.227001	1.605846	0.360038	2.269414	0.593856	0.593856		Station4
43016		28.529	118.8502	201304	2.633281	0.609565	0.927733	1.214176	0.272224	1.715898	0.449013	0.449013		Station4
43016		28.529	118.8502	201310	1.991018	0.46089	0.701456	0.918036	0.205828	1.297387	0.339498	0.339498		Station4
46082		30.91005	119.2078	201301	11.11386	2.57269	3.91553	5.124475	1.148931	7.242012	1.895078	1.895078		Station5
46082		30.91005	119.2078	201307	8.403163	1.945205	2.960523	3.874603	0.868704	5.475668	1.432864	1.432864		Station5
46082		30.91005	119.2078	201304	6.353611	1.470765	2.238444	2.929578	0.656825	4.140139	1.083385	1.083385		Station5
46082		30.91005	119.2078	201310	4.80395	1.112041	1.692482	2.215047	0.496624	3.130349	0.819145	0.819145		Station5
73069		30.34933	120.2885	201301	13.57268	3.141869	4.781798	6.258209	1.403119	8.844227	2.314343	2.314343		Station6
73069		30.34933	120.2885	201307	10.26227	2.37556	3.615506	4.731816	1.060895	6.687099	1.749869	1.749869		Station6
73069		30.34933	120.2885	201304	7.759277	1.796155	2.733675	3.577715	0.80214	5.056099	1.323072	1.323072		Station6
73069		30.34933	120.2885	201310	5.866771	1.358068	2.066925	2.705101	0.606496	3.822904	1.000371	1.000371		Station6
77114		31.96398	120.644	201301	13.39237	3.100129	4.718272	6.175068	1.384479	8.726732	2.283597	2.283597		Station7
77114		31.96398	120.644	201307	10.12594	2.344	3.567474	4.668954	1.046801	6.59826	1.726622	1.726622		Station7
77114		31.96398	120.644	201304	7.656195	1.772293	2.697358	3.530185	0.791484	4.988929	1.305495	1.305495		Station7
77114		31.96398	120.644	201310	5.788831	1.340026	2.039466	2.669164	0.598439	3.772117	0.987081	0.987081		Station7
94028		28.79039	120.987	201301	4.032463	0.933454	1.420679	1.859323	0.416869	2.627633	0.687595	0.687595		Station8
94028		28.79039	120.987	201307	3.048935	0.705782	1.074172	1.40583	0.315194	1.986747	0.519889	0.519889		Station8
94028		28.79039	120.987	201304	2.305293	0.53364	0.812179	1.062944	0.238317	1.502174	0.393087	0.393087		Station8
94028		28.79039	120.987	201310	1.743026	0.403484	0.614086	0.80369	0.180191	1.13579	0.297212	0.297212		Station8
101092		31.077	121.5603	201301	11.17943	2.587868	3.938631	5.154708	1.15571	7.284738	1.906258	1.906258		Station9
101092		31.077	121.5603	201307	8.452739	1.956681	2.977989	3.897462	0.873829	5.507973	1.441317	1.441317		Station9
101092		31.077	121.5603	201304	6.391096	1.479442	2.25165	2.946862	0.6607	4.164565	1.089776	1.089776		Station9
101092		31.077	121.5603	201310	4.832292	1.118602	1.702467	2.228115	0.499554	3.148817	0.823977	0.823977		Station9
103057		29.80381	121.4849	201301	6.048694	1.400181	2.131019	2.788984	0.625303	3.941449	1.031392	1.031392		Station10
103057		29.80381	121.4849	201307	4.573403	1.058673	1.611258	2.108744	0.47279	2.98012	0.779833	0.779833		Station10
103057		29.80381	121.4849	201304	3.457939	0.80046	1.218268	1.594416	0.357476	2.253262	0.58963	0.58963		Station10

Fig. 35 Species Data

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

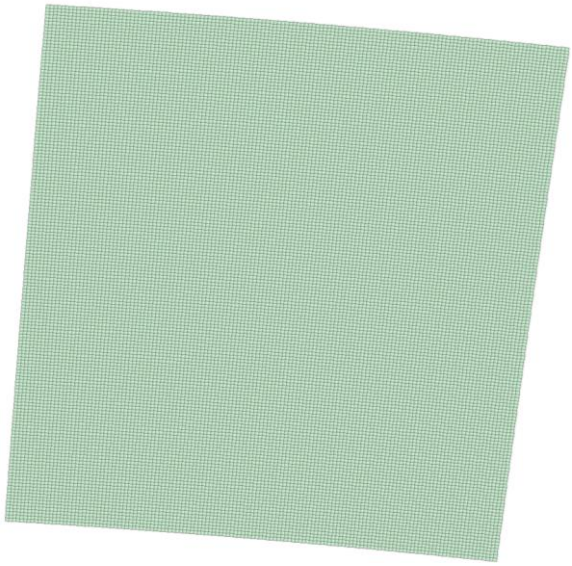


Fig. 36 Grid Definition File

➢ Click **Next** button to enter the interface of **BenMAP-CE Input Option,** as shown in the **错误!未找到引用源。**.

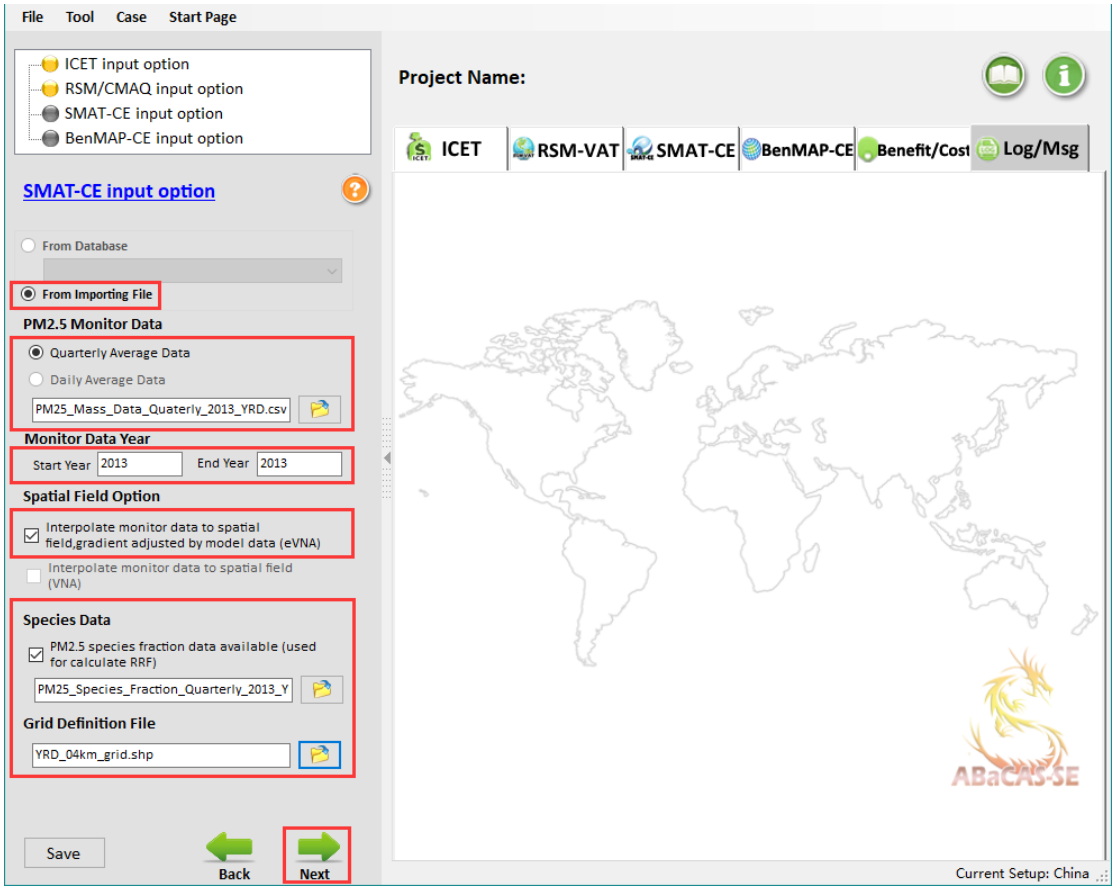


Fig. 37 SMAT-CE Input Option

➢ Click the file buttons  which correspond to **Pooled Grid Definition, CFG configuration file and APV configuration file** and then open them, as shown in the 错误!未找到引用源。. And the details of Pooled Grid Definition is shown in Fig.39.

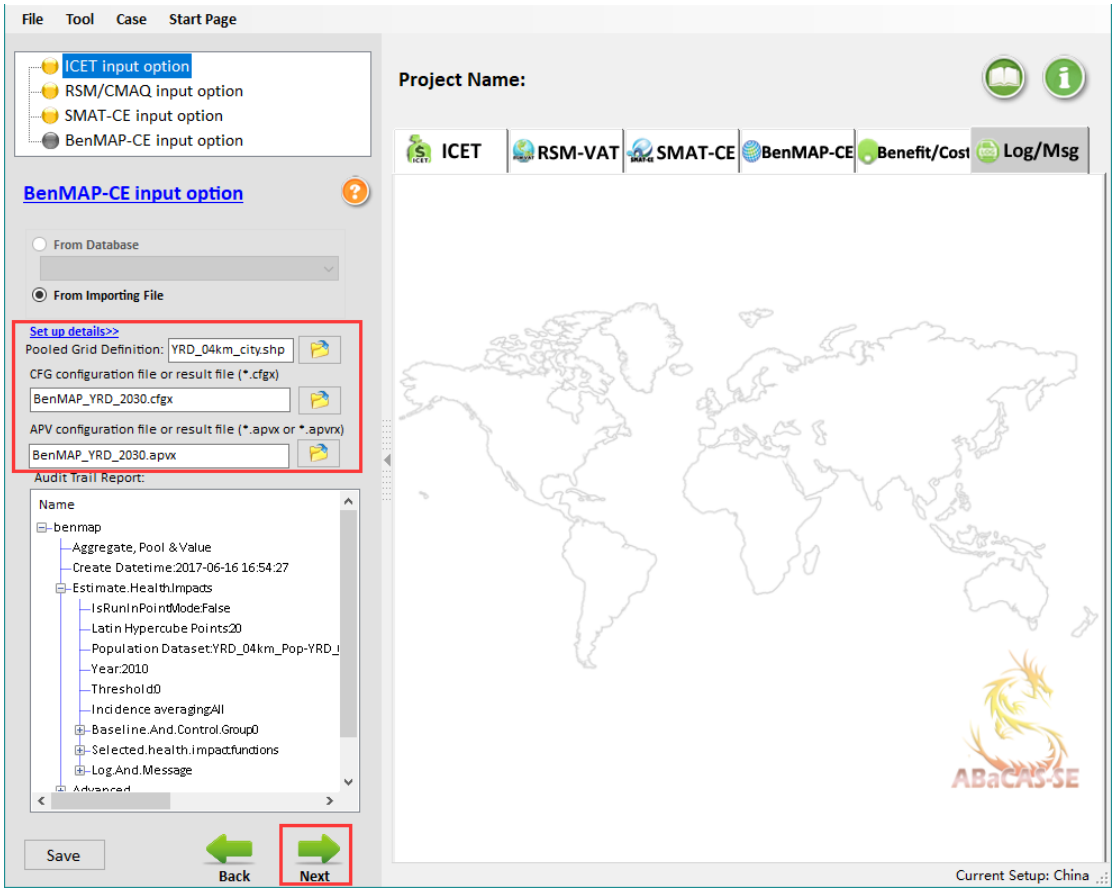


Fig. 38 BenMAP-CE Input Option

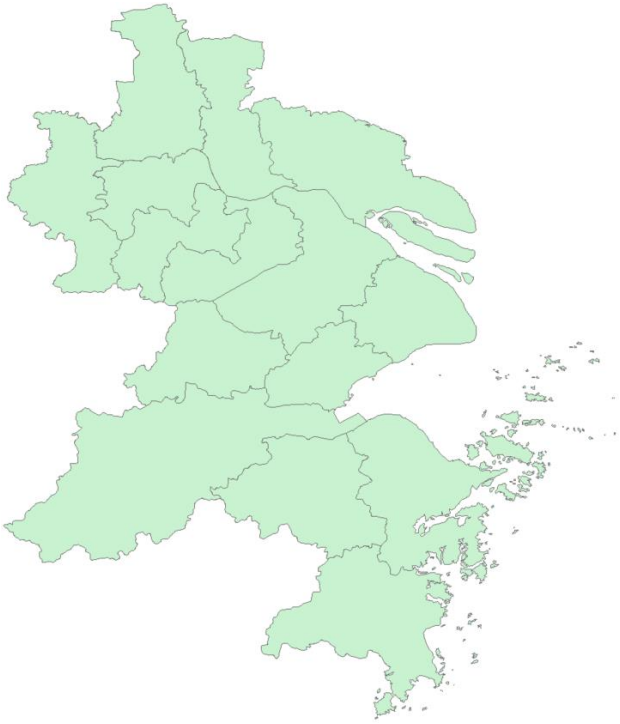


Fig. 39 Pooled Grid Definition

➢ Click **Next** button and 错误!未找到引用源。 will appear, choose **yes** to run the program.

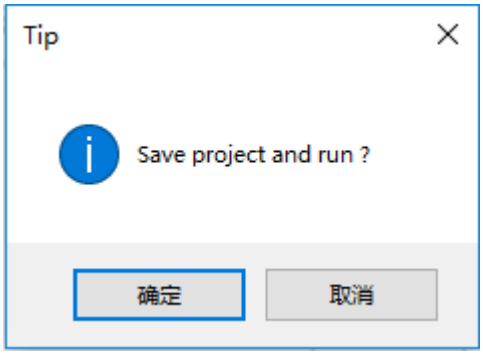


Fig. 40 Save project and run

6.3 View Result

6.3.1 ICET

6.3.1.1 Data results

➢ From the 错误!未找到引用源。, we can view more summary information which contains total removal cost, baseline emission and removal cost of each pollutant. For example, the total $PM_{2.5}$ removal cost in YRD is about 7453.1 million yuan, the baseline $PM_{2.5}$ emission is about 957.5 thousand ton and the removal cost of $PM_{2.5}$ is about 12439.9 yuan/ton and so on.

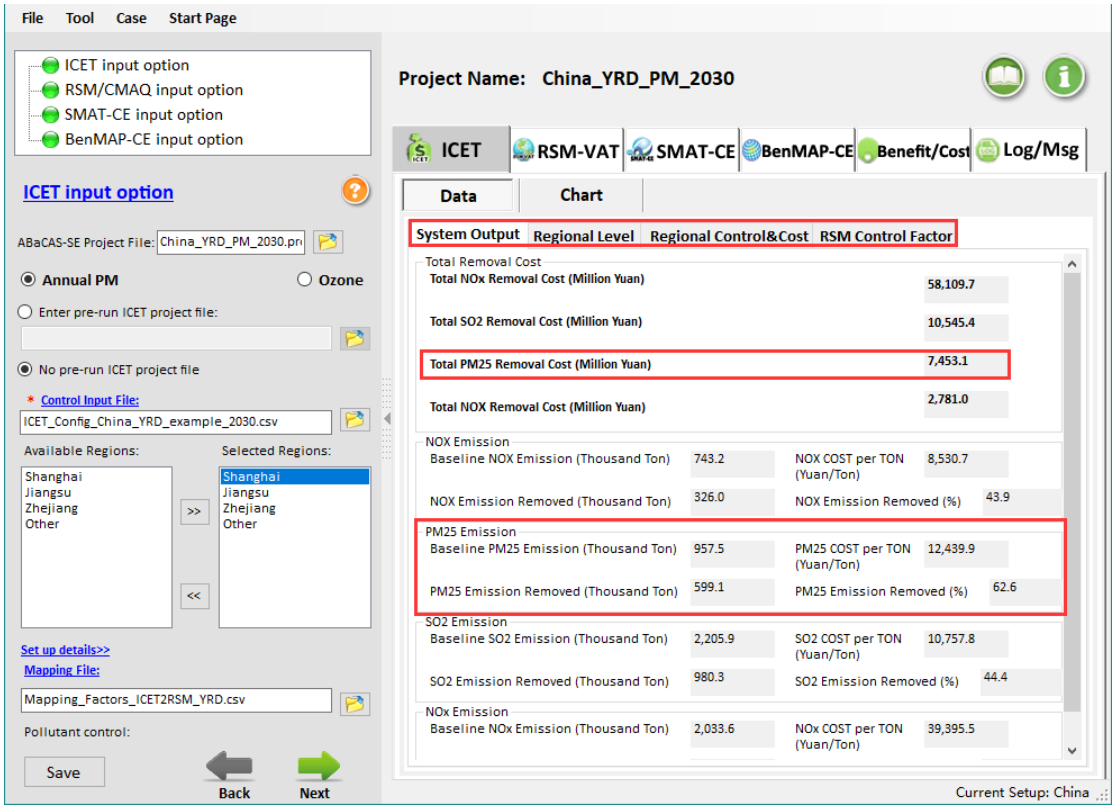


Fig. 41 Data results of ICET

6.3.1.2 Chart results

➢ From the 错误!未找到引用源。, we can directly view the emissions or control cost comparison of different regions in different pollutants.

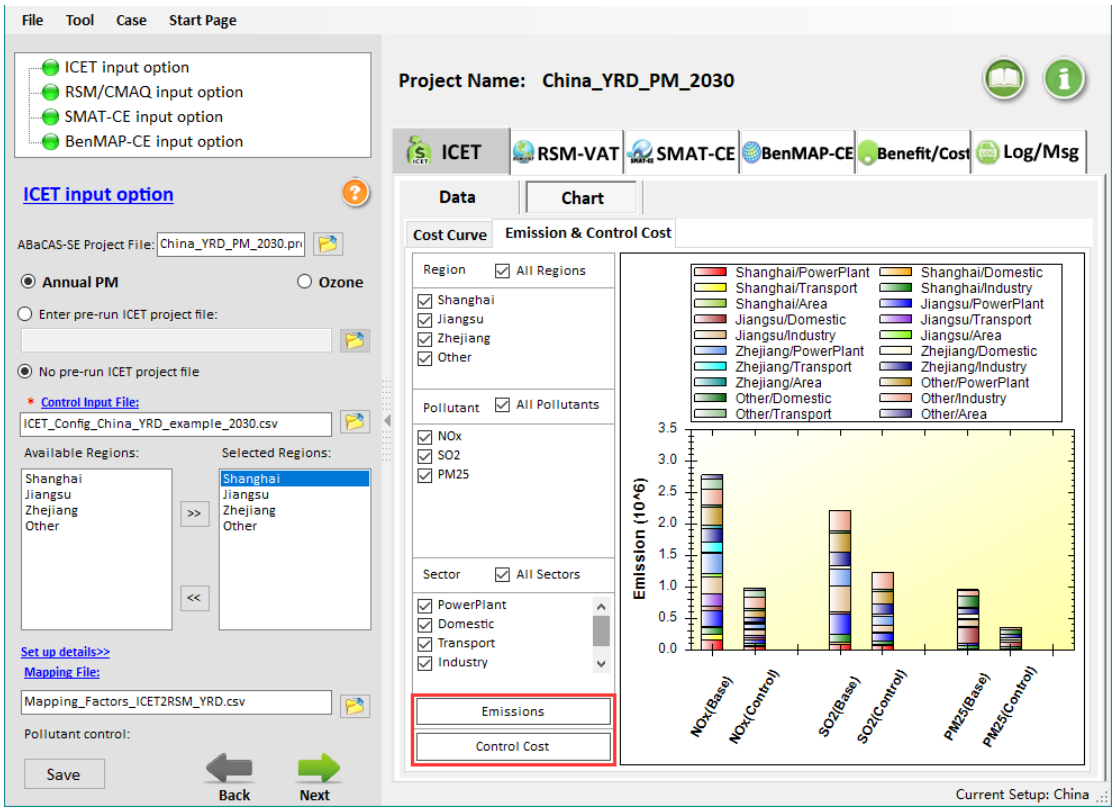


Fig. 42 Chart results of ICET

6.3.2 RSM-VAT

6.3.2.1 Map results

➢ From the 错误!未找到引用源。, we can intuitively know that the maps show the $PM_{2.5}$ concentration that responds in real time to the emission reduction control.

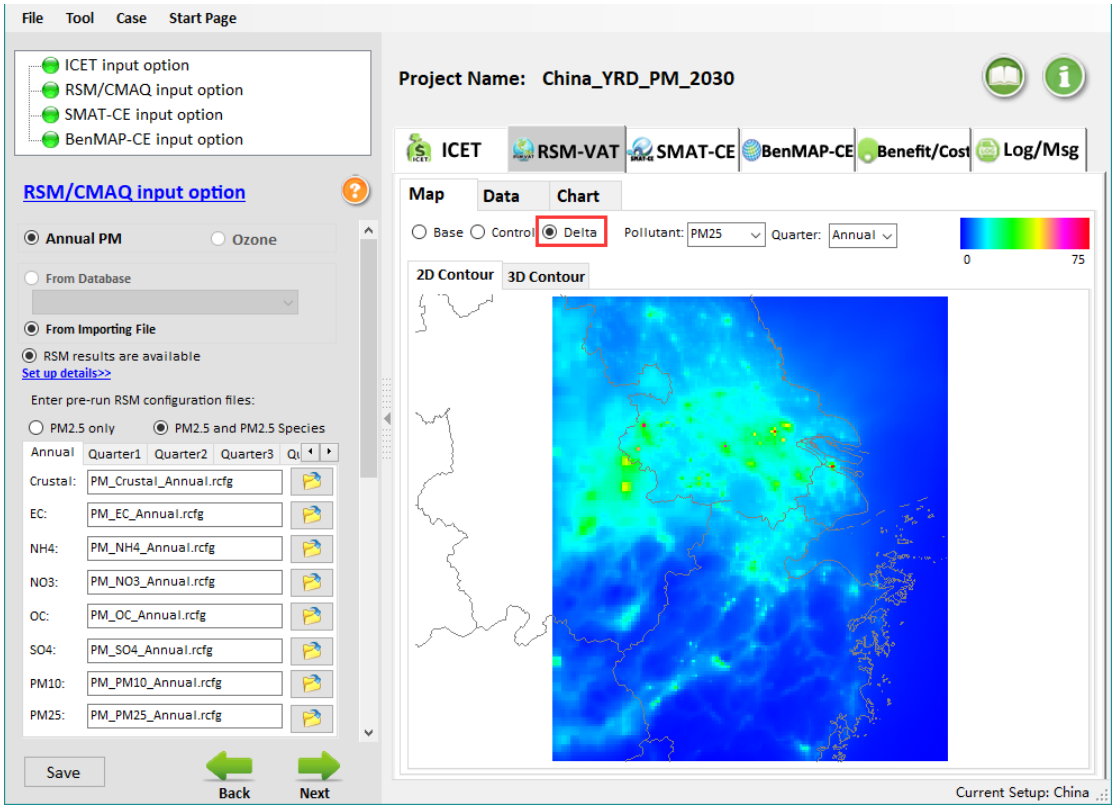


Fig. 43 Map results of RSM-VAT

6.3.2.2 Data results

➢ From the 错误!未找到引用源。, we can view more details information about the emission reduction effects.

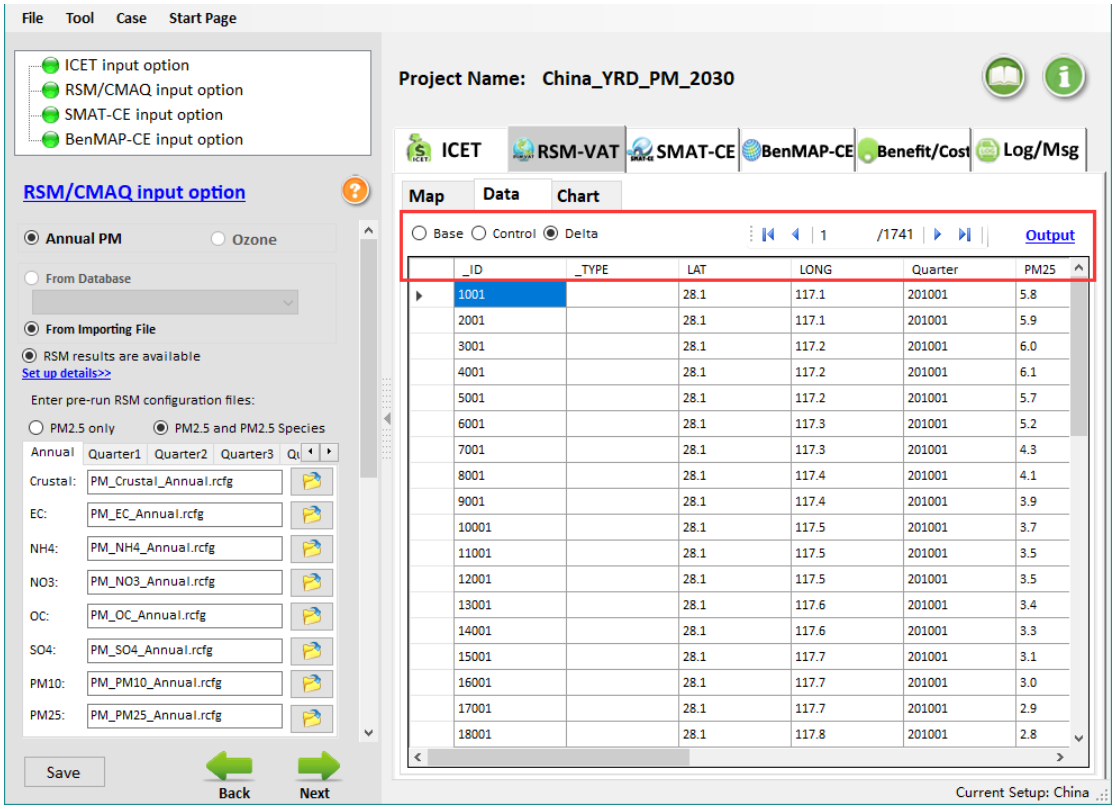


Fig. 44 Data results of RSM-VAT

6.3.2.3 Chart results

➢ From the 错误!未找到引用源。, we can directly view the emission reduction effects of emission control. For example, the $PM_{2.5}$ reductions in SH is about 9.0 $\mu g/m^3$.

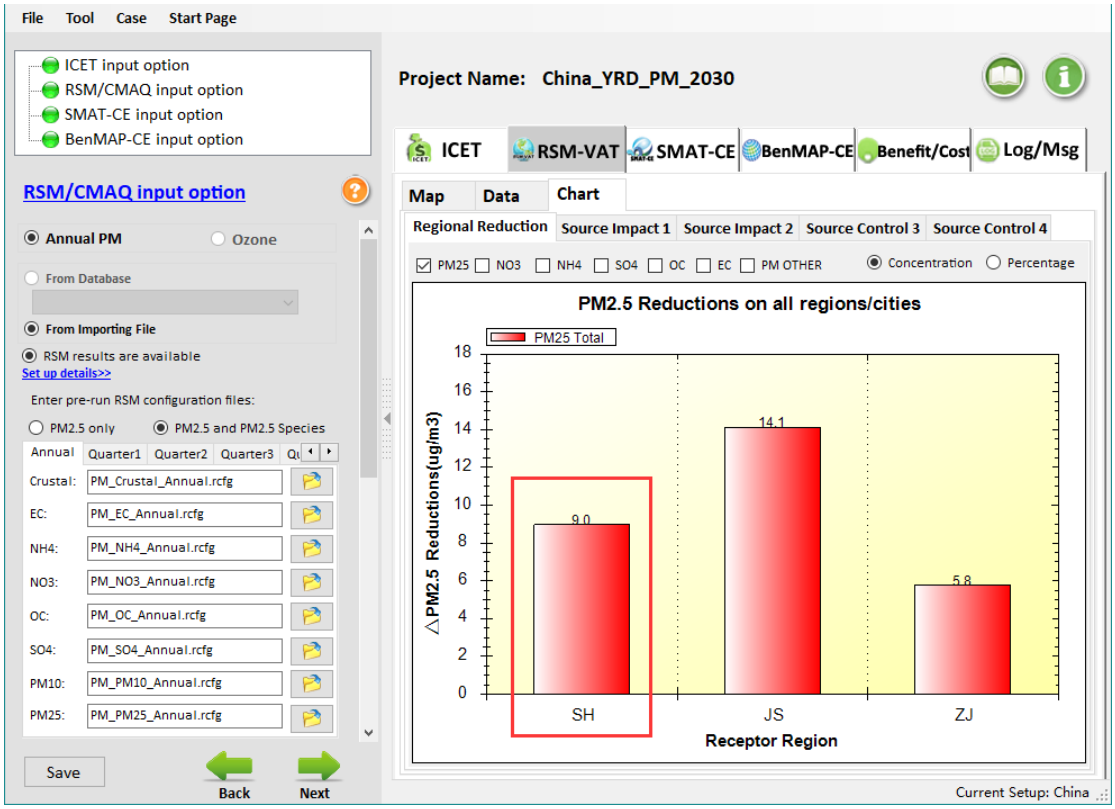


Fig. 45 Chart results of RSM-VAT

6.3.3 SMAT-CE

6.3.3.1 MAP results

➢ From the 错误!未找到引用源。, we can know that the maps show the $PM_{2.5}$ concentration of baseline value, predicted value and difference value and so on.

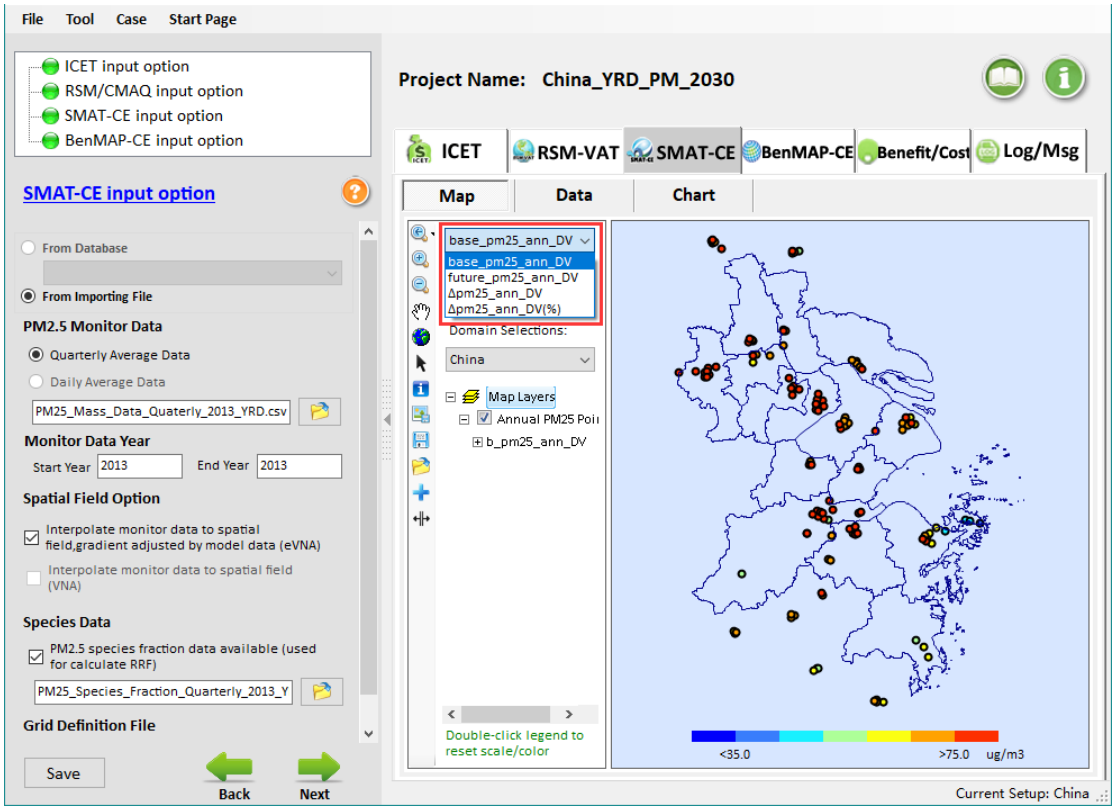


Fig. 46 Map results of SMAT-CE

6.3.3.2 Data results

➢ From the 错误!未找到引用源。, we can view more details information which contains station name, location name and the annual average concentration of $PM_{2.5}$ of each station and so on. For example, the annual average concentration of $PM_{2.5}$ of Anjia station is about 76.9 μg/m^3.

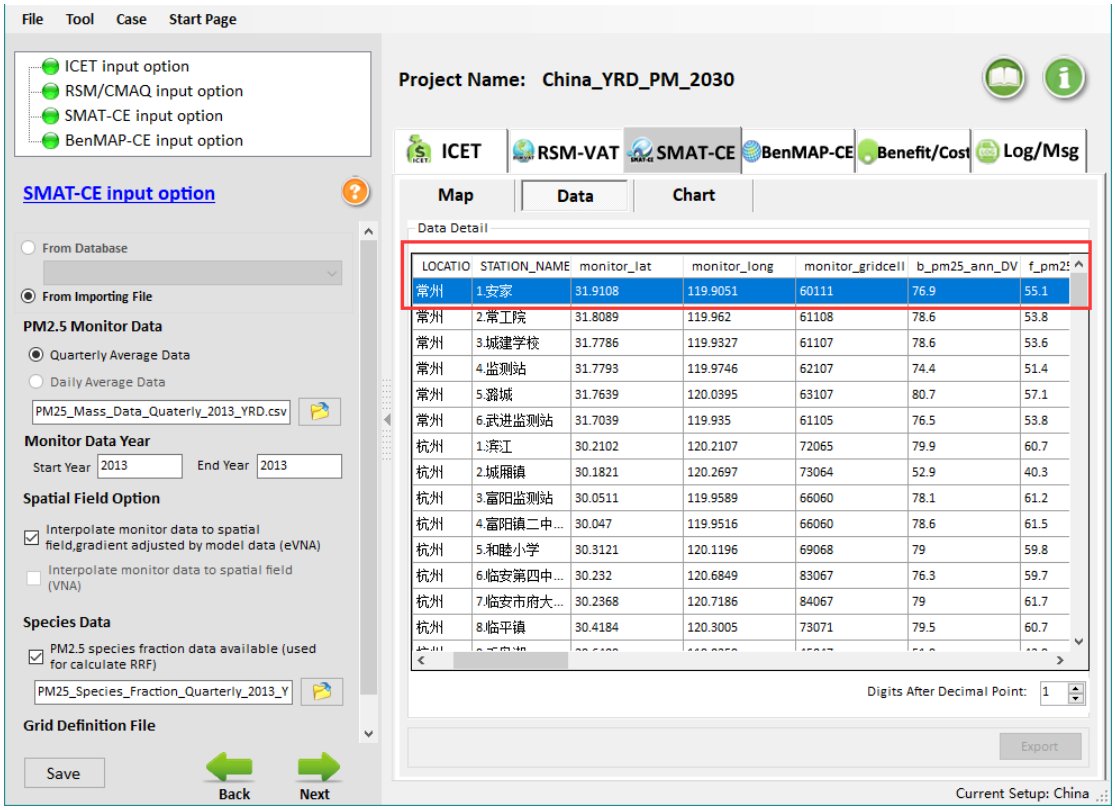


Fig. 47 Data results of SMAT- CE

6.3.3.3 Chart results

➢ From the 错误!未找到引用源。, we can directly view the comparison between the baseline and predicted values of different regions. For example, the baseline value in Changzhou is about 77.65 μg/m^3 but its predicted value is about 54.17 μg/m^3.

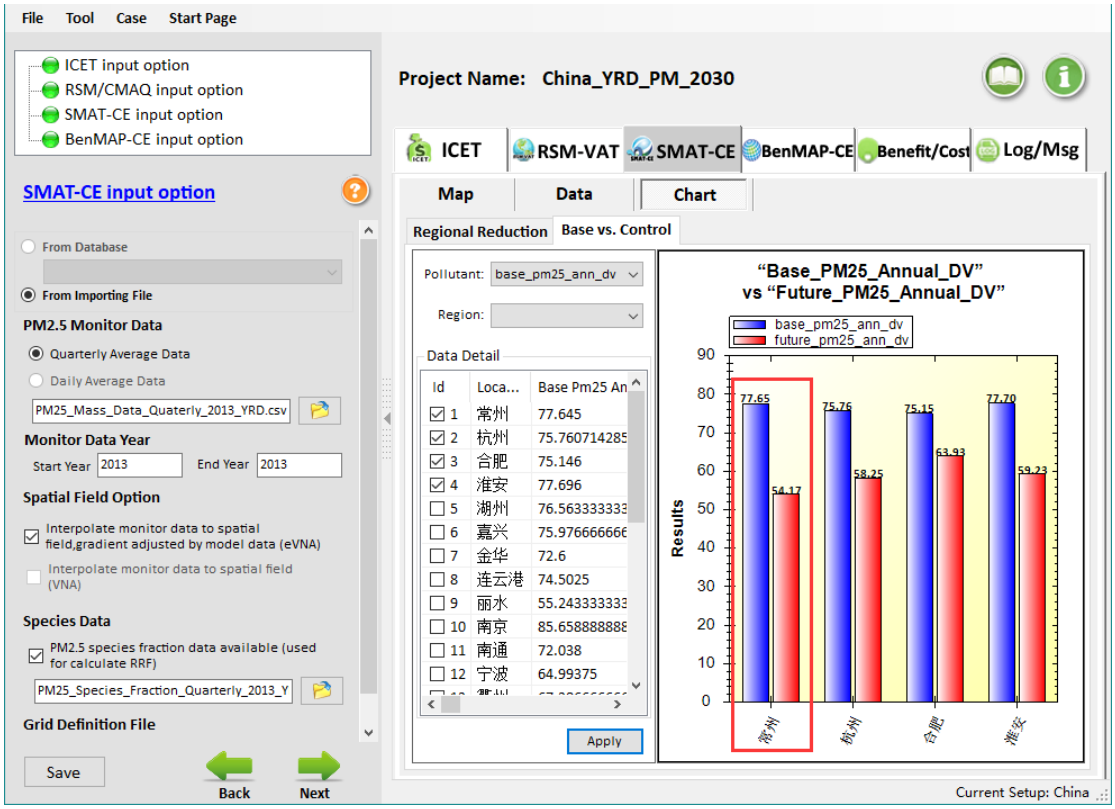


Fig. 48 Chart results of SMAT- CE

6.3.4 BenMAP-CE

6.3.4.1 Map results

➢ From the 错误!未找到引用源。, we can know that the maps show the mortality and valuation results of different regions.

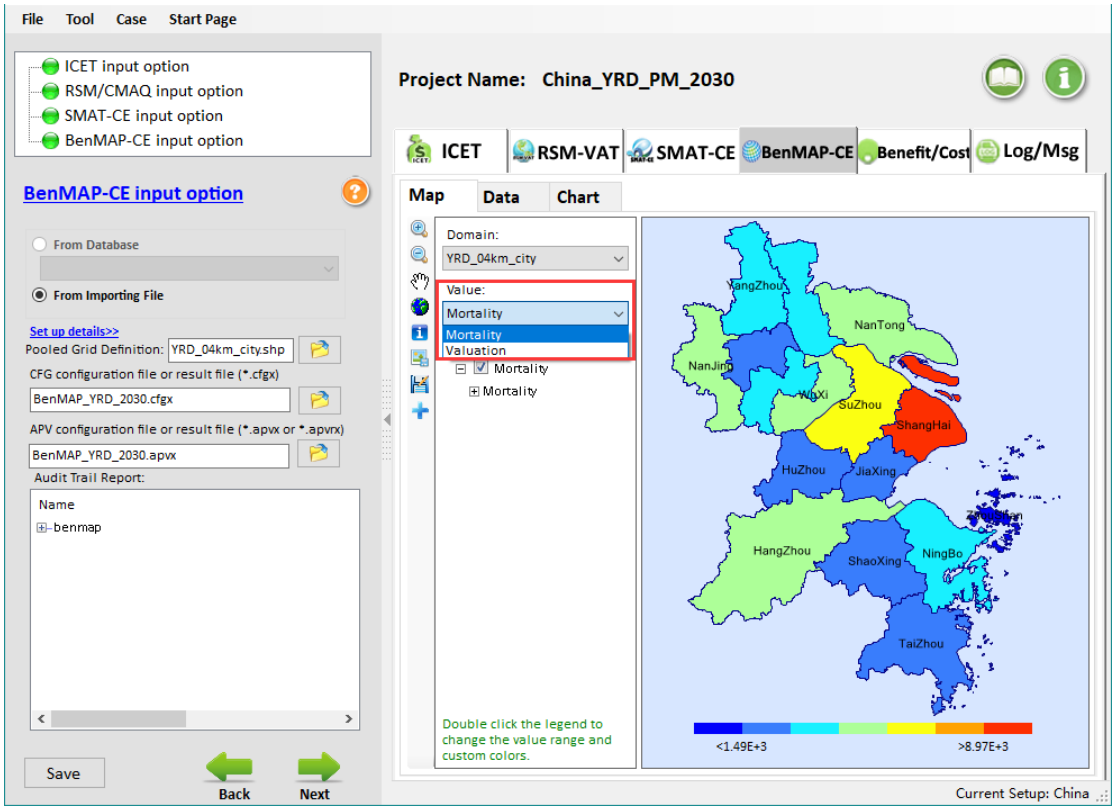


Fig. 49 Map results of BenMAP-CE

6.3.4.2 Data results

➢ From the 错误!未找到引用源。, we can view more details information which contains benefit, mortality, median benefit and so on. For example, the benefit in Shanghai is about 1184410255360 yuan.

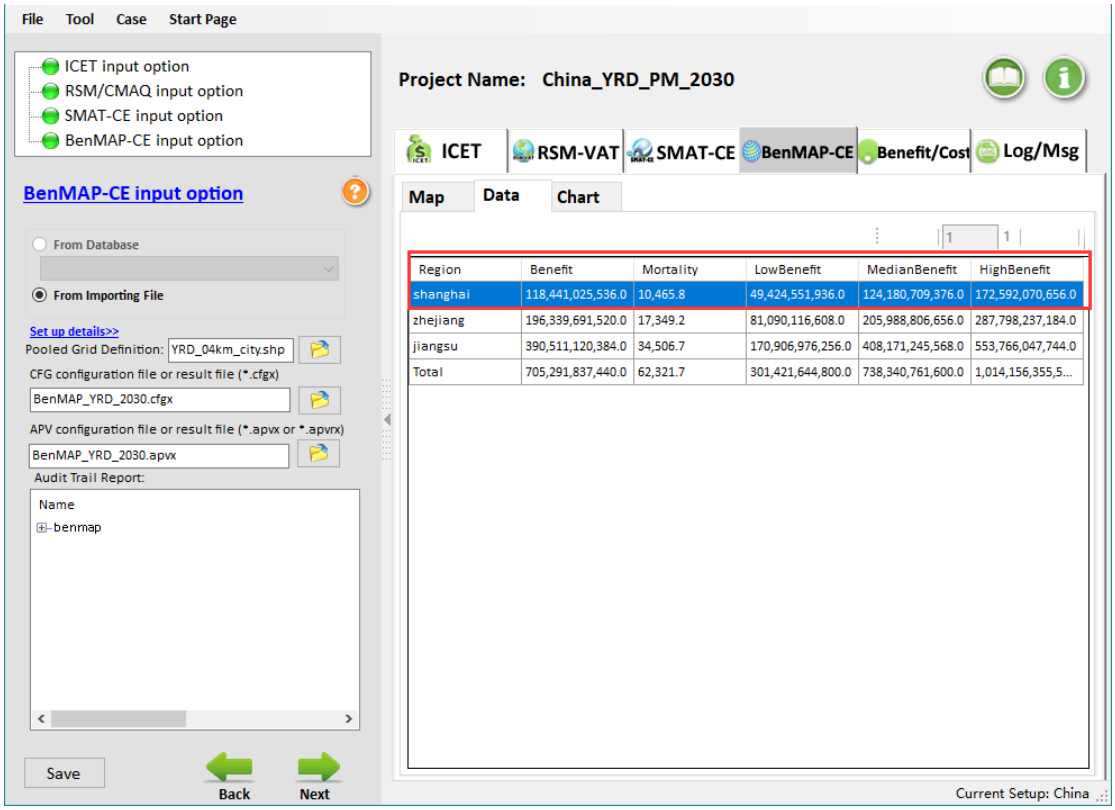


Fig. 50 Data results of BenMAP-CE

6.3.4.3 Chart results

➢ From the 错误!未找到引用源。, we can directly view the mortality and valuation results in different regions/cities. For example, the mortality in Shanghai is about 1.05E+4.

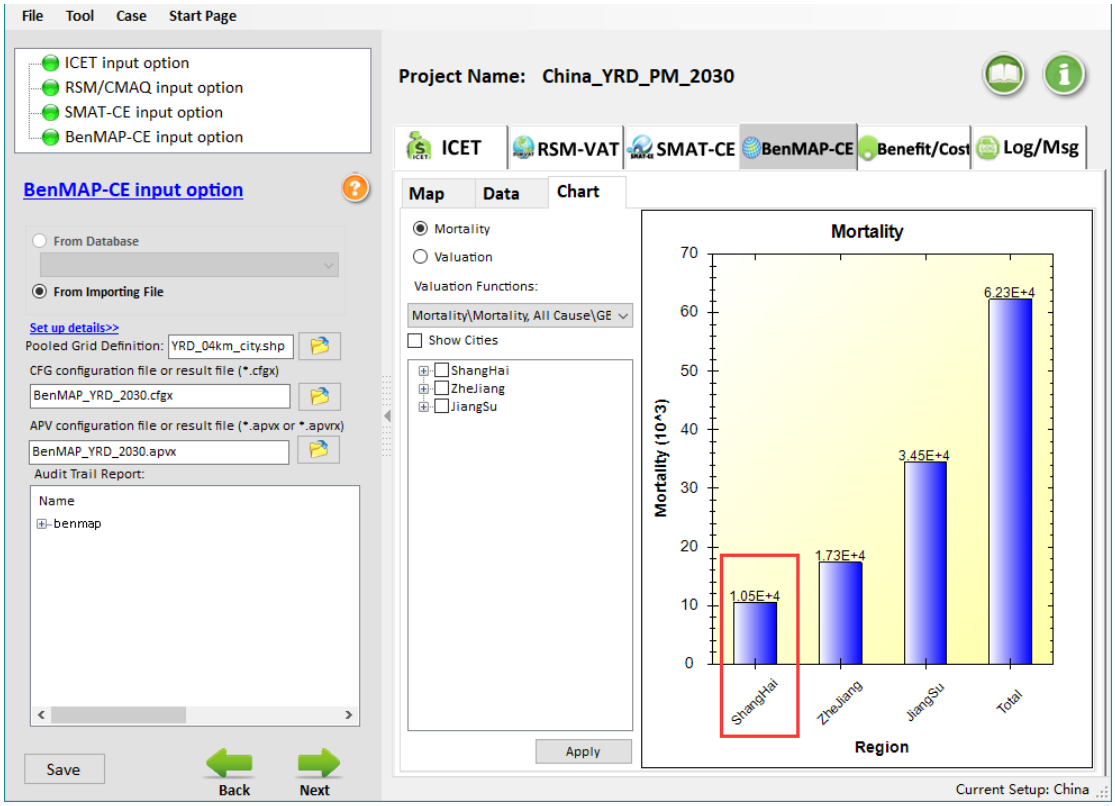


Fig. 51 Chart results of BenMAP-CE

6.3.5 Benefit/Cost

6.3.5.1 Chart results

➢ From the 错误!未找到引用源。, we can directly view total benefit/cost ratio under the pollutant control scenario determined from the beginning is about 9.6.

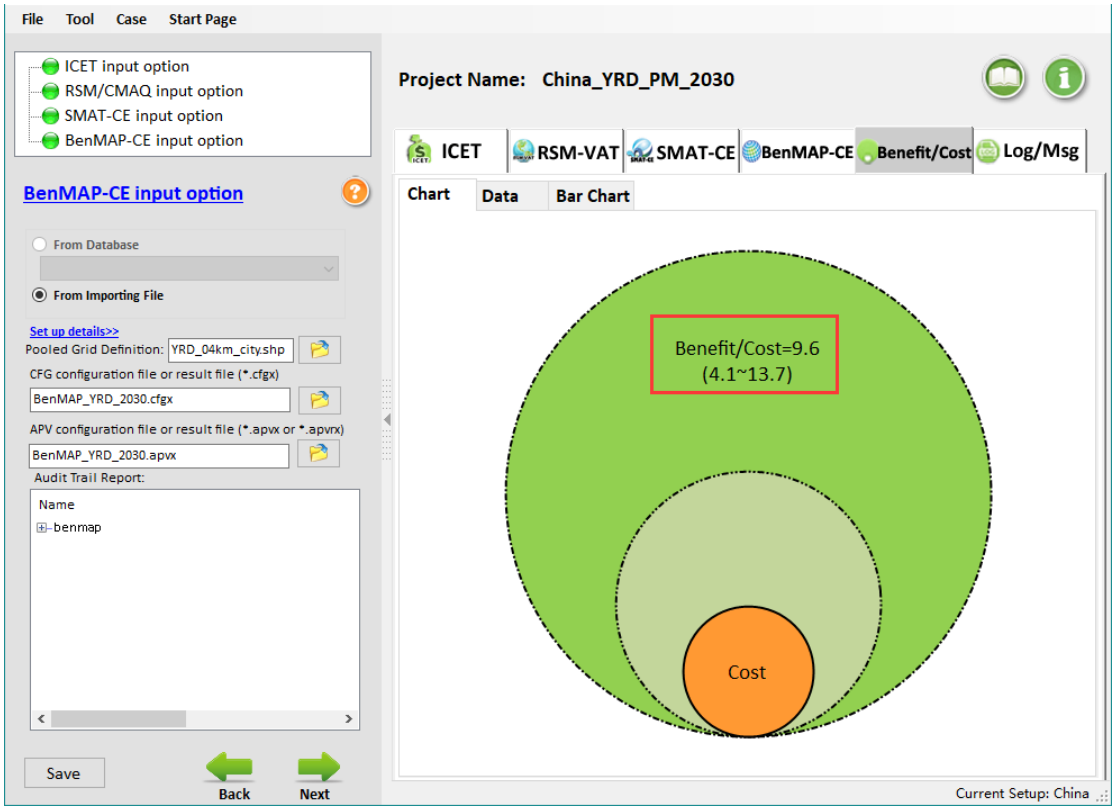


Fig. 52 Chart results of Benefit/Cost

6.3.5.2 Data results

➢ From the 错误!未找到引用源。, we can view more details information which contains cost, benefit, benefit/cost and so on. For example, the benefit/cost ratio in Shanghai is about 10.4.

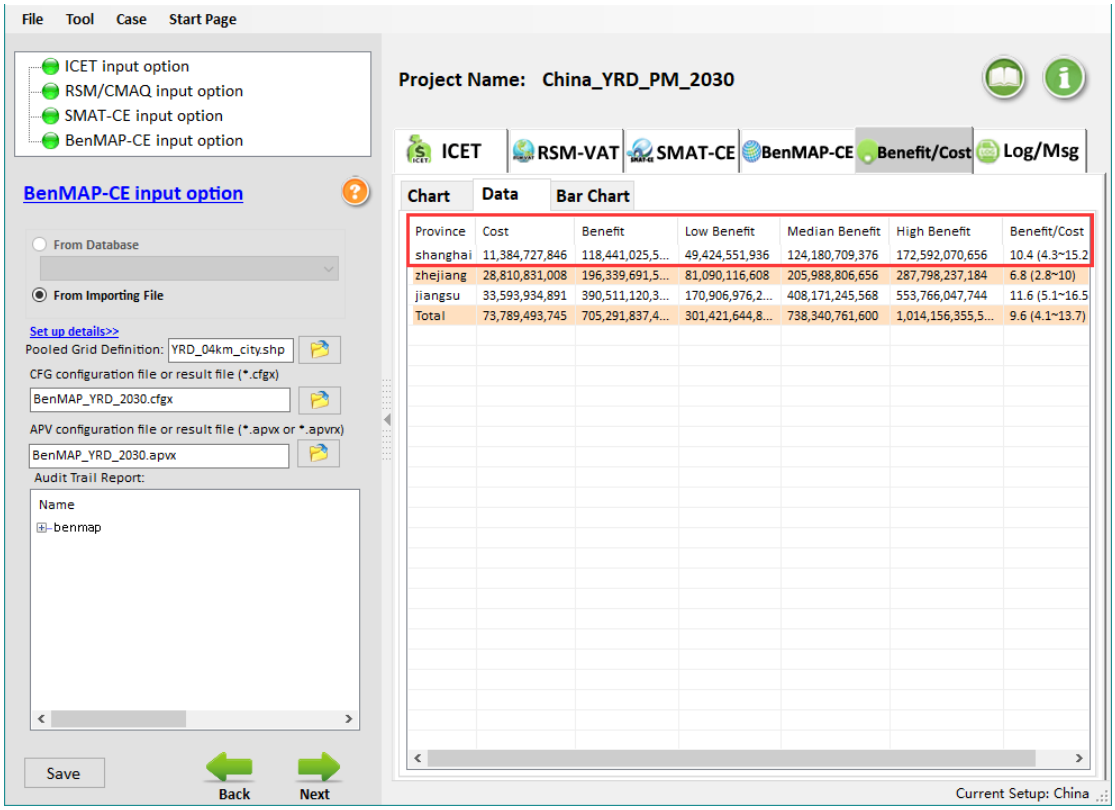


Fig. 53 Data results of Benefit/Cost

6.3.5.3 Bar Chart results

➢ From the 错误!未找到引用源。, we can view the benefit/cost ratios in different regions/cities more intuitively.

Fig.54 Bar Chart results of Benefit/Cost