
WA 5-03: Assessment System (ABaCAS) Development Support

Task 10: User's Manual for NEXUS 1.5

Contract No: EP-D-12-044

Assignment No: 5-03

Version: Final

Prepared for: Carey Jang
Work Assignment Contracting Officer's
Representative
US EPA/OAR/OAQPS/ AQAD/ AQMG
(Mail Code: C439-01)
109 T.W. Alexander Drive
Research Triangle Park, NC 27711

Prepared by: Yun Zhu, Shuxiao Wang, Shicheng Long,
Wenwei Yang, Tingting Fang, Ruolin
Huang, Zhifang Li, Weidong Chen, Zhenhua
Zhu, Yingzhi Yuan, and Qiong Wu
College of Environment & Energy
South China University of Technology
Guangzhou, 510006, Guangdong, China

Saravanan Arunachalam and Liz Adams
Institute for the Environment
University of North Carolina at Chapel Hill

Date: September 30, 2020

Acknowledgments

In cooperation with the U.S. EPA, the Institute for the Environment at the University of North Carolina at Chapel Hill (UNC-IE) along with the Tsinghua University, and the South China University of Technology (SCUT) developed the NEXUS software. This project was funded by the U.S. EPA under contract EP-D-12-044 to UNC-IE.

Table of Contents

1	Introduction.....	4
1.1	Computer Requirements.....	4
1.2	Installing/Uninstalling NEXUS.....	4
1.2.1	Installing NEXUS Software	4
1.2.2	Install Nexus Data.....	7
1.2.3	Uninstalling NEXUS	7
1.3	Contacts for Comments and Questions	8
2	Terminology and File Types.....	8
2.1	File Types.....	8
3	Main Interface.....	11
4	Data Viewer Module.....	12
4.1	Data Viewer Settings.....	12
4.2	Map.....	14
4.3	Chart & Table.....	17
4.3.1	Non-Attainment Area	17
4.3.2	Major Emission Sources	19
4.3.3	Top X Emission Sources	19
4.4	Data	20
5	Data Input Module	22
6	Data Query Module	24

List of Tables

Table 1 Data Source Files	10
---------------------------------	----

List of Figures

Fig. 1 Setup Window	5
Fig. 2 Choose Install Location	5
Fig. 3 Ready to Install	6
Fig. 4 Installation Processing	6
Fig. 5 Installation Complete	7
Fig. 6 Confirm for uninstallation	7
Fig. 7 Removing NEXUS	8
Fig. 8 Main Interface of NEXUS	11
Fig. 9 Main Interface of Data Viewer	12
Fig. 10 Setting Panel of Data Viewer	13
Fig. 11 Running Messages	14
Fig. 12 GUI of Map Module	14
Fig. 13 Map Window with Highlighted Map Controls	15
Fig. 14 View Data Content of Selected Region on Map Window	16
Fig. 15 Configure Window of Circle Color Bar	16
Fig. 16 Major Emission Sources Option	17
Fig. 17 Top X Emission Sources Option	17
Fig. 18 Set up Threshold for Screening and Display the Results in Non Attainment Area	18
Fig. 19 Non Attainment Area Window with Highlighted Configuration Options	19
Fig. 20 Query Emission Sources in Major Emission Sources	19
Fig. 21 Top X Emission Sources	20
Fig. 22 Data Window	20
Fig. 23 Filter Tool in Data Window	21
Fig. 24 Grouping Tool in Data Window	21

1 Introduction

NEXUS is a user-friendly NEXUS multi-pollutant analysis tool that allows for the identification of areas with multipollutant air quality issues (ozone, PM_{2.5}, and air toxics) and screening of these areas to assist EPA and others to determine whether a multipollutant, risk-based approach might be of value for that area to pursue. It provides map, chart and tables to display information about multipollutant issues for regions, and also vet the list of areas to get to a small number of truly viable candidates for which users can discuss possible collaboration(s) with state/local agencies.

1.1 Computer Requirements

- NEXUS requires a computer with:
- .Net Framework Version 4.0 or higher.
- Microsoft Visual C++ 2013 Redistributable.
- 64-bit Windows 7/Windows 8/Windows 10. (767 MB)
- GB RAM or greater.
- 10 GB free disk space or greater.

1.2 Installing/Uninstalling NEXUS

1.2.1 Installing NEXUS Software

- Download NEXUS Software Package from the Google Drive:
- https://drive.google.com/open?id=1Xl3VqtlRXeBt_FrfHpuCZYumxjqMR9hL;
- Double click NEXUS v1.3 setup.exe to install the program, it will appear the following figures.



Fig. 1 Setup Window

- Click “Next” button, users could choose install location in Fig. 2.

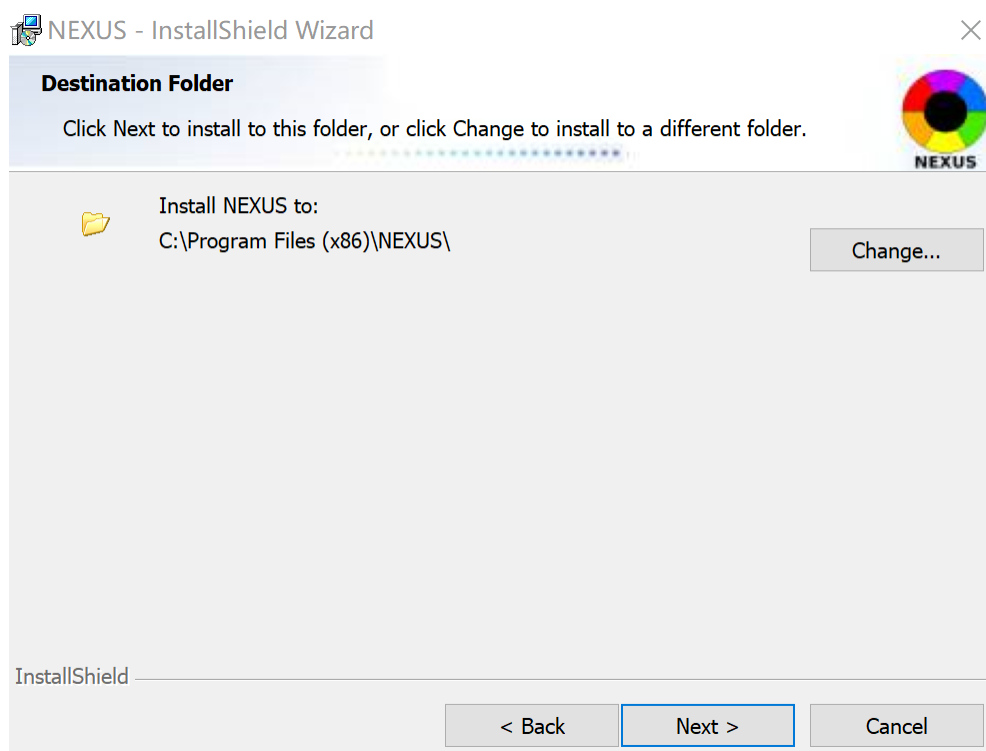


Fig. 2 Choose Install Location

- Click “Next” button, it will show the “Ready to Install” window as shown in Fig. 3.

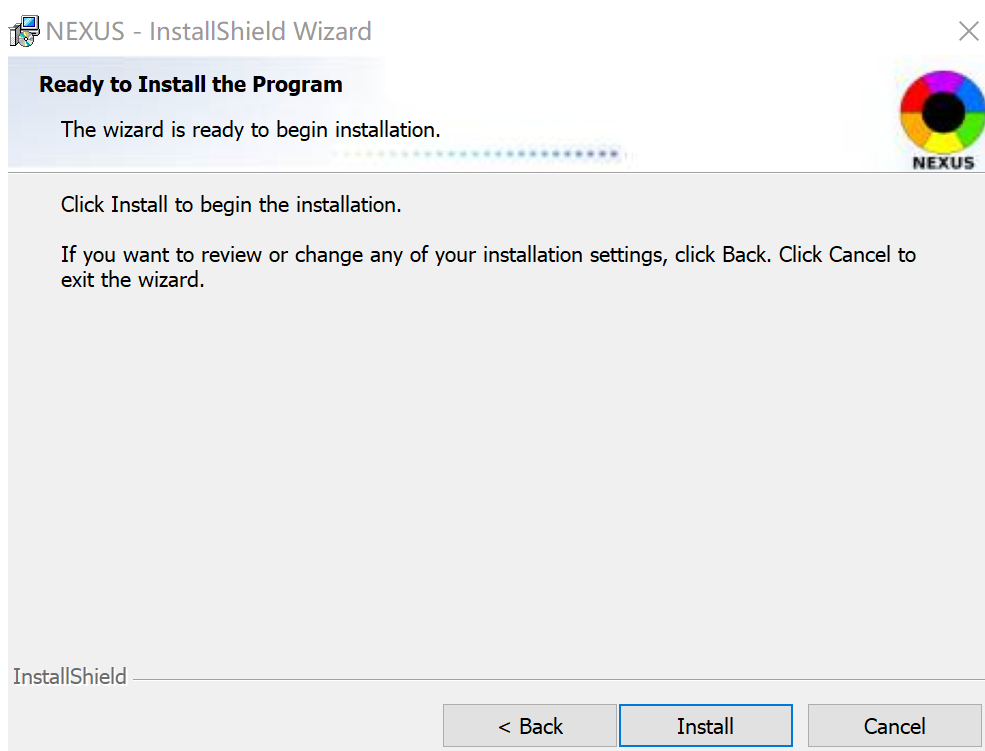


Fig. 3 Ready to Install

- Click the “**Install**” button and NEXUS will be installed.

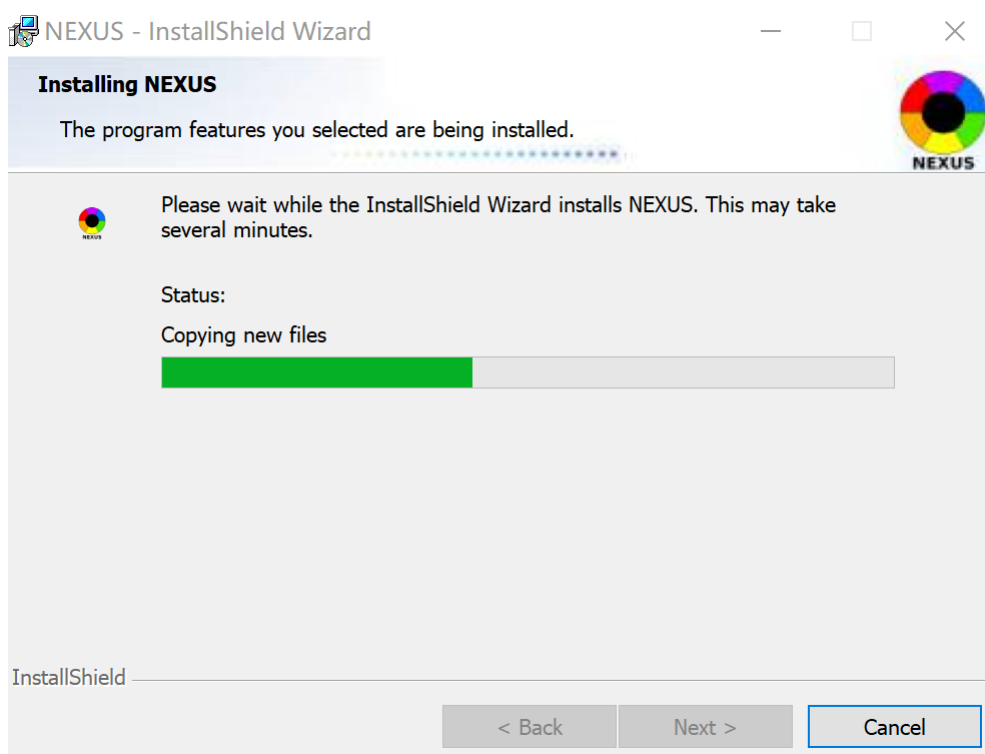


Fig. 4 Installation Processing



Fig. 5 Installation Complete

- Click the “**Finish**” button and installation complete.

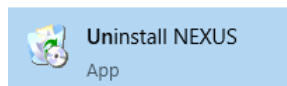
1.2.2 Install Nexus Data

- Download NEXUS Data Package: [NEXUS 1.5 Data.exe](https://drive.google.com/open?id=1Xl3VqtlRXeBt_FrfHpuCZYumxjqMR9hL)(1.89GB) from the Google Drive:
https://drive.google.com/open?id=1Xl3VqtlRXeBt_FrfHpuCZYumxjqMR9hL

- Double click NEXUS v1.3 Data.exe to install the data.

1.2.3 Uninstalling NEXUS

- Click “Uninstall



NEXUS” to uninstall the the following figure.

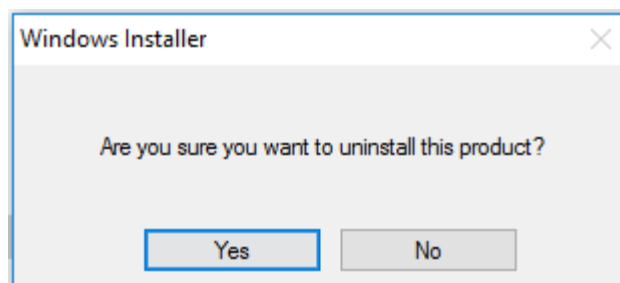


Fig. 6 Confirm for uninstallation

- Click “Yes” button, system will start to remove the NEXUS program as shown in next figure.

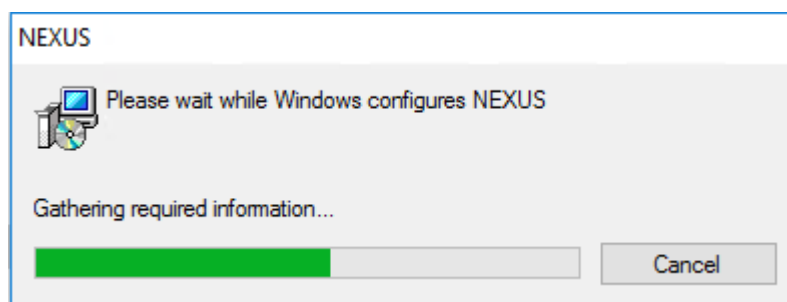


Fig. 7 Removing NEXUS

- After a few seconds, uninstallation will finish.

1.3 Contacts for Comments and Questions

For comments and questions, please contact the South China University of Technology, Environmental Simulation and Information Laboratory via email at: zhuyun@scut.edu.cn, or contact the Center for Community Modeling and Analyses System (CMAS) at the University of North Carolina at Chapel Hill via email at: cmas@unc.edu.

2 Terminology and File Types

The first section of this chapter explains common terms used in this user's manual and in the software, and references, where possible, other sections in this manual to find more detailed information. Section 2.2 describes in detail the necessary format for data files that can be read into NEXUS.

2.1 File Types

- **NEXUS Project File:** An existing NEXUS project file.
- **Data Source Files:** A set of source files providing the input data for NEXUS.

- Table 1 presents the names, format, data description and data source of the different files.

Table 1 Data Source Files

Data Input File Names	Data Format	Data Description	Data Source	Data Period
2014 O3_PM2.5 Fused Ambient_Risk. gdb	Geodataset	O ₃ /PM _{2.5} ambient & risk data at county/cens us tract level	from OAQPS MP team	2014
2014 NATA Risks.gdb	Geodataset	Air toxics ambient & risk data at county/cens us tract level	from OAQPS MP team	2014
“Ozone and PM2.5 DV> Ozone”	Excel	O ₃ design values at county level	From EPA public website: https://www.epa.gov/air-trends/air-quality-design-values	2013 to 2018
“Ozone and PM2.5 DV > PM2.5”	Excel	PM _{2.5} design values at county level	From EPA public website: https://www.epa.gov/air-trends/air-quality-design-values	2013 to 2018
“2018 EPA Ozone and PM Advance Areas.gdb”	Geodataset	O ₃ & PM _{2.5} Advance Areas	from OAQPS MP team	2018
“Index of Deep Disadvantage – Final Data.xlsx”	Excel	Index of poverty/disa dvantage at county level	from Univ. of Michigan website: https://poverty.umich.edu/projects/understanding-communities-of-deep-disadvantage/	2017
“NEI_County_ CAPs.gdb” “NEI_Facility_ HAPs_CAPs.g db”	Geodataset	Major emission sources and facility info. of CAPs & HAPs at county level	From OAQPS public website: ftp://newftp.epa.gov/EPADDataCommons/OAR/OAQPS/NEI/NEI_Facility_HAPs_CAPs.zip and ftp://newftp.epa.gov/EPADDataCommons/OAR/OAQPS/NEI/NEI_County_CAP.zip	2008, 2011, 2014

"2014 NATA Emissions"	Access Database (*.acddb)	NATA emissions data from 2014 NEI database, including various source groups	From EPA public website: https://www.epa.gov/national-air-toxics-assessment/2014-nata-assessment-results#emissions	2014
"Class1_FederalAreas.gdb"	Geodataset	Mandatory Class 1 Federal Areas	From Mandatory Class 1 Federal Areas Web Service: https://edg.epa.gov/data/public/OAR/OAQPS/Class1/Class1Areas.zip	—

3 Main Interface

The main interface of NEXUS is shown in Fig. 8. NEXUS has three modules, including **Data Viewer**, **Data Query** and **Data Input**.

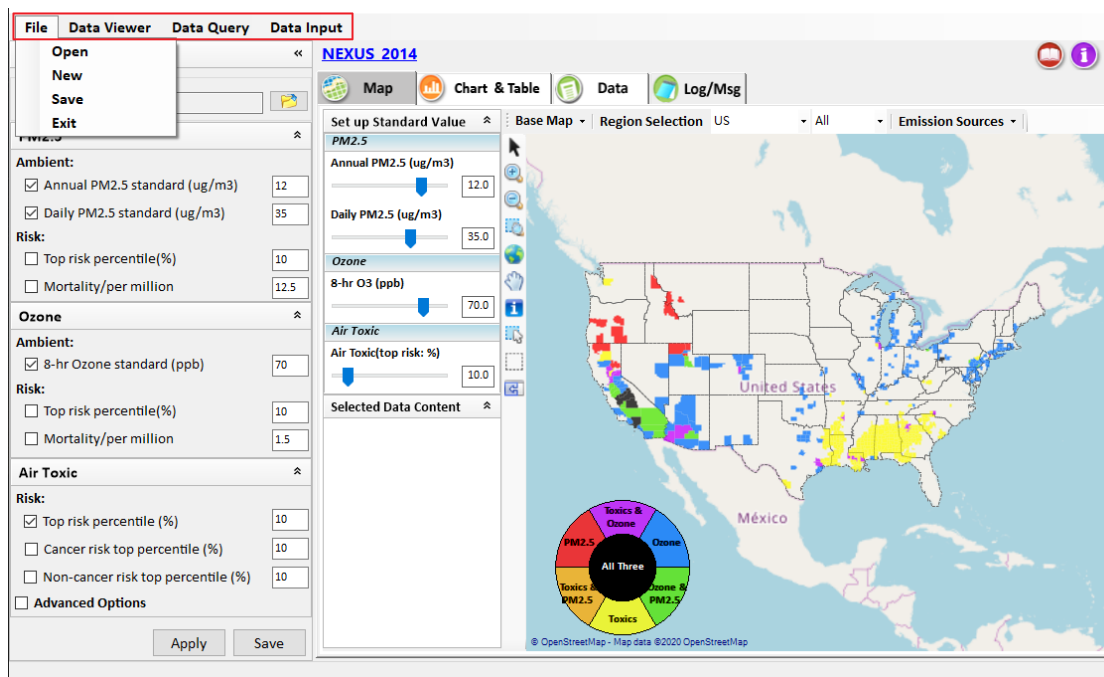


Fig. 8 Main Interface of NEXUS

➤ Click **File** button on the menu of the main interface, there are four options that users can choose.

- 1) Click **Open** button, locate the *.projx file and open it.
- 2) Click **New** button to create a new project.
- 3) Click **Save** button to save a created project.

- 4) Click **Exit** button to exit the NEXUS.
- ➤ Click **Data Viewer** button on the menu of the main interface to enter the Data Viewer module, which allows users to display data in different kinds of way, including map, chart, and table.
- ➤ Click **Data Query** button on the menu of the main interface to enter the Data Query module, which allows users to view query results to provide air quality, toxic exposure, population and location data to identify “multipollutant” areas.
- ➤ Click **Data Input** button on the menu of the main interface to enter the Data Input module, which allows users to edit the data sources of a NEXUS project.

4 Data Viewer Module

In this module, users can display data from data sources defined by the **Data Input** module. **Data Viewer Module** includes four submodules: (1) Map, (2) Chart & Table, (3) Data and (4) Log/Msg. As shown in Fig. 9, there are two panels at the interface of **Data Viewer Module**, the setting panel is on the left while the viewer panel is on the right.

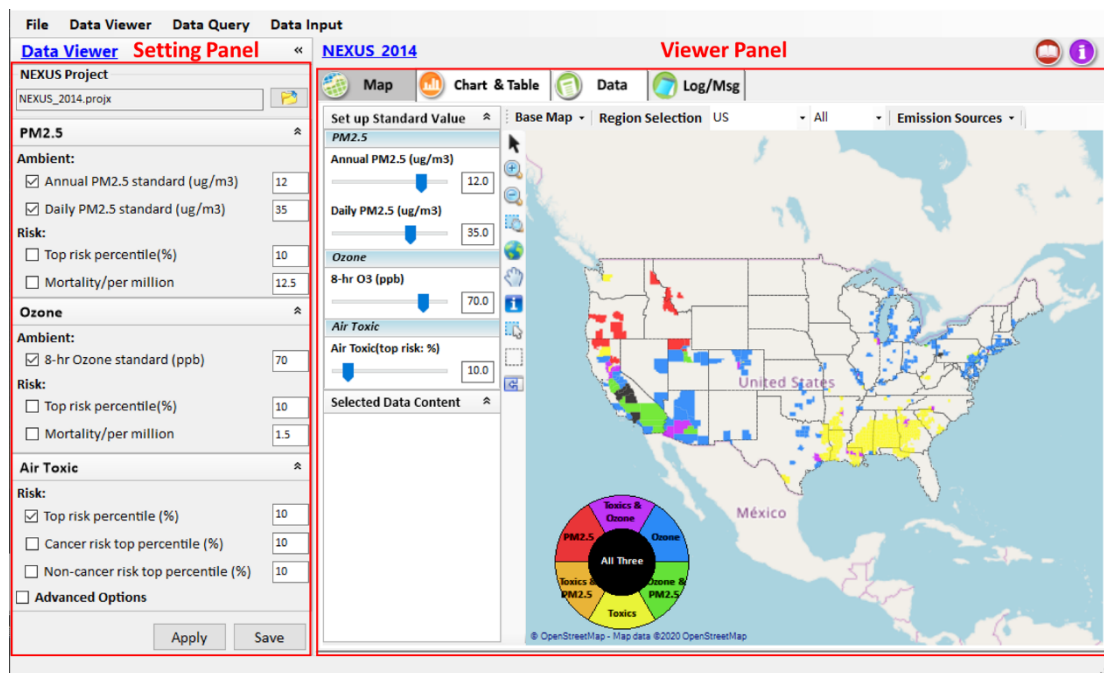


Fig. 9 Main Interface of Data Viewer

4.1 Data Viewer Settings

There are four different options at the setting panel of **Data Viewer**, including **NEXUS Project**, **PM_{2.5}**, **Ozone** and **Air Toxics**, as shown in Fig. 10. In this module, users can choose and set up standard values of concentrations and risks for the selected pollutants, which will be applied to the viewer panel.

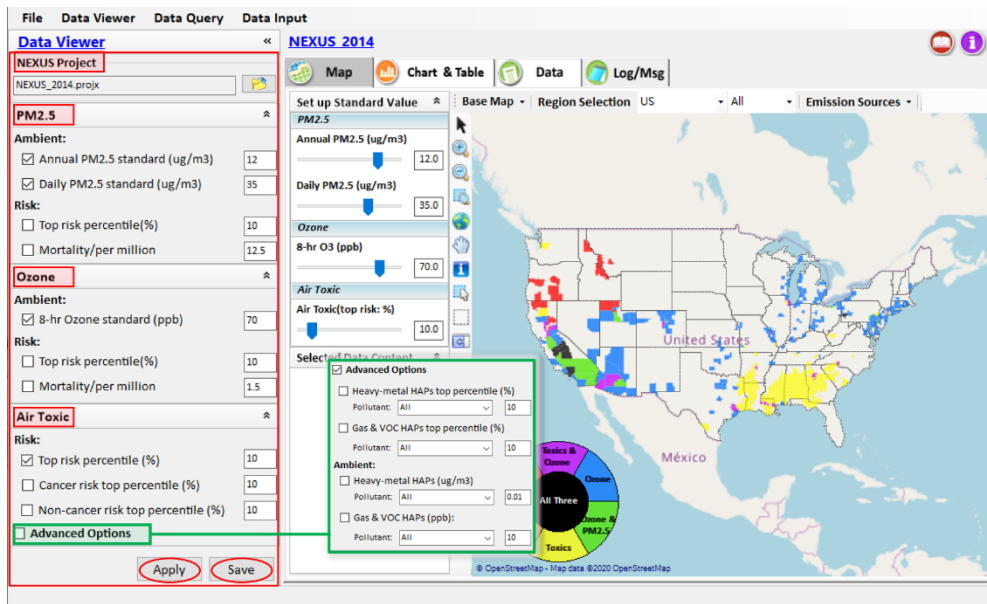


Fig. 10 Setting Panel of Data Viewer

- **NEXUS Project:** allows users to directly open a case that has been successfully run and saved without having to run again.
- **PM_{2.5}:** allows users to set up standard values for PM_{2.5}, including **annual PM_{2.5} standard** concentration, **daily PM_{2.5} standard** concentration, **top risk percentile** and the checked items will join to display on the viewer panel.
- **Ozone:** allows users to set up standard values for ozone, including **8-hr ozone standard** concentration, **top risk percentile** (based either on mortality number (person per year) or mortality rate (per 10K per year)). The checked items will join to display on the viewer panel.
- **Air Toxics:** allows users to set up a standard value for air toxics, including **top risk percentile**, **cancer risk top percentile** and **non-cancer risk top percentile**. The checked items will join to display on the viewer panel. User also can check the **Advanced Option** to get more settings for air toxic.
- **Advanced Option:** allows users to set up standard values for more air toxic pollutants, including **heavy-metal HAPs top percentile**, **gas & VOC HAPs top percentile**, **heavy-metal HAPs concentration** and **Gas & VOC HAPs concentration**. Users can choose a specific pollutant using the drop-down list and the selected items will join to display on the viewer panel.

After the input settings are completed, users can click the “Apply” button to apply the current settings and view the results immediately on the viewer panel. Users can also click the “Save” button to save the current setting as a NEXUS *.projx file, which will take a few minutes. Users can view the running messages at the bottom of the data viewer area, as shown in Fig. 11.

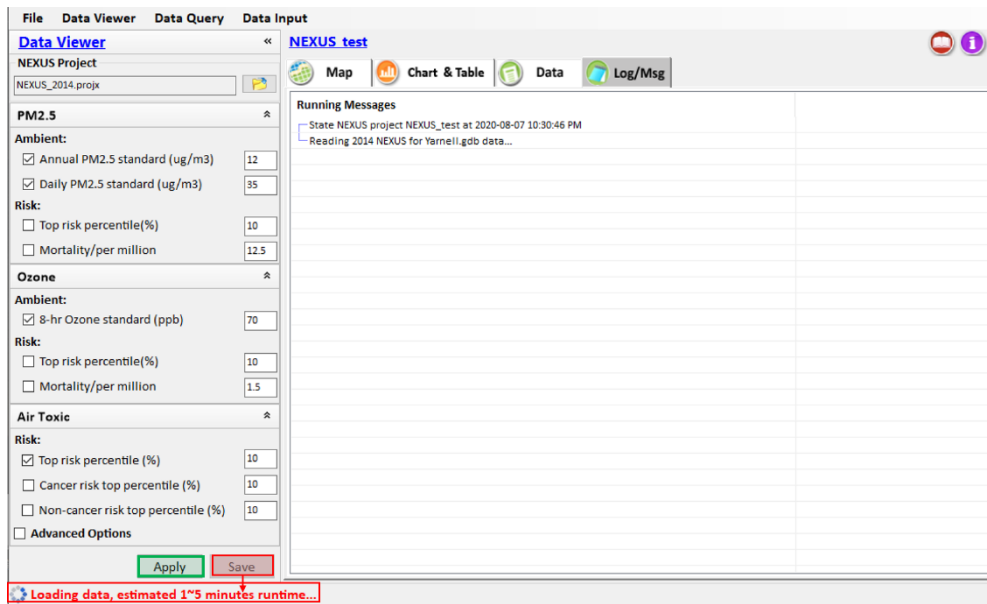


Fig. 11 Running Messages

4.2 Map

In the Map submodule within the Data Viewer Module, users can identify areas with different air pollutant issues, based on the standard values setting. An area could have one of the issues—Air toxics, Ozone, or PM_{2.5} (daily and/or annual), two of each, or all three. Areas with different kinds of issues will be displayed in unique colors, as the legend shows. Users can also perform different operations on map (e.g., size-maximize or size-restore). When moving the mouse over a colored region on the map, a tip containing the county name and air pollutant issue associated with each county will be displayed as shown in Fig. 14.

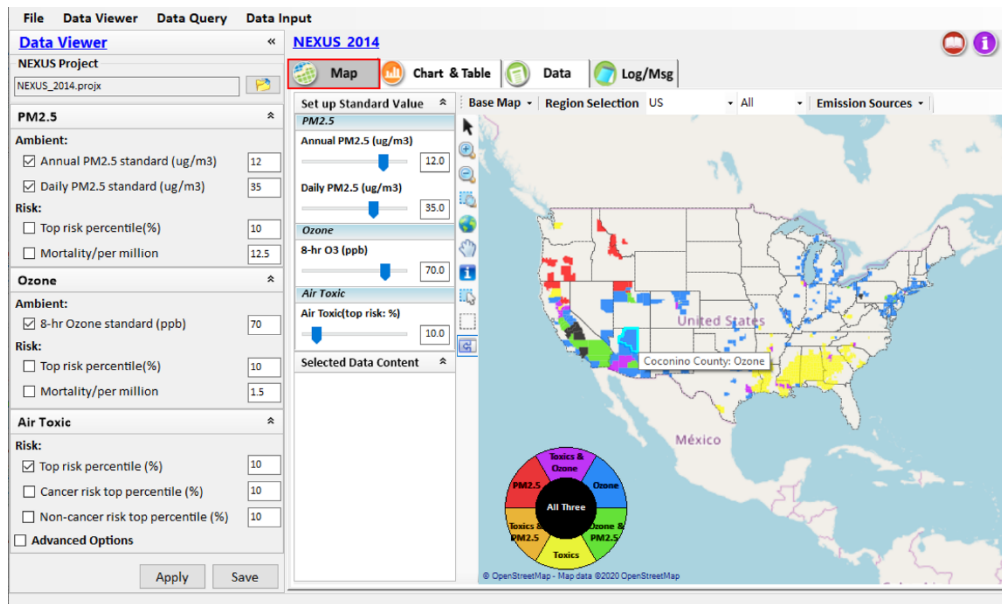



Fig. 12 GUI of Map Module

- **Set up Threshold:** As shown in the green box in Fig. 13, this module shows all the selected threshold settings for the project. Users can change the standard value of pollutants and view the recalculated results.

- **Zoom and Map Control:** As shown in the red box in Fig. 13, these options control zooming in/out and panning the map display, and allow users to select the map service. For example, click on the  button to select the **Identify** tool first, then while clicking on the map to select a region, the data content of this region will be shown on the **Selected Data Content** panel, as shown in Fig. 14.
- **Legend Controls:** As shown in the yellow box in Fig. 13, it identifies the issues in different colors. More detailed customization of the map display legend is available by clicking on Layer Controls section. As shown in Fig. 15, users can both select the color series for display and customize the color for a single piece in the configure window.
- **Base Map:** As shown in the blue box in Fig. 13, users are allowed to select online base maps or boundary lines for the Map module from the drop-down list.
- **Region Selection:** As shown in the blue box in Fig. 13, users are allowed to select a region to zoom through the drop-down list.

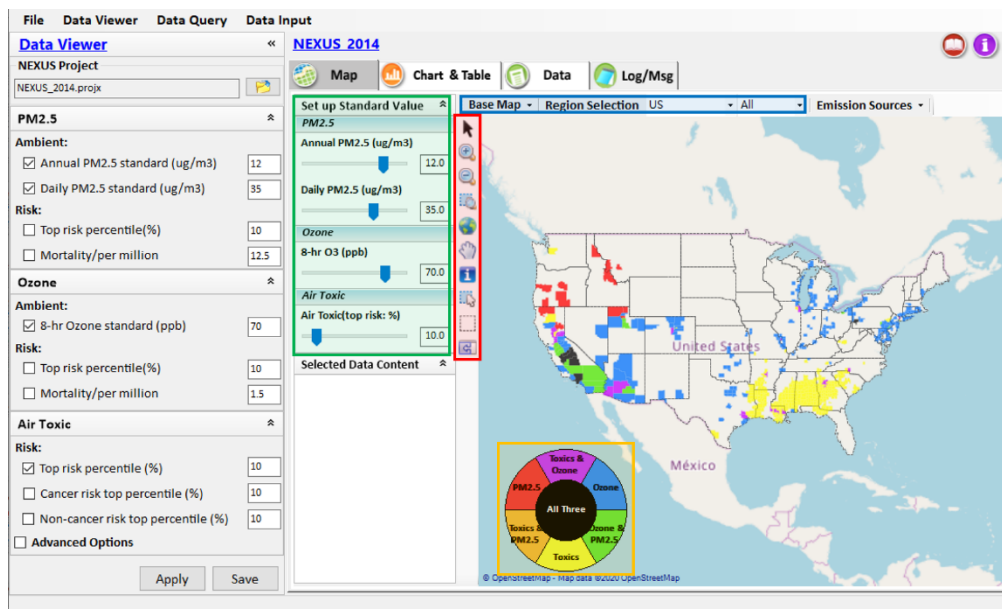


Fig. 13 Map Window with Highlighted Map Controls

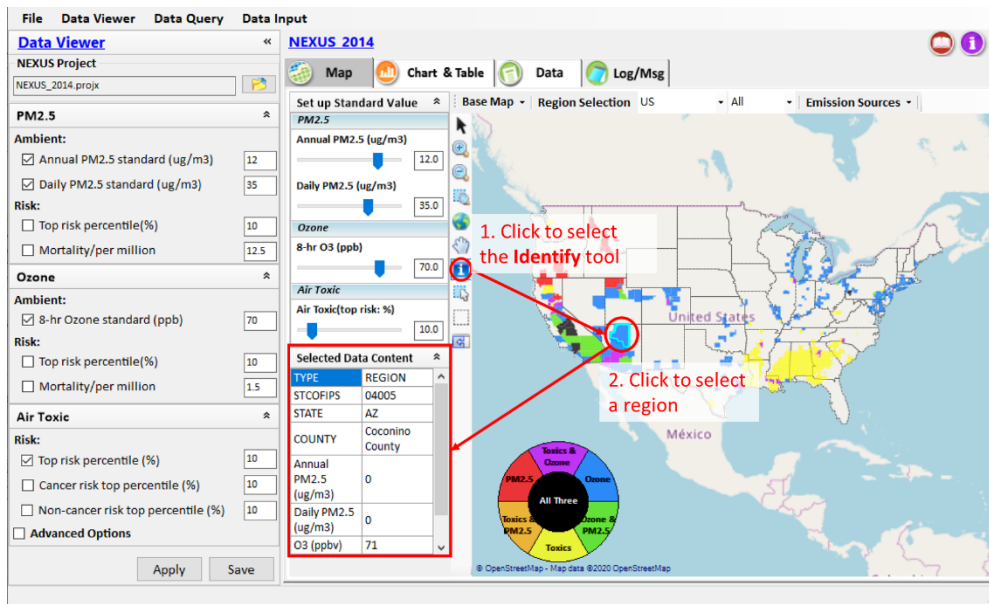


Fig. 14 View Data Content of Selected Region on Map Window

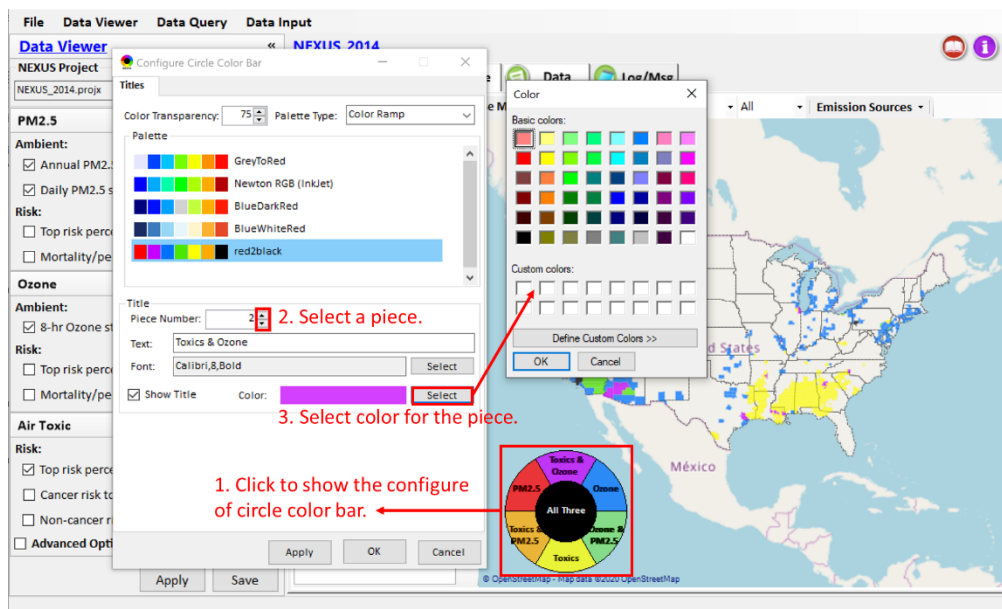


Fig. 15 Configure Window of Circle Color Bar

➤ **Major Emission Sources:** As shown in Fig. 16, users can click on the Chart and Table Tab, then click on **Major Emission Sources** option in the drop-down list to enter the module interface. Under this module, users can click the pollutant title to overlay emission sources on Map. And users can also click on a specified emission source maker to view it on map.

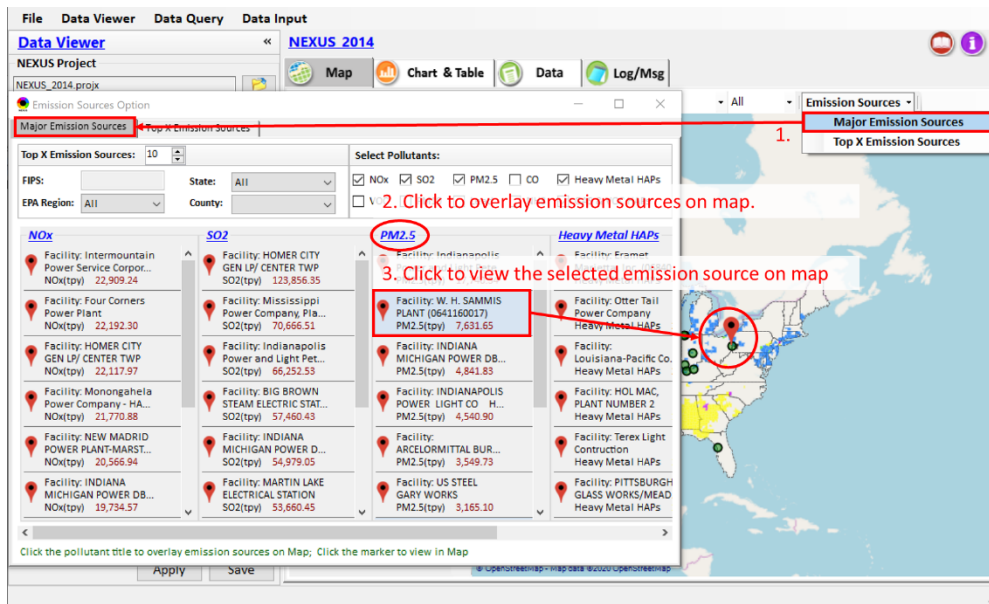


Fig. 16 Major Emission Sources Option

➤ **Top X Emission Sources:** As shown in Fig. 17, users can click on the Top X Emission Source option in the drop-down list to enter the module interface. Under this module, users can screen the pollutant sources and view the screening results in chart. Users can also click on a specified emission source marker in the result list to view it on map.

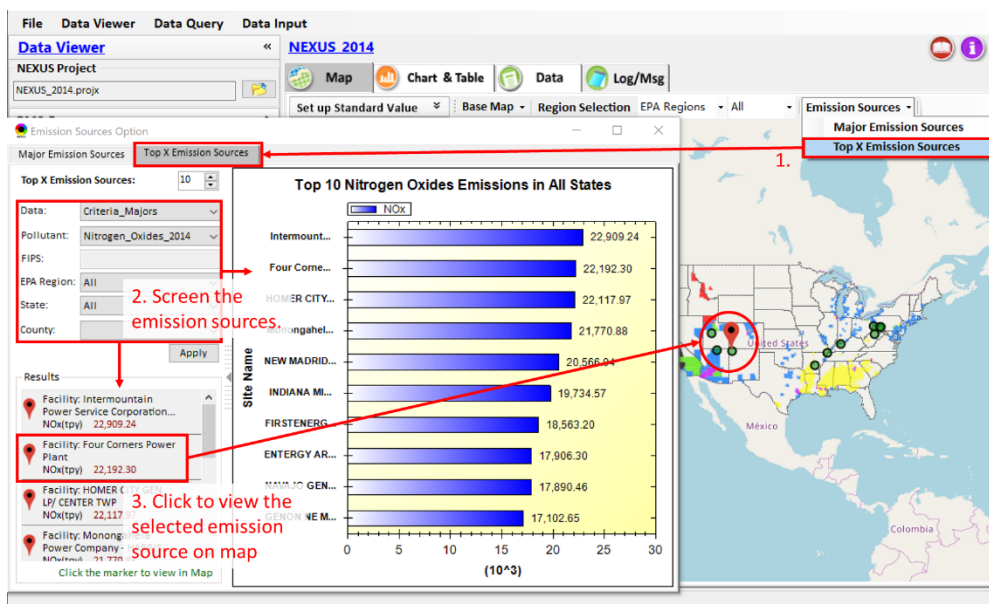


Fig. 17 Top X Emission Sources Option

4.3 Chart & Table

4.3.1 Non-Attainment Area

In this module, as shown in Fig. 18, users are allowed to view the non-attainment counties list, based on the user-defined standard values for pollutants. Users can also view detailed data of all counties that are identified as non-attainment areas below the current threshold value.

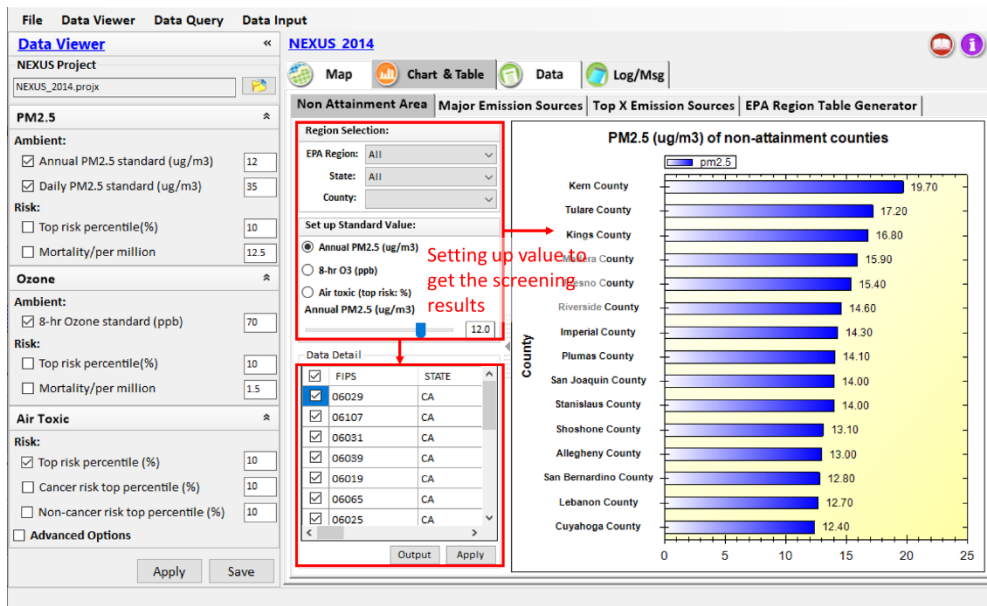


Fig. 18 Set up Threshold for Screening and Display the Results in Non-Attainment Area

- **Set up Standard Value:** As shown in the yellow box in Fig. 19, users are allowed to set up standard values for pollutants, which will be used for screening non-attainment areas.
- **Data Detail:** As shown in the green box in Fig. 19, details information of all non-attainment areas filtered based on the current standard setting will be listed. Users can check the areas on the list and click “Apply” to add them to the chart display.
- **Output:** As shown in the blue box in Fig. 19, users are allowed to export the detailed data of the current screening results to a .csv file by clicking the “Output” button.
- **Chart Option:** As shown in the red box in Fig. 19, right-click on the chart, it will display a selection box contains options to Copy the chart to the clipboard, export (Save Image As) an image of the chart and print the chart. The “Show Point Values” right-click option enables the values of a bar to be displayed when the mouse hovers over the bar. The Change Title and Legend right-click option enables customization of the variable names, title, and axes.

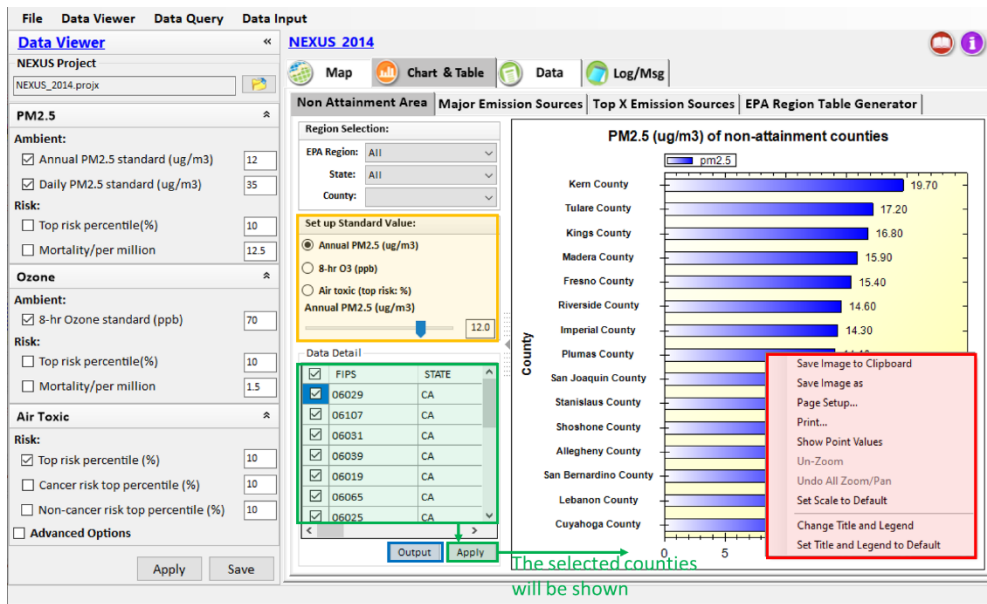


Fig. 19 Non-Attainment Area Window with Highlighted Configuration Options

4.3.2 Major Emission Sources

In this module, as shown in Fig. 20, users are allowed to query emission sources in the selected region according to the selected pollutants and the top x results will be listed. Users can also click on a pollutant or a marker to view the emission sources on map.

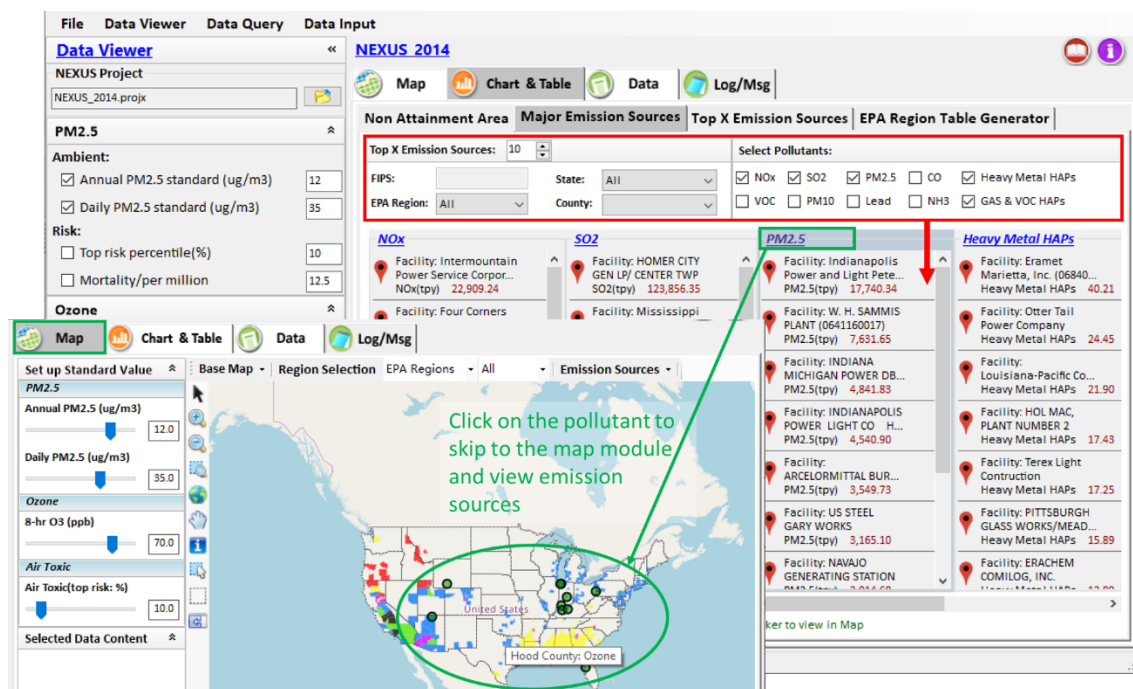


Fig. 20 Query Emission Sources in Major Emission Sources

4.3.3 Top X Emission Sources

In this module, as shown in Fig. 21, users are allowed to query emission sources and view the top X screening results in chart. Users can also click on a marker to view the emission sources on map.

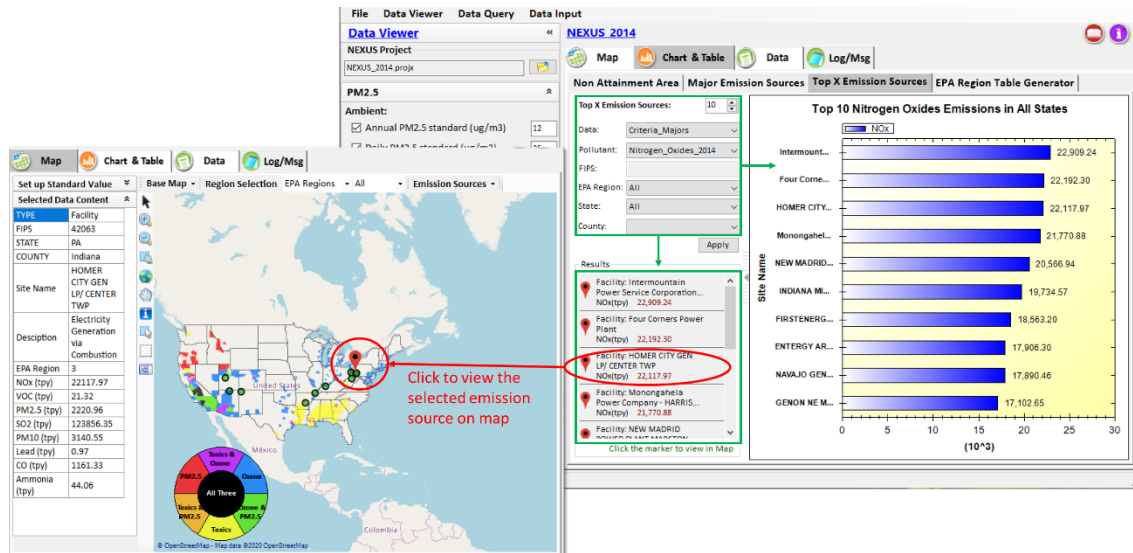


Fig. 21 Top X Emission Sources

4.4 Data

Data module provides more tabulated detailed information about different regions, as shown in Fig. 22. It also provides filter and group tool for data viewing and allow users to export data for further study.

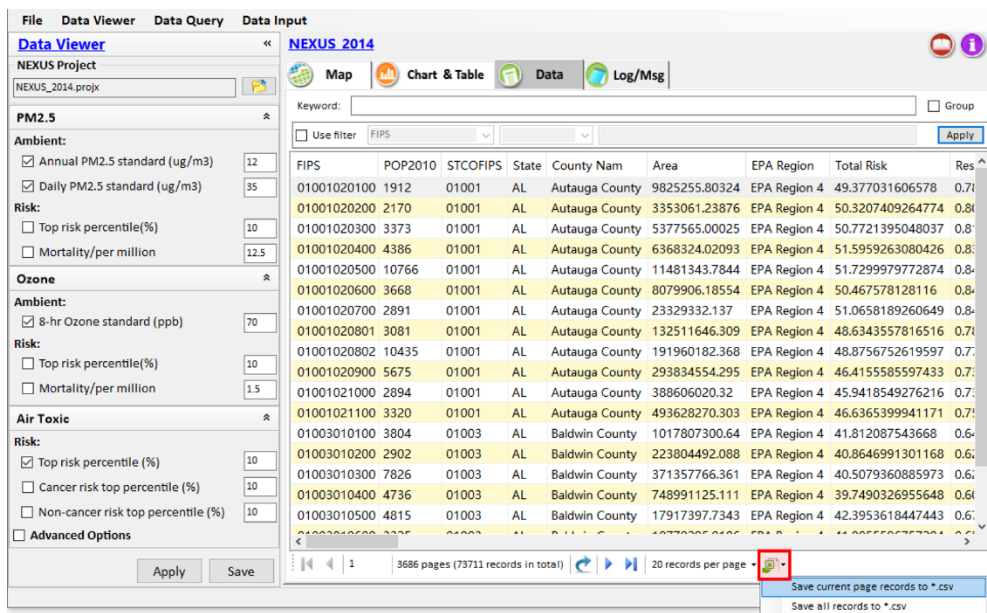



Fig. 22 Data Window

- **Save:** As shown in the red box in Fig. 22, users are allowed to save the current pager record or all records to a *.csv file by clicking the  button.
- **Filter:** As Fig. 23 shown, users are allowed to filter the data with self-defined keywords.
- **Group:** As Fig. 24 shown, users are allowed to group the data on the current page according to a selected column. To group the data, users should click on an item of chart header first for selecting the grouping basis, then check the “Group”

box to get the grouping results.

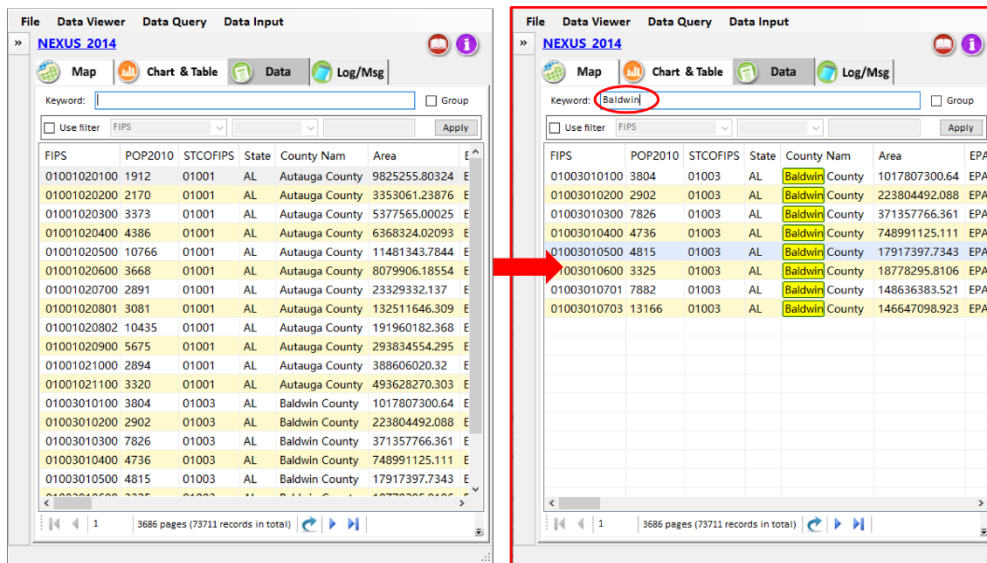


Fig. 23 Filter Tool in Data Window

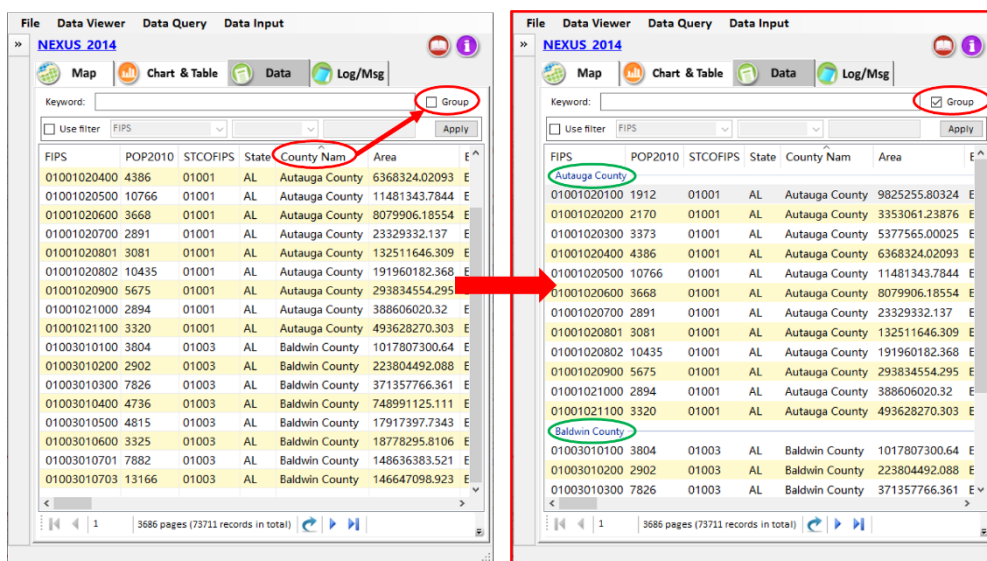


Fig. 24 Grouping Tool in Data Window

5 Data Input Module

In this module, users can define data sources for NEXUS in the setting area and preview input files in the data preview area, as shown in Figure 25. The data information for different sources can be found in chapter Error! Reference source not found. Error! Reference source not found.

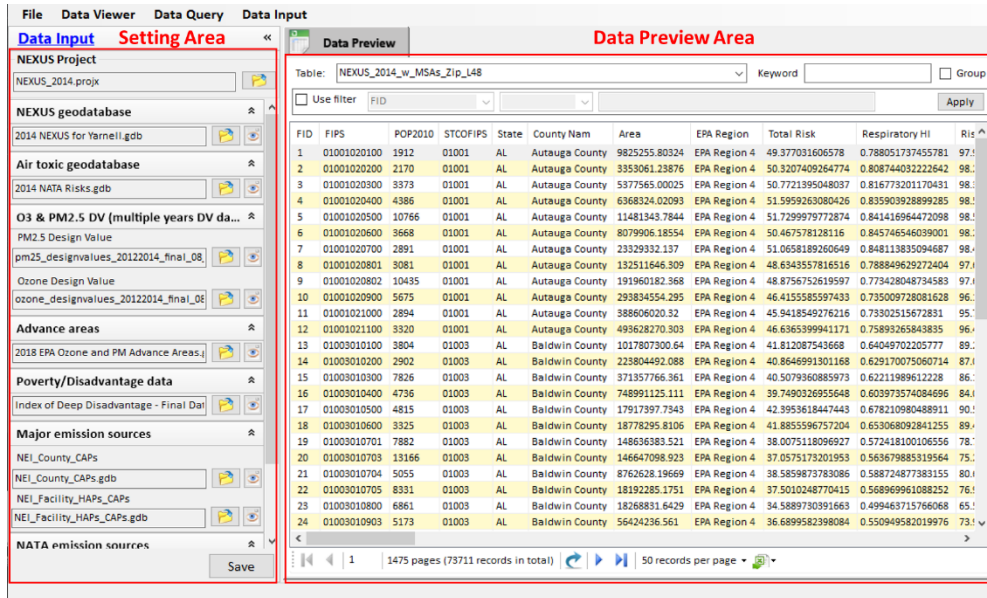




Fig. 25 Main Interface of Data Input

- **NEXUS Project:** allows users to directly open a case that has been successfully run without having to run again.
- **Load File/Dataset:** As shown in the red box in Fig. 26, users can click the  button to load input files for NEXUS. Users are allowed to define data sources for NEXUS geodatabase, air toxic geodatabase, O₃ & PM_{2.5} DV (multiple years DV data), advanced area, poverty/disadvantage data, major emission, sources, NATA emission sources and class areas. Both serial and csv file can be edited/updated with recent DV data from EPA.
- **File/Dataset Preview:** As shown in the green box in Error! Reference source not found., users can click the  button to preview files or datasets in the data viewer area.
- **Save:** users can click the “Save” button to save the current setting as a NEXUS *.proj file, which will take a few minutes.

FileData ViewerData QueryData Input

Data Input

NEXUS Project

NEXUS_2014.projx

NEXUS geodatabase

2014 NEXUS for Yarnell.gdb

Air toxic geodatabase

2014 NATA Risks.gdb

O3 & PM2.5 DV (multiple years DV da...
PM2.5 Design Value
pm25_designvalues_20122014_final_08
Ozone Design Value
ozone_designvalues_20122014_final_08

Advance areas

2018 EPA Ozone and PM Advance Areas.j

Poverty/Disadvantage data

Index of Deep Disadvantage - Final Da

Major emission sources

NEI_County_CAPs
NEI_County_CAPs.gdb
NEI_Facility_HAPs_CAPs
NEI_Facility_HAPs_CAPs.gdb

NATA emission sources

Data Preview

Table: NEXUS_2014_w_MSAs_Zip_L48

Keyword

Group

Use filter FID

Apply


		POP2010	STCOFIPS	State	County Nam	Area	EPA Region	Total Risk	Respiratory HI	Ris
1	01001020100	1912	01001	AL	Autauga County	9825255.80324	EPA Region 4	49.377031606578	0.788051737455781	97.1
2	01001020200	2170	01001	AL	Autauga County	3353061.23876	EPA Region 4	50.3207409264774	0.80874403222642	98.1
3	01001020300	3373	01001	AL	Autauga County	5377565.00025	EPA Region 4	50.7721395048037	0.816773201170431	98.1
4	01001020400	4386	01001	AL	Autauga County	6368324.02093	EPA Region 4	51.5959263080426	0.835903928899285	98.1
5	01001020500	10766	01001	AL	Autauga County	11481343.7844	EPA Region 4	51.7299979772874	0.84141696472098	98.1
6	01001020600	3668	01001	AL	Autauga County	8079906.18554	EPA Region 4	50.467578128116	0.845746546039001	98.1
7	01001020700	2891	01001	AL	Autauga County	23329332.137	EPA Region 4	51.0658189260649	0.848113835094687	98.1
8	01001020800	3081	01001	AL	Autauga County	132511646.309	EPA Region 4	48.6343557816516	0.788849629272404	97.1
9	01001020802	10435	01001	AL	Autauga County	191960182.368	EPA Region 4	48.8756752619597	0.773428048734583	97.1
10	01001020900	5675	01001	AL	Autauga County	293834554.295	EPA Region 4	46.415558597433	0.735009728081628	96.1
11	01001021000	2894	01001	AL	Autauga County	388606020.32	EPA Region 4	45.9418549276216	0.73302515672831	95.1
12	01001021100	3320	01001	AL	Autauga County	493628270.303	EPA Region 4	46.6365399941171	0.75893265843835	96.1
13	01003010100	3804	01003	AL	Baldwin County	1017807300.64	EPA Region 4	41.812087543668	0.64049702205777	89.1
14	01003010200	2902	01003	AL	Baldwin County	223804492.088	EPA Region 4	40.8646991301168	0.629170075060714	87.1
15	01003010300	7826	01003	AL	Baldwin County	371357766.361	EPA Region 4	40.5079360885973	0.62211989612228	86.1
16	01003010400	4736	01003	AL	Baldwin County	748991125.111	EPA Region 4	39.7490326955648	0.603973574084696	84.1
17	01003010500	4815	01003	AL	Baldwin County	17917397.7343	EPA Region 4	42.3953618447443	0.678210980488911	90.1
18	01003010600	3325	01003	AL	Baldwin County	18778295.8106	EPA Region 4	41.8855596757204	0.653068092841255	89.1
19	01003010701	7882	01003	AL	Baldwin County	148636383.521	EPA Region 4	38.0075118096927	0.572418100106556	78.1
20	01003010703	13166	01003	AL	Baldwin County	146647098.923	EPA Region 4	37.0575173201953	0.563679885319564	75.1
21	01003010704	5055	01003	AL	Baldwin County	8762628.19669	EPA Region 4	38.5859873783086	0.588724877383155	80.1
22	01003010705	8331	01003	AL	Baldwin County	18192285.1751	EPA Region 4	37.5010248770415	0.568969961088252	76.1
23	01003010800	6861	01003	AL	Baldwin County	18268831.6429	EPA Region 4	34.5889730391663	0.499463715766068	65.1
24	01003010903	5173	01003	AL	Baldwin County	56424236.561	EPA Region 4	36.6899582398084	0.550949582019976	73.1

Save

1475 pages (73711 records in total) 50 records per page

Fig. 26 Load and Preview File/Dataset

The Data Preview module supports several operations for data viewer, including keyword filter, group filter and output records to *.csv.

- **Keyword:** users can filter the data on the current page with self-defined keywords.
- **Group:** users can group the data on the current page according to a selected attribute. To group the data, users should click on an item of chart header first for selecting the grouping basis, then check the “Group” box to get the grouping results.
- **Use Filter:** users can check the option to filter data according to the field condition.
- **Output Records to *.csv:** users can save the current pager record or all records to a *.csv file by clicking the  button.

6 Data Query Module

In this module, users can query data by multiple conditions and view the result in map and table. It includes three parts: (1) Data query filter; (2) Map and (3) Attribute table.

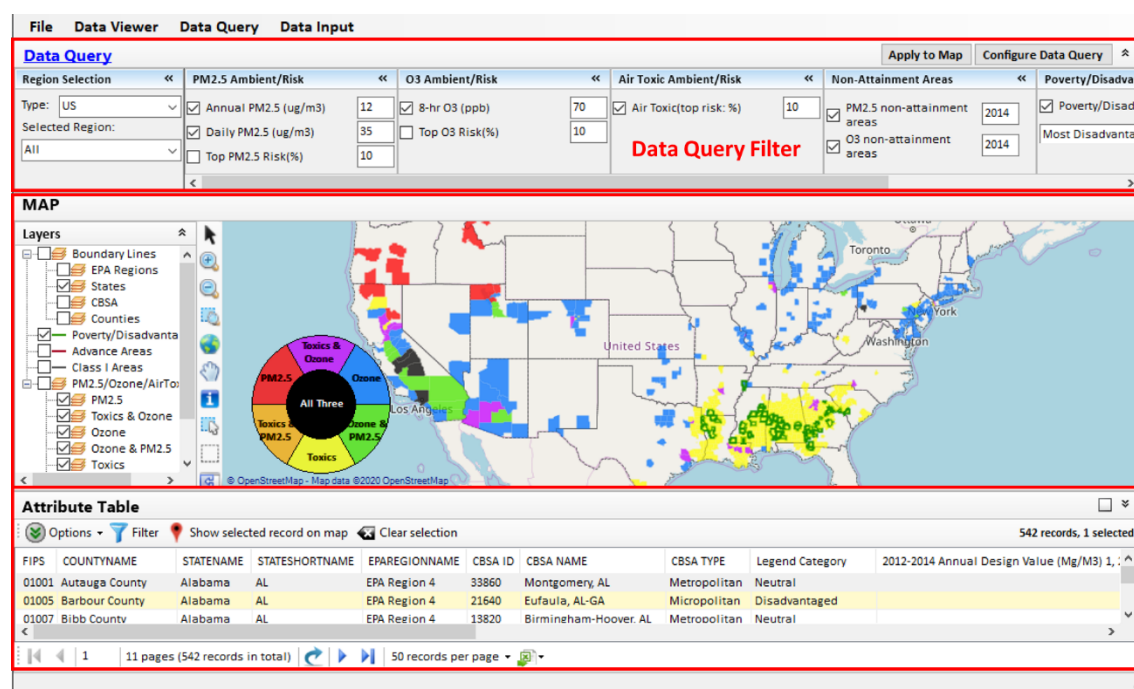


Fig. 27 Main Interface of Data Query

Under data query filter, it provides 7 filter panels (Region selection, PM_{2.5} ambient/risk, O₃ ambient/risk, air toxic, non-attainment areas, advance areas, poverty/disadvantage areas and class I areas) for users to check filters of interest. Besides, it provided a “Configure Data Query Filter” module for users to custom those filters as needed, as shown in Fig. 27.

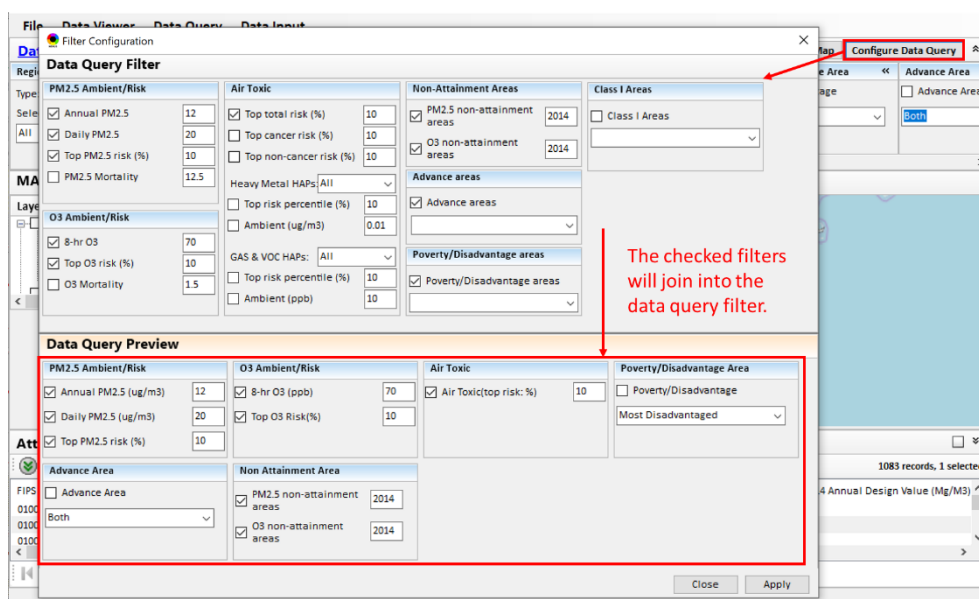


Fig. 28 Configure Data Query Filter Module

Under Map, the results that match those selected filters in Data query filter module will be shown in Map.

- **Layer:** As shown in the green box in Fig. 29, users can check or uncheck each filter under the layer panel on the left.
- **Zoom and Map Control:** As shown in the red box in Fig. , these options control zooming in/out and panning the map display, and allow users to select the map service.

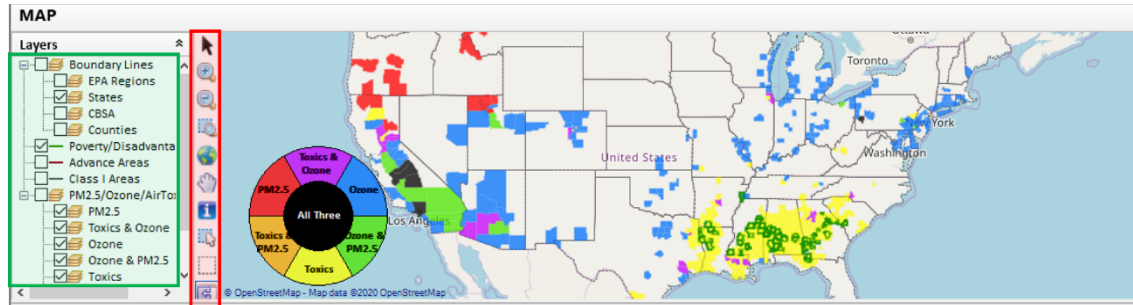



Fig. 29 Map Module of Data Query

Under Attribute table, the results that match those selected filters in Data query filter module will be also listed in this table.

- **Filter:** users can check the option to filter data according to the field condition.
- **Show selected record on map:** users are supported to select one or more records to show in map
- **Make the window float:** user can take out the “attribute table” to make it floating as shown in Fig. .
- **Output Records to *.csv:** users can save the current pager record or all records to a *.csv file by clicking the  button.

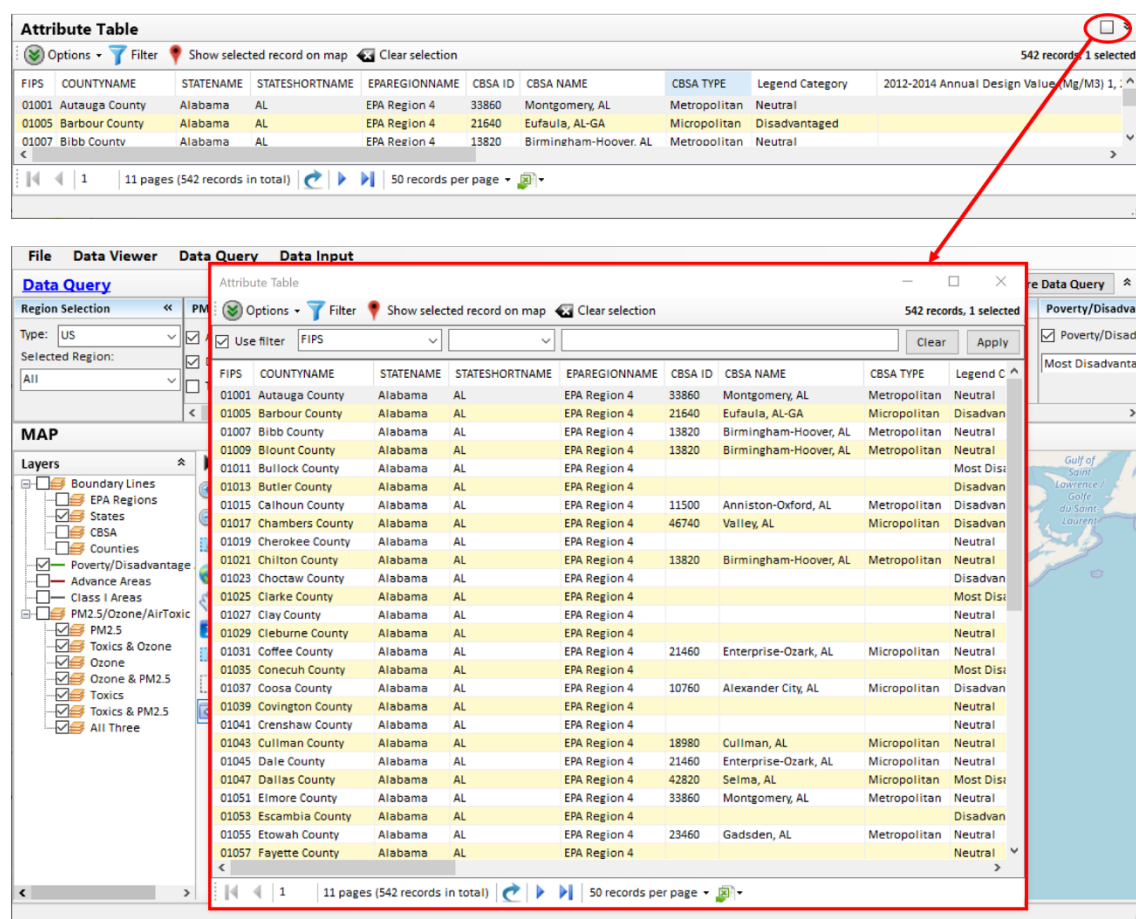


Fig. 30 Make the Attribute Table floating