

MOBILE6.2 On-Road Mobile Source Emissions Inventory Summaries

Texas Ozone Nonattainment Areas

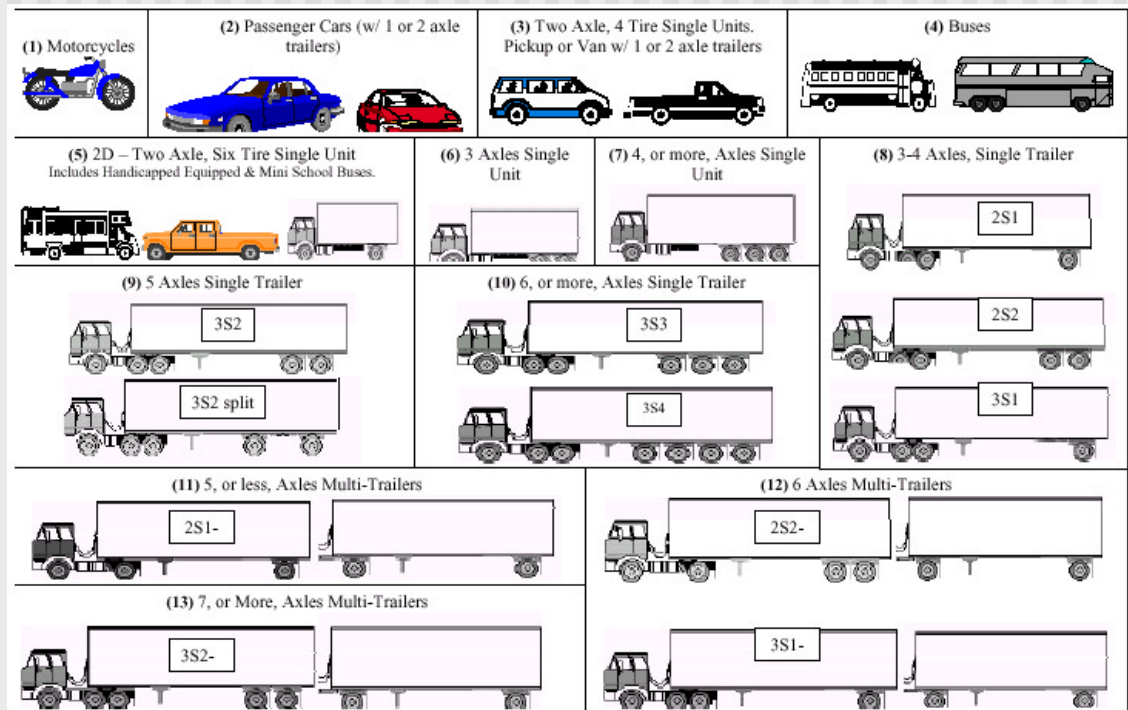
***Beaumont/Port Arthur
Dallas/Fort Worth
Houston/Galveston***

*Chris Kite
TCEQ Technical Analysis Division
(512)239-1959
ckite@tceq.state.tx.us*

2003 NARSTO Workshop

What Are Onroad Mobile Sources?

- Passenger Cars
- Pickup Trucks
- SUVs
- Vans & Minivans
- Motorcycles
- School Buses
- Transit Buses
- "18-Wheelers"
- Recreational Vehicles



MOBILE5 & MOBILE6 Vehicle Classification Summary

MOBILE5	MOBILE6		MOBILE5	MOBILE6		MOBILE5	MOBILE6
LDGV	LDGV		HDGV	HDGV2b		HDDV	HDDV2b
LDGT1	LDGT1			HDGV3			HDDV3
	LDGT2			HDGV4			HDDV4
LDGT2	LDGT3			HDGV5			HDDV5
	LDGT4			HDGV6			HDDV6
LDDV	LDDV			HDGV7			HDDV7
LDDT	LDDT12			HDGV8a			HDDV8a
	LDDT34			HDGV8b			HDDV8b
MC	MC			HDGB			HDDBT
							HDDBS

On-Road Mobile Sources Emissions Inventory Development

- Emissions inventory is combination of:
 - Level of Activity – Vehicle Miles Traveled (VMT)
 - Emission Rate per Unit of Activity – Grams per Mile (gpm)

- “Macro” or “County-Level” Emissions Inventories:
 - Total county VMT multiplied by composite emission rates
 - Total freeway VMT multiplied by freeway emission rates
 - Total arterial VMT multiplied by arterial emission rates

- “Micro” or “Link-level” Emissions Inventories:
 - Travel demand model segments roadway network into “links”
 - VMT & Average Speed estimated for each link by hour
 - Distribution of VMT by 28 MOBILE6 vehicle types estimated
 - NO_x, VOC, & CO emissions determined for each link by hour
 - Needed for spatial and temporal allocations of emissions

On-Road Mobile Emission Preprocessing System 2x (EPS2x) Modules

- EPS2x System
 - Converts “text” emissions inventory into binary “gridded” format for photochemical model
 - Contains many modules
- LBASE Module
 - Spatially allocate onroad “link” emissions within and among grid cells
 - Disaggregate emissions into components for speciation
- PREAM Module
 - Prepare “non-link” emissions for further EPS2x processing
- CHMSPL Module
 - Apply Carbon Bond IV (CB-IV) speciation
 - 10 VOC classes based on reactivity for ozone (olefins, paraffins, etc.)
 - Gasoline speciation data from 2000 Washburn Tunnel Study
 - NO_x emissions split into 90% NO and 10% NO₂

On-Road Mobile Emission Preprocessing System 2x (EPS2x) Modules

- **CNTLEM**
 - Applies NO_x, VOC, and/or CO adjustments to specific vehicle types
 - Adjustments do not vary by hour
 - Typically used to model control strategies

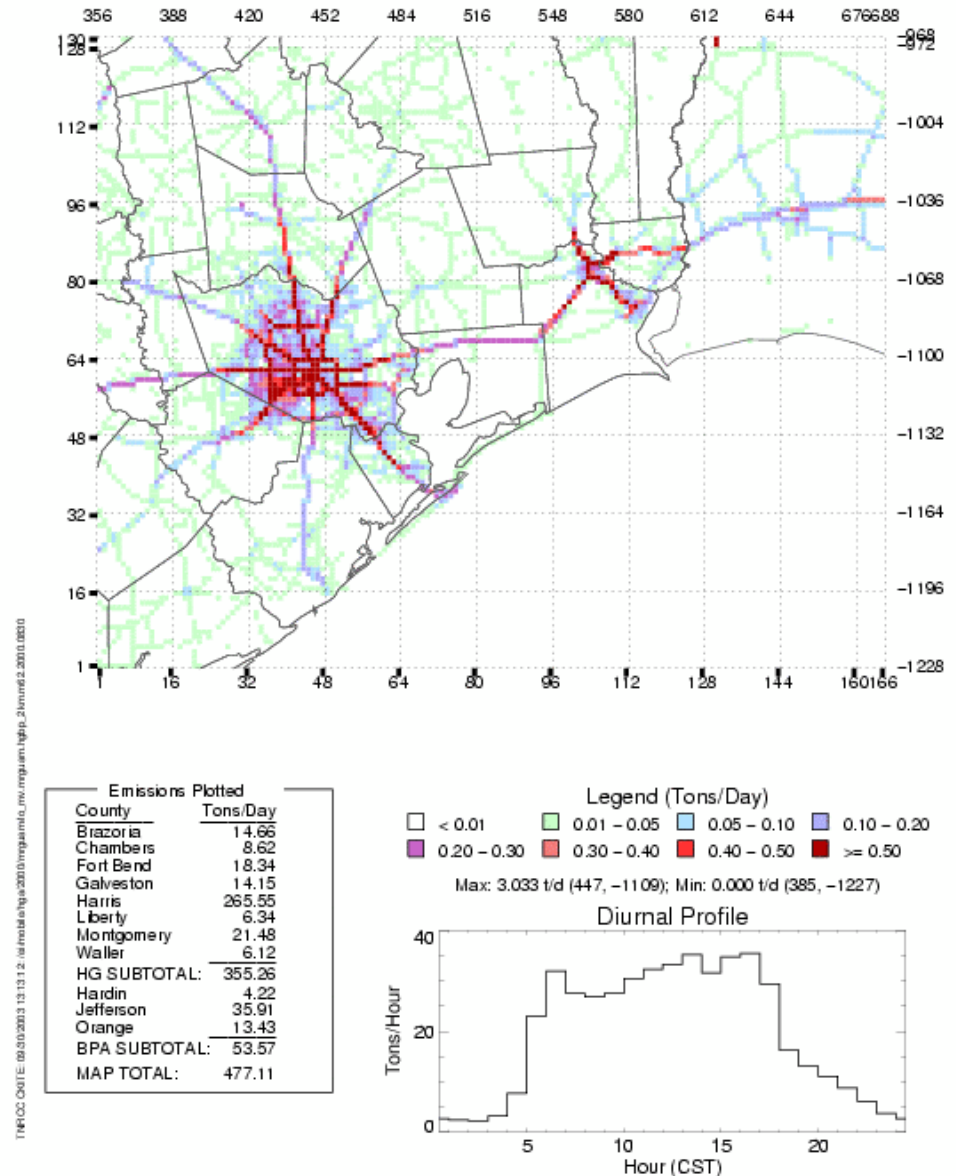
- **CNTLHR**
 - Hourly version of CNTLEM
 - Adjustments can vary by hour for each vehicle type
 - Necessary for application of temperature/humidity NO_x corrections

- **GRDEM**
 - Aggregate emissions by grid cell for each hour
 - Specific link locations no longer maintained
 - Spatially allocate “non-link” emissions based on roadway surrogates
 - Maintain county, vehicle type, and roadway type (freeway versus arterial drive cycle) emission contributions for each grid cell
 - Output is binary “gridded” file ready for photochemical model input

Houston/Beaumont 2000 MOBILE6.2 NO_x Emissions

- Subgrid Spatial Distribution
 - County Totals
 - Temporal Profile
- Central Standard Time
 - Rush Hour Peaks
 - Mid-Day Hump
- From Heavy-Duty Diesel Trucks

HGA & BPA 24-Hour MOBILE6.2 NO_x Emissions
2000 Base Case, Wednesday August 30th Episode Day
(2x2 Km Grid Cells)

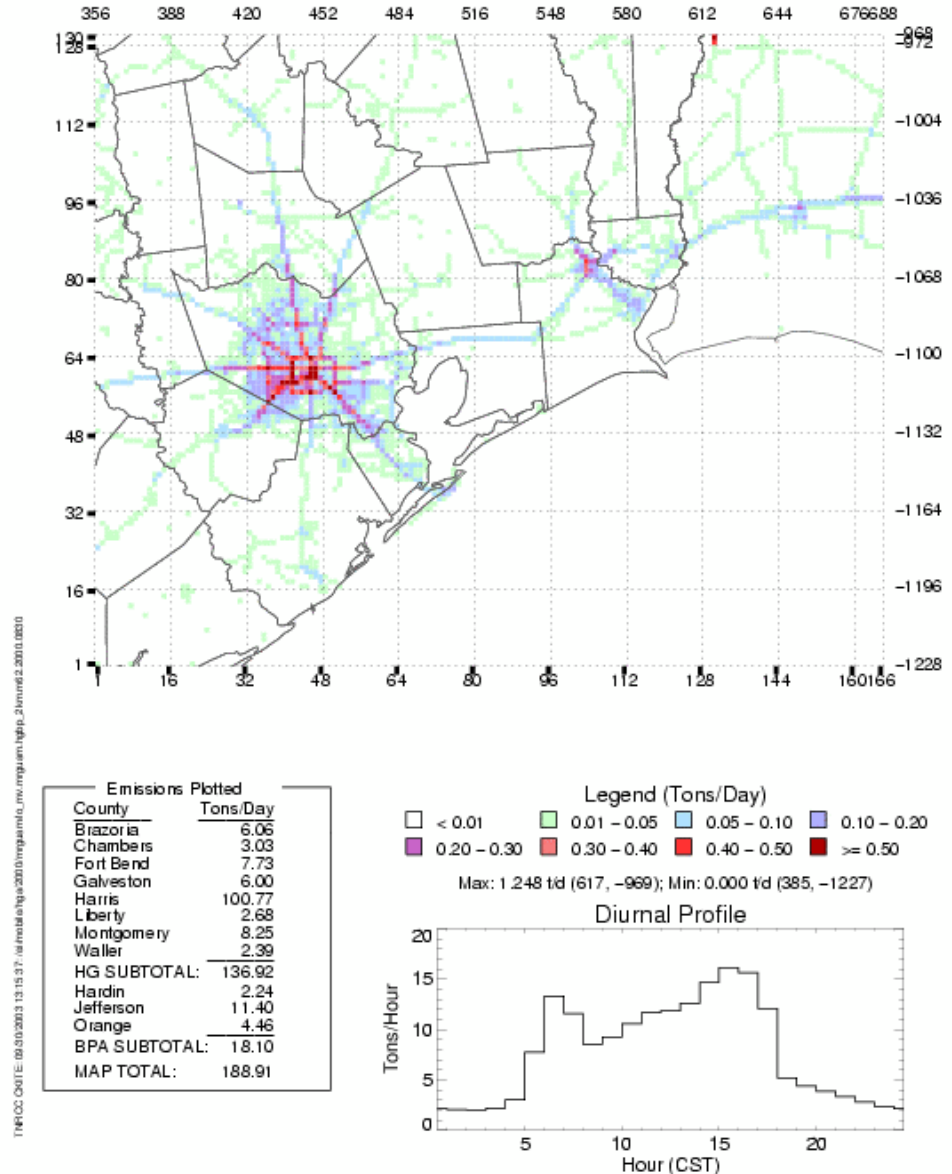


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Houston/Beaumont 2000 MOBILE6.2 VOC Emissions

- Subgrid Spatial Distribution
- County Totals
- Temporal Profile
- Central Standard Time
- Rush Hour Peaks
- Dominated by Gasoline Vehicles

HGA & BPA 24-Hour MOBILE6.2 VOC Emissions
2000 Base Case, Wednesday August 30th Episode Day
(2x2 Km Grid Cells)

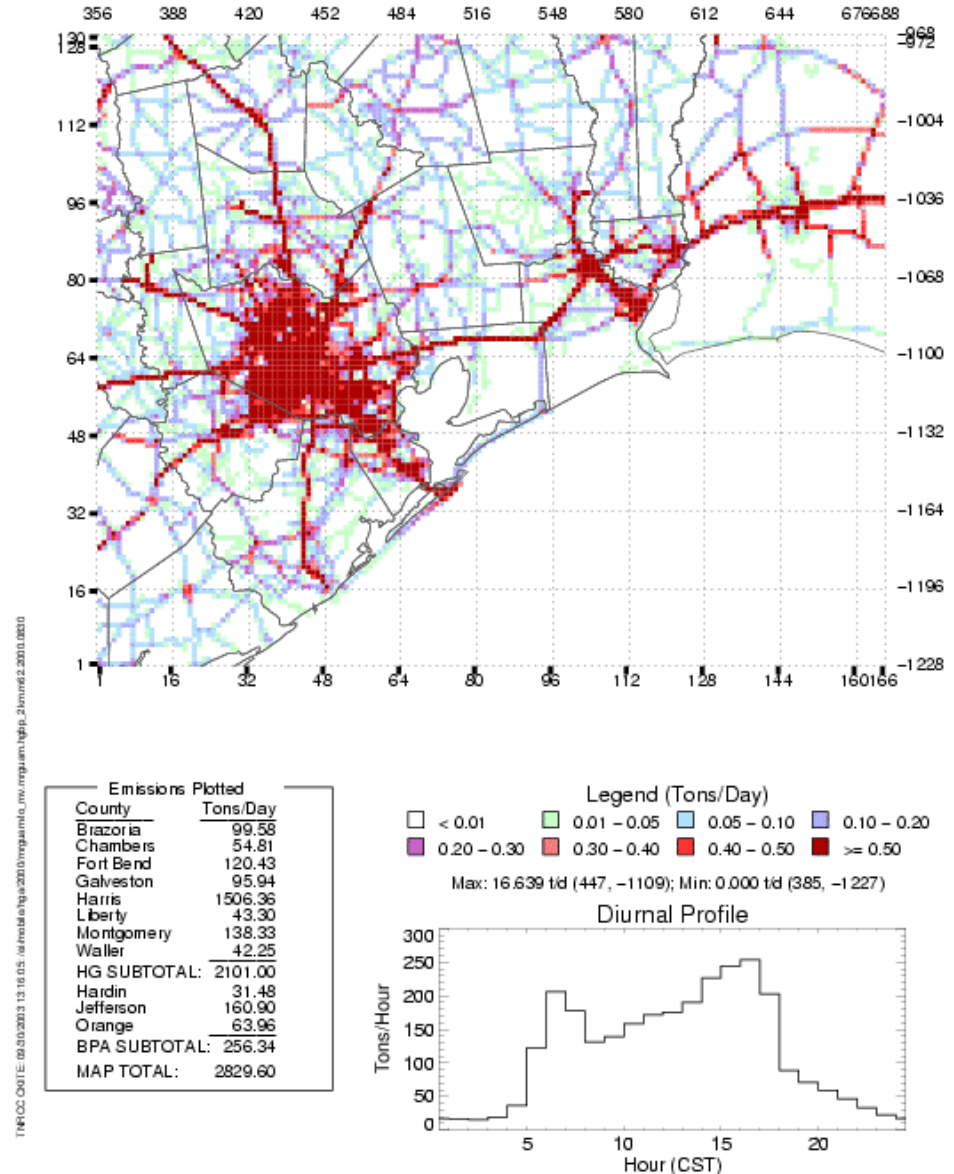


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Houston/Beaumont 2000 MOBILE6.2 CO Emissions

- Subgrid Spatial Distribution
 - County Totals
 - Temporal Profile
- Central Standard Time
 - Rush Hour Peaks
 - Dominated by Gasoline Vehicles

HGA & BPA 24-Hour MOBILE6.2 CO Emissions
2000 Base Case, Wednesday August 30th Episode Day
(2x2 Km Grid Cells)

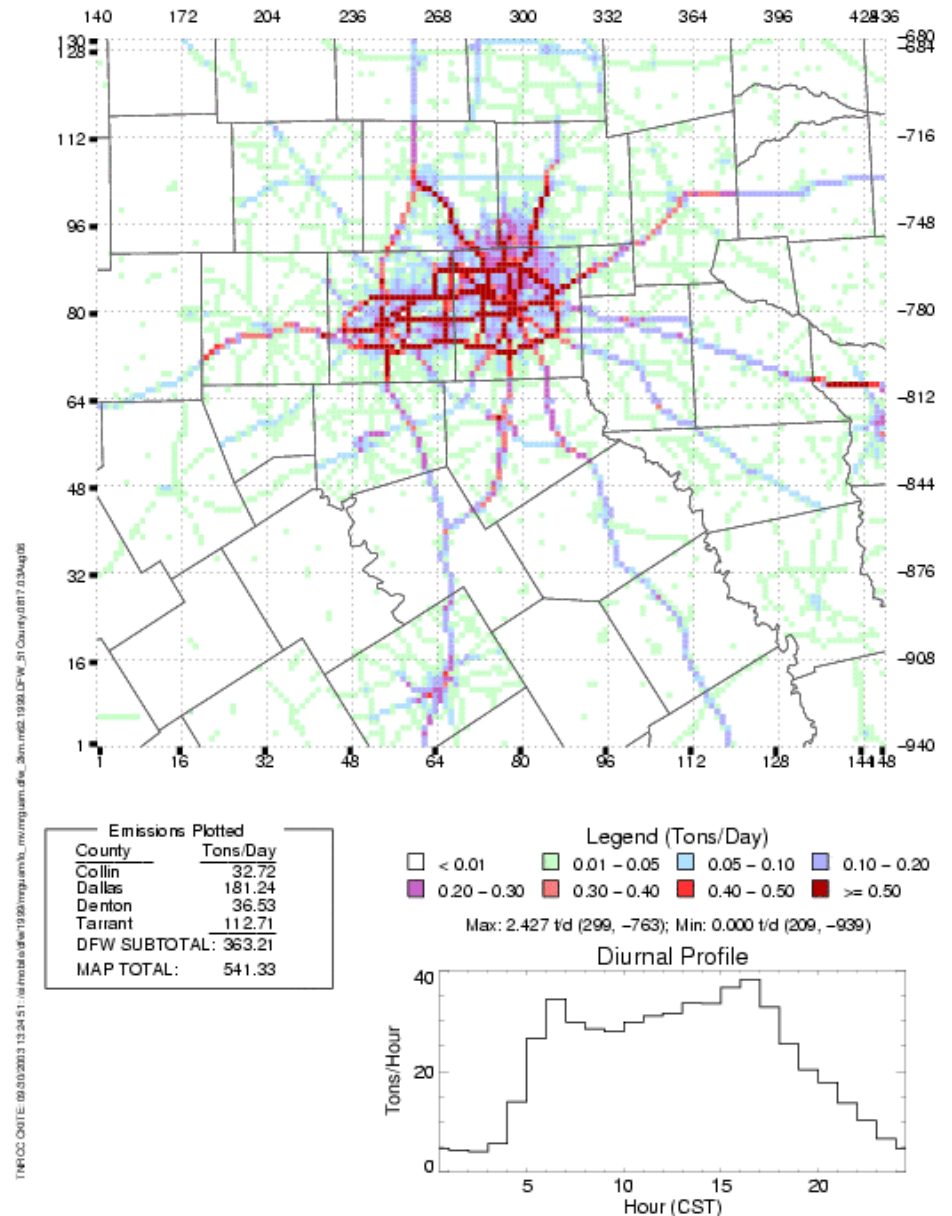


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Dallas/Fort Worth 1999 MOBILE6.2 NO_x Emissions

- Subgrid Spatial Distribution
- County Totals
- Temporal Profile
 - Central Standard Time
 - Rush Hour Peaks
 - Both gasoline & diesels are significant NO_x contributors

DFW 24-Hour MOBILE6.2 NO_x Emissions
1999 Base Case, Tuesday August 17th Episode Day
(2x2 Km Grid Cells)

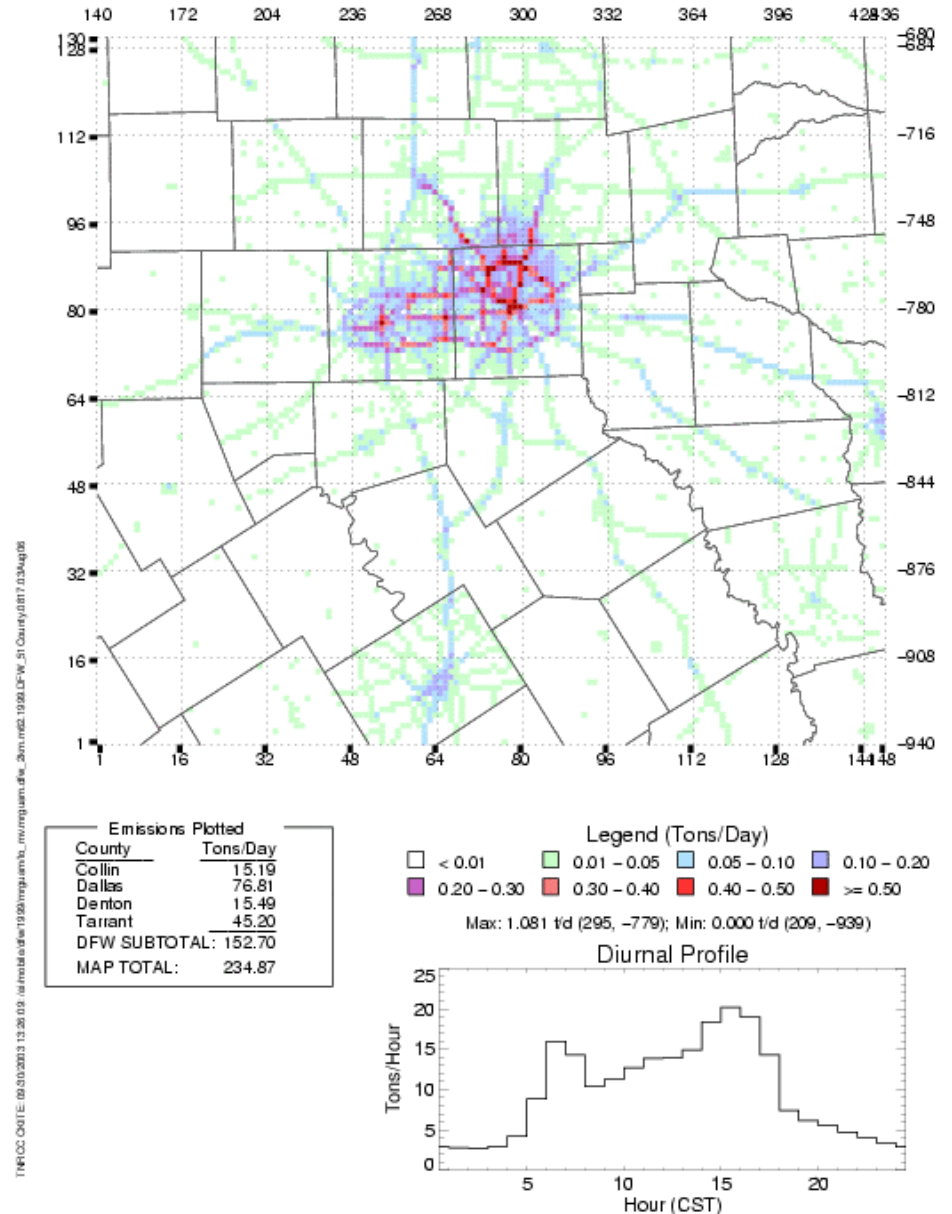


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Dallas/Fort Worth 1999 MOBILE6.2 VOC Emissions

- Subgrid Spatial Distribution
- County Totals
- Temporal Profile
 - Central Standard Time
 - Rush Hour Peaks
 - Dominated by Gasoline Vehicles

DFW 24-Hour MOBILE6.2 VOC Emissions
1999 Base Case, Tuesday August 17th Episode Day
(2x2 Km Grid Cells)

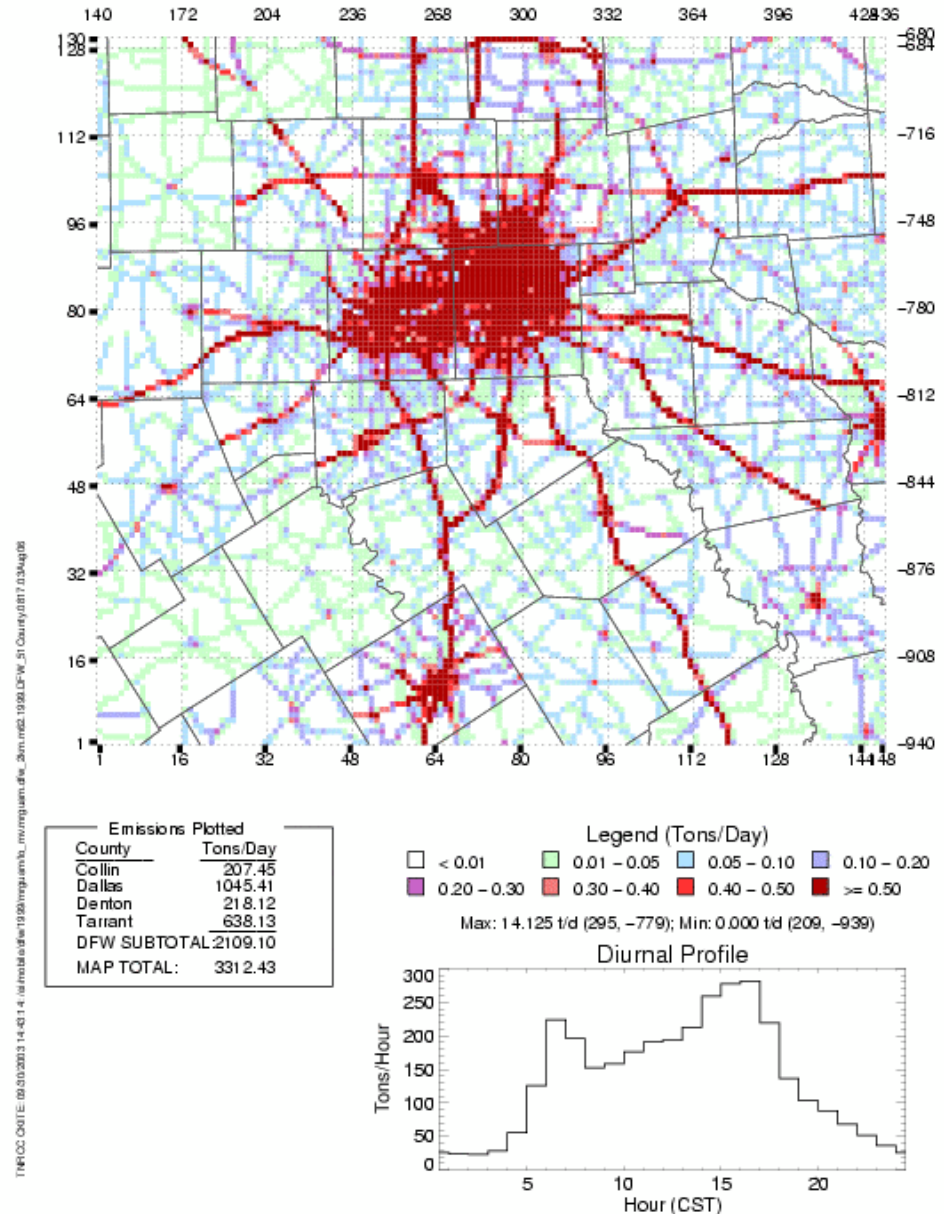


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Dallas/Fort Worth 1999 MOBILE6.2 CO Emissions

- Subgrid Spatial Distribution
- County Totals
- Temporal Profile
- Central Standard Time
- Rush Hour Peaks
- Dominated by Gasoline Vehicles

DFW 24-Hour MOBILE6.2 CO Emissions
1999 Base Case, Tuesday August 17th Episode Day
(2x2 Km Grid Cells)



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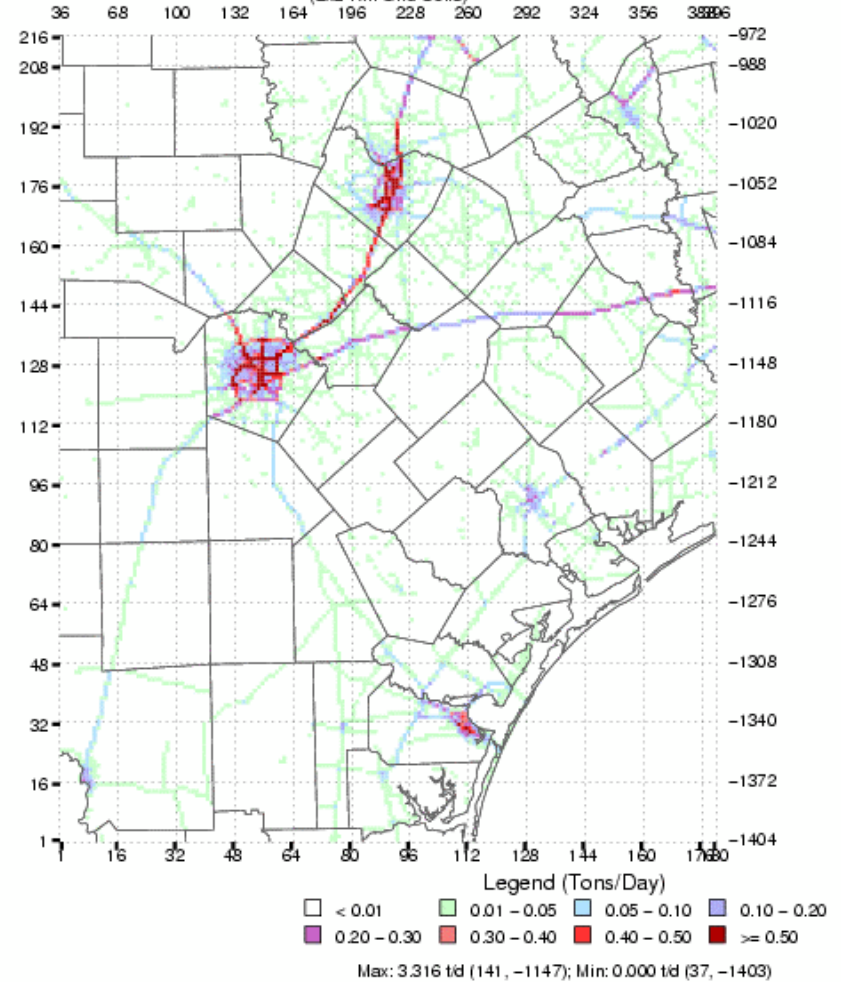
Near Nonattainment 1999 MOBILE6.2 NO_x Emissions

- Austin, Corpus Christi, San Antonio, & Victoria
- Subgrid Spatial Distribution
- Temporal Profile
 - Central Standard Time
 - Rush Hour Peaks

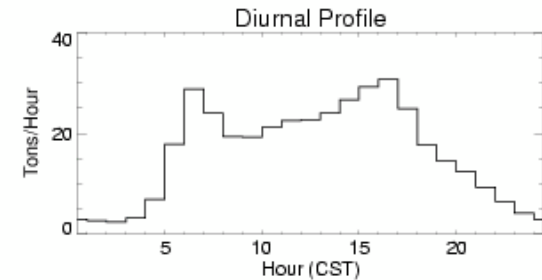
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NNA 24-Hour MOBILE6.2 NO_x Emissions

1999 Base Case, Monday September 20th Episode Day
(2x2 Km Grid Cells)



Total
Emissions:
394.134 T/D

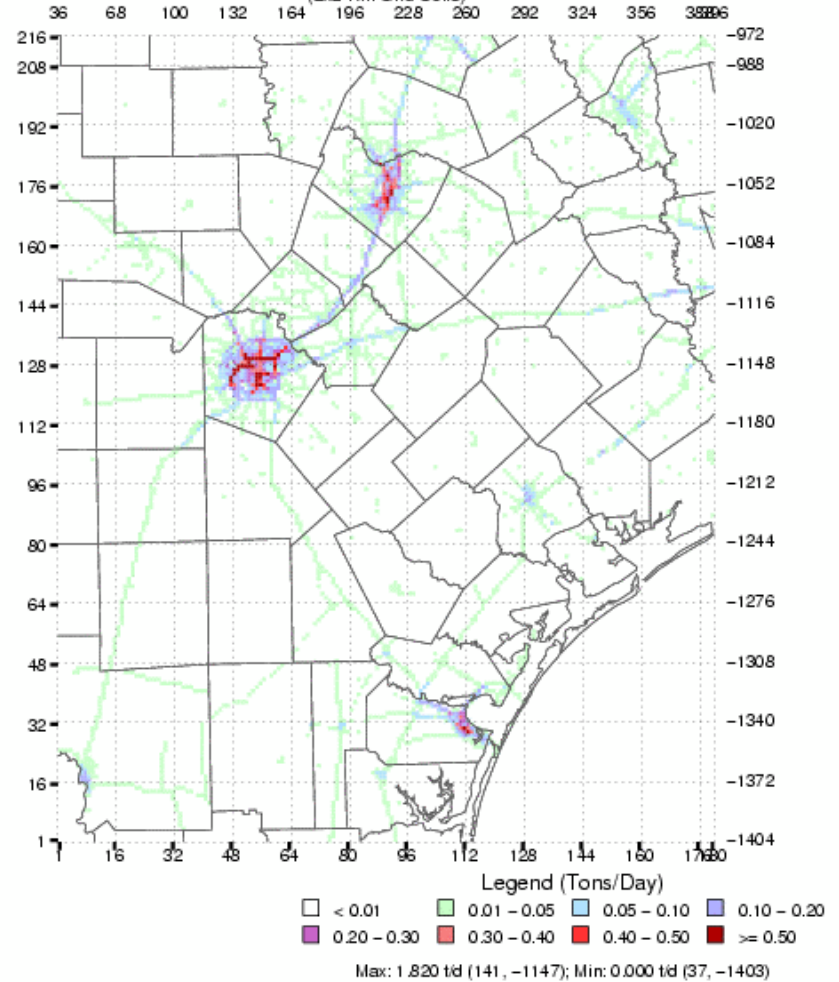


Near Nonattainment 1999 MOBILE6.2 VOC Emissions

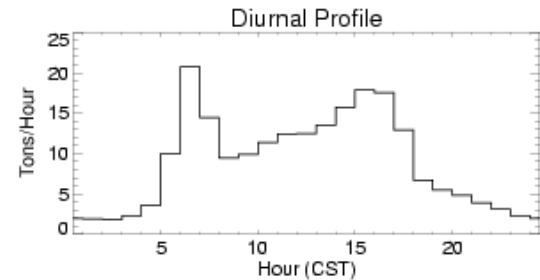
- Austin, Corpus Christi, San Antonio, & Victoria
- Subgrid Spatial Distribution
- Temporal Profile
 - Central Standard Time
 - Rush Hour Peaks
 - Dominated by Gasoline Vehicles

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NNA 24-Hour MOBILE6.2 VOC Emissions
1999 Base Case, Monday September 20th Episode Day
(2x2 Km Grid Cells)



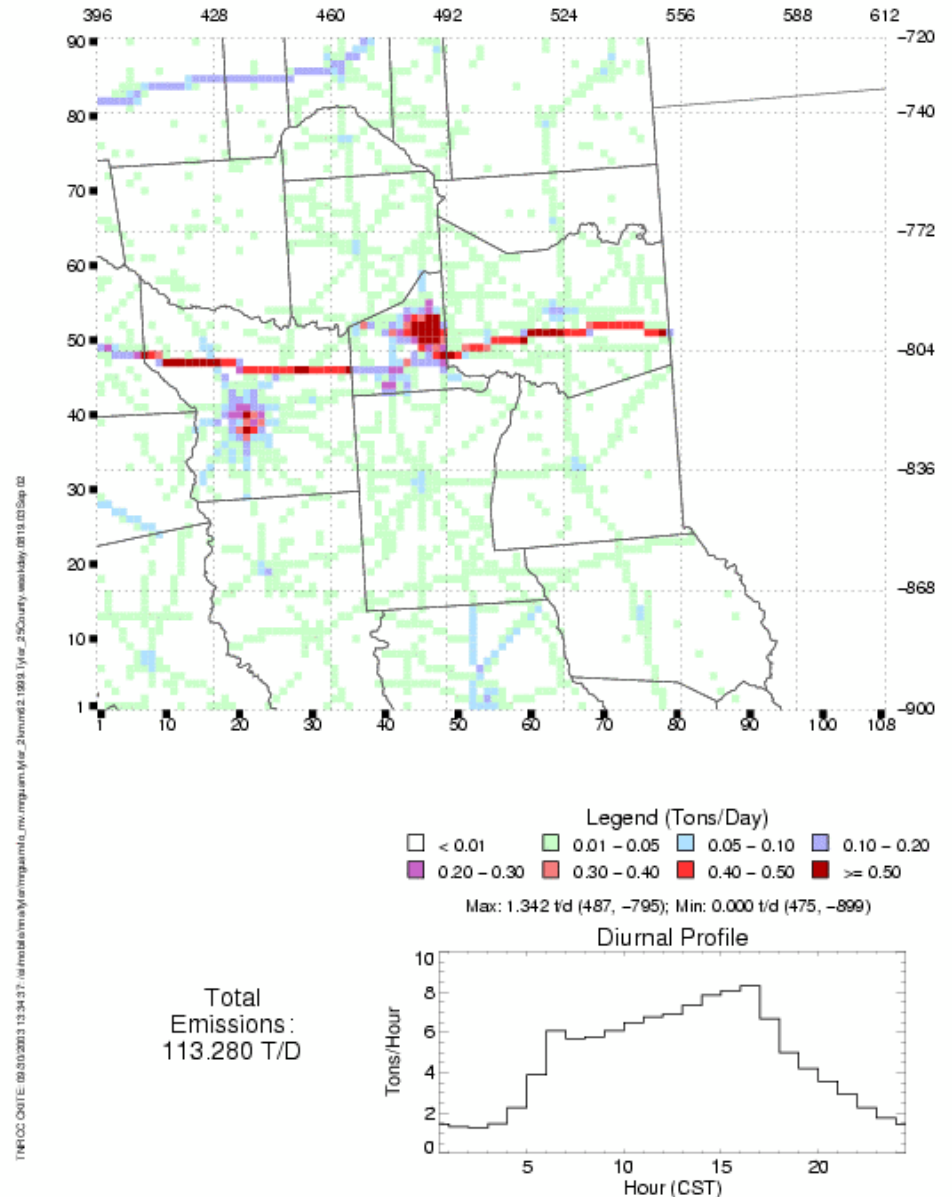
Total
Emissions:
216.527 T/D



Tyler/Longview 1999 MOBILE6.2 NO_x Emissions

- Louisiana portion not yet processed
- Subgrid Spatial Distribution
 - Significant Contribution from "18-Wheelers" on Interstate
- Temporal Profile
 - Central Standard Time
 - Rush Hour Peaks

Tyler/Longview 24-Hour MOBILE6.2 NO_x Emissions
1999 Base Case, Thursday August 19th Episode Day
(2x2 Km Grid Cells)

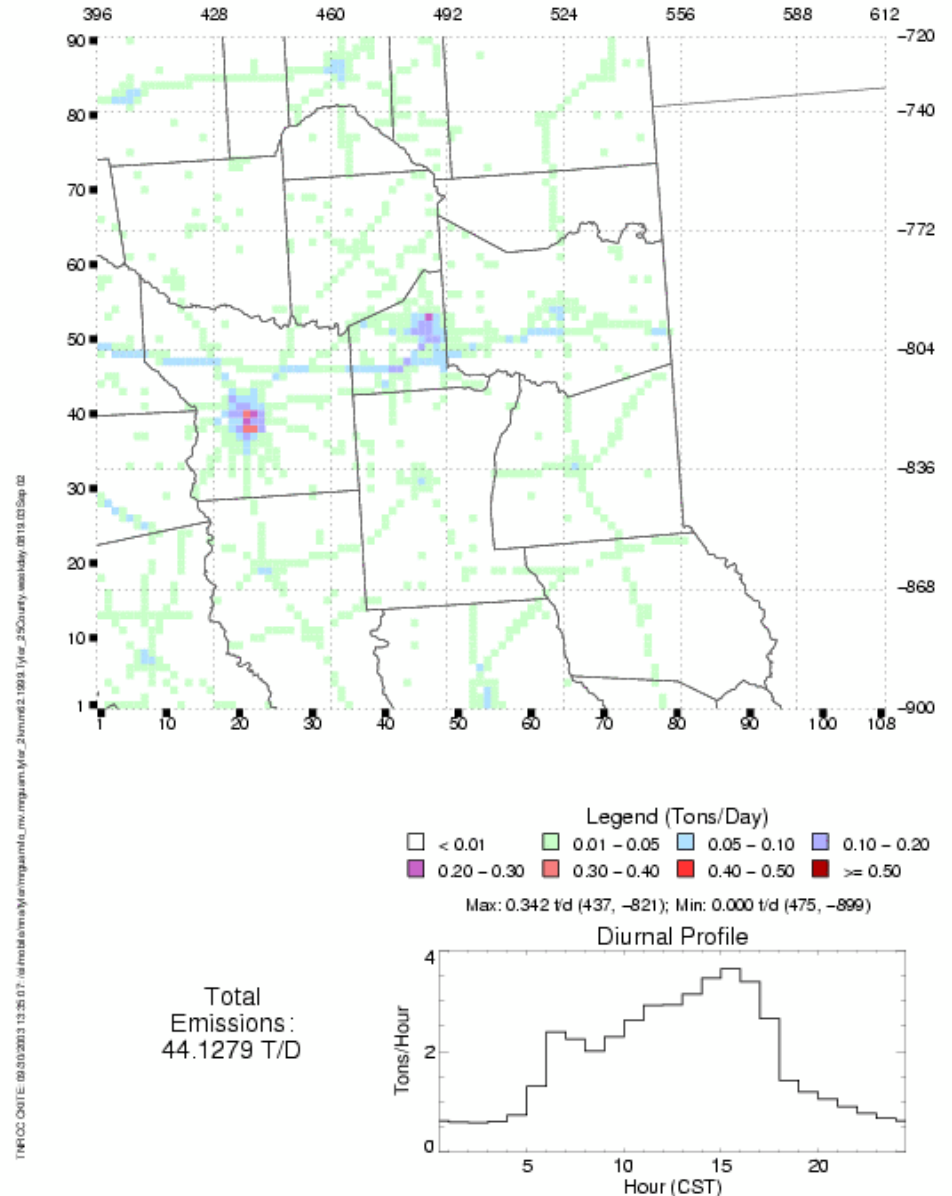


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Tyler/Longview 1999 MOBILE6.2 VOC Emissions

- Louisiana portion not yet processed
- Subgrid Spatial Distribution
- Temporal Profile
 - Central Standard Time
 - Rush Hour Peaks
 - Dominated by Gasoline Vehicles

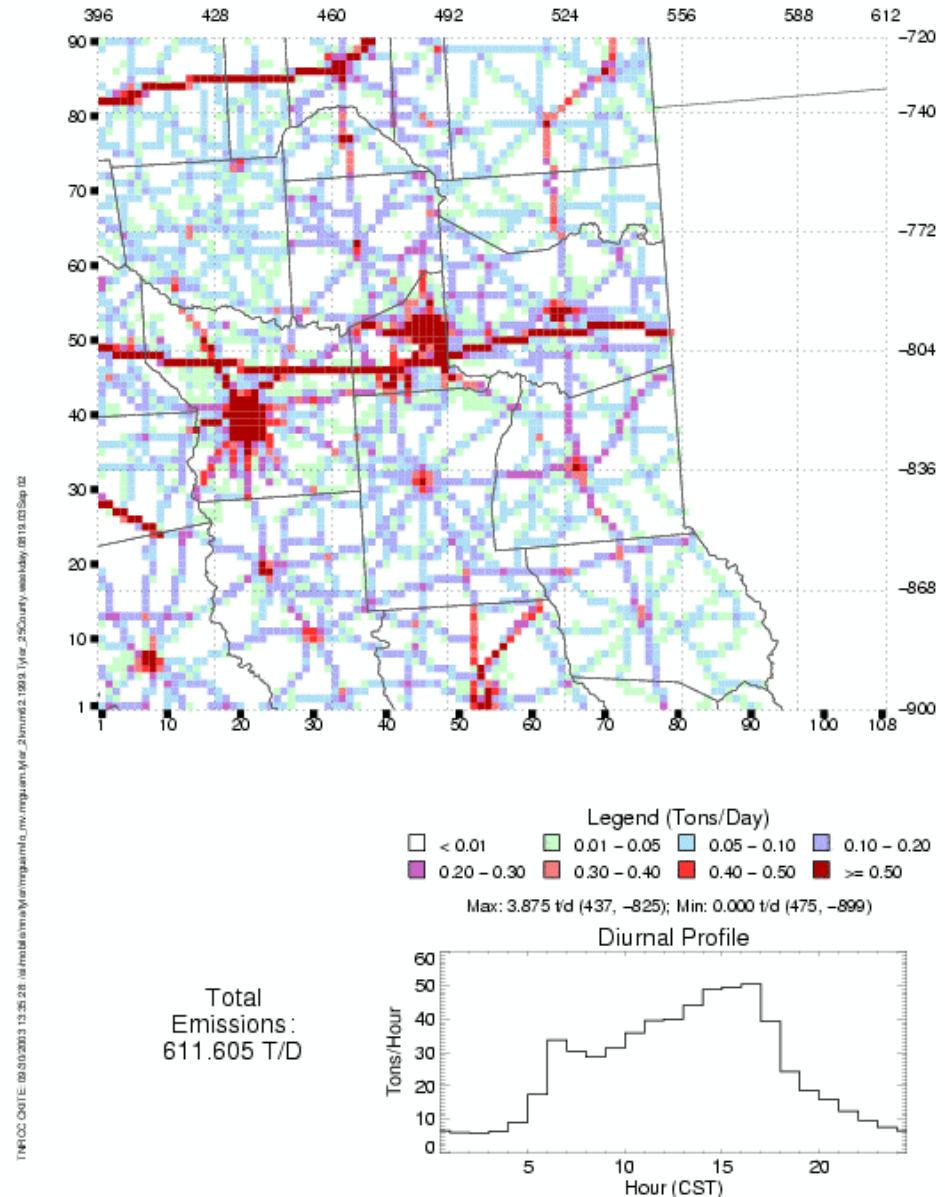
Tyler/Longview 24-Hour MOBILE6.2 VOC Emissions
1999 Base Case, Thursday August 19th Episode Day
(2x2 Km Grid Cells)



Tyler/Longview 1999 MOBILE6.2 CO Emissions

- Louisiana portion not yet processed
- Subgrid Spatial Distribution
- Temporal Profile
 - Central Standard Time
 - Rush Hour Peaks
 - Dominated by Gasoline Vehicles

Tyler/Longview 24-Hour MOBILE6.2 CO Emissions
1999 Base Case, Thursday August 19th Episode Day
(2x2 Km Grid Cells)



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Onroad Mobile Source Emission Inventories

Key Points

- Emission rates obtained from MOBILE6 and VMT obtained from either travel demand model or HPMS sources
- Time-of-day and geographical distribution of inventory essential for photochemical model
- Cars, Pickup Trucks, & SUVs comprise roughly 90% of VMT
 - Low emission rates on a per vehicle basis, but very high VMT
 - Account for roughly 50% of all NO_x, but about 90% of both VOC & CO
- Heavy-Duty Diesel Trucks comprise roughly 5% of all VMT
 - Due to high emission rates, can account for 40-50% of total NO_x
 - NO_x inventory very sensitive to amount of VMT attributed to heavy-duty diesel trucks
 - Houston "VMT mix" data indicate that Fridays, Saturdays, & Sundays have lower heavy truck VMT than typical "Weekdays"
- Total future emissions decline because increase in VMT typically more than offset by decrease in emission rates

Application of Diesel NO_x Corrections for Temperature & Humidity

- Neither MOBILE6 nor NONROAD model account for effects of temperature and humidity on diesel engine NO_x:
 - As temperature increases, NO_x increases
 - As humidity increases, NO_x decreases
- Houston Advanced Research Center (HARC) funded Environ proposal to:
 - Work with Southwest Research Institute (SwRI) to develop temperature/humidity NO_x correction equations by diesel technology type
 - Work with TCEQ to apply corrections to current Houston area inventories and run photochemical model to assess impact on estimated ozone levels

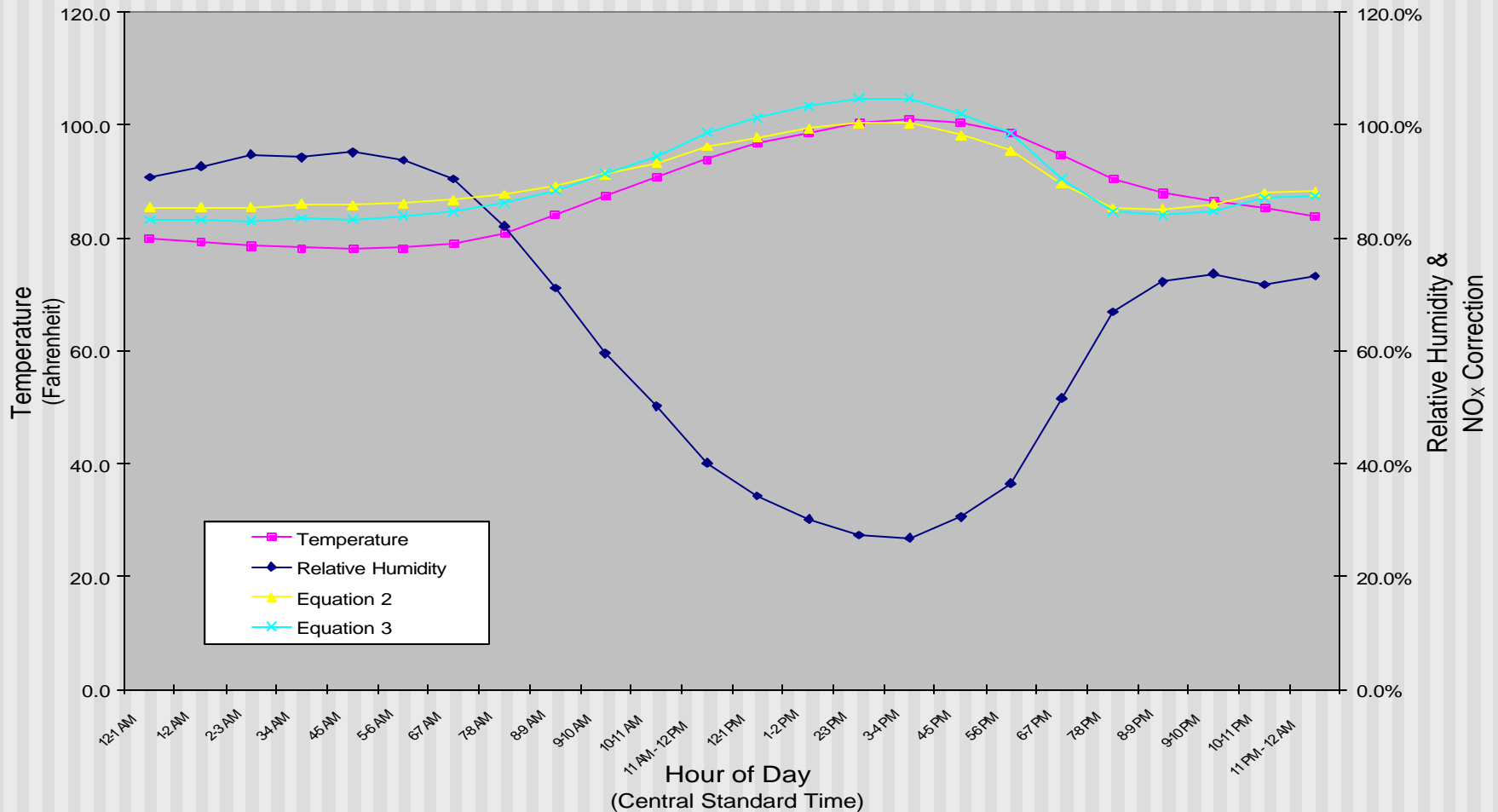
Recommended Diesel NO_x Correction Equations from Draft SwRI Report

- Equation “2” for 1993-and-older naturally aspirated diesel engines:
 - $KNO_x = 1 + 0.001368 (T_C - 29.444) - 0.01512 (H - 10.71)$
- Equation “3” for 1994-and-newer turbocharged diesel engines:
 - $KNO_x = 1 + 0.00446 (T_C - 29.444) - 0.018708 (H - 10.71)$
- T_C = Ambient temperature in degrees Celsius
- H = Absolute humidity (“mixing ratio”) in grams of water per kilogram of dry air

Diesel NO_x Corrections by Hour

Harris County Temperature & Humidity Data

Wednesday August 30, 2000



Application of Diesel NO_x Corrections Methodology for Equations 2 & 3

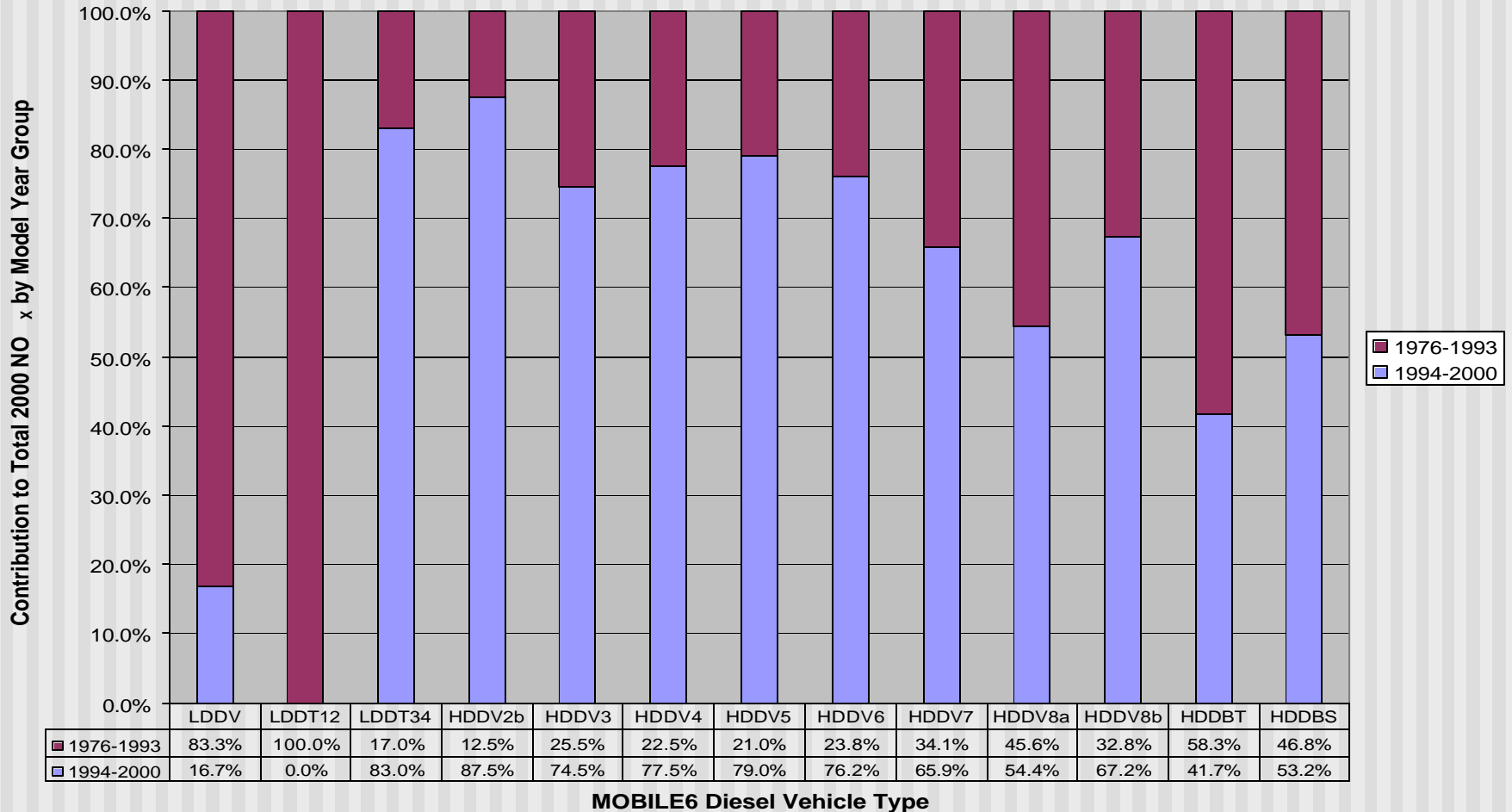
- Onroad Mobile Application
 - For 2000 & 2007, must determine portion of total NO_x from 1993-and-older and 1994-and-newer diesel vehicles
 - Couple MOBILE6 emission rates by 25 model years with VMT estimates by model year for 13 diesel vehicle types

- Nonroad Application
 - For 2000 & 2007, Environ ran NONROAD model to determine portion of total NO_x from naturally aspirated and turbocharged diesel engines
 - Each of ~60 diesel SCC codes divided into 0-50, 50-100, 100-175, and 175+ horsepower categories
 - Higher horsepower engines tend to be turbocharged
 - Weighting fractions different for each SCC code

Diesel Technology Weightings for 2000 Sample Nonroad Vehicle Types by SCC Code 8-County Houston/Galveston Area

<i>SCC Code</i>	<i>SCC Description</i>	<i>Equation 2 Naturally Aspirated</i>	<i>Equation 3 Turbocharged</i>
2270002021	Paving Equipment	46.4%	53.6%
2270002036	Excavators	20.6%	79.4%
2270002045	Cranes	15.9%	84.1%
2270002066	Tractors/Loaders/Backhoes	69.8%	30.2%
2270002069	Crawler Tractor/Dozers	8.8%	91.2%
2270003020	Forklifts	62.8%	37.2%
2270004056	Lawn & Garden Tractors (Commercial)	99.6%	0.4%
2270005015	Agricultural Tractors	28.5%	71.5%
2270008005	Airport Ground Support Equipment	18.8%	81.2%

Diesel NO_x Emissions Contribution by MOBILE6 Vehicle Type & Model Year for Harris County in Calendar Year 2000



Availability of TCEQ Onroad Mobile Source Inventory Data 1999, 2000, & 2007 Calendar Years

- **Houston-Galveston Air Quality Science Evaluation Website**
 - http://www.tnrcc.state.tx.us/air/aqp/airquality_photomod.html
 - Includes data for both 8-County Houston/Galveston area and 3-County Beaumont/Port Arthur area

- **Dallas-Fort Worth Onroad Mobile Inventory FTP Site**
 - <ftp://ftp.tnrcc.state.tx.us/pub/OEPAA/TAD/Modeling/DFWAOSE/Modeling/EI/Mobile/>
 - Includes data for “core” DFW area (Collin, Dallas, Denton & Tarrant Counties) along with data for surrounding “perimeter” counties of DFW MSA

- **Near Nonattainment Area Onroad Mobile FTP Site**
 - <ftp://ftp.tnrcc.state.tx.us/pub/OEPAA/TAD/Modeling/NearNonattainmentAreas/MobileEI/>
 - Includes data for Austin, Corpus Christi, San Antonio, Tyler/Longview, & Victoria areas