Comprehensive Data Management of WRAP Emissions Data

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ABSTRACT

The Western Regional Air Partnership (WRAP) is comprised of representatives from cooperating western states, tribes, and federal agencies. One of WRAP's primary goals is to develop technical and policy tools to assist its stakeholders in development of State Implementation Plans (SIPs), Tribal Implementation Plans (TIPs), and meeting requirements of the U.S. Environmental Protection Agency's (EPA's) Regional Haze Rule (RHR). An important component of this process is the ability to track pollutant emissions over time. WRAP has approached analysis of emissions data via two integrated avenues.

The Emissions Data Management System (EDMS) is a central repository of emissions inventory data. The inventories contained within the EDMS consist of multiple pollutants from Point, Area, Mobile, Biogenic, and Fire inventory sectors for 2002 and 2018 (addition of 2005 data is in progress). This, and addition of future inventories, will allow for tracking trends in air quality control across WRAP.

The Technical Support System (TSS), designed as a Web-based portal of comprehensive technical data and analytical results, houses SMOKE-processed emissions data. TSS-designated emissions sectors and inventory years are similar, though not identical, to those in the EDMS.

Integration of the EDMS and TSS is currently underway. The EDMS remains as an independent warehouse of detailed emissions data. Enhancements to the TSS data presentation tools allow users access to EDMS data, and the ability to compare native emissions inventories and emissions modeling data.

This paper will describe the methods for obtaining emissions data using the newly integrated EDMS and TSS data management systems.

INTRODUCTION

Under federal clean air laws, states and tribal areas that are not in compliance with National Ambient Air Quality Standards (NAAQS) are required to provide documentation or plans describing how they will become compliant with NAAQS. The U.S. EPA's Regional Haze Rule requires states, tribes and other federal programs to develop plans to mitigate pollution that causes visibility impairment in Class I Areas across the country. Air quality planners need supporting data and data presentation tools to prepare these plans. The WRAP has developed such tools on the TSS, integrating a number of different information resources under one Web-based umbrella. The data resources that feed into the TSS include:

- Visibility Information Exchange System (VIEWS) – The VIEWS Web site stores aerosol and optical visibility data collected by the Interagency Monitoring of Protected Visual Environments (IMPROVE) and cooperating programs to track and characterize haze across the United States. The TSS was developed on top of VIEWS technology and shares many structural features.

- Emissions Data Management System (EDMS) – The WRAP EDMS is an emissions inventory data warehouse and Web-based application that provides a consistent approach to regional emissions tracking to meet the requirements for SIP and TIP development and periodic review and updates.

- Fire Emissions Tracking System (FETS) – The FETS is a database with a Web interface for planned and unplanned fire events. Users can view fire data on-screen with a mapping tool and query the database for downloads of data into model-ready formats and CSV or DBF formats.

- WRAP Regional Modeling Center (RMC) – The WRAP RMC assists state and tribal agencies in conducting regional haze analyses over the western U.S. by operating regional scale, three-dimensional air quality models that simulate the emissions, transformation, and transport of pollutants and the effects on visibility in WRAP Class I Areas.

- Causes of Haze Assessment (CoHA) – The CoHA Web site is an online report that answers questions about the chemical components that cause regional haze, relationships of haze to meteorology, the emissions that cause haze, and the effects of previous and future emissions reductions on the worst and best visibility levels.

This paper describes how to access WRAP regional emissions, which are stored in the EDMS database and are available using the newly designed and enhanced data reporting tools on the TSS.

BACKGROUND

Emissions Data Management System (EDMS)

The Emissions Data Management System (EDMS) is an emissions inventory data warehouse and Web site (www.wrapedms.org) that provides regional WRAP emissions tracking to meet the requirements for SIP and TIP development, EPA regional haze rule, as well as support for modeling, tracking, and data analyses. The emissions inventories contained within the EDMS consist of visibility impairing pollutants that are released into the atmosphere by different sources. These include:

- Oxides of nitrogen (NO_X)
- Sulfur dioxide (SO_2)
- Particulate matter (PM)
- PM with an aerometric diameter of less than or equal to 10 or 2.5 micrometers ($PM_{10}/PM_{2.5}$)
- Elemental carbon (EC)
- Organic carbon (OC)
- Volatile organic compounds (VOC)
- Carbon monoxide (CO)
- Methane (CH_4)
- Ammonia (NH_3)

The emissions source categories that make up the inventory consist of:

- Point or stationary sources
- Area/non-point sources
- On-road mobile sources
- Off- or non-road mobile sources
- Fires
- Biogenic sources

The information contained in the EDMS is provided via a joint effort among the states, counties and tribal entities that make up the data providers located within the WRAP region. The WRAP Emissions Forum is responsible for oversight in the development of emissions tracking tools and quality assurance of these emissions data inventories. WRAP has contracted with Air Resource Specialists, Inc. (ARS), and Air Sciences, Inc. for the Web hosting and database development (provided by ARS) and the quality control and analysis (provided by Air Sciences) of these emissions data.

Each entity that contributed to the EDMS system has made a major effort to make the information as accurate as possible. Complete inventories often are provided by multiple agencies, take substantial time to prepare, and undergo revisions resulting in lag time between when the emissions occurred and when they are available. The WRAP entities regularly review data in the EDMS to updated missing data and correct data problems as they are identified.

Technical Support System (TSS)

The Technical Support System (TSS), supported and maintained by the Cooperative Institute for Research in the Atmosphere (CIRA) and other partners, has been developed to provide access to comprehensive technical data and analytical results prepared by WRAP Forums and Workgroups in one location. The data, results, and methods displayed on the TSS are intended to aid air quality planners in preparation, completion, evaluation, and implementation of the regional haze implementation plans and other western air quality analysis and management needs.

The data acquisition tools available on the TSS access data from several air quality data sources using a single data warehouse. The design of the TSS allows users to view and analyze datasets of different origin in a uniform, integrated manner with a common set of tools and Web services. This streamlines the decision-making process, allowing air quality planners to focus on strategies instead of the details of data management and manipulation.

INTEGRATION

The original EDMS Web interface was a stand-alone site, independent from the TSS. It was limited in its use as a data reporting and comparison tool, as there was no convenient way to compare pre-modeled emissions data with the SMOKE-processed modeling results. The graphical and spatial display tools were also limited. Users largely familiar with the TSS were looking for a more streamlined way of displaying and reporting summary emissions data. Based on a survey of registered EDMS users, many respondents stated a desire to make the EDMS more like the TSS, and have the EDMS linked to the TSS to allow data comparisons. One of WRAP's goals became leveraging existing TSS tools to present EDMS data via standard reports, an Ad-Hoc query tool, and a mapping protocol, including a distance tool. Inclusion of EDMS data in the TSS structure make it more accessible and intuitive to users with TSS experience.

Integration of the EDMS database with the TSS Web application benefits data users and the WRAP by combining the strengths of each application; making the EDMS database a useful data

storage and quality assurance mechanism for all detailed WRAP emissions data, while using the strength of the TSS to provide users with raw summary emissions data that are more accessible, robust, and less prone to error.

The EDMS still requires an independent Web presence for all of the supporting documentation and information related to the native emissions inventories. Figure 1 presents the relationship of the EDMS database, the EDMS Web site, and the TSS.

Figure 1. Roles of the EDMS database, EDMS Web site, and TSS.
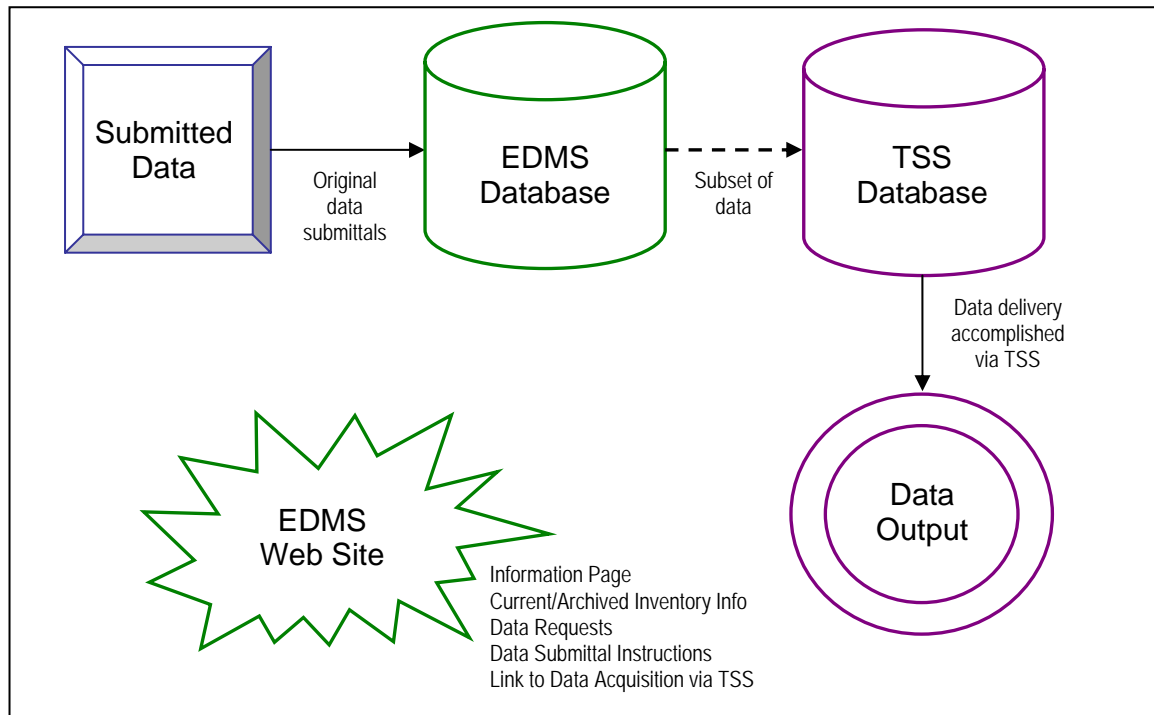
INTEGRATION STEPS COMPLETED

EDMS Web Site Home Page

A newly designed informational home page (Figure 2) continues to give EDMS a unique Web presence, providing a variety of EDMS related information including:

- EDMS background information
- Inventory description information
- Availability of current data (e.g., 2005 data upload status, publicly available and/or archived data inventories)
- Pollutant descriptions (e.g., clarification of PM categories, how EDMS data may differ from the TSS data)
- Data submittal and QC processes
- Frequently Asked Questions
- Links to data reporting and review tools on the TSS

This type of information was previously scattered across many different areas of the application and was difficult to find. A concise, straightforward information page gives users a reference point for all EDMS related information, not directly involved with obtaining data.

Figure 2. EDMS Web site home page.

EDMS Database

The EDMS database has become purely a data repository housing the various WRAP emissions inventories. Data from these inventories are routinely uploaded to the TSS server and are available via TSS tools: the Emissions Review Tool and the Emissions Inventory Reports.

DATA RETRIEVAL AND REVIEW

EDMS Summary Data Available via TSS Emissions Review Tool

The TSS Emissions Review Tool was developed to allow users to retrieve and graph SMOKE-processed emissions used for regional modeling. Data are presented graphically by parameter, emissions inventory ID, source category, region and/or county. (To access the Emissions Review Tool, go to http://vista.cira.colostate.edu/tss/Results/HazePlanning.aspx, click on the "Emissions and Source Apportionment" icon at the bottom of the page, then select "Emissions Review Tool" from the list of links).

The Emissions Review Tool has been recently modified to allow selection of EDMS data independent of or along with SMOKE-processed data. The following EDMS inventories are available:

- "2002 version 1" (Inventory 6)
- "2002 version 2" (Inventory 2)
- "2002 version 3" (Inventory 9)
- "2002 version 4" (Inventory 13)
- "2018 PRP version 1" (Inventory 12)

Comparison of these two data sets will yield similar, though not identical results. The EDMS data set contains native emissions submitted by state, local, and tribal agencies, while SMOKE-processed data are modeled. Additionally, the parameters and source categories contained in EDMS raw inventories and SMOKE-processed inventories differ slightly. Figures 3 and 4 present the selection of and side-by-side graphical comparison of EDMS native emissions and SMOKE-processed data for 2002.

Figure 3. TSS interface for EDMS and SMOKE-processed data comparison.

Figure 4. Graphical results for EDMS and SMOKE-processed data comparison.

Figure 1.
+ Show Data
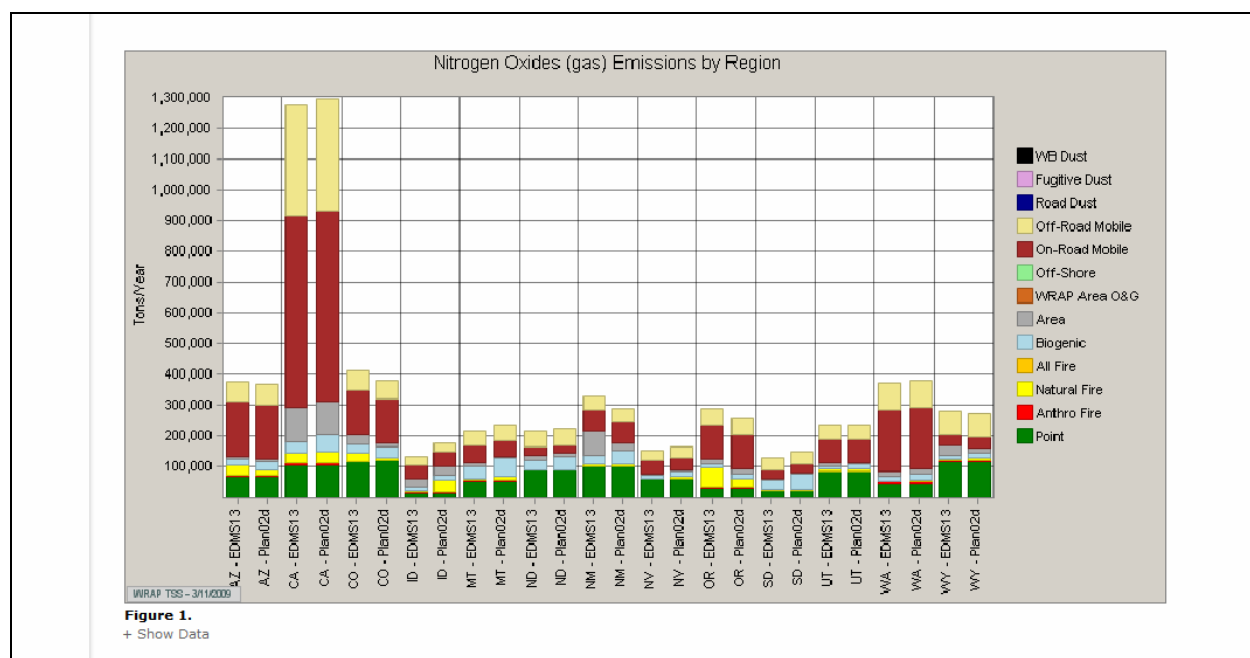
EDMS Emissions Inventory Reports

Retrieval of more detailed EDMS emissions inventories are a function of the Emissions Inventory Reports, available via the TSS Web application (http://vista.cira.colostate.edu/tss/edms.aspx). Available reports range from high-level summary information to very specific facility or fire data.

Users interested in high-level summary data can choose the "Totals for all Sectors" report (Figures 5 and 6). This report sums each pollutant (tons per year) by county and sector for the selected geographic area. It also includes a count of the number of records in each total for inter-regional comparison. This helps illustrate the difference between a small county with less than twenty reported sources and small pollutant totals, versus a very large county with hundreds of sources and very high concentrations of pollutants.

Figure 5. EDMS Emissions Inventory Reports interface.

Figure 6. EDMS Emissions Inventory Reports "Total Report for all Sectors" results.

Selected Report: Totals for All Sectors
All Sectors: (P)oint (A)rea (D)ust (M)obile (N)on-road Mobile (F)ire (B)iogenic
Values are in Tons Per Year

Selected FIPS: state_tribe_fips + county_fips in ('129' '145')

SECTOR	STATE_TF	STATE_TRIBE_NAME	COUNTY_	COUNTY_NAME	RECORDS	VOC	NOX	SO2	PM_FIL	PM_PRI	PM10_FIL	PM25_FIL	PM10_PRI	PM25_PRI	PM_CON	NH3	CO	EC	OC	CH4
A	46	SOUTH DAKOTA	99	MINNEHAHA CO	96	5411.239	1552.109	2511.225	0	0	613.5631	92.23376	1058.489	534.0168	93.40423	80.78269	2851.363	0	0	0
A	46	SOUTH DAKOTA	83	Lincoln County	76	1007.15	128.433	186.8727	0	0	105.8281	63.29635	223.4121	180.6635	7.494775	12.77841	1015.384	0	0	0
AF	46	SOUTH DAKOTA	99	MINNEHAHA CO	1584	11.92593	5.020004	0.695962	0	18.01797	0	0	17.7259	16.94593	0	2.563955	127.0895	4.447953	7.637968	9.003986
AF	46	SOUTH DAKOTA	83	Lincoln County	1584	11.92593	5.020004	0.695962	0	18.01797	0	0	17.7259	16.94593	0	2.563955	127.0895	4.447953	7.637968	9.003986
B	46	SOUTH DAKOTA	99	MINNEHAHA CO	1	3202.8	294.1	0	0	0	0	0	0	0	0	0	753.6	0	0	0
B	46	SOUTH DAKOTA	83	Lincoln County	1	3334.1	293.2	0	0	0	0	0	0	0	0	0	725.6	0	0	0
D	46	SOUTH DAKOTA	99	MINNEHAHA CO	7	0	0	0	0	0	6985.75	1397.141	10862.43	2010.521	0	0	0	0	0	0
D	46	SOUTH DAKOTA	83	Lincoln County	7	0	0	0	0	0	3153.368	630.6587	5850.428	1046.639	0	0	0	0	0	0
M	46	SOUTH DAKOTA	99	MINNEHAHA CO	96	2033.385	3555.377	106.604	0	0	0	0	92.84717	72.89995	0	115.6924	30721.49	43.42232	41.51329	0
M	46	SOUTH DAKOTA	83	Lincoln County	96	553.2355	1231.618	36.85913	0	0	0	0	36.16591	28.91367	0	35.01678	9089.564	17.88789	15.49111	0
N	46	SOUTH DAKOTA	99	MINNEHAHA CO	219	851.7088	1939.338	273.5767	0	0	0	0	200.5757	191.3379	0	1.292466	11476.3	136.5338	47.47952	0
N	46	SOUTH DAKOTA	83	Lincoln County	219	167.7179	698.8562	109.985	0	0	0	0	87.81196	84.41526	0	0.447494	1659.434	63.48169	18.32555	0
P	46	SOUTH DAKOTA	99	MINNEHAHA CO	17	444.22	147.21	496.36	0	42.61	0	0	42.21	0	0	0	25.14	0	0	0

Information for stationary point sources and fire data can be presented with varying levels of detail. Point source data can be downloaded cataloged by facility name (including options for details for stack and/or emissions release points), by Source Category Code (SCC), and future enhancements will include the ability to retrieve data based on BART-eligibility. Figures 7 through 9 display the "Point Source by SCC" report selection and results.

Figure 7. EDMS Emissions Inventory Reports interface for point source by SCC report.

Figure 8. EDMS Emissions Inventory Reports interface SCC selection screen.

Figure 9. EDMS Emissions Inventory Reports point source by SCC report results.

Fire emissions data can be displayed in annual tons for a selected region, displayed in tons per month by fire type or fuel type, or displayed with hourly resolution for specific periods of time. Figures 10 through 12 show the hourly fire report interface and data results.

Figure 10. EDMS Emissions Inventory Reports episodic fire report selection.

Figure 11. EDMS Emissions Inventory Reports episodic fire report date selection screen.

Figure 12. EDMS Emissions Inventory Reports episodic fire report results.

Similar selections and reports are available for the remaining sectors. Area, biogenic, and mobile sources are all categorized by SCC. Dust reports are a special report type, which summarize PM emissions using WRAP-defined dust-related SCCs and contain data also available using the area reports.

Additional Data Retrieval

In addition to the "standard reports" offered on the Emissions Inventory Reports Web page just described, reports with other content and formatting are available. All originally submitted data sets are stored in the EDMS database, so if a user is interested in NIF format data, data from an archived inventory, or some other special case data request the user would use the "contact us" feature of the EDMS Web site and such data would be provided.

FUTURE WORK

Future Inventories

EDMS developers are working in concert with the release of the new EPA Consolidated Emissions Reporting Schema (CERS). Beginning with the 2008 inventories, emissions data will be fully quality assured using the new schema structure and rules. All incoming data sets are accepted manually via direct submittal (see the "Submit Data" link on the EDMS home page) and stored within the EDMS database production tables. Pertinent information from the production tables is regularly incorporated with the TSS.

Mapping Tool

An Alpha version of a mapping tool, using Google Maps, is currently in development and will be available for review by the Emissions Forum. This tool will allow the user to:

- Show the locations of point sources in relation to county/state/tribal and Class I Area boundaries.
- Show geographical reference information, such as roads, cities, rivers, and lakes.
- Retrieve summary emissions data for any chosen county or facility, providing a spatial display of summary emissions data.
- Calculate the distance from a facility to a Class I or Tribal Area. This will help identify which facilities are subject to more stringent controls due to their proximity to the Class I or Tribal Area.

Figures 13 and 14 present preliminary products of the mapping tool, currently in development.

Figure 13. Map of facilities near Glacier National Park (Class I Area).
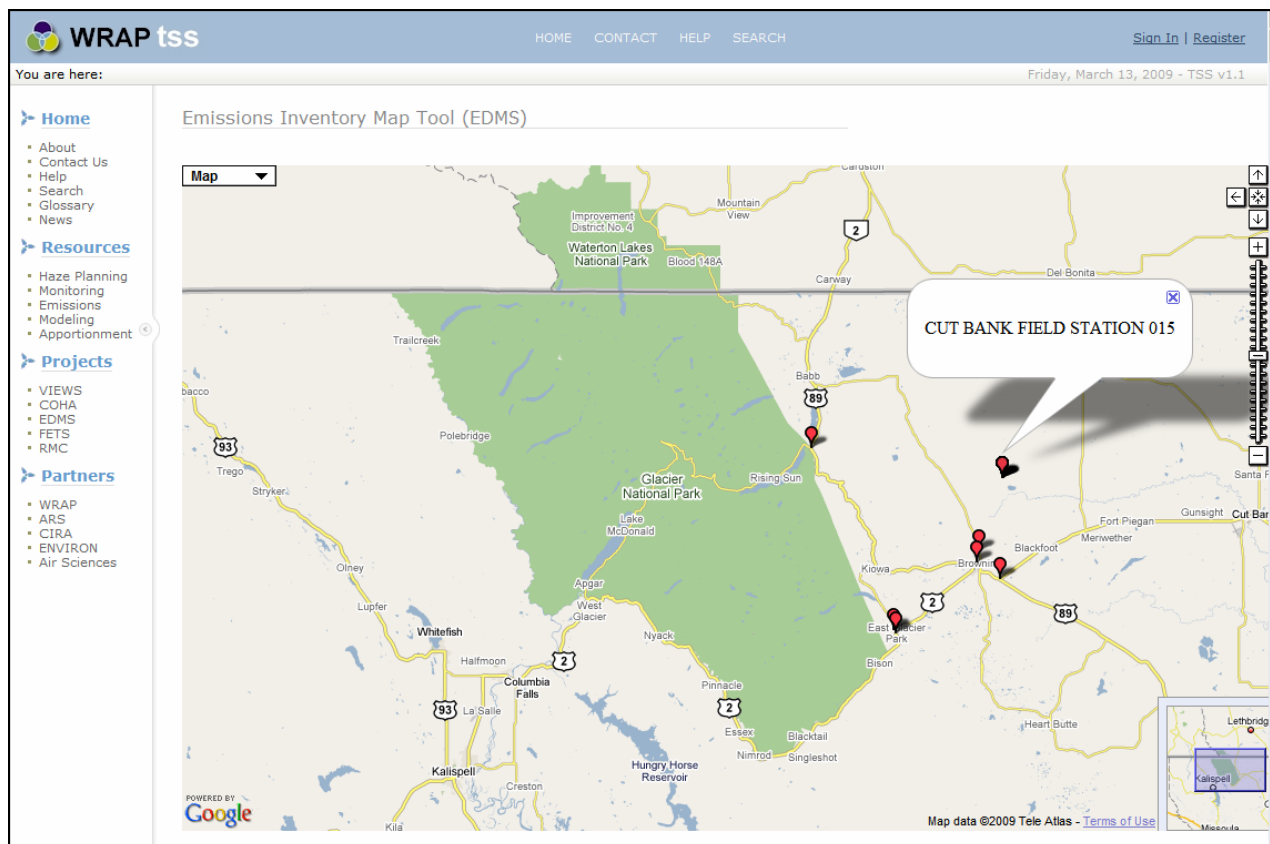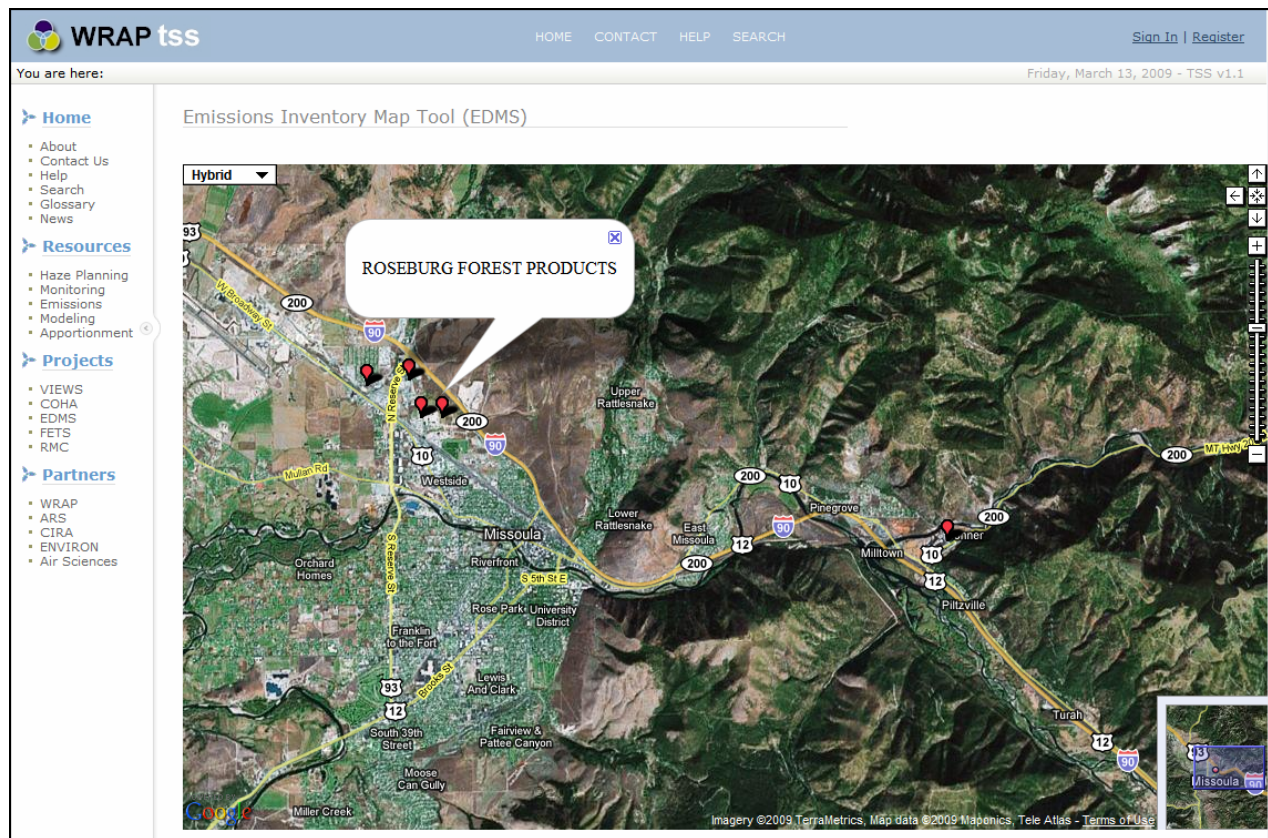
Figure 14. Hybrid map of point facilities near Missoula, MT

CONCLUSIONS

The WRAP has developed a useful emissions database and web interface to meet its goals of assisting member states assemble high quality regional inventories for future modeling efforts and track emissions trends related to air quality control, while adapting its inventory handling processes to comply with upcoming changes in EPA NEI Data submittals. The recent integration of the EDMS with the TSS has already significantly improved users' data access and reporting options. The EDMS/TSS integration is scheduled to be completed later this year.

KEY WORDS

Western Regional Air Partnership (WRAP)
Emissions Data Management System (EDMS)
Technical Support System (TSS)
Emissions Inventory
State Implementation Plan (SIP)
Tribal Implementation Plan (TIP)
Regional Haze Rule (RHR)