

Emissions Modeling For Photochemical Modelers

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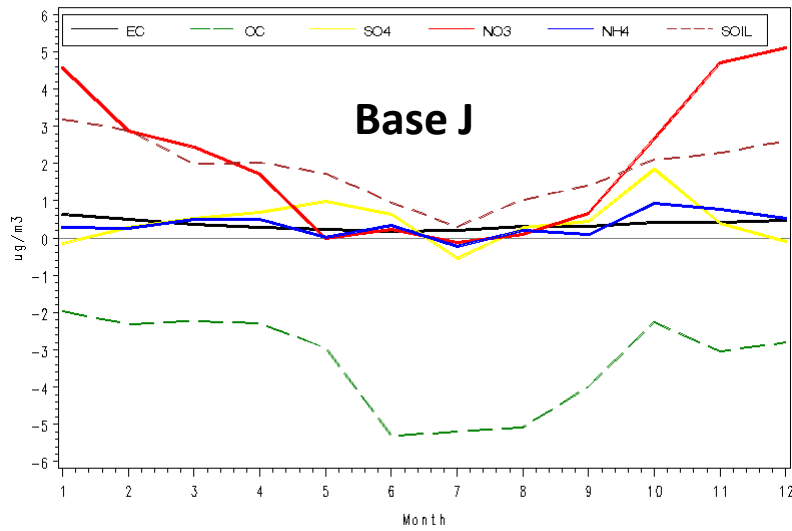
Photochemical Modelers Training

August 3-4th 2010

Overview

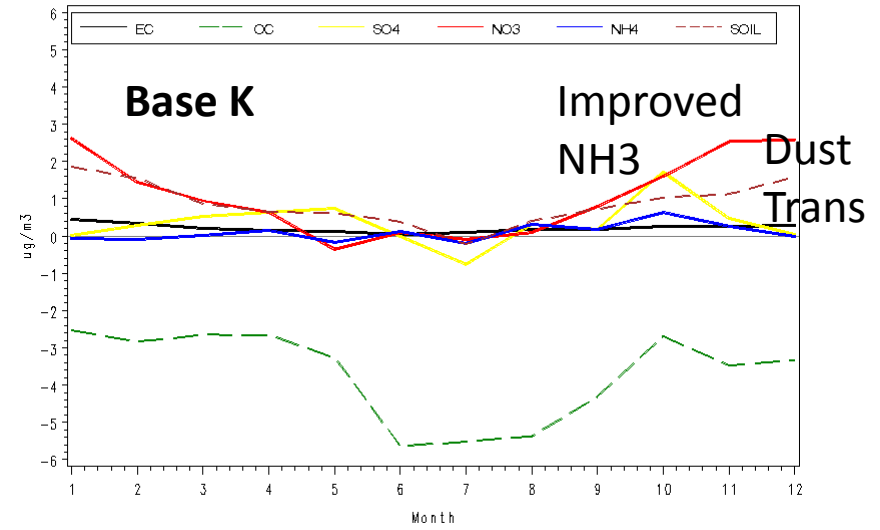
- Emissions Modeling (EM) Issues Every Photochemical Modeler Needs To understand
- What to look for in Emissions to identify quality
- Changes coming to Emissions Modeling
- Obstacles to the next round of SIPS

Monthly Average Mean Bias



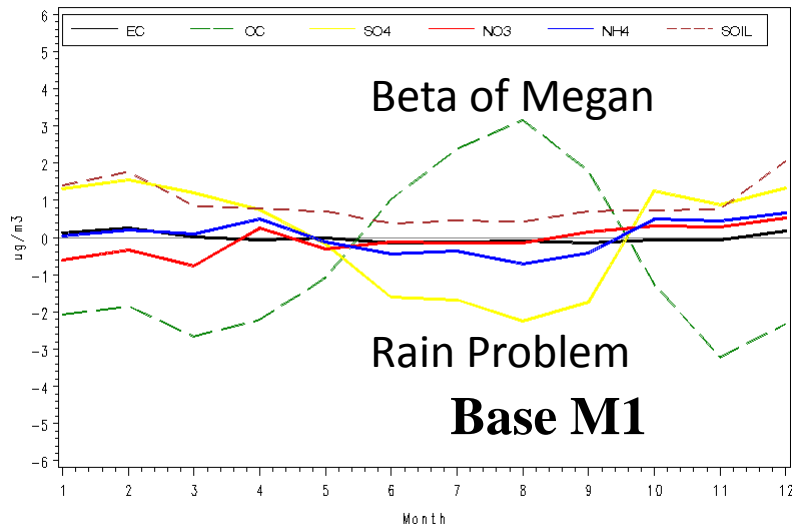
Kirk Baker - LADCO

Monthly Average Mean Bias



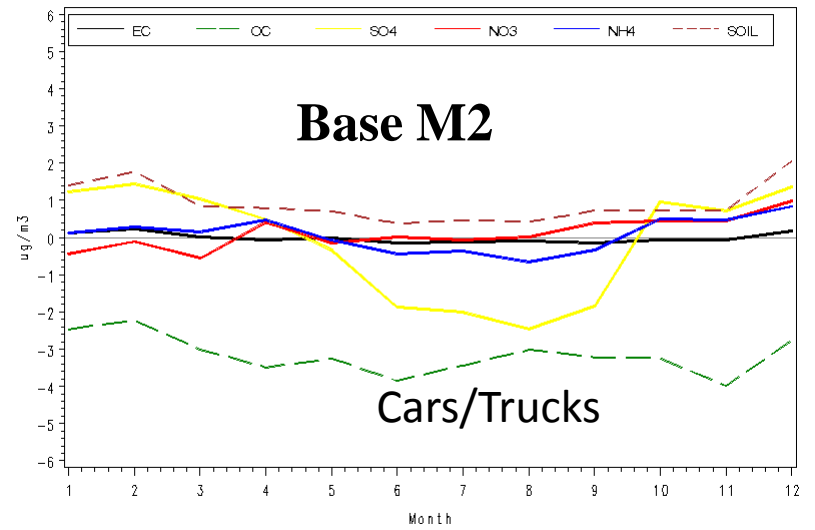
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Monthly Average Mean Bias



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Monthly Average Mean Bias



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Issues Every Photochemical Modeler needs to know

- The change to Multi-pollutant Modeling has changed the way emissions modeling is done.
 - Traditional Ozone Inventories had 5 sectors(Point, Nonroad, Area, Onroad, Biogenics)
 - New inventories added(Fires, agricultural NH₃, 2X area source categories, Complex EGU,)
 - Annual Month Specific Inventories need better temporal and new categories(residential wood and snowmobiles)

How Has This Changed EM?

- Need more than 1 emissions modeler to run all the sectors for all the days necessary for a SIP.
- Emissions modelers have less understanding of each individual sector.
- Regional Groups produce some sectors(Fires, Dust, Rail, Marine)
- More contractor support to accomplish goals which leads to misunderstandings between groups.

3 Major Parts of Emissions Modeling

Spatial Allocation

- Emissions modelers take inventories developed at different spatial scales to create modeling grid level inventories
- Surrogates can be a poor for certain categories. Housing = Lawn and Garden, water = Recreational Marine.
- Result in concentration or dilution of emissions.

Temporal Allocation

- Turn annual inventories into day and hour specific emissions estimates.
- Most complex job of emissions modelers. Motorboats, Agricultural Ammonia, EGUs.
- Parts: Year to Month, Month to Day of Week, Day of Week to Hour of day. Each is a function of the one before.
- Most obvious errors/differences come from this activity.

Chemical Speciation/Lumping

- Inventories are by pollutant but transport models need lumped groups.
- Default speciation acceptable for most categories but local fuels can influence results.
- VOC is generally stable but PM is changing all the time.
- Least likely to cause problems and difficult for modelers to detect problems. (How much ALD2 is too much for a given cell?)

What Modelers look for in emissions to identify quality

- No odd sources in lakes, recognizable activity between urban areas (population is not the only surrogate)
- Should see recognizable seasonal variation
- Weekdays, Saturdays, and Sundays differ
- Hourly variation by sector differs:
 - non-egu point is mostly flat
 - EGU has noticeable daytime peak, summer is lower than winter (SIPCALL)
 - Dust, Biogenics should change with Meteorology

What to look for in Emissions to identify quality(2)

- Everyone involved sees how the top 15 categories of PM are speciated.
- Back calculated emissions from CMAQ/CAMX files matches emissions inventory reports.
 - Remember apply correction for difference between actual average molecular weight and the photochemical models assumed molecular weight.

Future of Emissions Modeling

- 1KM Resolution Grids: As models like AERMOD and Benmap become more integrated we will need finer spatial resolution to inventories.
- More Meteorological effects and days specific emissions on the way.
 - 5 years ago(Onroad, Biogenics)
 - Now(Fires, limited EGU)
 - 5 years(Complex EGU, Agricultural NH₃, Nonroad)

Future of Emissions Modeling(2)

- Fires will likely all be satellite derived and days/hour specific.(Southeast may be an exception)
- Agricultural NH₃ will use process based models
 - Meteorology, Local Farming Practices have strong influence on emissions(Cow in Texas 76lbs/year, Cow in Wisconsin 14 lbs/year)
 - Must Capture Winter NH₃ spikes during episodes.

Ammonia Emissions from a Commercial Broiler House
Worley, J.W. 2002. ASAE Paper 024118

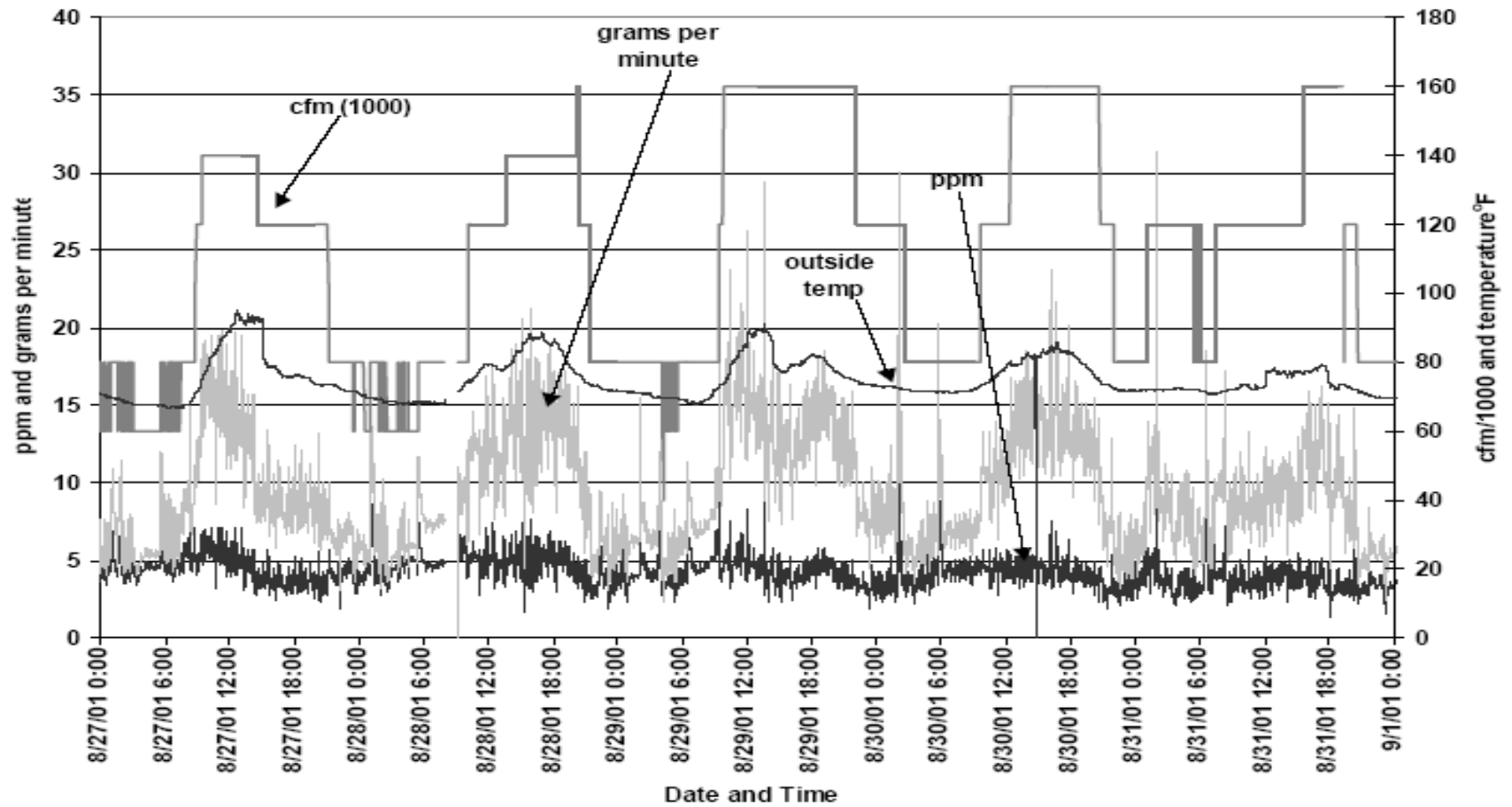
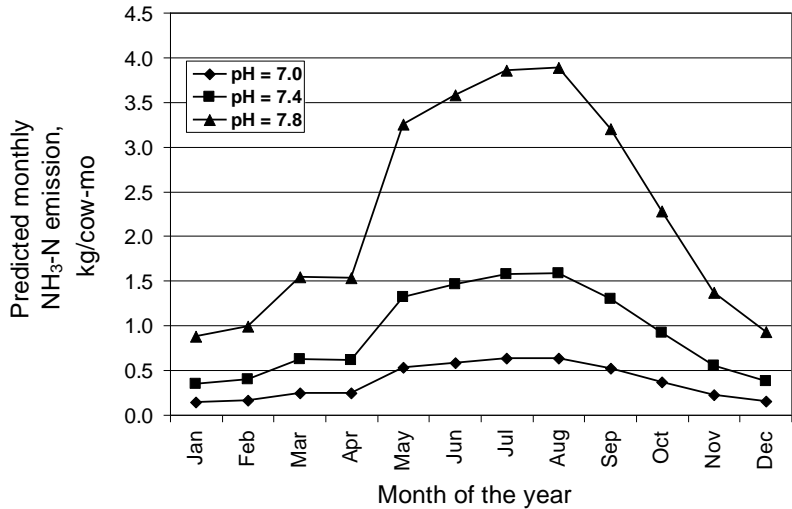
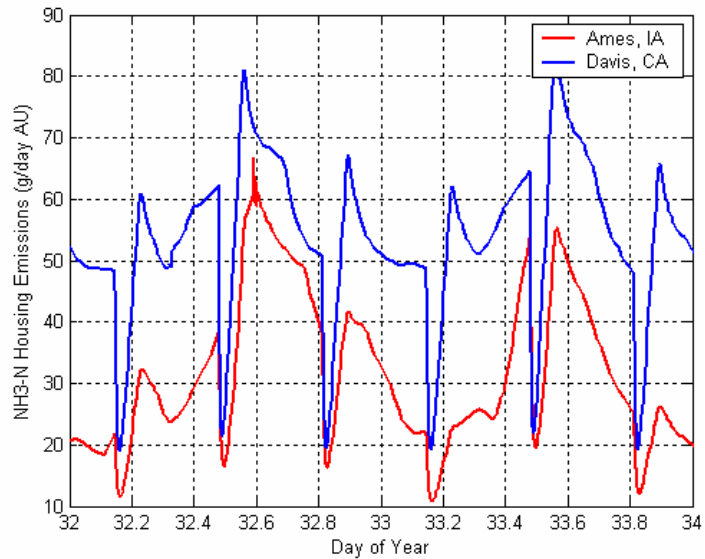
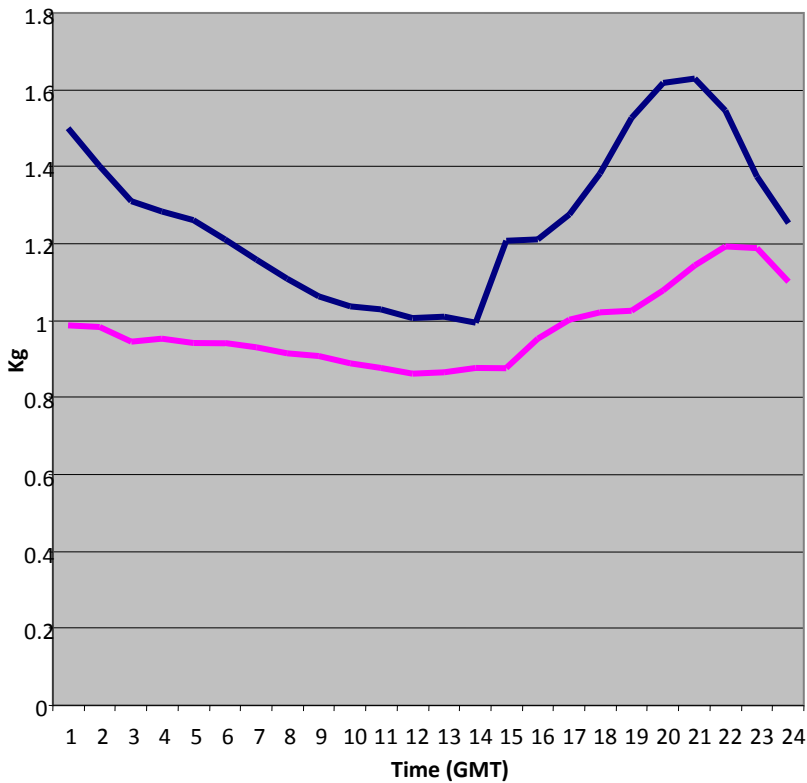
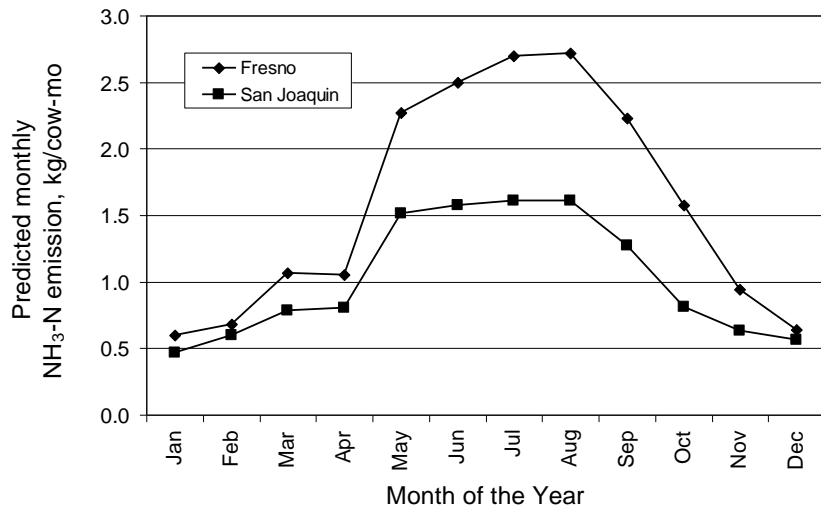


Figure 1. Raw data measured within the building in summer conditions

Predicted NH₃ Emissions from Dairy Lagoon under Different pH
(H=25ft and TAN=450mg/L, Fresno)



Predicted NH₃ Emissions from Dairy Lagoons
in Fresno and San Joaquin



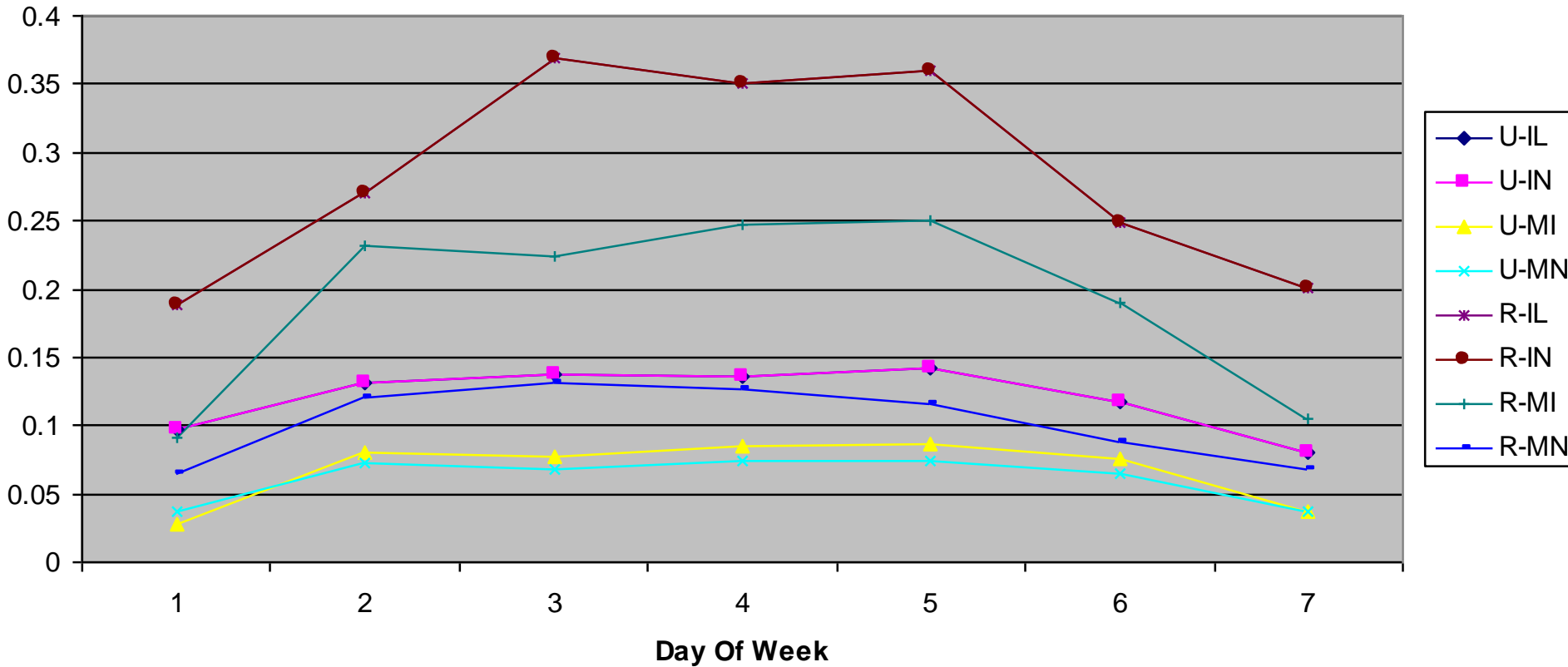
Future of Emissions Modeling

Onroad Mobile

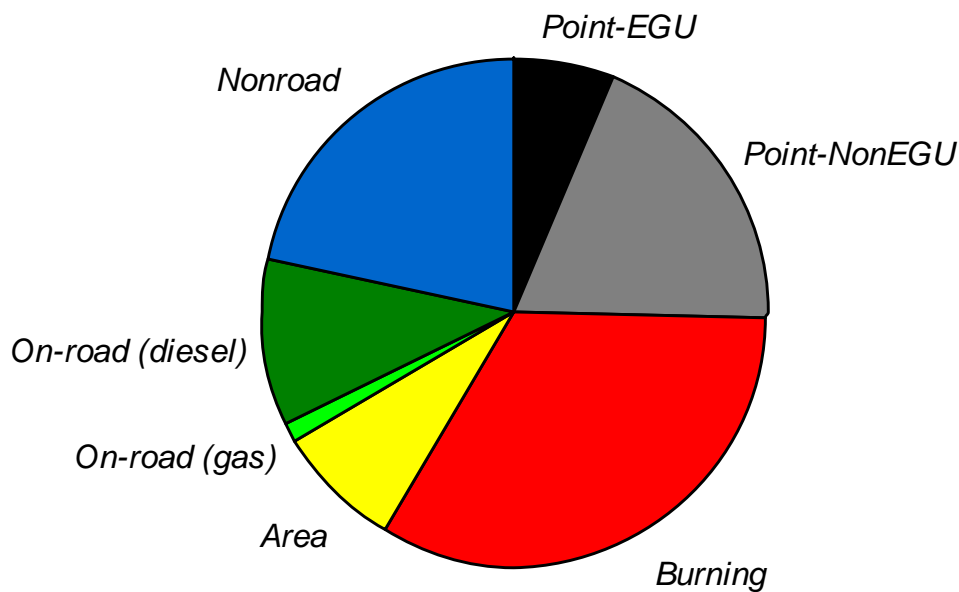
- Link Networks
 - Built on Travel Demand Models or Counts
 - Only way to build high spatial resolution inventory
 - Starts and Stop emissions geography use different activity than road traffic. (15 story parking ramps at 5PM)
 - How do you validate speeds, vehicle mix, etc in countywide data?
- High Temporal Resolution
 - Not just VMT but other activities(vehicle mix, speed)
 - While VMT is down 20% on weekends, Weekend NOX is down >50% because of HDDV decreases.
 - If there is congestion it occurs at different times and is likely not bi-modal.
 - Congestion modeling of speed to capture 5 MPH to 75 MPH swings in speed overlayed on complex VMT
- Organic Carbon - Semi-Volatile Organic carbon(C8-C40)

Interstate Vehicle Mix Percent by State and Urban/Rural

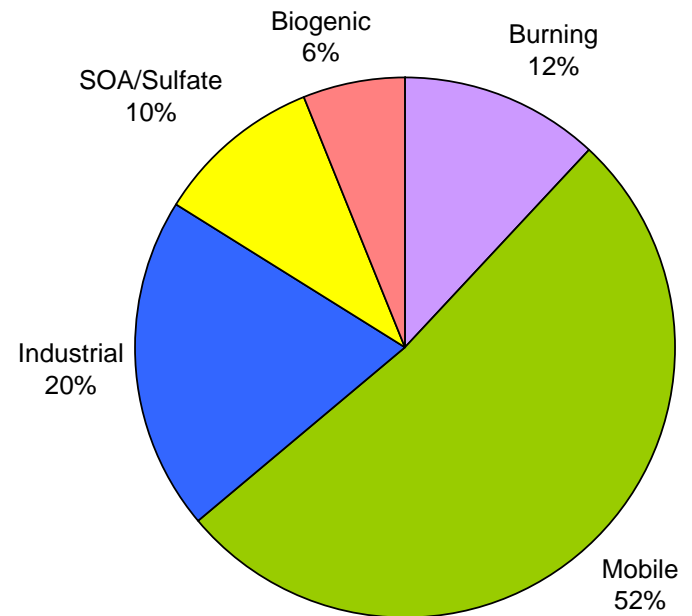
Vehicle mix



Need to Improve On-Road OC (Primary) Emissions



LADCO Regional Emissions



Typical Monitor-Based Source Apportionment Result

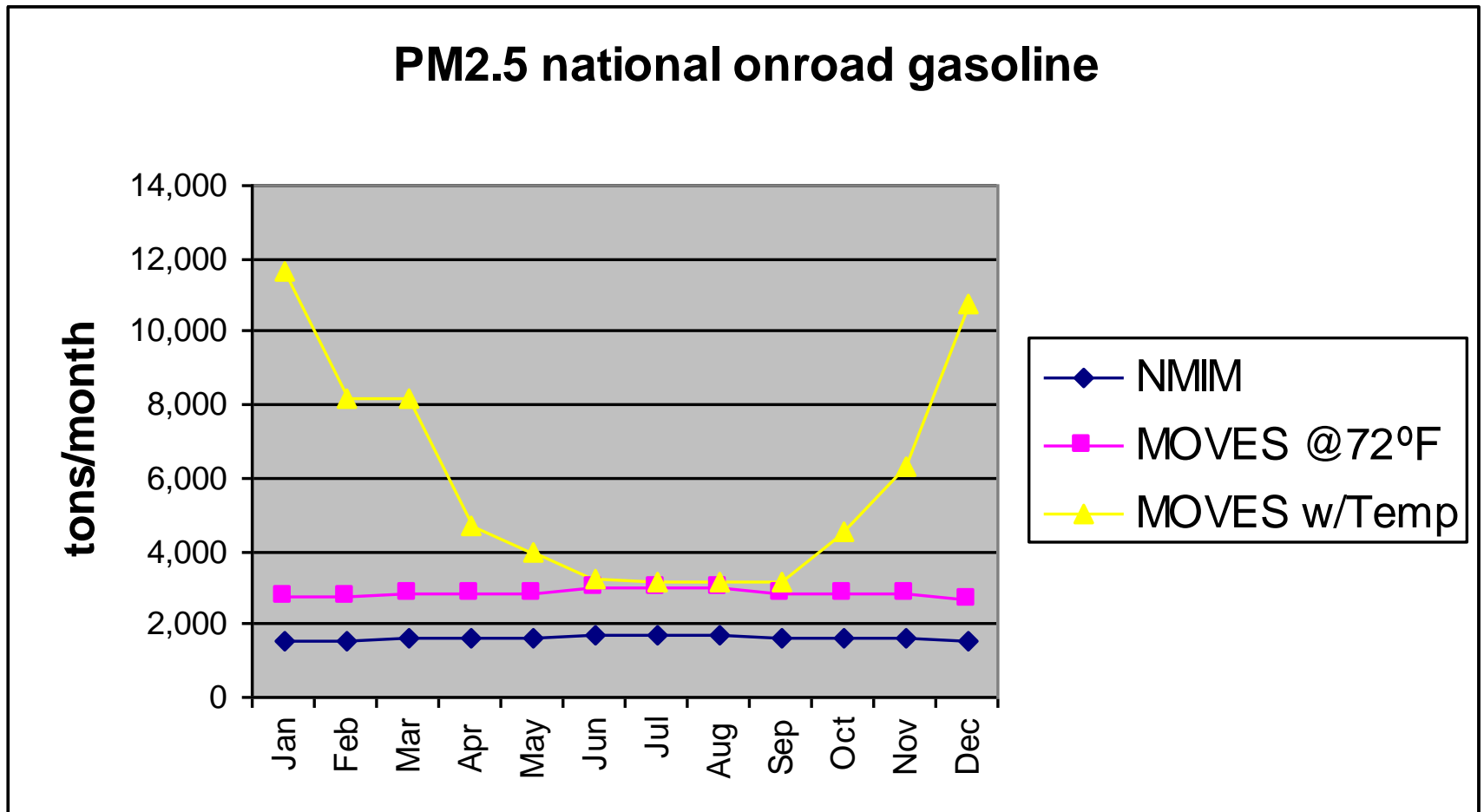
Obstacles To The Next Round Of SIPS.

- 2008 inventory not complete until 9/2010, Might need modeling done by 1/2011.
 - EPA's EIS system cause state inventory folks problems.
 - EPA will not deliver NEI until fall 2010
- No framework to share data between groups(MJOs, States, EPA) SOLUTION – Collaborative Data Sharing Group
- EGU Growth Methods(IPM Not likely) – SOLUTION: ERTAC

Obstacles To The Next Round Of SIPS(2).

- PM25 Condensable as a new pollutant.
- MOVES not released until December 2009
 - slow 600+ CPU days to run a Year)
 - New, LADCO won't have state inputs until DEC 2010.
 - Winter PM OC Increases
- NH3 model may not be ready until OCT/NOV
- Biogenics from MEGAN may be problematic.

Impact of MOVES emissions on onroad gasoline vs. NMIM



Priority ERTAC Projects

Eastern Regional Technical Advisory Committee

- Rail emissions
- Mobile source PM emissions
- Agricultural ammonia
- Area source comparability
- Electric Utility Temporal and Growth