Status of EPA's New Generation Mobile Source Emission Model

Presentation for

Mobile Source Technical Review Subcommittee

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New Generation Model Charge

- Establish comprehensive mobile source modeling system which:
  - → Includes all mobile sources
  - → Addresses all pollutants and emission processes we care about
  - → Allows emission estimation for legislative, regulatory and research
  - → Is based on sound scientific principles
  - → Is flexible enough to update and improve for many years to come

Why Undertake A New Approach?

- Current questions exceed current tools
  - → Analyses at finer scales
  - → Cross-pollutant and cross-source impacts
  - → Toxics, PM, Greenhouse Gases
- Improve the science
- Improve the software
- Respond to external review
  - → National Research Council, "Modeling Mobile Source Emissions", May 2000

Progress Thus Far...

- Charter signed by OTAQ, OAQPS, ORD, R4
- Issue Paper published May 2001
- Conceptual design developed
- Top-level software design contract initiated
- On-board emission data pilot study initiated
- Project plan developed

Use Cases

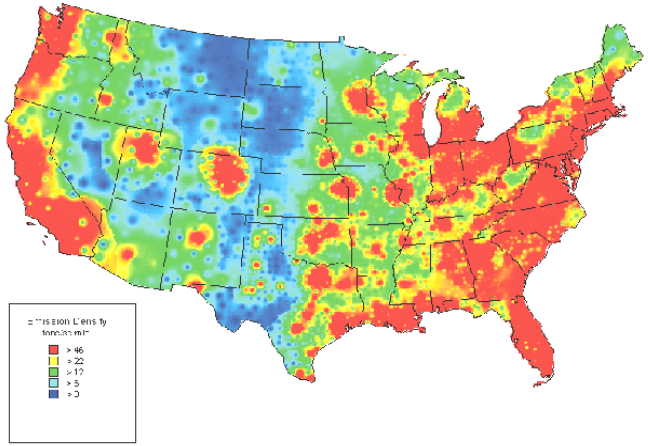
- National inventory development
  - → Regulatory support
  - → Trends
  - → Greenhouse Gases Sources & Sinks
- Legislative analyses
  - → SIPs
  - → Conformity
- International use
- Microscale analysis
  - → PM/CO Conformity
  - → Toxics “hot spots”

Use Cases

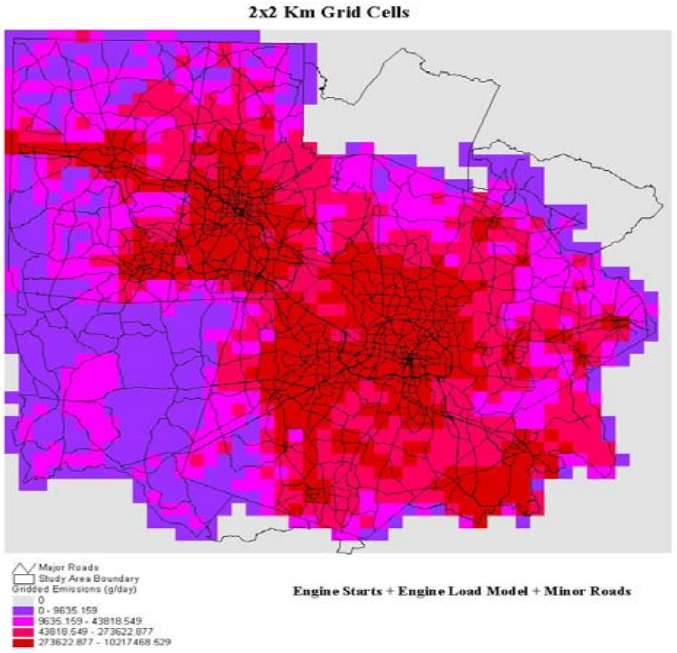
- Policy Evaluation
  - → New standards/technology
  - → New fuels
  - → Reducing VMT
  - → Reducing in-use emissions
- Model Integration
  - → Transportation: TRANSIMS, TDMs
  - → Emission Processors & AQ: EMS, SMOKE (MODELS3)
  - → Dispersion Models: CAL3QHC
- Validation, Uncertainty, Sensitivity
- Model expansion and updates

NGM Analysis Scales

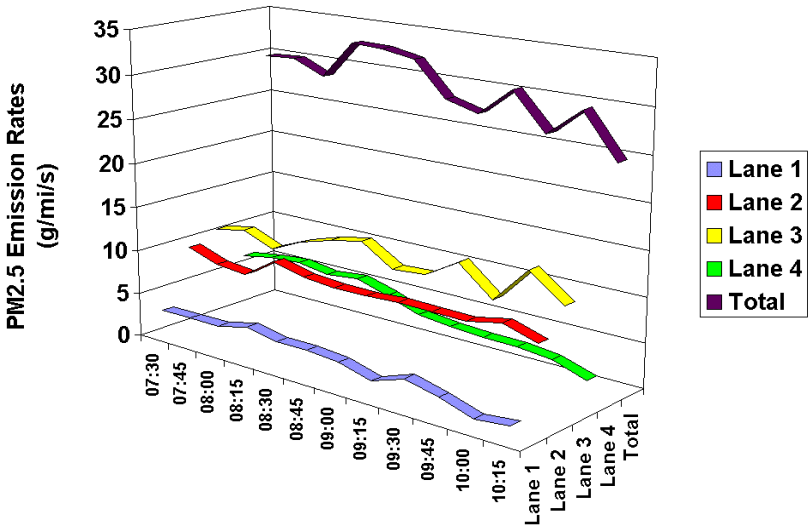
Macroscale



Mesoscale



Microscale



Conceptual Design

- One design supports all scales, pollutants, sources, emission modes
- Calculates inventories, not just emission factors
- Easy to update with new data or new pollutants
- Designed for validation
- Can implement in phases
- Integrates with other models
  - → Transportation: TRANSIMS, TDMs
  - → Emission Processors & AQ: EMS, SMOKE (MODELS3)
  - → Dispersion Models: CAL3QHC

Conceptual Design

- "Core" model
  - → Generic
  - → Can be applied at any scale
- "Implementations"
  - → EPA will develop national inventory implementation
  - → Mesoscale and microscale implementations would be developed by users
    - Could rely on many of the defaults from national inventory implementation

Design Concepts

- What is important for estimating emissions:
  - →How many emission sources?
  - →What type are they?
  - →What are they doing?
  - →What are the emissions associated with what they are doing?
- These questions apply regardless of source, scale, or pollutant
- Conceptual design focused on these questions

Design Processes

- Fleet characterization
  - → Determine number and type of emission source
- Activity characterization
  - → Determine fraction of time spent in operating modes
  - → emission "process": exhaust, evap, wear, leakage...
  - → emission "mechanism": start, A/C, enrichment...
- Emission calculation
  - → Determine emission rate for vehicle, operating mode, emission process, emission mechanism
  - → Calculate total emissions for area/time according to fleet population, activity distributions

Software Concepts

- Conceptual design fits well in object-oriented design approach
- Benefits of Object-Oriented design:
  - → modularity
  - → easier updates
  - → expandability to new sources, pollutants, processes
- New language would be required
  - → Java or C++

EPA Multi-Media Integrated Modeling System (MIMS)

- Under development by ORD
- Framework for linking models together
- Best example for need is MODELS-3:
  - → Current Situation:
    - Integration of MOBILE6 and MODELS-3 is troublesome, time consuming, and expensive
  - → With MIMS:
    - Initial MODELS-3 implementation Fall 2001
    - NGM in MIMS would allow easy linkage and updates
- We've contracted MCNC (MODELS-3 developers) to produce NGM MIMS design

On-Board Emission Measurement

- Considerable development over last decade
- Off-the-shelf units currently available
  - → HC, CO, NOx, CO_2, vehicle/engine parameters, GPS
- EPA's Portable Emission Measurement Strategy (PEMS)
  - → Will include emissions, vehicle/engine parameters, GPS
  - → Phase I: NOx, CO_2
    - Initial testing on non-road diesel equipment this summer
  - → Phase 2: HC, CO, PM, Toxics in works

On-Board Emission Pros & Cons

- Pros
  - →Measures in-use emissions as they are
  - →Accounts for all emissions synergies
  - →Relative inexpensive to deploy
  - →Can deploy remotely
    - Huge benefit for heavy-duty and off-road sources
    - Hope to work with State/Local/Regional POs
- Cons
  - →Could be difficult to isolate factors affecting emissions
  - →Starting from scratch in terms of modeling dataset
  - →Mass deployment in general public unproven

On-Board Data Analysis Pilot Study

- How can on-board data be used in NGM?
- Pilot test program collecting on-road data for LDVs, transit buses, nonroad equipment
- Analysis "shootout" contract:
  - → Develop conceptual methodology
  - → Demonstrate on pilot dataset
  - → Recommend sampling plan and role of alternate data
- Competitive process
  - → 7 bids, 3 awards: Ga Tech, NC State, UC Riverside
- Complete work January 2002

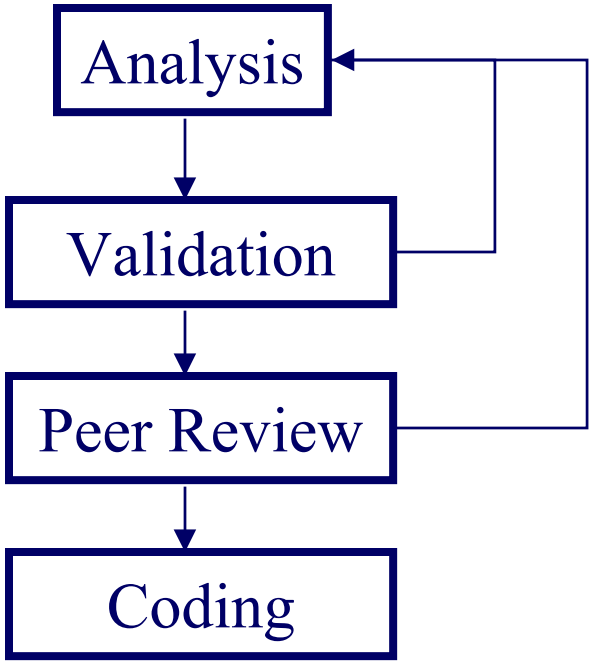
Proposed Project Plan - Implementation Phases

- Fuel Consumption Model
  - →On-road and off-road sources
  - →Allows validation step
  - →Foundation for all other pollutants
- Greenhouse Gas Model
  - →On-road and off-road sources
  - →Includes HFCs
- All Other Pollutants
  - →MOBILE and NONROAD replacements
- Integration with MODELS-3 & TRANSIMS

Proposed Project Plan - Steps Critical for Good Science

- Addressing model accuracy
  - → Defining and determining acceptable accuracy
  - → Estimating model uncertainty
  - → Frequent model validation and feedback
- Taking time for meaningful review
  - → Results must be reflected in final product
- Lots of documentation

Doing It Right Takes Time



Process repeated for every pollutant in the model!

Project Schedule

Milestone	Projected Date
Comprehensive Plan Drafted	Jun 02
Fuel Consumption Model	Aug 03
Greenhouse Gas Model	Jun 04
All Other Pollutants	Nov 05

Stakeholder Engagement

- Now is the time to get engaged
- FACA modeling workgroup
  - → Next steps: workgroup provides input to MSTRS on basic model concepts
  - → Is your group represented?
- Website
  - → http://www.epa.gov/otaq/ngm.htm
- Group mailbox: newgen@epa.gov