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Recent Updates to SMOKE

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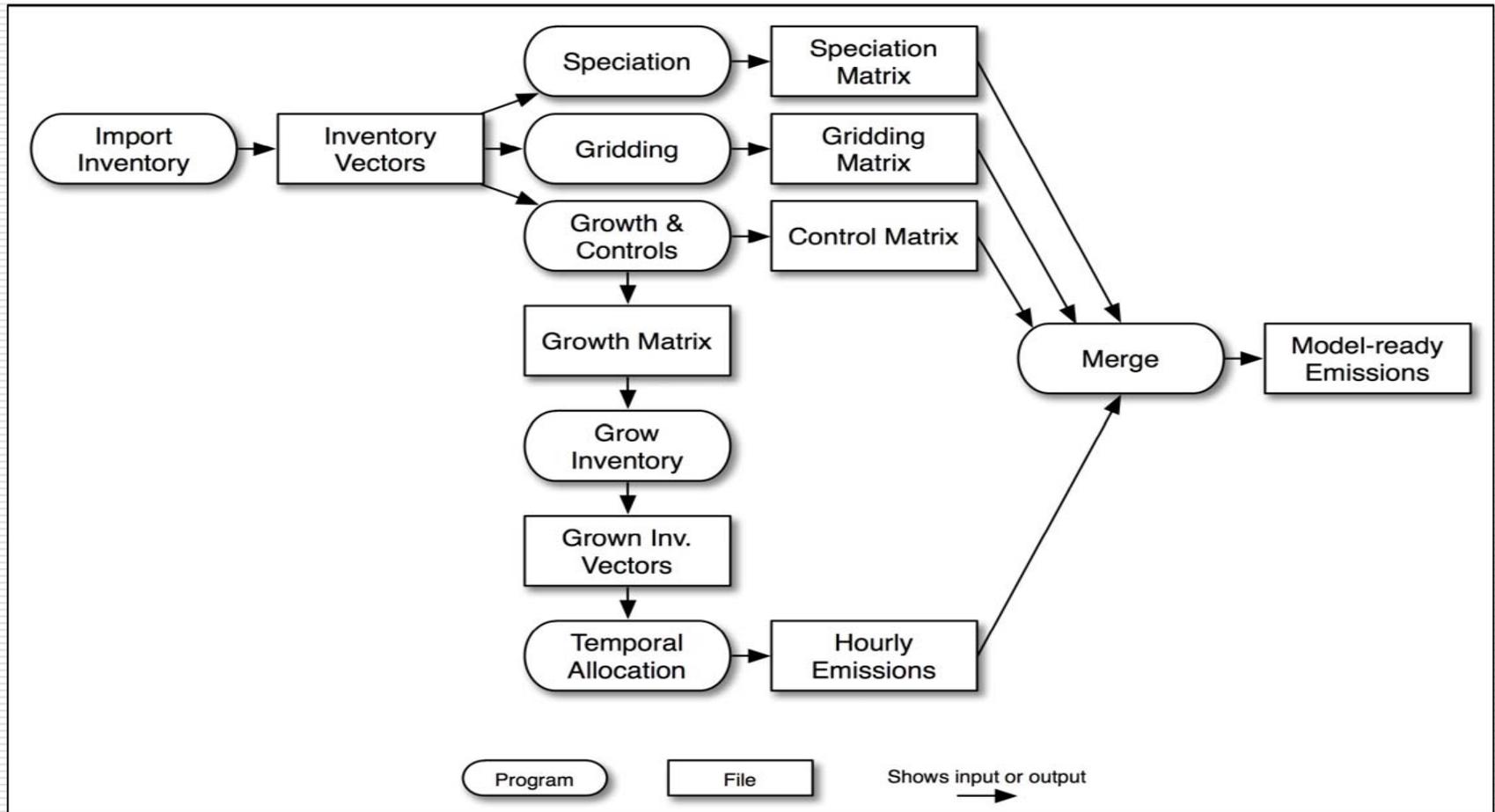


SMOKE / EMF

- EPA's Office of Air Quality Planning and Standards (OAQPS) is developing the one-model framework for toxics and criteria modeling for all air quality models used by U.S. EPA, including CMAQ, CAMx, REMSAD, and AERMOD.
 - In addition, OAQPS is developing an Emission Modeling Framework (EMF) to provide better management, versioning, quality assurance, and tracking of data used for emissions modeling.
 - A goal of the EMF is to provide better management and tracking of data used for emissions modeling and for the inputs and settings used to prepare emissions data input to air quality models.
 - A key component of the EMF is the SMOKE modeling system, which processes emissions inventories and related data into formats needed by air quality models.
 - SMOKE has been enhanced in recent years to facilitate the further integration of toxics and criteria processing within a one-model framework and to support better integration with the EMF (Houyoux *et al.*, 2005).
 - Many updates in support of this effort have been completed and underway:
 - (1) SMOKE version 2.2 was released in September, 2005
 - (2) SMOKE version 2.3 was released in October, 2007
 - (2) SMOKE version 2.3.2 is planned for a release in May 2007
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SMOKE Model System



SMOKE v2.3.2 Updates

Combining Criteria/Toxic Inventories

- In SMOKE version 2.3, **Smkinven** supports the option of combining CAP and HAP inventories
 - Updates on handling NONHAPVOC/NONHAPTOG, increase of a number of pollutants,,,,,
 - Expanded to several SMOKE core programs (*i.e.*, **Smkinven**, **Temporal**, **Smkreport**, and **Smkmerge**) for full extended applications
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SMOKE v2.3.2 Updates

Integration of BEIS 3.13

- Integration of BEIS 3.13 to the SMOKE system
 - Updated parameterization that account for the effects of **leaf temperature** and **solar radiation** on emissions
 - Schwede, D., Pouliot, G., Pierce, T., Changes to the biogenic emissions inventory system version 3 (BEIS3), 4th Annual CMAS Models-3 Users's Conference, Chapel Hill, NC, September, 2005.
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SMOKE v2.3.2 Updates

New Interface **EDMS2Inv**

- FAA's Emissions and Dispersion Modeling System (EDMS) for aircraft, GSE, APU, and stationary sources using activity/operation, to create hourly emissions inputs for AERMOD
 - NEI airport annual emission including aircraft is county basis emission
 - For temporally and spatially better representative emissions from airport sources, we have developed an interface, called **EDMS2Inv** in the SMOKE modeling system
 - Vertically allocate hourly emissions into the model layers
 - Enables processing of hourly emissions inventories from the FAA EDMS model to create emissions inputs to the air quality modeling system.
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SMOKE v2.3.2 Updates

New Interface **EDMS2Inv**

- List of Country/State/County per airport
 - Relative coordinate → Latitude and Longitude
 - Assign EDMS Source ID to SCC
 - Start/End Dates

 - PTINV : A mater (annual) format
 - PTHOUR : A format of hour-specific inventory
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SMOKE v2.3.2 Updates

Fully Extended ORL Format

- In SMOKE v2.3, **Smkinven** was updated to support upto 39 columns in ORL format
 - This update allows **Smkinven** to read up to 64 columns although they are not in use
 - This update allows **Grwinven** to output all those additional information to grown inventory.
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SMOKE v2.3.2 Updates

Multiple SMKINVEN_FORMULA

- Previously, only one formula at a time
- Allows multiple formulas available
- Double-quote-enclosed string of 512 char.
- A comma-delimited list for formulas
- An output from one formula may not be used as an input to another formula

EX: SMKINVEN_FORMULA =

“PMC=PM10-PM2_5, EXH__PMC=EX__PM10-EXH__PM2_5”



SMOKE v2.3.2 Updates

New PTDAY and PTHOUR Format

Position	Name	Type	Description
1-2	STID	Int	State Code (required)
3-5	CYID	Int	County Code (required)
6-20	FCID	Char	Facility ID/Plant ID (required)
21-32	CHAR1	Char	If PTINV in EMS-95 format: Stack ID (required) If PTINV in IDA format: Point ID
33-44	CHAR2	Char	If PTINV in EMS-95 format: Device ID (required) If PTINV in IDA format: Stack ID
45-56	CHAR3	Char	If PTINV in EMS-95 format: Process ID (required) If PTINV in IDA format: Segment
57-61	POLID	Char	Pollutant name (required)
62-69	DATE	Char	Date in MM/DD/YY. Years less than 70 are treated as century 2000. (required)
70-72	TZONNAM	Char	Time zone name. Valid entries GMT, ADT, AST, EDT, EST, CDT, CST, MDT, MST, PDT, and PST. (required)
73-90	DAYTOT	Real	Daily emissions total (short tons/day) (required)
92-101	SCC	Char	Only if PTINV in IDA format: SCC (required)
103-118	DATNAM	Char	Inventory Pollutant Code (16-characters) (optional) that matches same column of Inventory Table. It is the name of the pollutants used in the RAW IDA or ORL inventory files. This field should be used instead of the "POLID" field when pollutant names are longer than 5 characters. If this field is filled, POLID is not used.

SMOKE v2.3.2 Updates

Customized **Smkmerge** Output Names

- `SMKMERGE_CUSTOM_OUTPUT`: [default : N]
 - Define your own output file names from **Smkmerge**

 - **E|A|M|P]OUT** : Processing source output file.
 - **PING** : CMAQ PinG file
 - **ELEV** : Elevated-point-sources file
 - **REP[E|A|M|P]G** : Emission totals report file
-

SMOKE v2.3.2 Updates

Minor Updates

- Error message for duplicate entries in INVTABLE to prevent doubling day- and hour-specific emissions in **Smkinven**
 - Fixed a sequential run bug when running Smkinven with annual, day- and hour-specific inventories together in **Smkinven**
 - Error message for duplicate entries in GSREF to prevent assigning incorrect X-referencing speciation profile in **Spcmat**
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SMOKE v2.3.2 Updates

Minor Updates

- Fixed a bug of skipping the second processing date when running consecutive dates using PROCDATES option in **Temporal**
 - Fixed missing one hour emission on daylight saving time (DST) date when running multiple consecutive processing dates in **Temporal**
 - Updated **Grwinven** to properly apply pollutant-specific control packets to the inventory
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SMOKE v2.3 Updates

④ Memory Reduction for Gridding

- Previous **Grdmat** approach requires large amount of memory as the number of surrogate codes and grid cells increase
 - Instead, process only the assigned surrogate codes one at a time
 - Use surrogates either from a single file or multiple files
 - 90% reduction on memory usage.

 - Note: **[A|M]GPRO** are no longer in use.
 - **SMK_DEFAULT_SRGRID** (default : 100)
 - **SMK_USE_FALLBACK** (default : Y)
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SMOKE v2.3 Updates

@ Memory Reduction for Gridding

```
#GRID US12NC_66X52 1128000.0 -672000.0 2000.0 12000.0 66 52 1 LAMBERT METERS 33.0 45.0 -97.0 -97.0 40.0
# Surrogate information for continental US 12-km grid
# Columns: Region, Code, Description, File
USA,100,Population,amgpro.12km_041604.nc.txt
USA,110,Housing,amgpro.12km_041604.nc.txt
USA,120,"Urban Population",amgpro.12km_041604.nc.txt
USA,130,"Rural Population",amgpro.12km_041604.nc.txt
USA,140,"Housing Change and Population",amgpro.12km_041604.nc.txt
USA,150,"Residential Heating - Natural Gas",amgpro.12km_041604.nc.txt
USA,160,"Residential Heating - Wood",amgpro.12km_041604.nc.txt
USA,170,"Residential Heating - Distillate Oil",amgpro.12km_041604.nc.txt
USA,180,"Residential Heating - Coal",amgpro.12km_041604.nc.txt
USA,190,"Residential Heating - LP Gas",amgpro.12km_041604.nc.txt
USA,200,"Urban Primary Road Miles",amgpro.12km_041604.nc.txt
USA,210,"Rural Primary Road Miles",amgpro.12km_041604.nc.txt
USA,220,"Urban Secondary Road Miles",amgpro.12km_041604.nc.txt
USA,230,"Rural Secondary Road Miles",amgpro.12km_041604.nc.txt
```

SMOKE v2.3 Updates

@ Non-sequential Temporal Processing

- Previous **Temporal** approach can process a single continuous time period during each execution (Optional)
 - Limits applications when only a representative days plus holidays are needed
 - New Processing Dates File : **PROCDATES**
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SMOKE v2.3 Updates

#	1st of	each month	for 2005
20050101	0	250000	! January
20050201	0	250000	! February
20050301	0	250000	! March
20050401	0	250000	! April
20050501	0	250000	! May
20050601	0	250000	! June
20050701	0	250000	! July
20050801	0	250000	! August
20050901	0	250000	! September
20051001	0	250000	! October
20051101	0	250000	! November
20051201	0	250000	! December



SMOKE v2.3 Updates

ORL FIRE

- A list of fires-specific characteristics
- **Location coordinates, Material Burned, NFDRS code, Heat Content .**

```
#ORL FIRE
#TYPE Point Source Inventory for Fires
#COUNTRY US
#YEAR 2001
#DESC SAMPLE DATA SET BASED ON FL Dept of Forestry Data
#DESC Created by George Paulick 3/16/2006
#DESC FIRE EVENTS FILE
#POLLUTANT CO NOX SO2 NH3 PM2_5 PM10 VOC FUEL_LOAD ACRESBURNED HGHOUR ENHOUR
#DESC fips      fireid      locid  SCC      Fire name      Lat      Lon      NDRSCODE  MATBURNED  HEATCONTENT  VALUE
37358      2001-05-0206  -9     28100010F0  'Mallory Swamp flaming'  36.2358  -78.9508  0         -9         HEATCONTENT  8001
37358      2001-05-0206  -9     28100010S0  'Mallory Swamp smoldering' 36.0550  -79.1230  0         -9         HEATCONTENT  8002
```



SMOKE v2.3 Updates

ORL FIREEMIS (Day-specific fire data)

Fuel Loading, Acres Burned, Emissions by Pollutant,
Begin and End hour

(2) Day-specific fire inventory

```
#ORL FIREEMIS
#TYPE Point Source Inventory for Fires
#COUNTRY US
#YEAR 2001
#DESC Sample Data created by George Pouliot 3/16/2006
#DESC DAILY FIRE EMISSIONS FOR FIRE EVENTS
#POLLUTANT CO NOX SO2 NH3 PM2_5 PM10 VOC FUEL_LOAD ACRESBURNED BEGHOUR ENDFEED
#DESC FIPS FIREID LOCID SCC DATA DATE DATAVALUE BEGHOUR ENDFEED
37358 2001-05-0206 -9 28100010FO ACRESBURNED 05/22/01 415 5 12
37358 2001-05-0206 -9 28100010FO FUEL_LOAD 05/22/01 6.61 5 12
37358 2001-05-0206 -9 28100010FO PM2_5 05/22/01 27.41 5 12
37358 2001-05-0206 -9 28100010FO PM10 05/22/01 31.93 5 12
37358 2001-05-0206 -9 28100010FO CO 05/22/01 328.61 5 12
37358 2001-05-0206 -9 28100010FO NOX 05/22/01 6.99 5 12
37358 2001-05-0206 -9 28100010FO VOC 05/22/01 15.48 5 12
37358 2001-05-0206 -9 28100010FO SO2 05/22/01 1.92 5 12
37358 2001-05-0206 -9 28100010FO NH3 05/22/01 1.51 5 12
37358 2001-05-0206 -9 28100010SO ACRESBURNED 05/22/01 1415 0 23
37358 2001-05-0206 -9 28100010SO FUEL_LOAD 05/22/01 23.60 0 23
37358 2001-05-0206 -9 28100010SO PM2_5 05/22/01 127.41 0 23
37358 2001-05-0206 -9 28100010SO PM10 05/22/01 131.93 0 23
37358 2001-05-0206 -9 28100010SO CO 05/22/01 1328.61 0 23
37358 2001-05-0206 -9 28100010SO NOX 05/22/01 16.99 0 23
37358 2001-05-0206 -9 28100010SO VOC 05/22/01 115.48 0 23
37358 2001-05-0206 -9 28100010SO SO2 05/22/01 11.92 0 23
37358 2001-05-0206 -9 28100010SO NH3 05/22/01 11.51 0 23
```

SMOKE v2.3 Updates

@ New ORL Wildfires Inventory

- SMOKE treats as a point source with day-specific data
- Internal computation of wildfire heat flux

$$\begin{aligned} \text{Heat flux (BTU/day)} = & \text{ acres burned (acre/day) } \\ & * \text{ fuel consumed (tons/acre) } \\ & * \text{ heat content (BTU/lb) } \\ & * \text{ (2000 lb/ton) } \end{aligned}$$

- Re-normalized temporal hourly factors.
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SMOKE v2.3 Updates

Revised Inventory Processing

- **Smkinven** reads the new extended ORL formats
 - Source Type, ORIS and Boiler ID codes for point sources
 - Matches hourly point source data to annual data in IDA or/and ORL format
 - Allows multiple plant descriptions and FIPS codes for an ORIS ID when matching hourly point data to annual data
 - Treats duplicate sources with different Boiler IDs as separate sources
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SMOKE v2.3 Updates

@ Revised Control Processing

- Cntlmat accepts source type codes of 03 and 04 for nonroad and onroad mobile respectively
 - Cntlmat accepts 12 new cases in the projection packet for plant-specific source matching.
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SMOKE v2.3 Updates

@ Revised Control Processing

1. Country/State/County code, plant ID, point ID, stack ID, segment ID, 8-digit SCC code, pollutant
 2. Country/State/County code, plant ID, point ID, stack ID, segment ID, pollutant
 3. Country/State/County code, plant ID, SCC, pollutant
 4. Country/State/County code, plant ID, point ID, stack ID, pollutant
 5. Country/State/County code, plant ID, point ID, pollutant
 6. Country/State/County code, plant ID, pollutant
 7. Country/State/County code, plant ID, point ID, stack ID, segment ID, 8-digit SCC code
 8. Country/State/County code, plant ID, point ID, stack ID, segment ID
 9. Country/State/County code, plant ID, SCC
 10. Country/State/County code, plant ID, point ID, stack ID
 11. Country/State/County code, plant ID, point ID
 12. Country/State/County code, plant ID
-



SMOKE v2.3 Updates

④ Revised Growth Processing

- Updated **Cntlmat** since **Cntlmat** only stores the final multiplicative or growth factor in the control or growth matrix
 - **Grwinven** can output the correct control efficiency, rule effectiveness, and rule penetration values to the grown and/or controlled inventory.
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SMOKE Potential Updates

- A new program **Aermerge** will create output files suitable for input to AERMOD.
 - All programs in SMOKE can share PROCDATES file for the non-sequential dates processing in one single execution.
 - **Smkreport** could create a monthly reports.
 - Update **Smkreport** to include profile descriptions when reporting temporal, speciation, and gridding profile information.
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SMOKE Support

User's Manual

www.ie.unc.edu/cempd/products/smoke/version2.3/html

Download available at

<http://www.smoke-model.org>

CMAS Help Desk (<http://www.cmascenter.org>)

Emissions modeling email list (emregional@listserv.unc.edu)

<http://bugzilla.unc.edu>
