



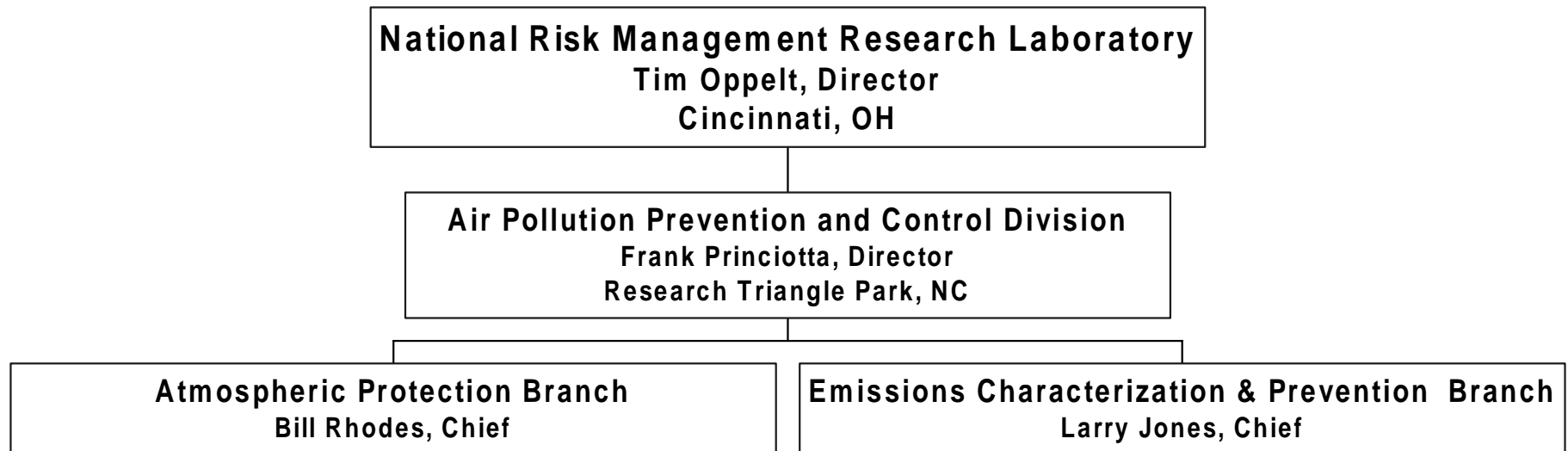
# Overview of Mobile Source Research and Modeling Efforts

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Office of Research and Development  
Research Triangle Park, NC**

**Mobile Sources Technical Review Subcommittee  
Clean Air Act Advisory Committee  
Arlington, VA  
April 18, 2001**

# Partial Organization Chart for NRMRL





# Mobile Source Research Areas

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- v Emissions model application and development
- v On-road vehicle emissions characterization
- v Source/emissions technology assessments
- v Source/emissions control technology verification



# Background/History

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- v National Acid Precipitation Assessment Program emissions inventories (1980's)
- v North American Research Strategy for Tropospheric Ozone (NARSTO)
  - v **Initial emphasis on ozone precursor pollutants, later expanded to include particulate matter**
  - v **Biogenics emissions research**
  - v **Mobile sources emissions research**
- v Cooperative agreement with Georgia Tech for mobile emissions research started in early 1990's



# Mobile Source Modeling Research Goals

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- ✓ Develop better “real world” estimates of highway vehicle emissions
- ✓ Reduce uncertainty of emissions estimates
- ✓ Contribute knowledge of activity vs. emissions relationships to other models
- ✓ Develop research model capability for assessing emissions control & policy issues



# Support of ORD Strategic Goals

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- v Improve approaches for managing risks
- v Characterize sources of ozone precursors, particulate matter, and air toxics
- v Develop advanced air quality simulation models to relate sources, emissions, & receptors
- v Integrate information to provide sound scientific base and technical support for Agency policies



# Modeling Research Components & Participants

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- v Atlanta mobile model development
  - v GIT lead w/ APPCD collaboration
- v RTP mobile model development
  - v APPCD in-house team w/ GIT collaboration
  - v NC Department of Transportation and NC local planning agency contribution
- v Heavy-duty diesel emissions research
  - v B. Harris will describe in next presentation



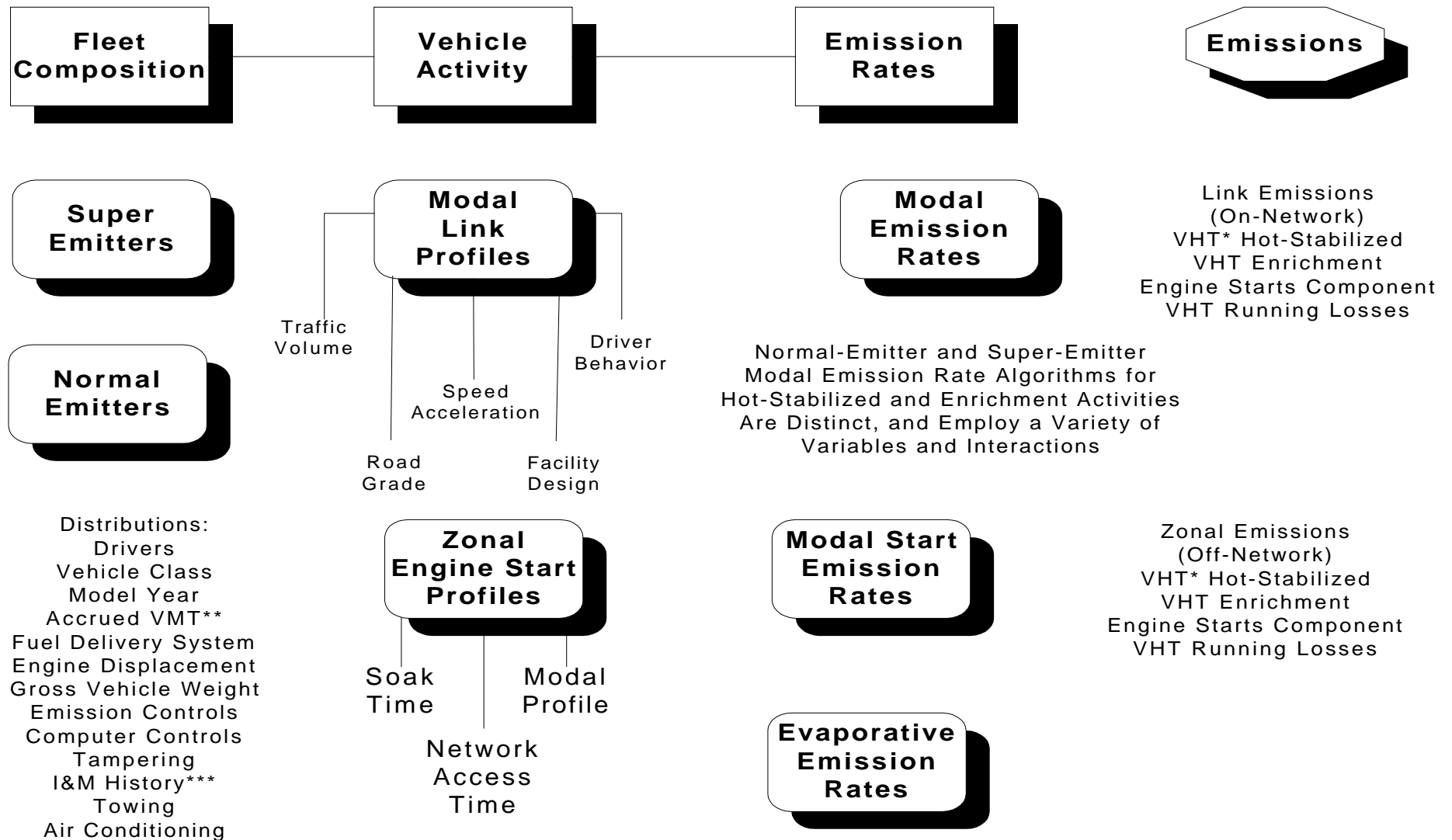
# MEASURE

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- v Mobile Emissions Assessment System for Urban and Regional Evaluation
- v Geographic Information System (GIS) modeling framework
- v Modal modeling approach
- v Desired characteristics:
  - v **Affordable**
  - v **Accurate**
  - v **Stated confidence level**
  - v **Validation is possible**
  - v **Consider new fuels and technologies**
  - v **Available in 5 to 10 years**

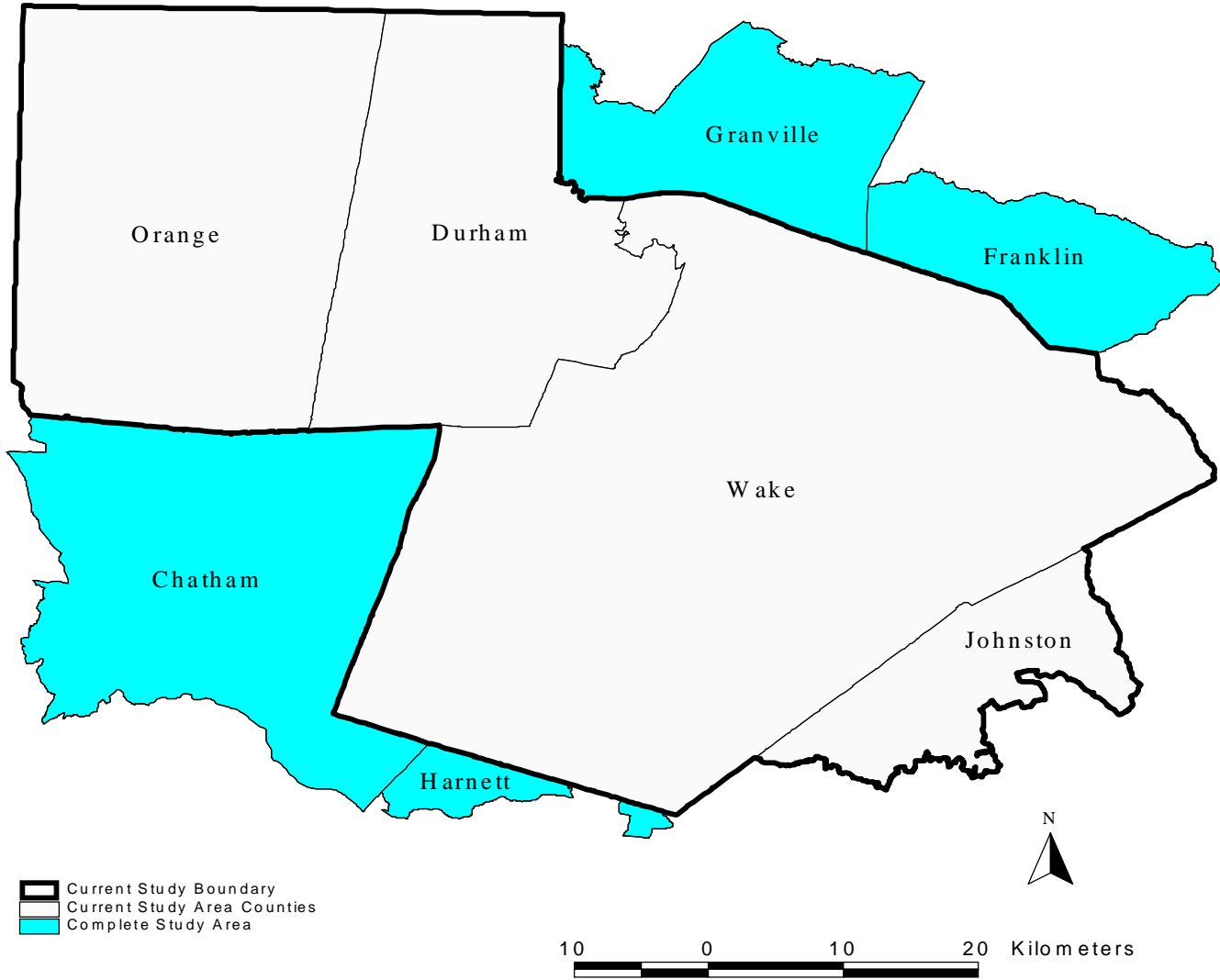


# MEASURE Conceptual View



(\*) VHT = Vehicle Hours Traveled  
 (\*\*) VMT = Vehicle Miles Traveled  
 (\*\*\*) I&M = Inspection & Maintenance

# RTP Study Area





# MEASURE Modules

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- v Modal emissions modules for carbon monoxide (CO), nitrogen oxides (NO<sub>x</sub>), and hydrocarbons (HC)
  - v Engine starts for light duty gasoline vehicles (LDGV) by start zone
  - v Hot stabilized emissions for major roads on link basis
    - v **Aggregate modal module for LDGV**
    - v **Power demand module for LDGV and light duty gasoline trucks (LDGT1, LDGT2)**
  - v Hot stabilized emissions for minor roads on zonal basis



# MEASURE Modules

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- v Non-modal modules
  - v Evaporative module for HC for all vehicle classes
    - v Based on MOBILE5b
  - v Particulate module for  $PM_{10}$  and  $PM_{2.5}$  for all vehicle classes
    - v Based on PART5 for exhaust, brake, tire wear and on AP-42 for fugitive dust



# MEASURE-RTP Future Plans

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- v MOBILE6 update and integrated MOBILE-MEASURE development
- v Coordination with OTAQ New Generation Model Working Group
- v Potential research and development:
  - v **On-road emissions module for commercial and heavy-duty trucks**
  - v **Modeling of particulate and air toxic emissions**

# Light-Duty Vehicle Emissions Characterization

- v 1993 Chevrolet Lumina test vehicle





# Light-Duty Vehicle

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- v On-board analyzers for measurement of tailpipe gaseous emissions (CO, CO<sub>2</sub>, NO<sub>x</sub>, HC, and NH<sub>3</sub>)
- v Data acquisition system for recording of emissions and engine parameter data
- v Global Positioning System (GPS) for measurement of road grades



# Light-Duty Vehicle

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- v Work completed
  - v **Characterization of ammonia emissions**
  - v **Comparison with remote sensing measurements**
  - v **Development and testing of protocols for grade data collection with GPS**
- v Work planned
  - v **Additional ammonia emissions tests**
  - v **Toxics emissions tests (1,3-butadiene)**
  - v **Complete grade data collection for RTP-area major roads**





# Remote Sensing

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- √ 1997 summertime fleet characterization for MEASURE-RTP
  - √ **Data collected for 19 sites**
  - √ **Cross-referenced to vehicle registration data**
  - √ **Determine vehicle emitter distributions**
  - √ **MEASURE will relate fleet characteristics to demographics/land use/registrations**



# Remote Sensing

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- v Contributing to Coordinating Research Council study (Project No. E-23)
  - v **For entire study, remote sensing measurements at selected sites in six cities are being collected to identify trends over a 5-year period**
  - v **Information will be used to estimate high exhaust emitter populations**
  - v **We are collecting 20,000+ remote sensing readings annually at freeway entrance ramp location in Raleigh**
  - v **Work will conclude in 2001**



# APPCD Mobile Team Contacts

<b>Name</b>	<b>Subject</b>	<b>E-Mail</b>
<b>Bruce Harris</b>	<b>Heavy-duty on-road vehicle</b>	<b><a href="mailto:harris.bruce@epa.gov">harris.bruce@epa.gov</a></b>
<b>Julian Jones</b>	<b>Remote sensing</b>	<b><a href="mailto:jones.julian@epa.gov">jones.julian@epa.gov</a></b>
<b>Sue Kimbrough</b>	<b>GIS modeling</b>	<b><a href="mailto:kimbrough.sue@epa.gov">kimbrough.sue@epa.gov</a></b>
<b>John Kinsey</b>	<b>Heavy-duty on-road vehicle</b>	<b><a href="mailto:kinsey.john@epa.gov">kinsey.john@epa.gov</a></b>
<b>Chuck Mann</b>	<b>In-house team leader</b>	<b><a href="mailto:mann.chuck@epa.gov">mann.chuck@epa.gov</a></b>
<b>Richard Shores</b>	<b>Light-duty on-road vehicle</b>	<b><a href="mailto:rshores@epa.gov">rshores@epa.gov</a></b>



# Global Climate Change Technology Assessments

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- v Support United States Global Change Research Program
- v NRMRL focus on assessment of impacts of global climate change on air and water quality for energy production and transportation sectors
- v Consequences of global change on tropospheric ozone and particulate matter
- v APPCD contact
  - v **Bob Hendriks (hendriks.bob@epa.gov)**



# Global Climate Change Technology Assessments

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- v Methodology for integrated technology assessments has been developed
- v Focus on personal transportation technologies
- v Address key questions related to technology developments that will affect emissions
- v Need to define technical scenarios for assessments
- v Consider technological changes, socioeconomic factors, adaptations to climate changes



# Transportation Scenarios

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- v **Systematic analysis of how specific alternative fuels and vehicle power systems influence emissions of greenhouse gases, ozone precursors, and particulate matter**
- v **Determine what combinations of fuels and vehicle power systems are likely to penetrate the market in particular timeframes**
- v **Evaluate socioeconomic changes that would influence future decisions about personal transportation and resultant emissions**
- v **Determine how the impacts of such changes can be modeled in global change impact assessments**



# Environmental Technology Verification (ETV) Program

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- v Independent measures to verify performance of innovative technical solutions
- v Accelerate entrance of new technologies into the marketplace
- v Operates through public/private testing partnerships
- v Voluntary for commercially available technologies (is not regulatory or applicable to technologies undergoing research and development)
- v Information at [www.epa.gov/etv](http://www.epa.gov/etv)



# ETV Program

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- v Stakeholder advisory committee has regular meetings (last on 3/8/2001)
- v Generic test protocol for retrofit air pollution control technologies for diesel engines being developed by technical panel (Anticipated May 2001 completion)
- v Technology verification center performs tests and publishes results
- v EPA OTAQ reviews data submitted by manufacturers/vendors and determines allowable voluntary reduction plan SIP credits





# ETV Program

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- ✓ For mobile sources, focus on heavy-duty diesel engines (highway and non-road)
- ✓ Verification of diesel emission retrofit control technologies for particulate and NO<sub>x</sub>
- ✓ Voluntary retrofit program for State Implementation Plan (SIP) credits
- ✓ APPCD contact
  - ✓ Ted Brna (brna.ted@epa.gov)



# ETV Program

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- v Technology groups
  - v Diesel oxidation catalysts and particulate filters
  - v Selective catalytic reduction for NO<sub>x</sub> control
  - v Fuel-borne catalysts, fuel reformulations and additives, including biodiesel
  - v Lubricants and lubricant additives



# National Exposure Research Laboratory (NERL)

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- v MicroFac model
  - v **Microscale emissions model**
  - v **Needed to estimate real-time emissions to support human exposure studies**
  - v **Developed from MOBILE5/6 data**
  - v **Needs actual traffic fleet data, or can be run using defaults**
  - v **Contact**
    - v **Alan Huber (huber.alan@epa.gov)**
  - v **Also on OTAQ New Generation Model workgroup**



# National Exposure Research Laboratory (NERL)

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- v Emissions processors within MODELS-3 framework
  - v **Community Multi-scale Air Quality (CMAQ) modeling system**
  - v **Includes Emissions Modeling System**
  - v **Processes emissions inventory data to achieve spatial and temporal resolution**
  - v **Sparse Matrix Operator Kernel Emission (SMOKE) system adaptation to framework processes county and link VMT data and calls MOBILE5b for emission factors**
  - v **Bill Benjey (benjey@hpcc.epa.gov)**



# National Exposure Research Laboratory (NERL)

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- v Source apportionment & characterization
  - v Ethanol fuel blend studies
  - v Mobile source fingerprinting in California
  - v Contact: Peter Gabele  
([gabele.peter@epa.gov](mailto:gabele.peter@epa.gov))