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MOBILE EMISSION MODELING USING THE MARAMA EMISSIONS MODELING FRAMEWORK

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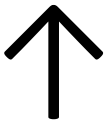
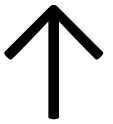
Overview

- Background
  - Onroad emissions processing using SMOKE-MOVES
  - MARAMA Emission Modeling Framework (EMF)
- Integration of Mobile Emissions Modeling Into MARAMA EMF

MOVES Background
MOVES can be run in 2 modes:

Inventory Mode	Emission Rate + SMOKE-MOVES
county scale	regional scale
monthly averaged temperatures	hourly temperature
Inputs: Source Activity Data	Inputs: Source Activity Data
Output: non-modeling inventory	Output: emission rates in "look-up" tables
Emission rates embedded in the model	Look-up tables are input to SMOKE-MOVES
conformity analysis	air quality modeling
	
county level by month	grid cell by hour

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What kinds of emission factors?

- Rate-per-distance (RPD): running exhaust, brake and tire wear, evaporative emissions
- Rate-per-vehicle (RPV): start exhaust, evaporative emissions
- Rate-per-profile (RPP): fuel vapor venting
  - Emissions are dependent on temperature profiles
- Rate-per-(hotelling) hour (RPH): idle and auxiliary power unit exhaust

Look-up Tables = Emission Rates varying by Temperature, Model Year and Relative Humidity

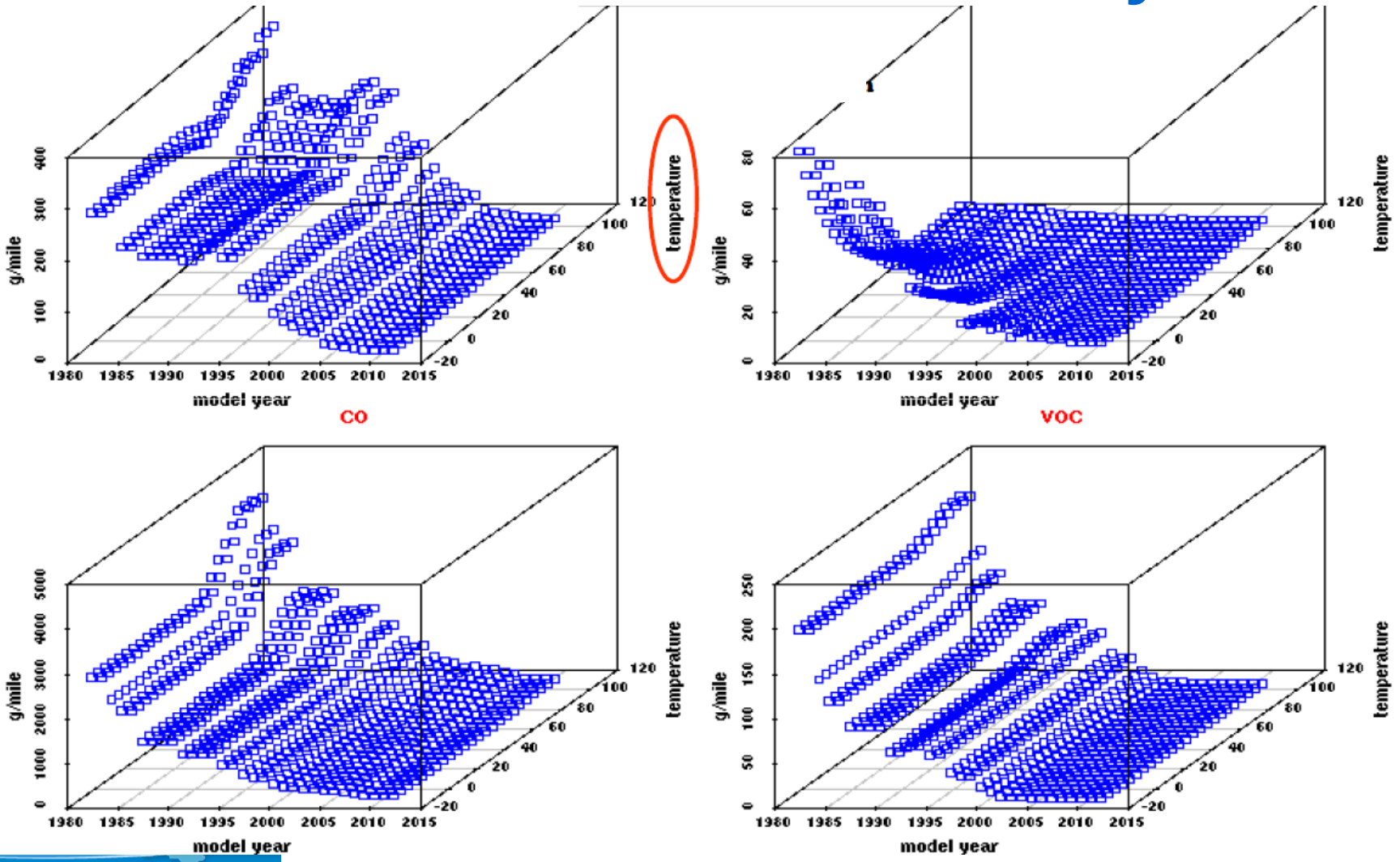
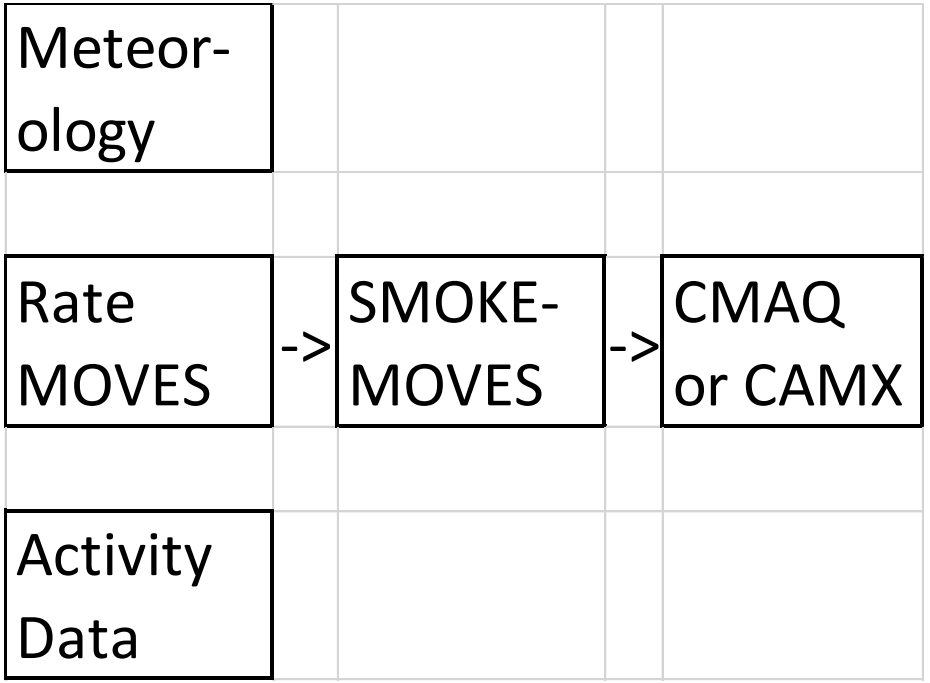


Chart from Jin-Sheng Lin, VADEQ

SMOKE-MOVES



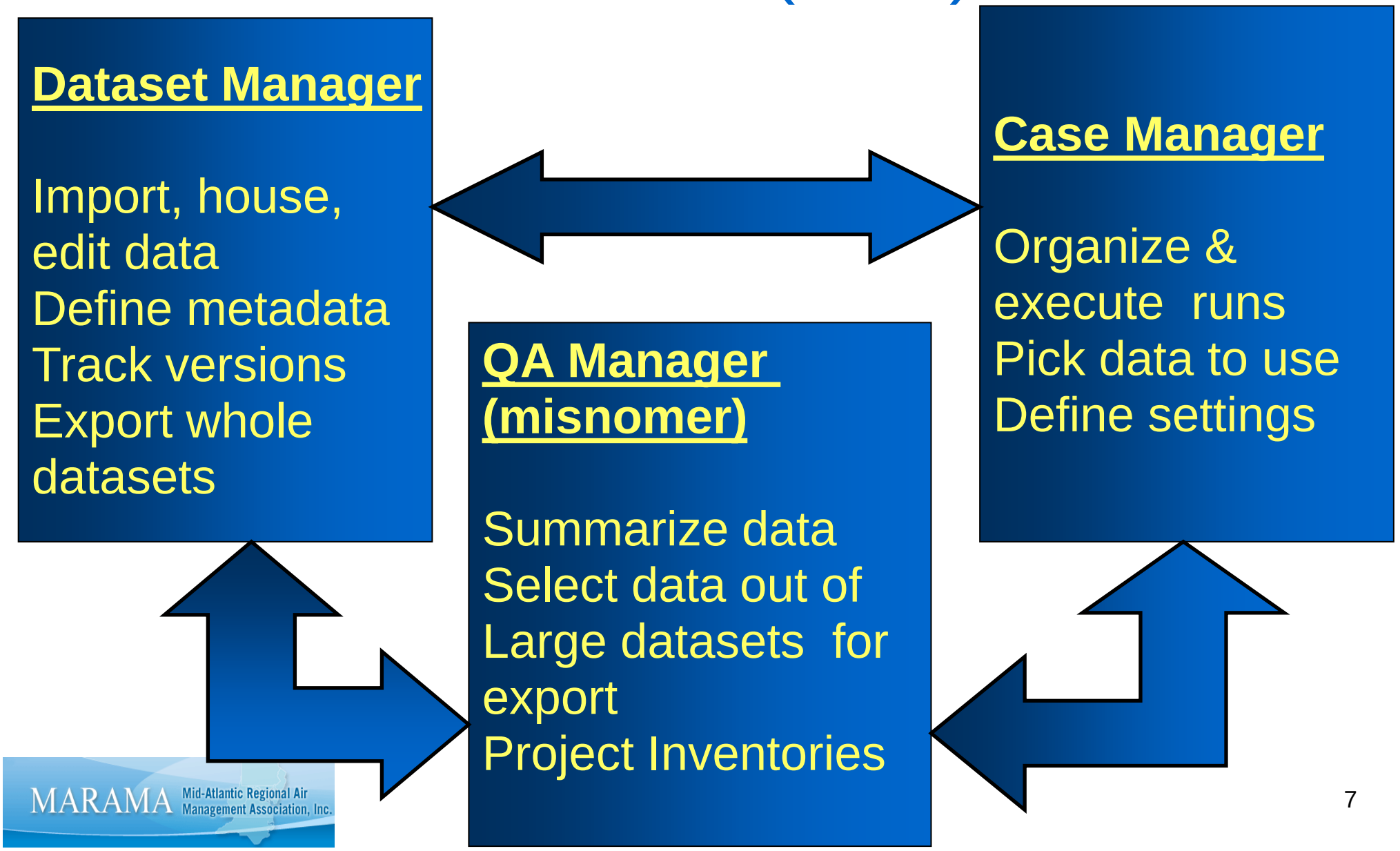
Part of SMOKE modeling system

Combines mobile activity data, Look-up table emission factors with meteorology

Creates gridded mobile emissions for Air Quality Models like CMAQ and CAMX

MOVES Emission Rate look-up tables are an input to SMOKE MOVES

What is the EPA Emission Modeling Framework (EMF)?



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How has MARAMA extended EMF to run MOVES?

Users can:

- **»Select and download small parts of larger inventory files for analysis on their own machine**
- **»Merge files and download combined file**
- **»Project inventory to future years**
- **»Run SMOKE**
- **»Temporalize files - DONE**
- **»Perform analyses online - DONE**
- **»Run SMOKE-MOVES and Rate Mode MOVES – In Process**

Cloud installation - Remote secure online access to inventory, analysis tools and models.

SMOKE-MOVES in EMF- In Process

- GUI creates custom run scripts containing parameters and settings
- Scripts control and automate runs
- EMF datasets exported as files
- Multiple cloud computer launched to run each job in the case
- Run documented in metadata created by the script

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SMOKE-MOVES Processing Times

Job	Start Time	End Time	Run Time
January onroad RPD	02:52:27	18:55:37	16 hours, 3 minutes
January onroad RPH	20:00:23	20:08:52	8 minutes
January onroad RPP	20:22:32	21:45:54	1 hour, 23 minutes
January onroad RPV	21:58:09	02:35:26	4 hours, 37 minutes
January onroad merge	15:34:55	15:39:17	4 minutes

- Each job runs on its own Amazon instance
- 48 month/mode jobs could be run simultaneously; and merge jobs after each month is finished

Other Parts of SMOKE-MOVES - In Process

- EMF case that runs **Met4moves**
  - Pre-processing program that scans meteorology data and outputs min/max temperature data for each reference county and fuel month
- EMF case that runs **Rate Mode MOVES**
  - Each job in the case generates emission factors for a single reference county
  - A job can run all four rate modes (RPD, RPH, RPP, RPV) or any combination

Rate Mode MOVES Run Times

- Run times a single temperature bin/profile in a single reference county for all pollutants
- Each reference county run on a single Amazon instance; each Rate Mode MOVES runspec processed sequentially
- All 284 reference counties could be run simultaneously

Emissions mode	Run Time	# of Runspecs	Total (approximate)
Rate-per-vehicle	38 minutes	37	1 day
Rate-per-profile	4 minutes	121	8 hours
Rate-per-distance	26 hours	2	2+ days

Conclusion

MARAMA adapted USEPA EMF to benefit our states
- Remote access, analysis of inventories, new tools
- Run SMOKE

Current EMF project: Run MOVEs for AQ modeling
- SMOKE-MOVES, Rate Mode MOVES, Met4MOVES
- Still a work in progress

Advantages:
- Run in parallel to speed processing
- EMF maintains run documentation and file organization

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Resources

- EMF User's Guide
  - https://www.cmascenter.org/emf/internal/guide.html
- SMOKE-MOVES and the EMF Guide
  - https://www.cmascenter.org/emf/internal/smoke_moves/