Sonoma Technology, Inc.
Air Quality Research and Innovative Solutions

Technical Memorandum

October 6, 2011 STI-910221-4231

To: Venkatesh Rao, U.S. EPA

From: Erin K. Pollard, Yuan Du, Sean M. Raffuse, and Stephen B. Reid

Re: Preparation of Wildland and Agricultural Fire Emissions Inventories for 2009

The U.S. Environmental Protection Agency's (EPA) Emissions Inventory and Analysis Group (EIAG) compiles the National Emissions Inventory (NEI) and disseminates inventory data, summaries, model-ready files, and analyses based on the NEI. To support this program and analyses conducted by a variety of users, it is necessary to develop an emissions inventory for the year 2009. An important part of this inventory development is the estimation of emissions from fires, as was previously done by Sonoma Technology, Inc. (STI) for the years 2006 through 2008. This work was done via Work Assignment (WA) 5-17 under Contract No. EP-D-05-004 and via an addendum to WA 5-17 to develop 2008 fire inventories in EPA's Emissions Inventory System (EIS) "Events" format.

As part of the current WA 2-21, STI previously revised the 2008 fire inventories to remove fires that may have been double-counted due to issues with the ISC-209 fire report data used as inputs to version 1 of the Satellite Mapping Automatic Reanalysis Tool for Fire Incident Reconciliation (SMARTFIRE v1) (Pollard et al., 2011). Since the 2008 fire inventory updates were completed, STI has completed the development of SMARTFIRE v2 under funding from the U.S. Department of the Interior (DOI) and with support from the USDA Forest Service (USFS). This new version of SMARTFIRE serves as a framework that supports multiple fire activity data reconciliation streams. We developed a retrospective stream for this work that was implemented in SMARTFIRE v2 and used to prepare the 2009 fire inventories.

As part of this project, we developed documentation of the key differences between SMARTFIRE v1 and SMARTFIRE v2. This technical memorandum contains the documentation, along with additional information on the methods used to develop the 2009 fire inventories and a summary of the 2009 fire activity and emissions data.

Overview of SMARTFIRE v2

SMARTFIRE, an algorithm and database system, uses both satellite-detected and ground-reported fires to produce daily fire information (locations and area burned). SMARTFIRE v1 reconciles ICS-209 ground reports and hot spots from the National Oceanic and Atmospheric Administration (NOAA) Hazard Mapping System (HMS) (Ruminski et al., 2006). This reconciliation is performed using a single algorithm that relies primarily on the HMS data to provide the information critical for emissions inventories—fire location, daily growth, and final size. In contrast, SMARTFIRE v2 is not a single algorithm; rather, it is a modular framework for collecting, processing, and reconciling fire information from a variety of sources. Key updates to SMARTFIRE v2 include:

- Capability of ingesting data from many types of fire information sources, including satellite-derived fire detections, satellite- or helicopter-derived burn scar polygons, and ground-based reports from federal and state agencies.
- Support for more than one reconciliation algorithm, or "stream."
- Incorporation of improved methodologies for determining fire type, fire size, and fire date.

Additional details about each of these improvements are provided in the subsections that follow.

Input Data Sources

SMARTFIRE v2 can accommodate an arbitrary number of fire information data sources and is designed to ingest new data sources as they become available with minimal coding required. Three data sources were identified and used in the 2009 fire emissions inventory.

NOAA HMS Fire Detects

NOAA's HMS combines automated fire detections from several satellite-based instruments with daily human quality control (QC). HMS data are available daily on a 1-km resolution grid. This data set provides the most complete coverage of all data sets used. In addition, the routine daily information provides the best estimate of the temporal profile of fire activity. The HMS data, however, provide only rough estimates of fire size—both under-predicting and over-predicting fire sizes—depending on the vegetation type. HMS provides no information on fire type, name, or other attributes.

ICS-209 Reports

The Incident Command teams produce Incident Command Summary Reports, known as ICS-209s, on fires for which there is a federal response. For large fires, updated ICS-209s are produced nearly daily. For small fires, they may be produced many months after the event has concluded. ICS-209s provide accurate data about final fire size, and information about temporal profiles for large fires. ICS-209s also contain useful metadata, such as fire name, fire type, and fuels burned. ICS-209s provide no information about fire shape and only crude information about fire location (i.e., the fire ignition location). In addition, ICS-209 reports are hand-created and often contain errors.

GeoMAC Fire Perimeters

The Geospatial Multi-Agency Coordination Group (GeoMAC) is an Internet-based mapping application that provided daily fire perimeter data in shapefile format based on input from incident intelligence sources, GPS data, and infrared imagery from satellites. Information provided by the perimeter data includes perimeter collection date, fire name, fire number, current acreage, fire agency, and specific fire-related comments.

SMARTFIRE v2 Stream Algorithm

SMARTFIRE v2 is a modular framework that supports more than one reconciliation algorithm, or stream. Each stream can employ any of the input data sets available in the database and establish which data sets have precedence over the others to provide specific information. This means that streams can be designed specifically for retrospective emissions inventory processing and take advantage of higher quality data sets that are not available in real time.

Each fire event in a SMARTFIRE v2 reconciled output stream is made up of eight data elements. Each element is derived independently. Any given fire event may be detected by one or more data sources, and the elements are calculated based on a hierarchy.[1] **Table 1** lists the elements of each fire event in SMARTFIRE v2 and the precedence of each data source as implemented in the SMARTFIRE v2 Retrospective Stream.[2]

Table 1. Fire data elements and data source precedents of the SMARTFIRE v2 Retrospective Stream.

Element	Description	Source Precedence
Size	Final size of the fire	1. GeoMAC 2. ICS-209 3. HMS
Shape	Final burn scar shape	1. GeoMAC 2. HMS 3. ICS-209
Growth	Daily size of the fire	1. HMS 2. ICS-209 3. GeoMAC
Name	Fire name	1. GeoMAC 2. ICS-209 3. HMS
Fire type	Fire type assignment (wildfire vs. prescribed burn)	1. ICS-209 2. GeoMAC 3. HMS
Location	Latitude and longitude of fire	1. GeoMAC 2. HMS 3. ICS-209
Start date	First date of fire	First to detect
End date	Last date of fire	1. HMS 2. ICS-209 3. GeoMAC

[1] In practice, many fire events (particularly prescribed burns) are only captured in HMS data and are not subject to the data hierarchy shown in Table 1.
[2] Note that alternative reconciliation streams may be desirable for other analyses, such as the forecasting of smoke impacts from current-day fires.

Fire Type Determination

SMARTFIRE v2 assigns a fire type to fires from all data sets, typically either wildfire or prescribed fire. As shown in Table 1, fire type in the SMARTFIRE v2 Retrospective Stream is assigned based on ICS-209 if available, then GeoMAC, and finally HMS. Fire type is provided explicitly in ICS-209 data. Because GeoMAC is primarily a wildland fire data set, all GeoMAC fires are assumed to be wildfires. If fires are detected by HMS only, we assume fire type based on location and time. **Figure 1** shows the fire season map used to assign fire types for HMS fires. The fire season map was developed by analyzing the Monitoring Trends in Burn Severity (MTBS) data set for the years 1984-2006 to determine the typical wildfire season for each state and analyzing the Forest Service Activity Tracking (FACTS) prescribed burn data set for one year (10/1/2009 to 9/30/2010) to estimate the prescribed burning season. For many states in the West, the seasonal patterns of wild and prescribed fires were distinct. In other states, particularly in the southeastern United States, the seasons were not separable. For those states, fires detected by HMS only are presumed to be prescribed burns. This is because (1) the majority of fires in the southeastern region are prescribed, and (2) wildfires are often represented in other data sets.

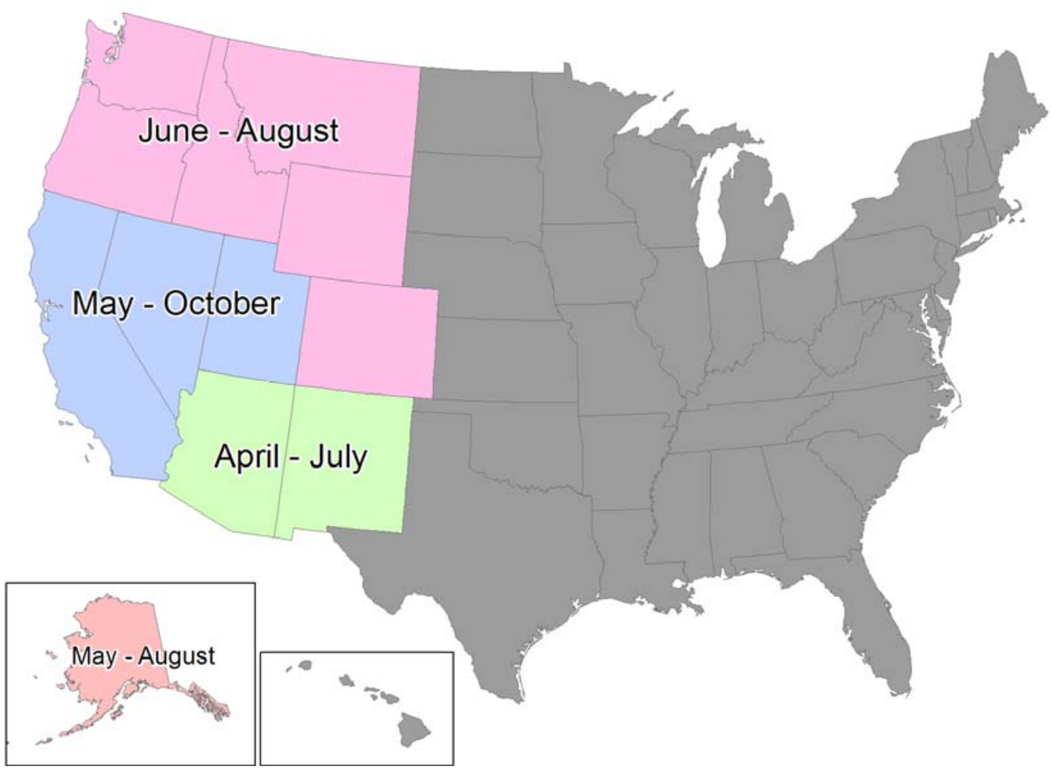

Figure 1. Wildfire season map for assigning fire type to fires detected by HMS only. Fires outside of the wildfire time period are given a fire type of “prescribed burn.”

Fire Size Determination

The precedence of fire size determination in the SMARTFIRE v2 Retrospective Stream is GeoMAC → ICS-209 → HMS (see Table 1). This is a major change from SMARTFIRE v1, where HMS takes precedence and GeoMAC is not included. GeoMAC data are geographic polygons. Fire size for events with GeoMAC data is calculated as the GeoMAC polygon area. If GeoMAC data are not present but ICS-209 data are, the area field is used. If only HMS data are available, the fire size is estimated in two different ways, depending on the number of HMS "pixels" have detected the fire.

For large fires, SMARTFIRE v2 approximates the burn perimeter by drawing a circular buffer (radius = 800 m) around each pixel and merging the resulting circles into polygons. For HMS fire detections greater than 10 pixels, fire size is reported as the area of the merged polygons.

For small fires (i.e., HMS fire detections less than 10 pixels), the buffering method described above does not accurately represent the actual fire size. Therefore, to estimate the size of fires represented by a small number of HMS pixels, we developed burned area per pixel estimates. In SMARTFIRE v1, a single relationship of about 100 acres per pixel was developed and used for all fires, regardless of size or location. For SMARTFIRE v2, this relationship depends on vegetation type, as shown in **Table 2**. To develop the area per pixel relationships, MTBS burn perimeters for 2003-2008 were intersected with the Fuel Characteristic Classification System (FCCS) 1-km resolution map (http://www.fs.fed.us/pnw/fera/fccs/maps.shtml). Each FCCS fuelbed was assigned to one of 12 broad vegetation classes and each MTBS perimeter was also assigned to one of the vegetation classes. Linear area per pixel relationships were developed for all fires as well as fires that were less than 10,000 acres.

Table 2. Area per HMS pixel statistics and final area per pixel values used in SMARTFIRE v2.

Vegetation Type	All Fires			Fires < 10,000 acres			Final
	Area/ Pixel	R-Squared	No. of Fires	Area/ Pixel	R-Squared	No. of Fires	Area/ Pixel
Closed Conifer	47.6	0.92	485	46.5	0.4	371	46
Boreal	322.6	0.69	8	322.6	0.69	8	100
Aspen	91.7	0.94	26	384.6	0.13	24	80
Grassland	172.4	0.85	476	126.6	0.29	414	150
Other	135.1	0.62	848	163.9	0.23	800	100
Eastern Deciduous	122.0	0.66	175	122.0	0.2	169	122
Juniper	90.1	0.75	206	70.9	0.47	180	80
Open Conifer	69.4	0.75	812	73.0	0.31	754	70
Pacific Broadleaf	303.0	0.49	69	147.1	0.26	53	150
Shrubland	196.1	0.47	811	212.8	0.19	643	200
Savanna	500.0	0.26	151	101.0	0.46	137	100
Riparian	75.2	0.98	149	114.9	0.1	144	75

ICS-209 Date Determination

Original ICS-209 records contain several date fields, including report date, start date, control date, and expected containment date. The start date represents the first day of the fire while the report date is the date that the report was submitted. For actively managed wildfires, a new ICS-209 record is typically created about once per day. Therefore, the report date accurately represents the burning time for those fires. However, for some smaller fires, particularly in certain jurisdictions, ICS-209 reports are not generated until months after the event has concluded. For these fires, the report date does not represent a daily snapshot of an active fire. SMARTFIRE v1 uses only the report date to assign an ICS-209 record to a particular date. While this is correct for the majority of fires and the vast majority of area burned, it is incorrect for many small fires.

The SMARTFIRE v2 Retrospective Stream uses both the report and start date fields, along with the area burned field, to determine the actual date represented by a particular ICS-209 record. The method assumes that fires increase in size by at least ten acres per day. It calculates the number of days between the start date and the report date and divides the area burned by the number of days. If that value is greater than ten, the report date is used. Otherwise, the start date is used.

The control date is the day the fire incident was declared controlled while the expected containment date represents the date on which full containment is expected. Though not used in the current version of SMARTFIRE v2, these dates were used during the manual QC process before and after SMARTFIRE v2 reconciliation.

Technical Approach

Data Sources

The following sources of activity were used to develop the 2009 fire inventories:

- Inputs to SMARTFIRE v2
  - *HMS* data were acquired daily from the NOAA HMS system via FTP as part of a routine process. Data were acquired in ASCII text format available at http://satepsanone.nesdis.noaa.gov/FIRE/fire.html.
  - *ICS-209 Reports* in BlueSky input format (a .csv-style format) were acquired nightly via FTP.from USFS servers (ftp2.fs.fed.us).
  - *GeoMAC* fire perimeter data were downloaded via the United States Geological Survey (USGS) GeoMAC wildland fire support website (http://rmgsc.cr.usgs.gov/outgoing/GeoMAC/)
  - *Moderate Resolution Imaging Spectroradiometer (MODIS)* satellite data were downloaded via the USFS Remote Sensing Applications Center website (http://activefiremaps.fs.fed.us/gisdata.php). Data were converted from shapefiles to ASCII text files and used to fill in the blank dates from HMS.

- *Fuel Moistures* – Fire weather observation files (fdr_obs.dat) were acquired for each analysis day from http://72.32.186.224/archive/www.fs.fed.us/land/wfas/archive. Files were acquired and combined for database ingest using Python scripts.
- *Fuel Loading* – FCCS 1-km fuels shapefile and lookup table were provided by the AirFire Team.

Preparation of Activity Data

SMARTFIRE v2 was used to process and reconcile fire activity data from HMS, ICS-209 Reports, and GeoMAC fire perimeters. In addition, SMARTFIRE v2 was used to generate daily input files for emissions processing through the BlueSky Framework for wildland fires.

MODIS data were used to gap-fill for dates on which data were missing from the HMS: January 30, April 8, September 28, and October 8, 2009.

Satellite fire data were categorized as “wildland” or “agricultural” fires by intersecting the fire data with FCCS gridcode <> 0 (wildland) and FCCS gridcode = 0 (agricultural) (see **Figure 6**). This fire-typing process was accomplished using the FCCS module in the BlueSky Framework. After fire-typing, wildland and agricultural fires were processed separately.

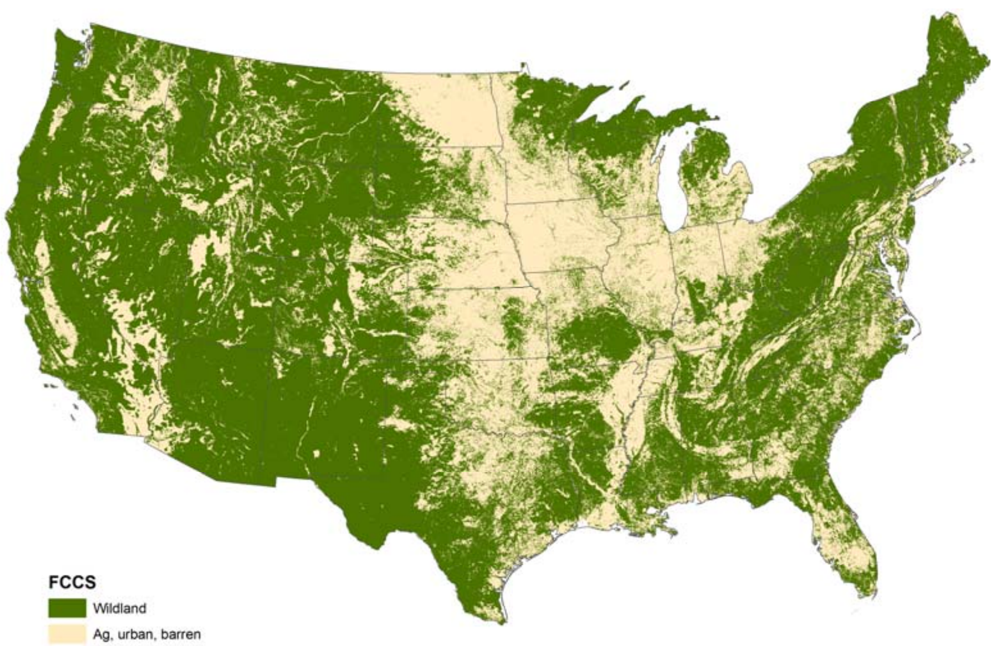

Figure 6. Distribution of wildlands in the FCCS database.

Process Stream

The BlueSky Framework provides several choices of models at each step of the smoke modeling process. The model chain used for this project is summarized in **Table 3**.

Table 3. Model chain for the 2009 Wildland Fire Emissions Inventory Development.

Data Type	Model Used	Version No.
Activity data	SMARTFIRE	Version 2.0, Build 812
Fuel loading	FCCS	As implemented in BlueSky Framework 3.1.0, revision 6700
Fuel consumption	Consume 3.0	
Emissions	Fire Emission Production Simulator (FEPS)	

Emissions Processing

The following steps were applied to process activity data and estimate emissions:

1. *Assign fuel moistures* – Individual fire locations from SMARTFIRE v2 prediction points were assigned to the nearest fire weather station reporting on that day using VBA code in AssignFuelMoisture06_08.mxd. This code produced a lookup table (yyyy_Join.csv) of fire IDs, station IDs, dates, and distances.
2. *Append latitude/longitude* – The SMARTFIRE v2 prediction points table does not include latitude and longitude as attributes (they are inherent in the shape field). They were added using a GIS application before exporting the attribute table to a text file called SF_PredictionPoints_yyyy_LatLon.txt.
3. *Create BlueSky input file* – The daily input files for the BlueSky Framework (fire_locations_yyyymmdd.csv) were created using VBA code in CreateFireLocations.xls. Input tables are stored in the Microsoft Access database CreateFireLocInput.mdb, including the tables SF_PredictionPoints_yyyy_LatLon and yyyy_JOIN. If the distance between the fire and the nearest fire weather station was greater than 300 km, default values were assigned (fuel_moisture_10hr = 9; fuel_moisture_1khr = 12). Outputs were created in .csv format and saved directly to the BlueSky Framework install.
4. *Process through BlueSky Framework* – A module was customized for the BlueSky Framework to calculate hazardous air pollutant (HAP) emissions using emission factors provided by EPA. The Framework is currently designed to process one day at a time. A shell script (batchEmissions) was used to process emissions one year at a time. The resulting files are daily BlueSky outputs.
5. *Post-process emissions* – The BlueSky Framework produces three output files for each day. For this project, we only required fire_locations_yyyymmdd.csv, which is the same as the input file, but with additional calculated fields (fuel loading, emissions, and consumption) appended to each fire record. The daily files were concatenated using a Python script, ConcatEmissions.py, into yearly files (fire_locations_yyyy.csv) for ingest into the emissions.mdb database and analysis.
6. *Prepare agricultural data* – Agricultural fires are now designated through the FCCS module in the BlueSky Framework. Fire locations from SMARTFIRE v2 with geographic information (latitude-longitude and county Federal Information Processing Standard [FIPS] code) in .csv format are read in the FCCS module and intersected with the FCCS fuel-loading file in network Common Data Form (NetCDF) format, which was rasterized from the FCCS 1-km shapefile. The module assigned an FCCS code to each fire record. Satellite fires with FCCS code = 0 were extracted from the yearly file

(fire_locations_yyyy.csv) to make a yearly agricultural fire table (AgActivityClean_yyyy) in the emissions.mdb database.

7. *Preparing wildland fire data* – Fire_Locations_yyyy tables in the emissions.mdb database were merged into one table (WF_locations_All) after filtering out the agricultural data.

Emissions QA/QC

For the 2009 fire inventories produced with SMARTFIRE v2, several steps were taken to QC the data and confirm that the new algorithms and data sets incorporated into SMARTFIRE v2 were working appropriately.

Before Running SMARTFIRE v2:

- We reviewed input data sets and identified any data gaps that needed to be filled with alternative data (e.g., gaps in HMS data were filled with MODIS data).
- We identified fire incidents that appeared to be double-counted in individual data sets and removed duplicate records.
- We examined fires with long durations to identify fires that may have erroneous start dates.
- We spot-checked reported location coordinates for selected fires.

After Running SMARTFIRE v2:

- We checked the location, duration, final shape, and final size for large fire events (i.e., area burned > 25,000 acres) to ensure that the results were reasonable.
- We ran SMARTFIRE v1 for 2009 and compared the results with the results obtained using SMARTFIRE v2 (these comparisons are documented in detail in a later section of this memorandum).
- We produced and reviewed summary tables and plots of the 2009 fire inventory data.

Summary of 2009 Fire Inventories

In the 2009 fire inventories, the bulk of emissions originate from two regions: the West and Southeast United States. This concentration of emissions is consistent with previous national fire inventories prepared by STI for EPA and can be seen in the emissions density plot shown in **Figure 7**. The national spatiotemporal pattern, shown in detail in **Figure 8**, depicts the monthly average $PM_{2.5}$ emissions for each state. The springtime emissions are mostly from the southeastern states, where prescribed burning is a common land management practice in spring. The summer/fall emissions occur primarily in the West, particularly in California, Oregon, and Washington. **Figures 9 and 10** depict the area burned by county for wildland and agricultural fires calculated by SMARTFIRE v2.

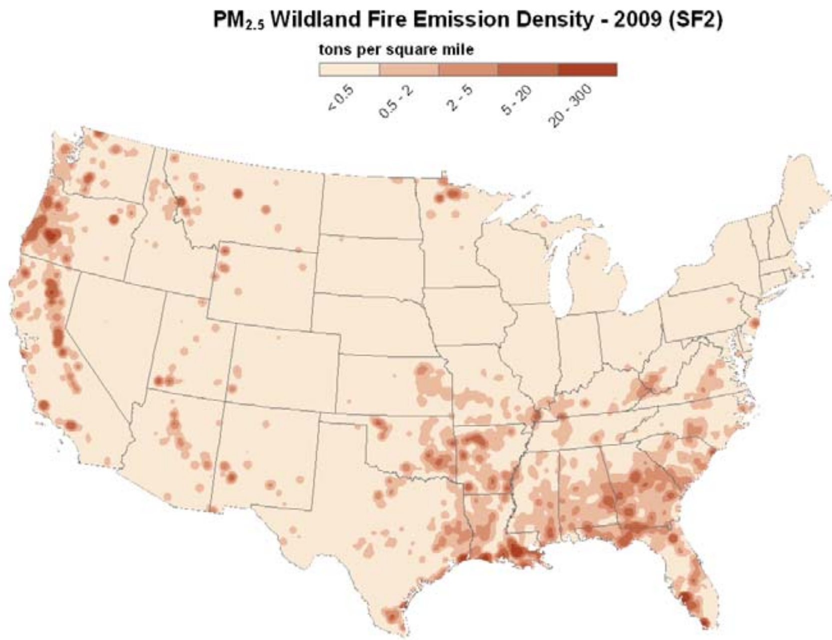

Figure 7. 2009 wildland fire $PM_{2.5}$ emissions density plot.

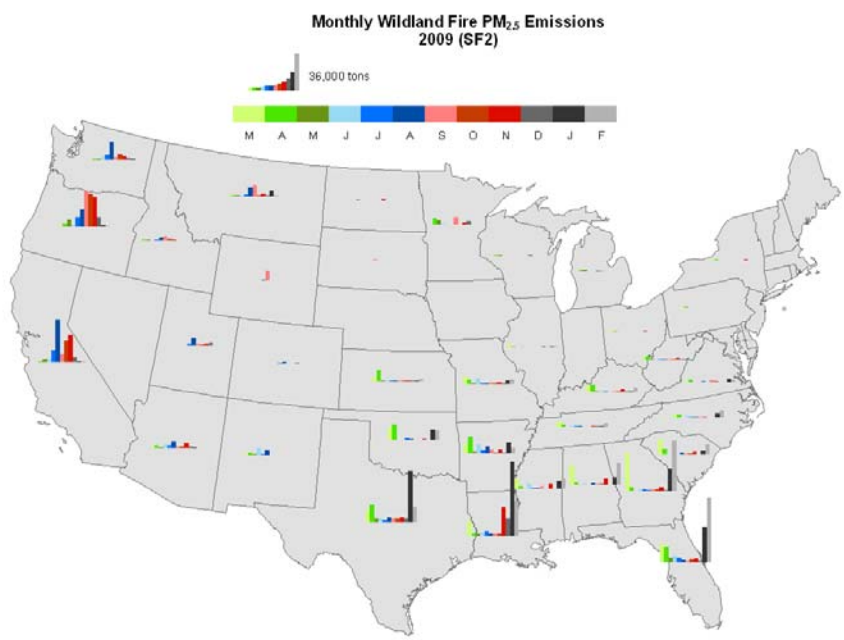

Figure 8. 2009 average monthly $PM_{2.5}$ emissions from wildland fires by state.

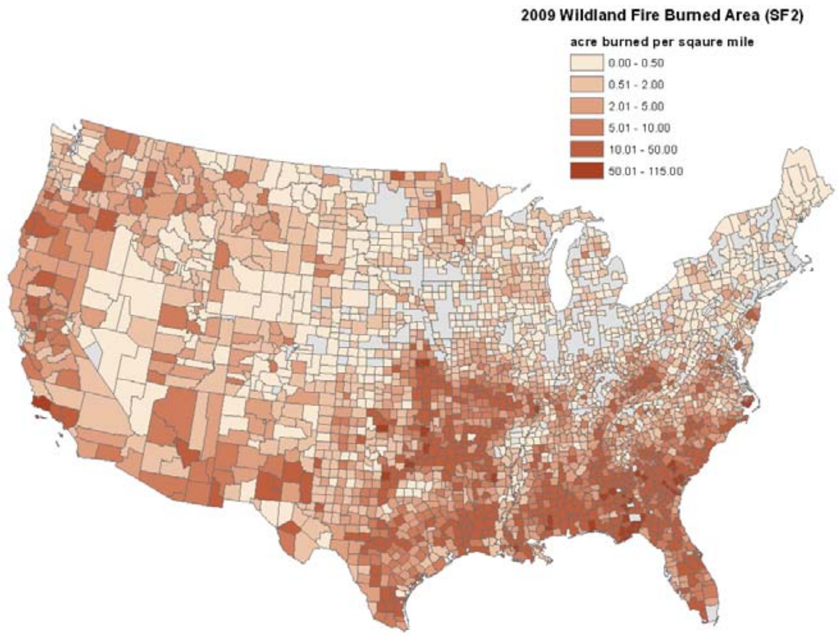

Figure 9. 2009 wildland fire area burned by county.

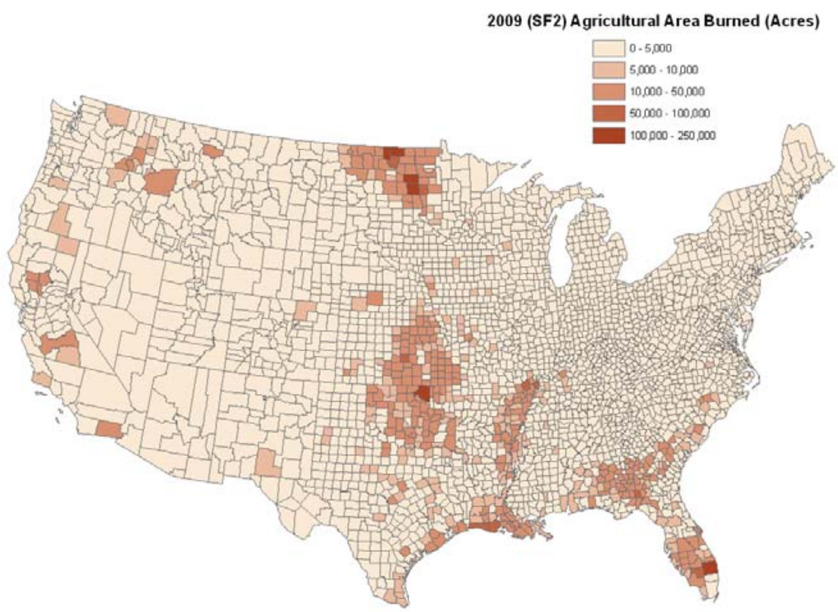

Figure 10. 2009 agricultural fire area burned by county.

Comparison of SMARTFIRE v1 and SMARTFIRE v2

To evaluate the effects of the modifications to SMARTFIRE, we directly compared the output from SMARTFIRE v2 to the output of SMARTFIRE v1 using the same HMS and ICS-209 2009 inputs. **Table 4** provides a summary of 2009 outputs for both versions of SMARTFIRE.

Table 4. 2009 fire activity and emissions estimates developed using versions 1 and 2 of the SMARTFIRE model.

Parameter	Version 1	Version 2	Change (%)
Area	10,858,090	13,620,425	25.44
Consumption	126,216,447	126,323,853	0.09
Number of fires	62,348	64,248	3.05
$PM_{2.5}$	1,449,496	1,460,335	0.75
PM_{10}	1,710,405	1,723,195	0.75
CO	16,914,502	17,070,064	0.92
CO_2	193,463,959	193,411,613	-0.03
CH_4	825,409	832,301	0.83
NO_x	219,273	217,998	-0.58
NH_3	277,387	279,874	0.90
SO_2	123,589	123,719	0.11
VOC	3,987,437	4,023,190	0.90
HAPs	377,832	378,153	0.09

Note that the total area burned estimate from SMARTFIRE v2 is about 25% higher than the total area burned estimate from SMARTFIRE v1, though consumption and emissions estimates are similar for both models. This result occurred for several reasons:

1. *HMS fire size assumption changes* – As shown in Table 2, the assumed fire size per pixel varies by vegetation type in SMARTFIRE v2; the resulting fire size estimate may be higher or lower than estimates from SMARTFIRE v1. In general, fire sizes increased on land cover with low fuel loadings like grassland, where fires are short-lived and fast-moving. In these cases, a significant increase in fire size does not lead to a large increase in fuel consumption.
2. *Fire type changes* – In SMARTFIRE v1, the fires detected solely by HMS were designated as “unknown” fires, while in SMARTFIRE v2 these fires were categorized as either “Wildfire (WF)” or “Prescribed Fire (RX)”. Within the BlueSky Framework, the Consume model assigns prescribed fires a canopy fraction of zero, while unknown fires were previously assigned a canopy fraction of 0.4. Therefore, a change in fire designation from “Unknown” to “Prescribed” results in a reduced canopy fuel loading.

3. *Fire weather changes* – In the BlueSky Framework, fire weather data are assigned to each fire based on the centroid of its geographic shape. In SMARTFIRE v2, the final fire shape is determined by perimeter polygons from GeoMAC shapefiles, while in SMARTFIRE v1, fire shapes were determined through a merger of HMS- and ICS209-based perimeters (Raffuse et al., 2009). In some cases, the change of centroid results in different fire weather data being assigned to a fire and, therefore, to different fuel consumption calculations.

Figures 11 and 12 show differences in area burned and $PM_{2.5}$ emissions estimates resulting from the SMARTFIRE v1 and SMARTFIRE v2 runs for 2009 (note that in both plots, results from v1 are subtracted from results for v2). **Table 5** provides a state-by-state summary of differences in results from the two versions of the SMARTFIRE model.

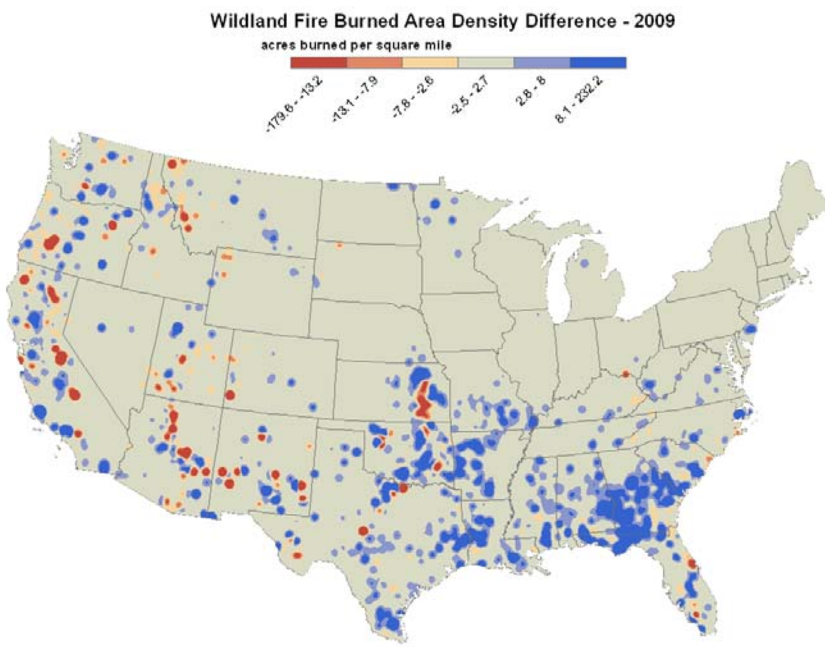

Figure 11. 2009 differences in wildland fire area burned calculations between SMARTFIRE v2 and SMARTFIRE v1.

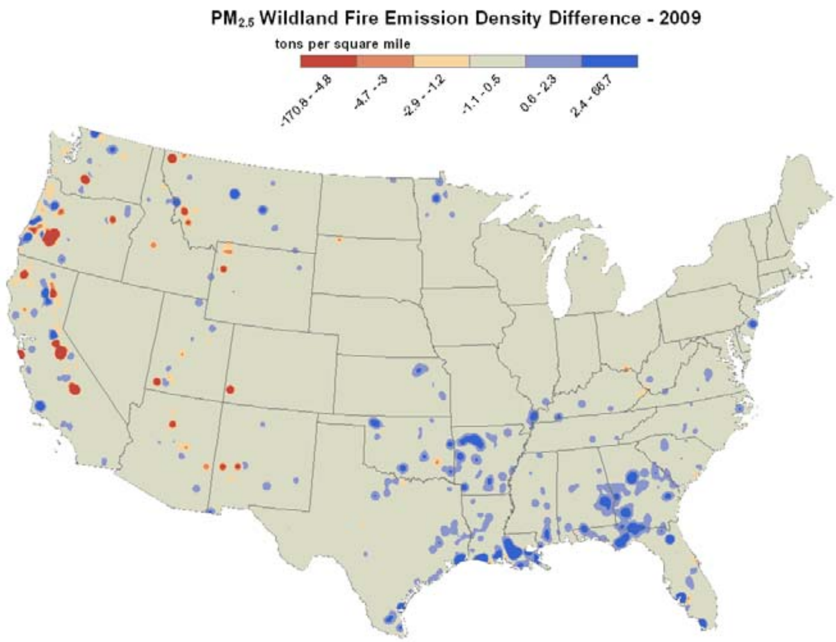

Figure 12. 2009 differences in wildland fire $PM_{2.5}$ calculations based on outputs from SMARTFIRE v2 and SMARTFIRE v1.

Table 5. Comparison of state-level fire activity data for SMARTFIRE v1 and SMARTFIRE v2.

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State	Version 1		Version 2		Change	
	Area (acres)	Fire #	Area (acres)	Fire #	Area (acres)	Fire #
Alabama	470,314	3,259	697,075	3,118	48.21%	-4.33%
Arizona	585,504	2,065	521,745	1,746	-10.89%	-15.45%
Arkansas	255,254	1,769	464,161	1,728	81.84%	-2.32%
California	977,151	3,314	1,015,789	3,953	3.95%	19.28%
Colorado	140,870	670	120,032	681	-14.79%	1.64%
Connecticut	500	5	710	6	42.00%	20.00%
Delaware	1,900	19	2,600	22	36.84%	15.79%
Florida	781,549	4,503	1,079,966	5,454	38.18%	21.12%
Georgia	911,091	6,674	1,469,878	6,413	61.33%	-3.91%
Idaho	153,642	1,044	153,115	1,142	-0.34%	9.39%
Illinois	30,640	273	38,389	283	25.29%	3.66%
Indiana	13,564	124	17,572	126	29.55%	1.61%
Iowa	17,664	165	20,928	178	18.47%	7.88%
Kansas	425,489	3,209	515,598	4,572	21.18%	42.47%
Kentucky	122,912	885	133,853	813	8.90%	-8.14%

Table 5. Comparison of state-level fire activity data for SMARTFIRE v1 and SMARTFIRE v2.

State	Version 1		Version 2		Change	
	Area (acres)	Fire #	Area (acres)	Fire #	Area (acres)	Fire #
Louisiana	341,909	2,353	496,744	2,196	45.29%	-6.67%
Maine	6,352	61	4,436	63	-30.17%	3.28%
Maryland	16,332	116	16,372	108	0.25%	-6.90%
Massachusetts	623	5	732	5	17.46%	0.00%
Michigan	17,991	156	24,857	162	38.16%	3.85%
Minnesota	86,070	683	130,200	698	51.27%	2.20%
Mississippi	348,263	2,508	461,613	2,406	32.55%	-4.07%
Missouri	312,048	2,499	444,455	2,592	42.43%	3.72%
Montana	284,754	1,603	248,550	1,528	-12.71%	-4.68%
Nebraska	29,141	268	51,295	285	76.02%	6.34%
Nevada	39,393	192	53,250	192	35.18%	0.00%
New Hampshire	823	7	1,220	8	48.24%	14.29%
New Jersey	15,975	90	28,568	91	78.82%	1.11%
New Mexico	527,266	1,381	588,906	1,174	11.69%	-14.99%
New York	13,789	116	14,930	120	8.27%	3.45%
North Carolina	218,917	1,612	267,660	1,540	22.27%	-4.47%
North Dakota	30,657	259	49,006	251	59.85%	-3.09%
Ohio	28,059	125	21,244	119	-24.29%	-4.80%
Oklahoma	652,677	3,032	914,447	3,602	40.11%	18.80%
Oregon	525,382	2,683	454,565	2,646	-13.48%	-1.38%
Pennsylvania	24,603	205	25,956	198	5.50%	-3.41%
Rhode Island	200	2	244	2	22.00%	0.00%
South Carolina	354,948	2,319	490,343	2,320	38.15%	0.04%
South Dakota	45,942	350	48,500	340	5.57%	-2.86%
Tennessee	87,003	623	121,456	574	39.60%	-7.87%
Texas	1,276,398	7,179	1,632,887	6,947	27.93%	-3.23%
Utah	197,279	845	201,157	729	1.97%	-13.73%
Vermont	2,116	20	2,874	21	35.81%	5.00%
Virginia	80,615	593	115,655	586	43.47%	-1.18%
Washington	214,452	1,171	234,971	1,190	9.57%	1.62%
West Virginia	66,672	538	83,838	512	25.75%	-4.83%
Wisconsin	34,240	311	43,783	338	27.87%	8.68%
Wyoming	89,157	465	94,297	470	5.77%	1.08%

Summary

SMARTFIRE v2 represents a significant step forward in the use of multiple fire information data sources for the development of fire emissions inventory activity data. This new capability is demonstrated in the SMARTFIRE v2 Retrospective Stream developed for the 2009 wildland fire emissions inventory. Critical updates incorporated into SMARTFIRE v2 include the inclusion of retrospective data, support for more than one data reconciliation algorithm, and improved methodologies for determining fire type, fire size, and fire date. As new data sets become available and additional research is completed, the algorithms can be continually improved.

Deliverables

STI is providing the revised inventories in the following formats:

- Microsoft Access files formatted identically to those prepared for the previous effort (WA 5-17 under Contract No. EP-D-05-004).
- SMOKE ORL format, as described in Section 2.2 of the work plan.
- EIS Events Format, which consists of Microsoft Access-based “staging tables” that can be converted to XML format by EPA’s Consolidated Emissions Reporting Schema (CERS) XML file generator and uploaded to EIS. STI populated the Access staging tables with 2009 fire emissions data and produced separate Access databases for each state.

In addition, STI is providing all relevant daily and aggregated data and metadata in Microsoft Access or Excel tables.

References

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