Development of a Community Emissions Model - CONCEPT

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For NW-AIRQUEST

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What Do Emissions Modelers DO?

- Spend most of our time integrating new data into our models.
- Identifying and repairing problematic data
- Reformatting data
- Understanding sources and quality of data
- A small fraction of our time is spent on executionWhat would CMAQ look like if they had the challenges of emissions model?

What do emissions models do?

- Mostly Database Manipulation
  - Merge the area source inventory with an SCC temporal profile table.
- Generally not calculation intensive
  - Exception Mobile6
- Fairly simple calculations if you can understand the data sources
- Future is emissions models that input activity and output emissions.

What Emissions Modelers Need In An Emissions Model?

- Need to easy access to intermediate data sets.
- Need to make it easy to implement new data
  - Visualization tools
  - Comprehensive flexible diagnostic tools
  - Need to be able to trace a single record completely through the entire process.
- Process 4-5 times faster than photochemical model (problem for MOBILE6)

Open Emissions Model - CONCEPT

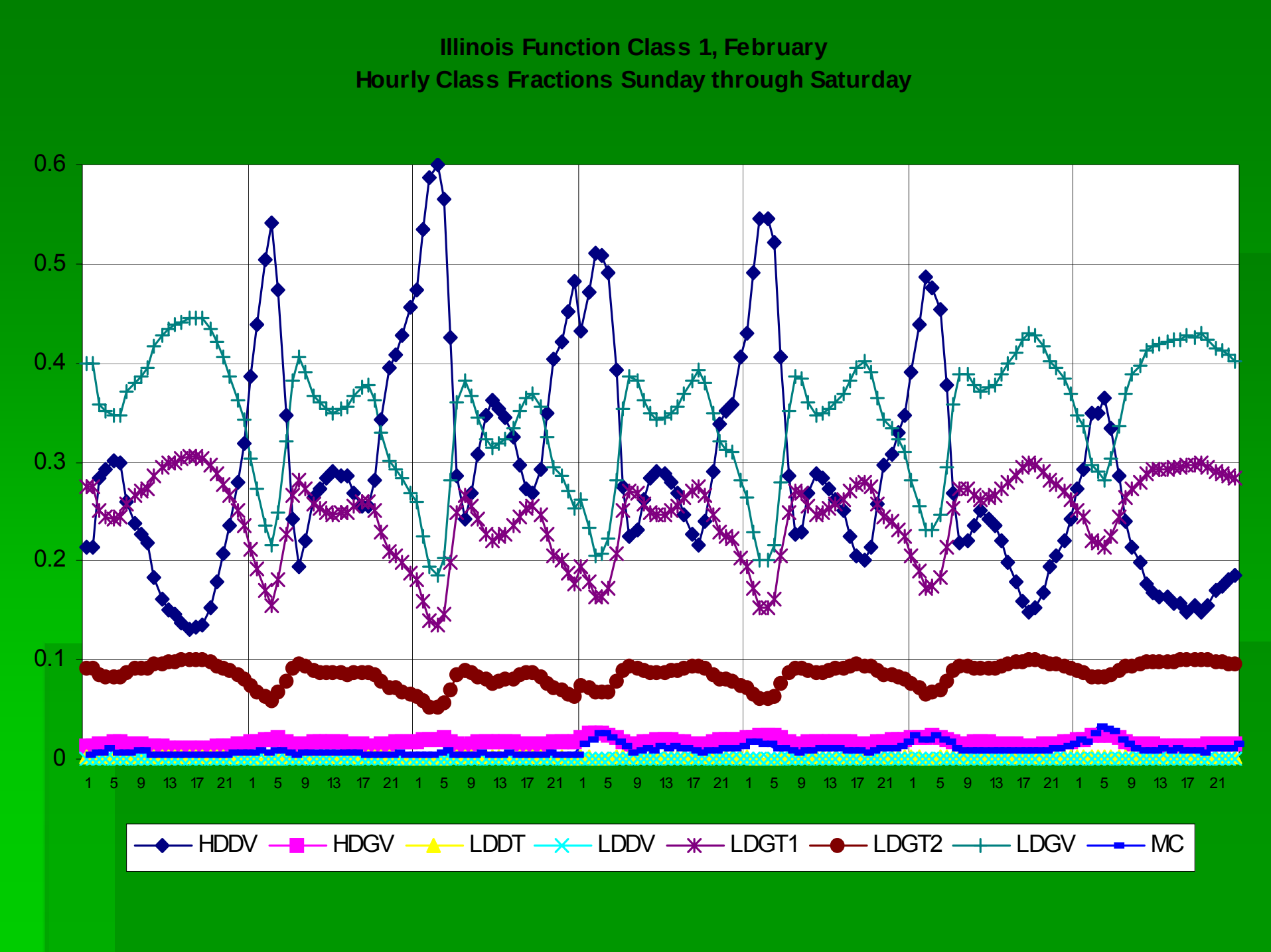
- Use RPO Data Exchange Protocol
  - Base on NIF3.0 format
  - Extensions for Spatial, Temporal, Link Networks
- Include Point and Area models with updated temporalization to fit NIF
- Biogenics model is an SQL version of BEIS3 for data transparency
- Speciation to handle SAPRC, CB-IV, HG and output to CAMX or CMAQ – No Fixed Species
- Updated Onroad and Nonroad models
- Growth and control will compute strategy costs and interpolate/extrapolate growth/control.

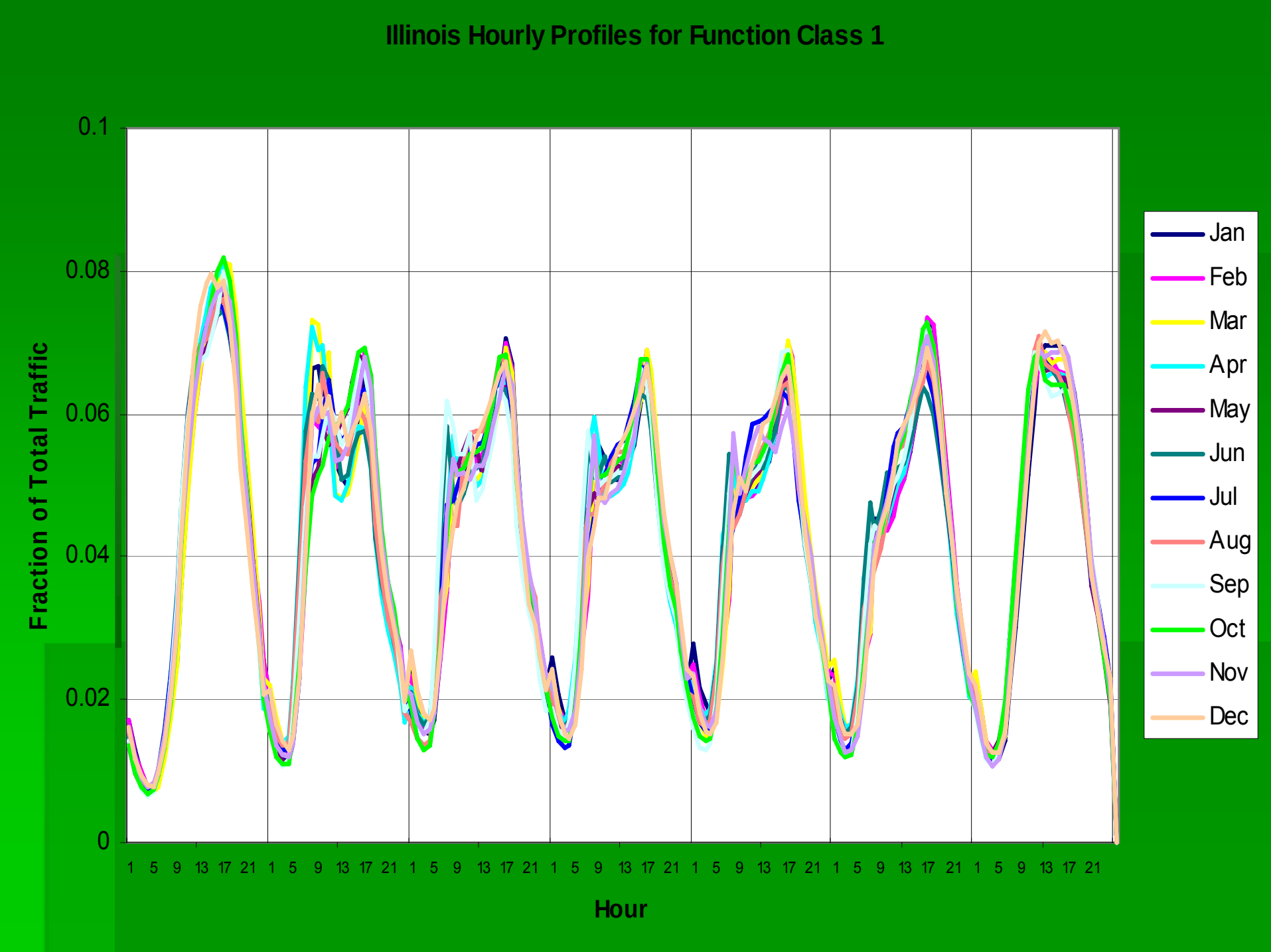
CONCEPT - On Road

- Mobile model based on Mobile6
  - Link based processing at high spatial resolution where needed
  - Lower temperature resolution (county) for large domains
- Processing speed most important to improve
- Includes T3 tool for conversion/use of Urban TDMs

Concept MV Temporal

- Need to capture weekend/weekday and hourly variation in VMT, Vehicle Mix, and Speed.
- Capture the lack of HDDV on weekends.
- Borman Expressway(Southern Chicago)
- Capture weekday bi-modal and weekend single mode temporalization


Illinois Function Class 1, February
Hourly Class Fractions Sunday through Saturday
0.6
0.5
0.4
0.3
0.2
0.1
0
1 5 9 13 17 21 1 5 9 13 17 21 1 5 9 13 17 21 1 5 9 13 17 21 1 5 9 13 17 21 1 5 9 13 17 21 1 5 9 13 17 21
HDDV
HDGV
LDDT
LDDV
LDGT1
LDGT2
LDGV
MC


Illinois Hourly Profiles for Function Class 1
Fraction of Total Traffic
0.1
0.08
0.06
0.04
0.02
0
1 5 9 13 17 21 1 5 9 13 17 21 1 5 9 13 17 21 1 5 9 13 17 21 1 5 9 13 17 21 1 5 9 13 17 21 1 5 9 13 17 21
Hour
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Transportation Translation Tool (T3)

- Separate project LADCO funded
- Build a conversion tool for link based travel demand model and count based networks as inputs to CONCEPT.
- Make it flexible so that new networks can be added easily.
- LADCO has 19 urban and 6 statewide networks to incorporate.
- Will be used for PM/O3 SIPS, Provide rapid replacement of new networks

CONCEPT Vehicle Speed Processing

- Most Travel models generate Peak Weekday Traffic
- Don’t model weekdays
- VOC/NOX ratios on weekends change chemistry
- Congestion occurs during different hours on weekends/Friday nights.
- CONCEPT Uses volume delay functions from TDMs to correct vehicle speeds

Nonroad Model

- EPA's Nonroad2004 model into CONCEPT.
  - Use Grid Specific, hour specific temperatures to calculate emissions
- Input is EPA Nonroad model inputs not emissions estimates.
- NONROAD Processing speed is bottleneck. But you only run it once.
- Temperature correction part of CONCEPT not NONROAD

Biogenic Model

- Includes Current BEIS algorithms
- Includes a gridding processor that creates spatial surrogates for specific grids.
- Transparency allows users to trace estimates back to plant species, plant communities.

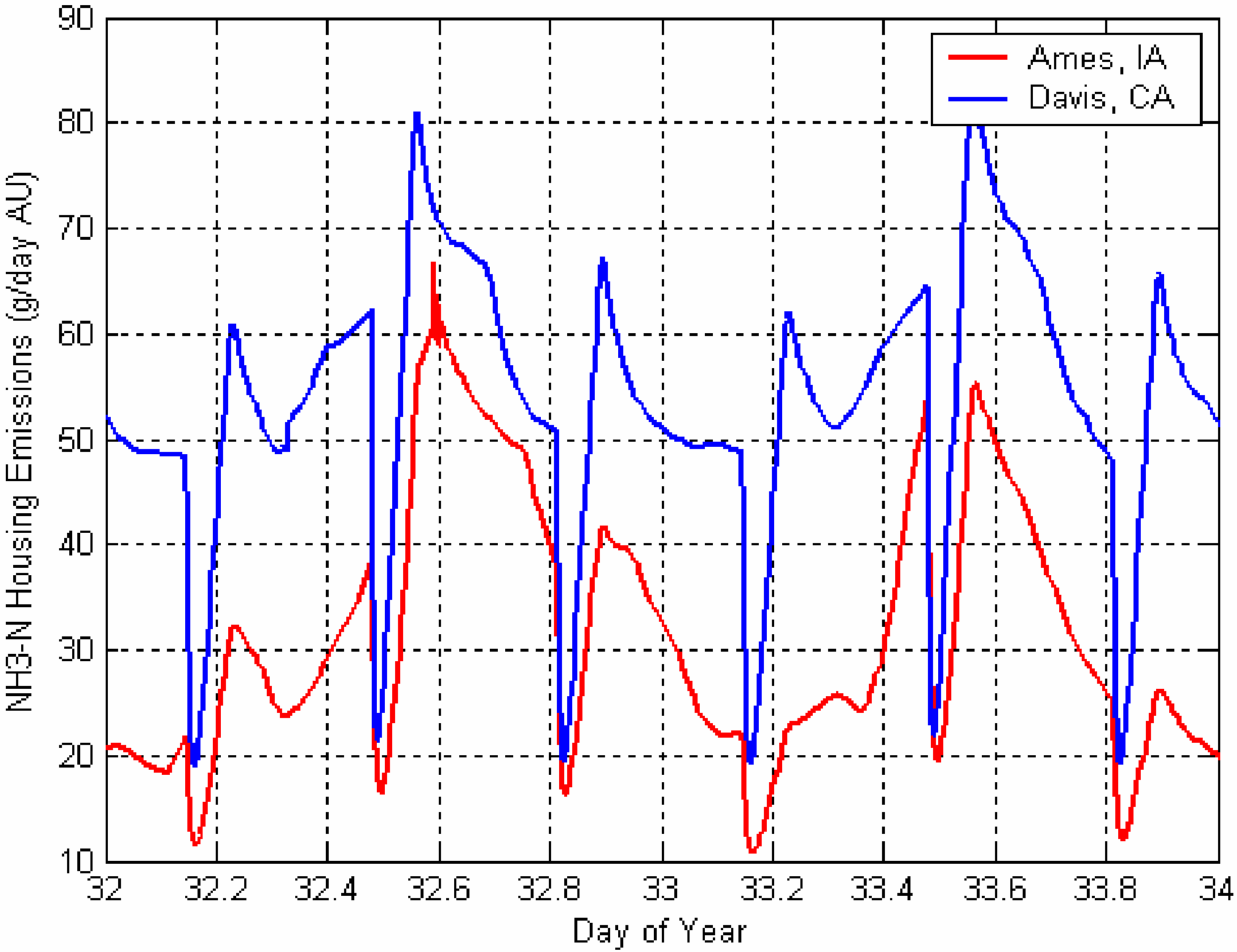
Biogenics SOA Modifications.

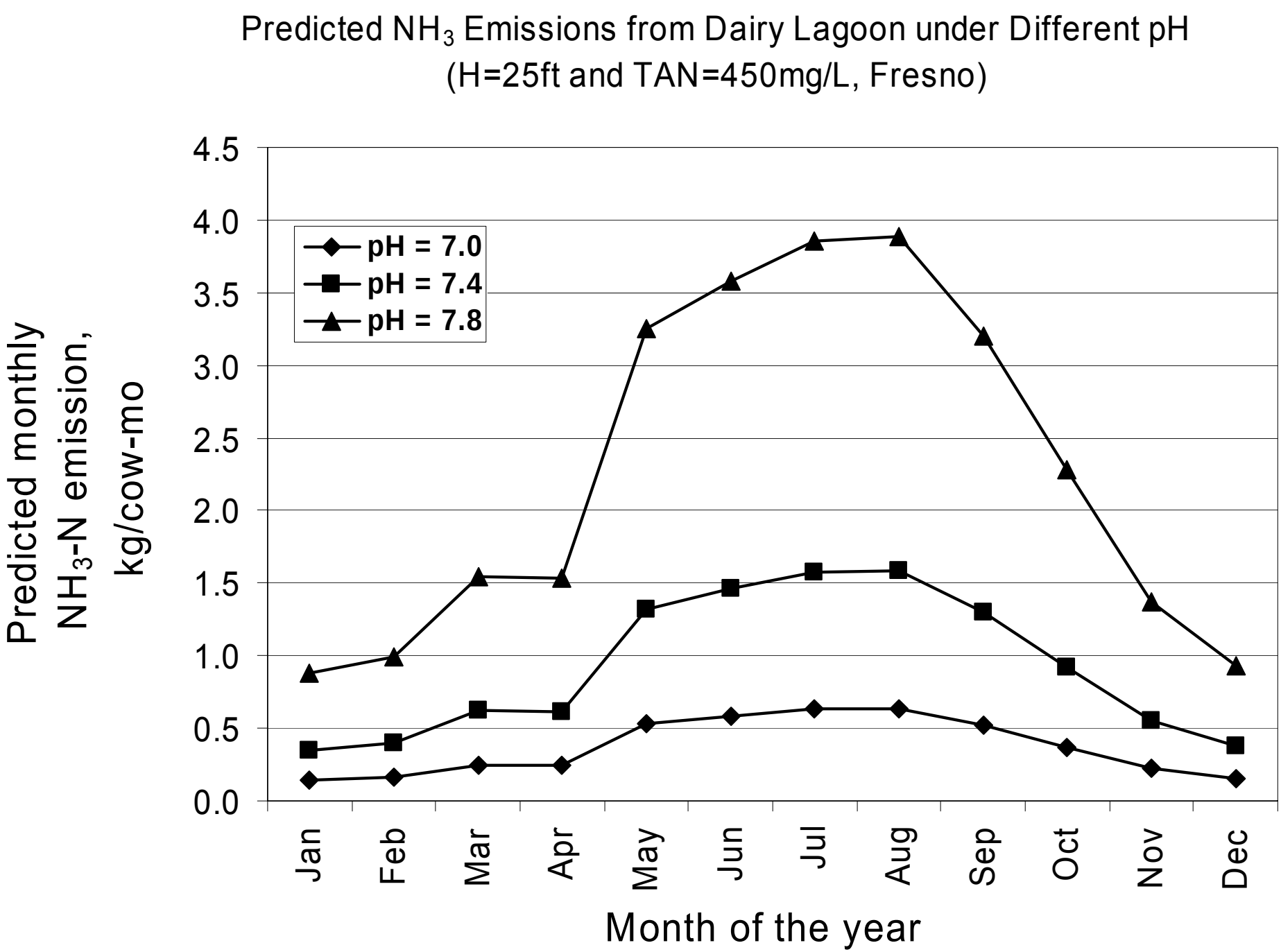
- SOA Chemistry ≠ Ozone Chemistry
- Include discrete species specific to SOA Chemistry
- Synchronized with Modifications to CAMX

Species	Existing CBIV	New CBIV + SOA
Sesquiterpenes	PAR TERPB	SQ1
Methylbutenol	OLE PAR	MT1
Isoprene	ISOP	ISP1
α-pinene	OLE PAR ALD2 TERPB	MT1

Process Based NH3 Model

- UC Riverside/UC Davis/ Environ
- Track the physical process that drive NH3 emissions
- Sensitive to Feed N Content, Lagoon PH, Wind Speed
- See day to day Variation
- Very SLOW. Needs Improvement


Ames, IA
Davis, CA
NH3-N Housing Emissions (g/day AU)
Day of Year
90
80
70
60
50
40
30
20
10
32
32.2
32.4
32.6
32.8
33
33.2
33.4
33.6
33.8
34


Predicted NH_3 Emissions from Dairy Lagoon under Different pH
(H=25ft and TAN=450mg/L, Fresno)
Predicted monthly NH_3-N emission, kg/cow-mo
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
pH = 7.0
pH = 7.4
pH = 7.8
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month of the year

Spatial Allocation

- Built on PostGIS (Not ARC/INFO)
- Build surrogates from continental super domain surrogates.
- Process census, TIGER lines, land use, road network links, points
- PostGIS spatially enabled SQL database so access to intermediate data sets can be tied back to geo-spatial data easily.
- QGIS(arcview) allows users to look at spatial attributes of data AND other attributes within model

Spatial processing outside US

- 11 Digit Spatial ID that includes country, state/province, county/census division, and Jurisdiction/tribal codes.
- Other countries are not just wayward states of the US. (Canada≠ US State ID 75)
- Model is truly global while also ready for high spatial resolution!
- Working on getting early users from Hong Kong, Australia, Canada, and EU to help us test global inventories.

Growth and Control

- Similar to Point/Area models in SMOKE/EMS.
- RPO Control Protocol allows interpolation/extrapolation of controls
- Allows complex temporal attributes. Summer only controls.

Community Development Model

- Built with the community in mind:
  - Minimized alternate programming languages
    - PostgreSQL, PERL, PostGIS.
- User derived documentation(#3 Download!)
- Code is to be GPL so nobody owns it
- Promote the development of new model components by third parties
  - Process based NH3 model – UC Riverside/UC Davis
  - Electric utility CEM/day specific/temperature model
  - QA Tools should come from community (EIIP)

Community of Developers

- A community is not a common set of financial contributors
- Judge a community model by:
  - The number of community based improvements that make it into the public release
  - The frequency of updates/improvements.
  - The hurtles an individual must cross before they get their work implemented.

In CONCEPT and not currently in SMOKE

- Will read in NEIv3.0 format and allow complex temporal processing (IDA converter not required)
- Next Generation growth and control model will be an integral part of CONCEPT
- Simple Cost and interpolation model in Growth/Control
- 2 part spatial surrogate development tool integrated
- Process based ammonia model
- Build Lumped Speciation on the fly
- EPA's NONROAD model built in CONCEPT
- Multiple Performance enhancement for Mobile6
- Direct integration with travel demand models

Open Emissions Model

- Regional Planning Organizations Fund Development 2/3 LADCO and 1/3 other RPO's
- Alpine Geophysics and Environ contractors
- QA Tool written by EIIP (CEP)
  - Fall 2005
- Schedule:
  - Version .14 April 2005.
  - Version .15 December 2005.

Emissions Model Paradigm Is Changing

- Moving Away from Emissions Processors
- Towards Emissions Models
  - Generate Emissions
  - Input is activity and Emission Rates
- From 3 models in the early 90's to 7 now.
- Increasing burden on states/locals that need to run models: Can one person do it?
- Forces need for specialization and canned versions with model and all inputs based on trusted sources.

Want More Info

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