



# 2005 & 2006 Episodic Ozone Modeling EI Development Update

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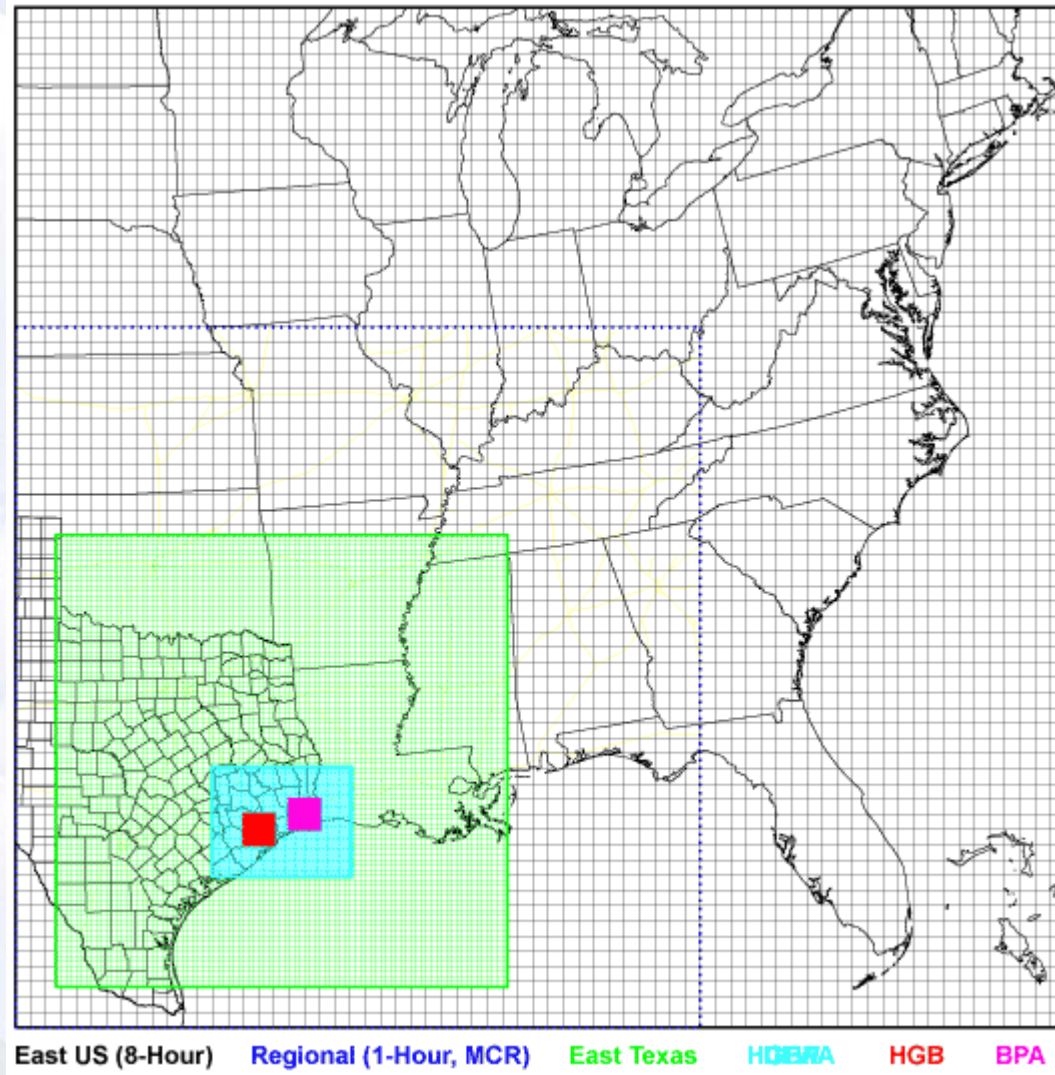
**Southeast Texas Photochemical Modeling  
Technical Committee Meeting  
April 24, 2007**

35 Pages  
April 24, 2007

Ron Thomas  
Air Quality Division

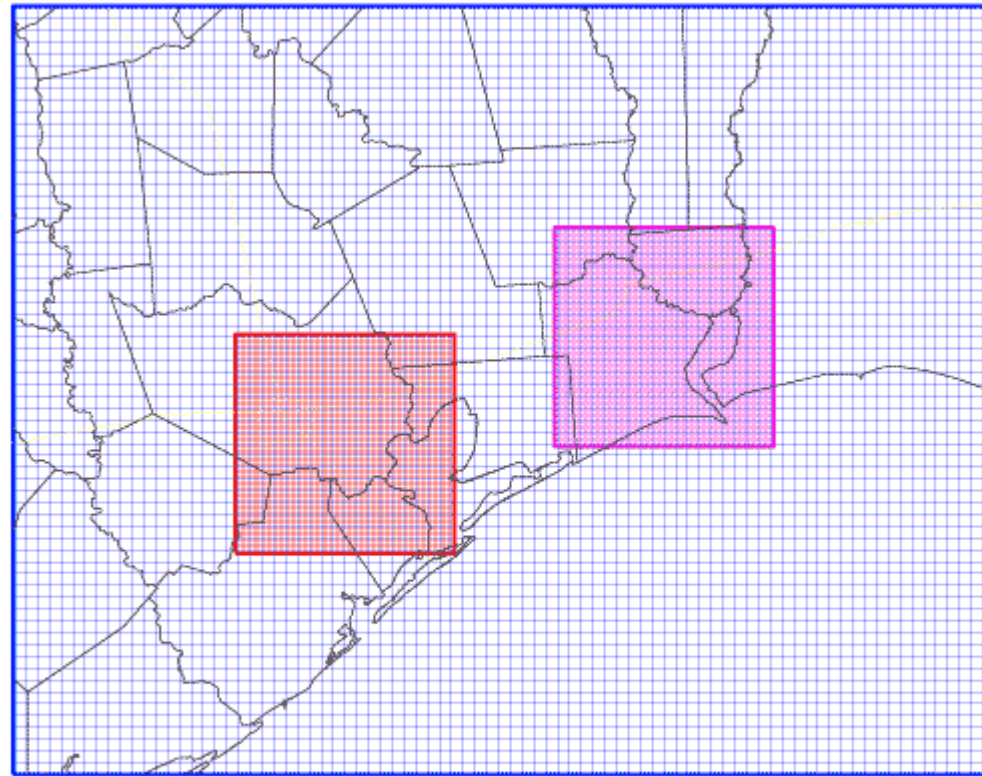


# HGB CAMx Modeling Domain





# HGB “Fine Grid” CAMx Modeling Domain



HGBPA Subdomain

HGB Subdomain

BPA Subdomain



# 2005 & 2006 HGB Episodes

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- May 19 – June 3, 2005
  - School in session until Thursday May 26
  - Memorial Day weekend from May 27-30
- **June 15 – June 30, 2005**
- **July 26 – August 8, 2005**
- May 31 – June 16, 2006
- August 1 – October 15, 2006
  - Period of TxAQS II Study
  - Not all calendar days considered
  - Includes school, non-school, and Labor Day weekend



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# Data Sources and Status for Each Source Category

## Overview



# ***On-Road Mobile Source Inventory Development Plans***

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- “SIP quality” link-based on-road inventories for 8-County HGB and 3-County Beaumont/Port Arthur (BPA)
- “SIP quality” non-link inventories for all other Texas Counties
  - Only need link-based inventories for metropolitan areas within fine grid domain
  - Due to relative reduction factor approach for 8-hour ozone modeling, inventory development methodology should be consistent between base and future cases
- Expect 2005/2006 on-road inventory availability in Fall of 2007:
  - TTI work scheduled for completion in late Summer of 2007
  - TCEQ processing with EPS3 will take roughly two months
- Regional 2005 Completed with National Mobile Inventory Model (NMIM)



## ***Current “Placeholder” On-Road Inventories for Preliminary Photochemical Modeling***

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- “SIP quality” 2007 on-road inventories developed back in 2003-2004 have been adjusted (backcast factors developed) for interim use so preliminary photochemical modeling runs can proceed
- For each county and vehicle type:
  - Vehicle miles traveled (VMT) interpolated between 2002 and 2007 “SIP quality” inventories
  - Relative NO<sub>x</sub>, VOC, and CO emission rate differences determined with MOBILE6.2
  - Final emission adjustment factors determined and applied to 2007 photochemical modeling inventories



# Summary of 8-County HGB On-Road Weekday Emissions From 2000-2012

Calendar Year	Daily VMT	On-Road Weekday Emissions (tons per day)		
		NO <sub>x</sub>	VOC	CO
2000 "SIP Quality"	127,460,894	356.70	151.07	2,110.85
2002 "SIP Quality"	128,379,434	311.00	133.49	1,798.77
<b>2005 Interpolated</b>	<b>138,963,302</b>	<b>254.17</b>	<b>110.13</b>	<b>1,489.20</b>
2007 "SIP Quality"	146,019,215	200.09	90.44	1,282.97
2009 "SIP Quality"	149,476,895	165.83	79.33	967.43
2012 "SIP Quality"	160,787,260	117.31	63.20	829.24



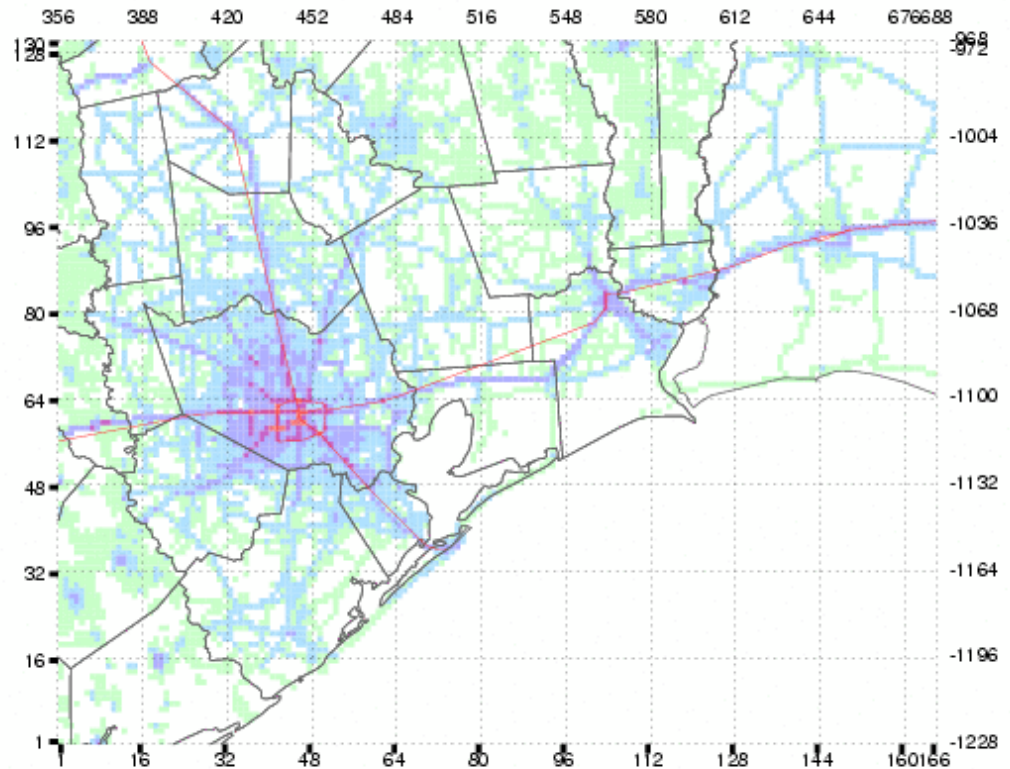
## Sample On-Road Data From NMIM

- Using EPA's National Mobile Inventory Model (NMIM) to estimate on-road and nonroad emissions for non-Texas states
- Sample NMIM on-road output for 6 Louisiana Parishes contained in HGB subdomain:
  - Allen
  - Beauregard
  - Calcasieu
  - Cameron
  - Jefferson Davis
  - Vernon

<b>Calendar Year</b>	<b>Weekday Emissions (tons per day)</b>		
	<b>NO<sub>x</sub></b>	<b>VOC</b>	<b>CO</b>
2000	30.43	19.09	226.49
2002	29.57	17.63	216.86
2005	21.76	13.08	147.54
2006	19.78	12.12	128.49
2007	18.46	11.50	122.84
2009	15.75	10.00	109.96
2012	11.72	8.16	95.21



# 2km On-road Mobile NO<sub>x</sub> Emissions Tileplot for 6/21/05 (Tuesday)

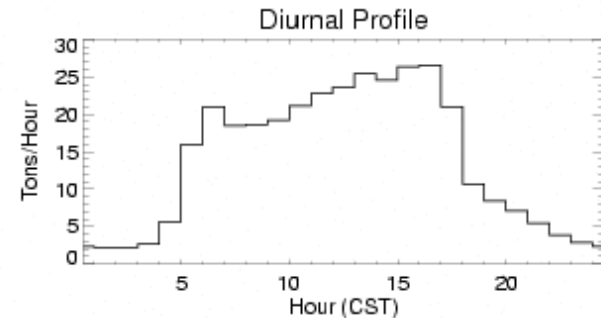


bc05jul.regular0.hgbpa\_04km On-Road Mobile Source NO<sub>x</sub> Emissions, 08/30/2005

Emissions Plotted	
County	Tons/Day
Brazoria	10.48
Chambers	5.81
Fort Bend	16.40
Galveston	9.05
Harris	172.15
Liberty	5.23
Montgomery	20.81
Waller	5.33
<b>HGB SUBTOTAL:</b>	<b>245.25</b>
Hardin	2.95
Jefferson	18.68
Orange	8.88
<b>BPA SUBTOTAL:</b>	<b>30.51</b>
<b>MAP TOTAL:</b>	<b>338.23</b>

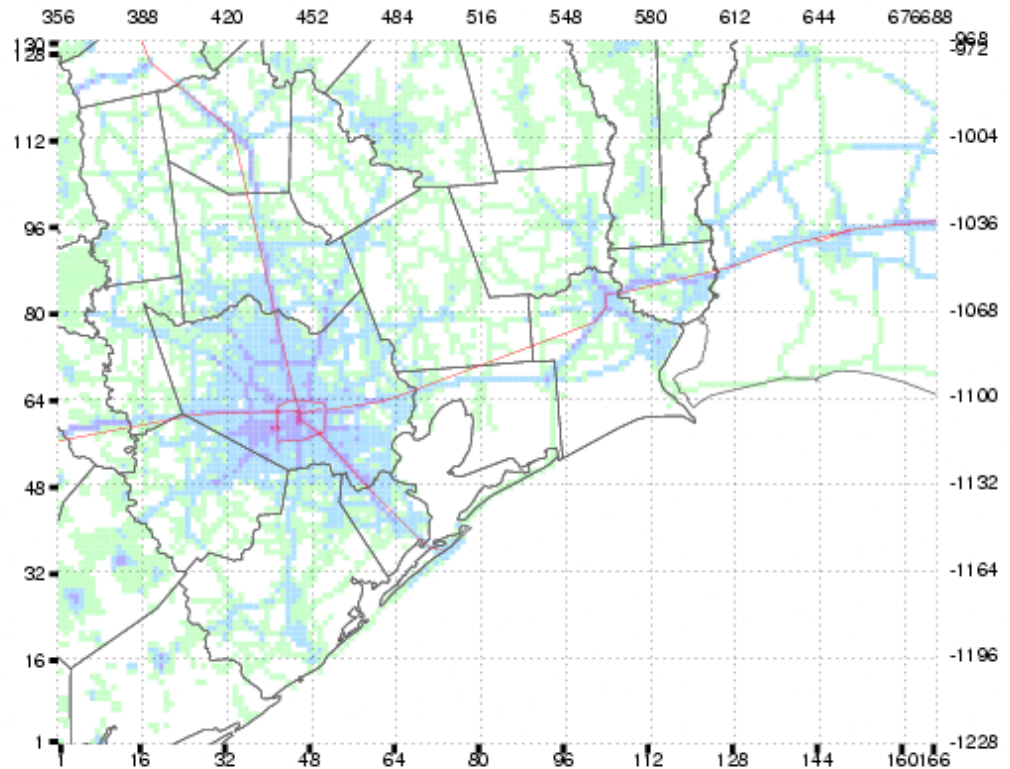


Max: 1.789 t/d (447, -1109); Min: 0.000 t/d (385, -1227)



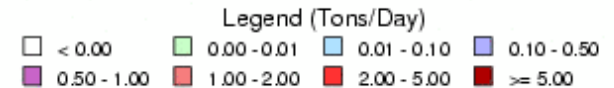


# 2km On-road Mobile NO<sub>x</sub> Emissions Tileplot for 6/26/05 (Sunday)

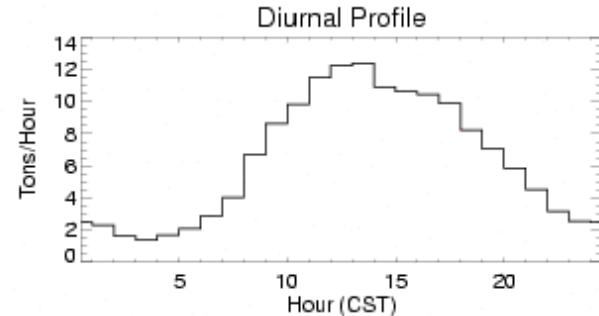


bc05jul.regular0.hgbpa\_04km On-Road Mobile Source NO<sub>x</sub> Emissions, 08/27/2005

Emissions Plotted	
County	Tons/Day
Brazoria	4.50
Chambers	2.46
Fort Bend	6.80
Galveston	4.17
Harris	74.51
Liberty	2.32
Montgomery	8.57
Waller	2.26
<b>HGB SUBTOTAL:</b>	<b>105.60</b>
Hardin	1.53
Jefferson	8.40
Orange	3.91
<b>BPA SUBTOTAL:</b>	<b>13.84</b>
<b>MAP TOTAL:</b>	<b>153.01</b>



Max: 0.805 t/d (447, -1109); Min: 0.000 t/d (385, -1227)





# Non-road Modeled Data

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- Texas Nonattainment Areas
  - Updated Surveys
  - Ships as pseudo points and projected with cargo trends
  - NONROAD model run for 2005
- Texas Attainment Counties
  - Start with TexAER 2002 PEI
  - Trains, planes, and ships grown to 2005 using EGAS5
  - Trains and harbor vessel federal controls applied for 2005
  - NONROAD model categories projected to 2005 from 2002 with NMIM ratio
- Other states
  - National Mobile Inventory Model (NMIM) run for 2005
  - Trains, planes, and ships as above, starting with 2002 NEI
- Offshore (MMS, 2000 GWEI, 2005 update?)
- Canada, 2000



## 2005 & 2006 8-county HGB Nonroad Source Emissions

<b>Calendar Year</b>	<b>Weekday Nonroad Emissions (tpd) (excludes shipping)</b>	
	<b>NO<sub>x</sub></b>	<b>VOC</b>
2005	130.0	94.5
2006	125.9	89.6



# **Comparison of 8-County HGB Non-Road Weekday Emissions**

Category	HG00_b5 (tpd)		HG02_b6 (tpd)		HG05_b6b (tpd)	
	NOx	VOC	NOx	VOC	NOx	VOC
Agriculture	2.95	0.44	3.1	0.47	2.73	0.43
Aircraft	4.46	1.27	5.56	1.59	6.05	1.73
Commercial	6.47	8.67	8.08	13.7	7.46	12.67
Construction	45.62	8.36	55.78	12.45	52.1	10.85
GSE	1.21	0.41	0.79	0.09	0.72	0.09
Industrial	14.72	3.59	37.71	8.9	33.45	7.9
Commercial Lawn+Garden	1.42	10.64	7.87	45.41	7.21	35.84
Residential Lawn+Garden	1.33	11.47	0.83	12.31	0.95	13.36
RR Maintenance	0.14	0.03	0.08	0.02	0.07	0.02
Logging	0.44	0.24	0.4	0.26	0.31	0.23
Locomotives	17.8	0.72	23.62	1.52	17.92	1.52
Oil+Gas	13.61	3.47	0.63	0.13	0.46	0.11
Recreational Equipment	0.21	3.56	0.18	3.79	0.18	5
Recreational Boating	0.96	16.02	0.5	5.51	0.56	4.94
Ships	37.54	0.85	36.89	0.92	34.47	0.97
<b>total</b>	<b>148.88</b>	<b>69.74</b>	<b>182.02</b>	<b>107.07</b>	<b>164.64</b>	<b>95.66</b>
<b>minus ships</b>	<b>111.34</b>		<b>145.13</b>		<b>130.17</b>	



# Area Source Modeled Data

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- Texas Nonattainment Areas
  - 2005 data from draft TexAER data
- Texas Attainment Counties
  - Start with TexAER 2002 PEI
  - Projected to 2005 with EGAS5
- Other states
  - Start with 2002 NEI
  - Projected to 2005 with EGAS5
- Offshore (MMS, 2000 GWEI, 2005 update?)
- Canada, 2000



## 2005 & 2006 8-county HGB Area Source Emissions

<b>Calendar Year</b>	<b>Weekday Area Source Emissions (tpd)</b>	
	<b>NO<sub>x</sub></b>	<b>VOC</b>
<b>2005</b>	43.0	260.5
<b>2006</b>	42.8	264.4

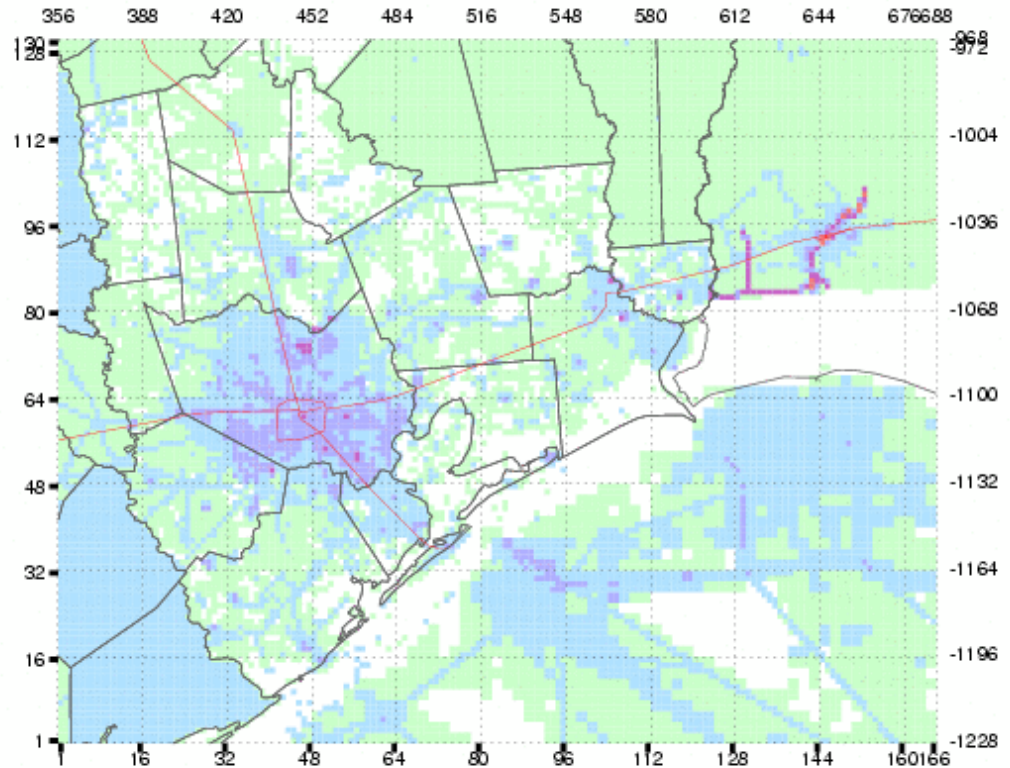


# Comparison of 8-County HGB Area Source Weekday Emissions

Category	area00_b5a (tpd)		area05_b6 (tpd)	
	NOx	VOC	NOx	VOC
Architectural Coating	0	27.26	0	30.36
Asphalt Paving	0	7.93	0	8.49
Auto Refinishing	0	3	0	3.18
Bakeries+Breweries	0	0.69	0	1.32
Drycleaning	0	5.06	0	2.8
Graphic Arts	0	0.86	0	0.91
Industrial Fuel Use	15.46	0.42	16.21	0.53
Leaking Underground ST	0	2.31	0	2.34
Oil+Gas Production	21.94	16.24	23.75	17.54
Open Burning	0.33	6.68	0.73	9.42
Pesticide Use	0	0.01	0	0.01
Petro Transport+Refueling	0	76.7	0	67.62
Residential Fuel Use	2.66	0.15	2.29	0.13
Solvent Use and Surface Clean/Coat	0	93.08	0	107.31
Traffic Marking	0	0.6	0	0.6
Waste Treatment	0	7.45	0	7.96
<b>total</b>	<b>40.39</b>	<b>248.44</b>	<b>42.98</b>	<b>260.52</b>

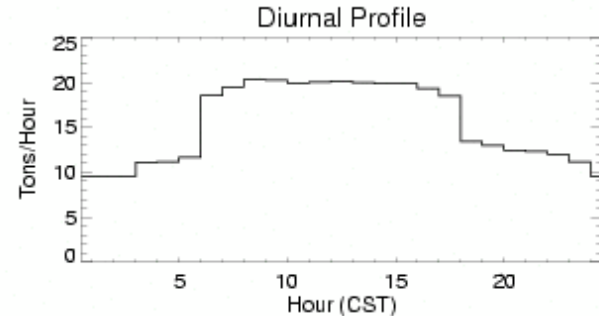
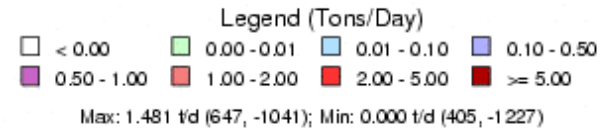


# 2km Area/Non-road/Offshore NOx Emissions Tileplot for 6/21/05 (Tuesday)



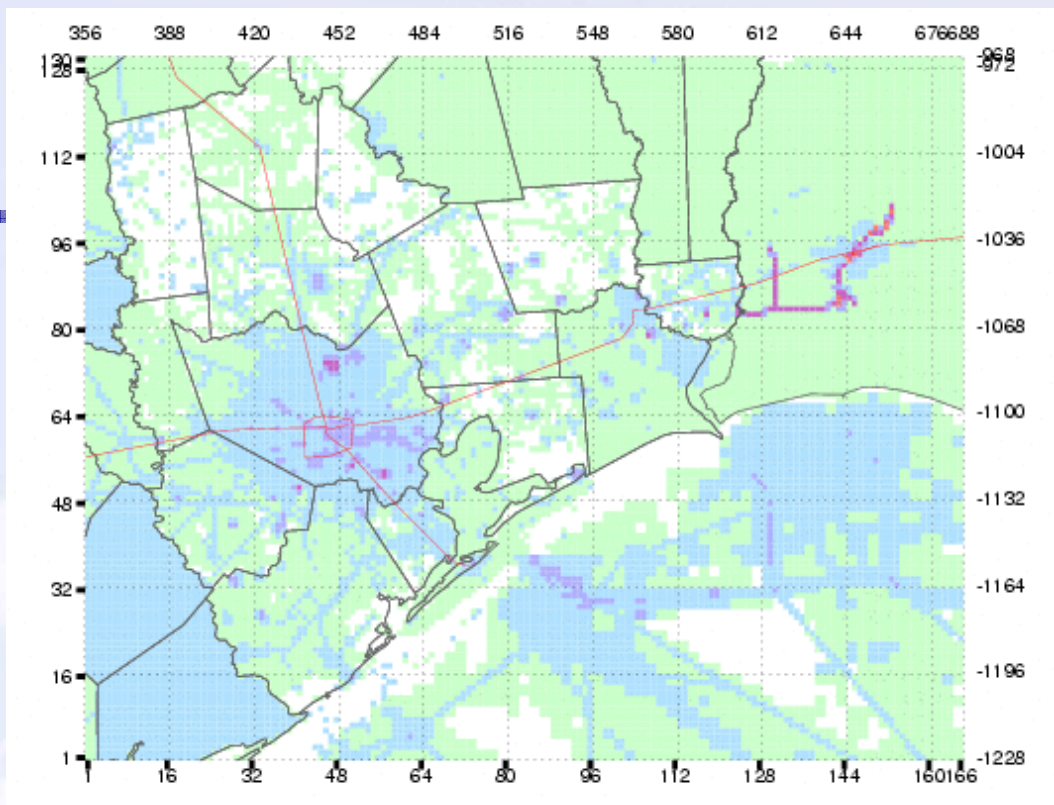
by05\_6b.hgbpa\_04km Total Merged Area NonRoad Offshore Source NO<sub>x</sub> Emissions, 08/03/2005

Emissions Plotted	
County	Tons/Day
Brazoria	12.17
Chambers	4.53
Fort Bend	13.81
Galveston	8.95
Harris	116.16
Liberty	6.62
Montgomery	8.61
Waller	1.75
<b>HGB SUBTOTAL:</b>	<b>172.60</b>
Hardin	3.10
Jefferson	11.49
Orange	5.44
<b>BPA SUBTOTAL:</b>	<b>20.03</b>
<b>MAP TOTAL:</b>	<b>373.22</b>



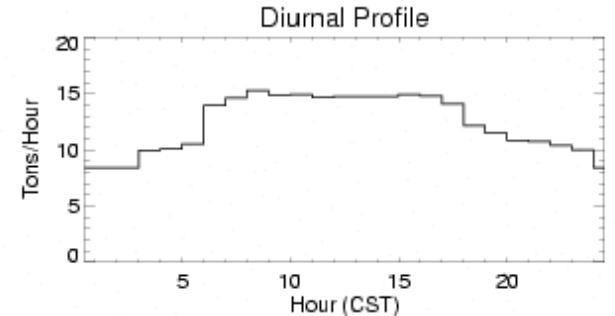
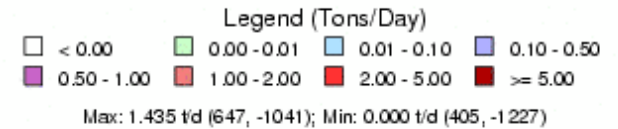


# 2km Area/Non-road/Offshore NO<sub>x</sub> Emissions Tileplot for 6/26/05 (Sunday)



by05\_6b.hgbpa\_04km Total Merged Area NonRoad Offshore Source NO<sub>x</sub> Emissions, 08/07/2005

Emissions Plotted	
County	Tons/Day
Brazoria	9.49
Chambers	4.17
Fort Bend	9.85
Galveston	6.87
Harris	62.40
Liberty	5.91
Montgomery	5.82
Waller	1.46
<b>HGB SUBTOTAL:</b>	<b>105.97</b>
Hardin	2.66
Jefferson	7.71
Orange	4.47
<b>BPA SUBTOTAL:</b>	<b>14.85</b>
<b>MAP TOTAL:</b>	<b>297.68</b>





# Sources of Point Source Modeled Data

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- STARS snapshot (2004, 2005)
- Special Inventory (2005, 2006)
- CCEDS (EE/MSS 2005, 2006)
- Acid Rain Program CEM (all states 2005, 2006)
- Louisiana (LDEQ, 2004 AFS)
- Oklahoma (ODEQ, 2005 NEI)
- Arkansas (ADEQ, 2005 NEI)
- Offshore (MMS, 2000 GWEI, 2005 update?)
- Regional (NEI, 2002 Final or 2002 RPO)
- Canada (Canada, 2000)
- Mexico (BRAVO, 2000)



## ***Point Source Inventory Status***

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- **2005 STARS data currently incomplete and not fully quality assured/controlled**
  - When complete (June 1 ?), will use 2005 STARS for all 2005 & 2006 episodes with 2005 and 2006 Hourly (Acid Rain, CCEDS, SI) where applicable
- **For preliminary photochemical modeling runs:**
  - Started with 2004 STARS data
  - Substituted hourly episodic 2005 Acid Rain data
  - Will substitute hourly CCEDS and SI data
    - Start with worst case CCEDS data to test sensitivity
    - Writing code to extract and convert STARS SI data
  - Using 2002 NEI data for non-Texas non-Acid Rain; will grow to 2005 with EGAS5

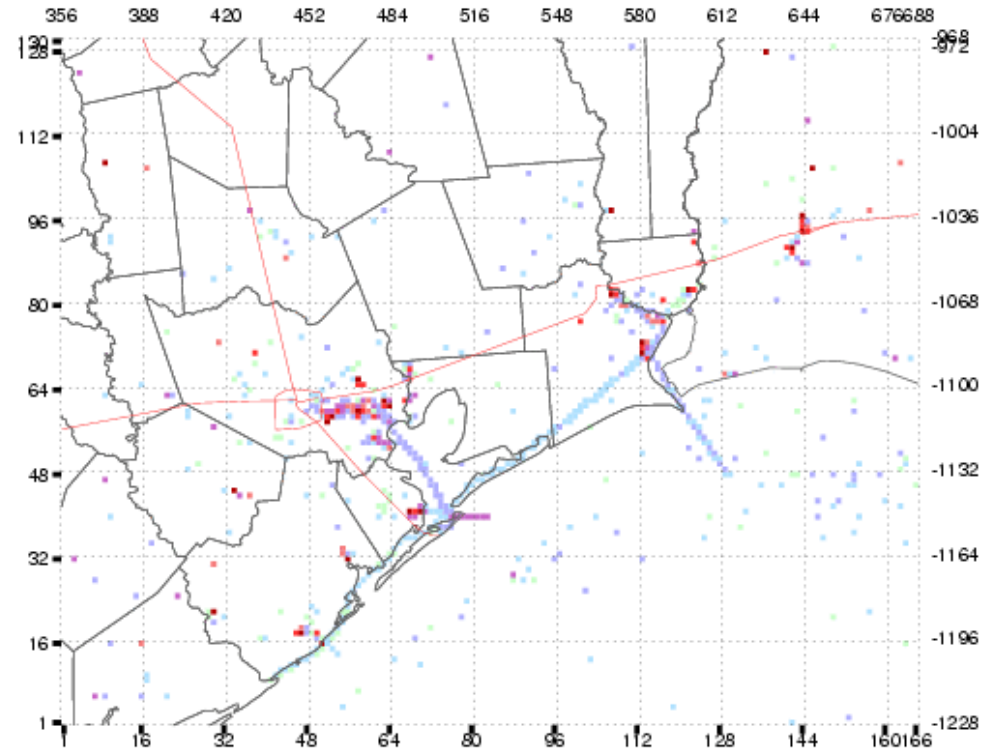


## Comparison of 8-county HGB Point Source STARS Data

<b>STARS Database</b>	<b>8-County Daily Emissions (tpd)</b>		
	<b>NO<sub>x</sub></b>	<b>VOC</b>	<b>HRVOC (subset of VOC)</b>
2000	448.6	183.7	27.1
2004	232.1	198.0	19.2
2005 (Incomplete)	164.0	123.3	27.1

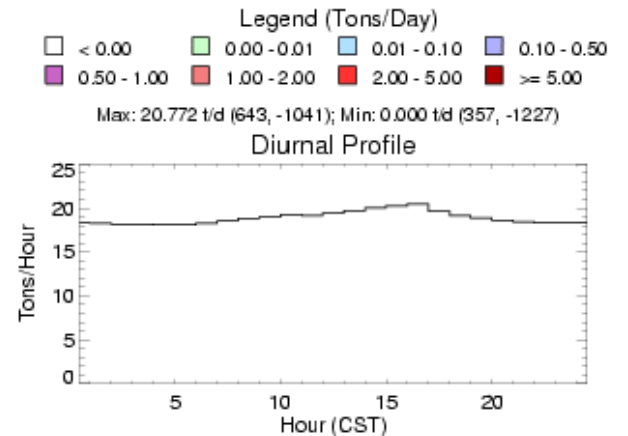


**2km Elevated NO<sub>x</sub> Emissions (Point Source and Ships) Tileplot for 6/19/05 (Sunday, lowest day of the episode)**



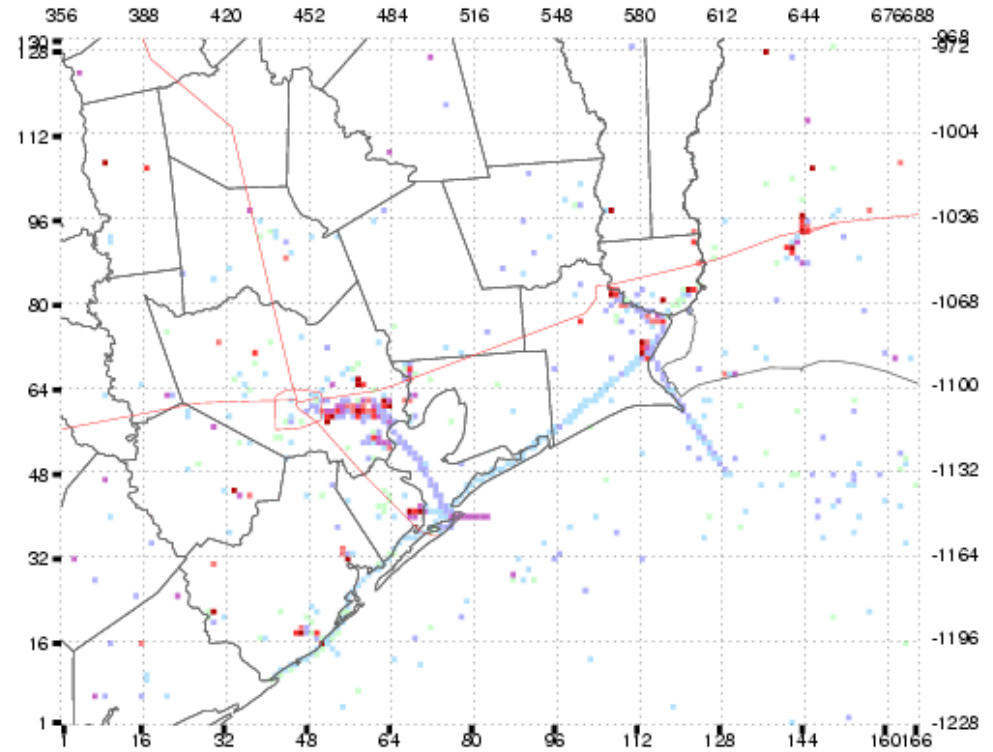
hg8h2.bc05jun.regular0 All Elevated Source Emissions, 06/19/2005: NO<sub>x</sub>

Emissions Plotted	
County	Tons/Day
Brazoria	52.33
Chambers	11.99
Fort Bend	20.28
Galveston	35.34
Harris	117.11
Liberty	0.87
Montgomery	3.28
Waller	1.20
<b>HGB SUBTOTAL:</b>	<b>242.40</b>
Hardin	1.41
Jefferson	57.53
Orange	22.42
<b>BPA SUBTOTAL:</b>	<b>81.36</b>
<b>MAP TOTAL:</b>	<b>453.37</b>



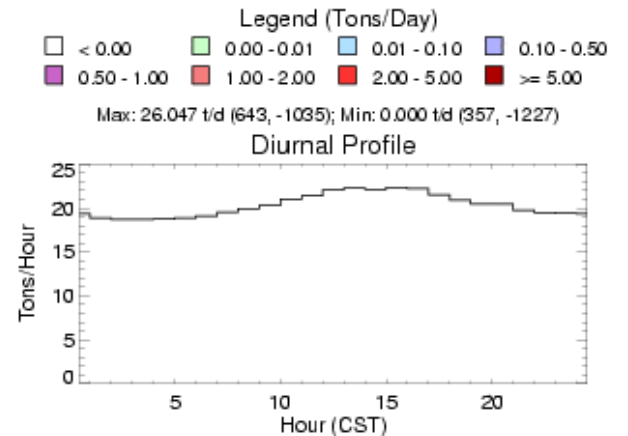


**2km Elevated NO<sub>x</sub> Emissions (Point Source and Ships) Tileplot for 6/30/05 (Thursday, highest day of the episode)**



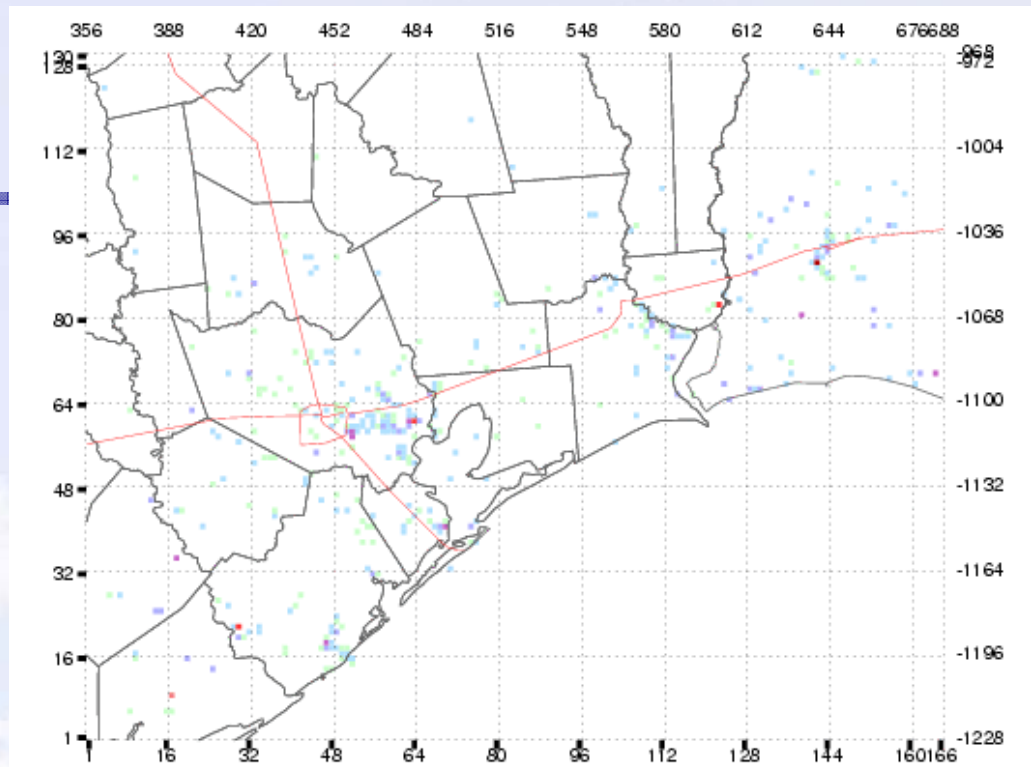
hg8h2.bc05jun.regular0 All Elevated Source Emissions, 06/30/2005: NO<sub>x</sub>

Emissions Plotted	
County	Tons/Day
Brazoria	52.96
Chambers	12.22
Fort Bend	24.88
Galveston	35.37
Harris	124.26
Liberty	0.87
Montgomery	3.23
Waller	1.20
<b>HGB SUBTOTAL:</b>	<b>254.40</b>
Hardin	1.41
Jefferson	57.45
Orange	38.02
<b>BPA SUBTOTAL:</b>	<b>96.88</b>
<b>MAP TOTAL:</b>	<b>487.93</b>



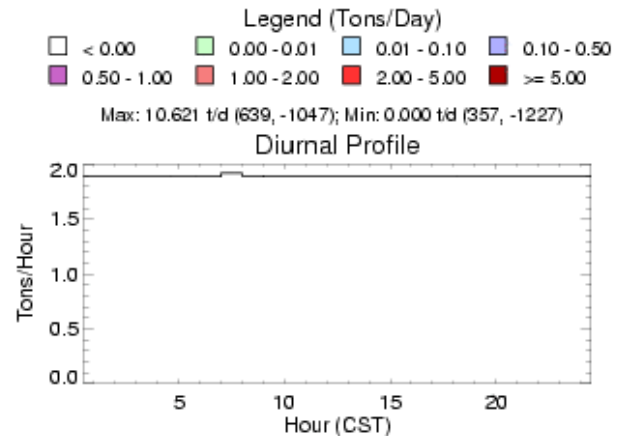


# 2km Low Level Point Source NO<sub>x</sub> Emissions Tileplot for 6/21/05 (Tuesday)



hg8h2.bc05a\_osd Low Level Point Source Emissions, 06/22/2005: NO<sub>x</sub>

Emissions Plotted	
County	Tons/Day
Brazoria	6.79
Chambers	0.32
Fort Bend	0.32
Galveston	1.87
Harris	9.80
Liberty	0.15
Montgomery	0.40
Waller	0.16
<b>HGB SUBTOTAL:</b>	<b>19.82</b>
Hardin	0.22
Jefferson	1.85
Orange	2.67
<b>BPA SUBTOTAL:</b>	<b>4.74</b>
<b>MAP TOTAL:</b>	<b>45.96</b>





# Sources of Biogenic Modeled Data

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- Land Cover & Vegetation Data
  - UT Center for Space Research has developed new data, circa 1999-2003. Uses data from Texas Forest Service's Houston Green project, USDA Forest Inventory & Analysis data, new USGS National Land Cover Data, recent satellite and aerial photography
- Temperature Data
  - Kriging of observed surface temperatures to generate grid cell values by day and hour
- Photosynthetically-Active Solar Radiation data
  - GOES8 satellite-derived data
- Model Used: GloBEIS3
  - Guenther, et al. & Environ, 1999



## ***Biogenic Emissions Inventory Status***

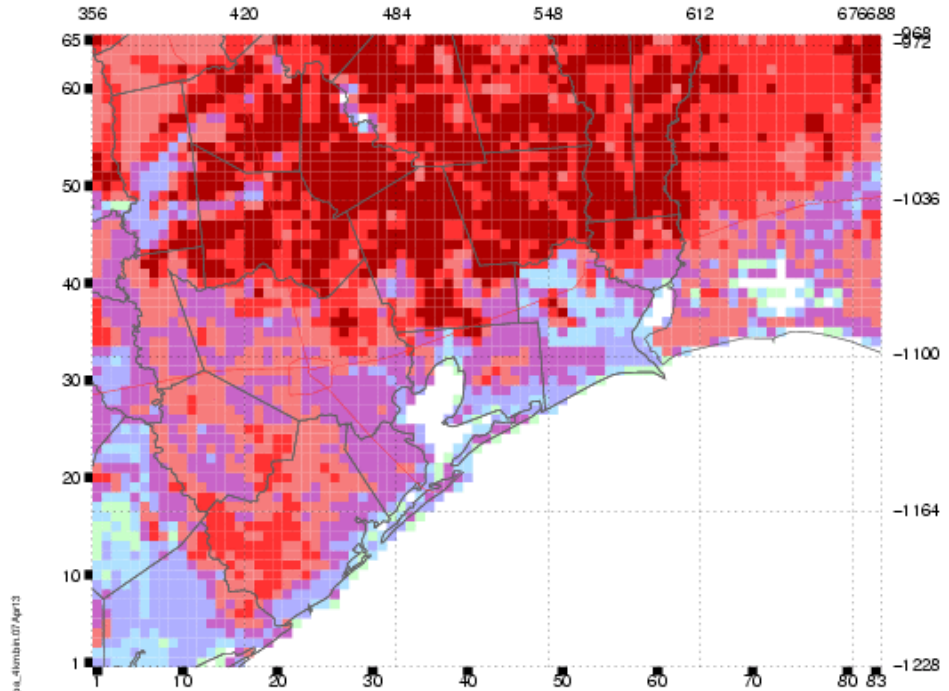
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- Currently developed at 4km in HGB-BPA domain; will be regrided at 2km like rest of processed categories
- Updated land cover data from UT-CSR has been processed
- Upcoming SPLTBEIS will allow for better speciation of individual compounds for GloBEIS



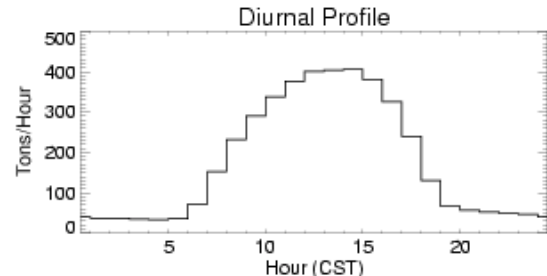
# 4km Biogenic VOC Emissions Tileplot for 6/21/05 using old (Wiedinmyer, 2001) Land Cover data

wiedin\_cb4.wiedin\_cb4.hgbpa\_4km Biogenic VOC Emissions, 06/21/2005



T:\HDD\MESTES\0413\2007\1814\05\ref\bio\emissions\2005\0621\wiedin\_cb4\hgbpa\_4km\hgt07Apr13

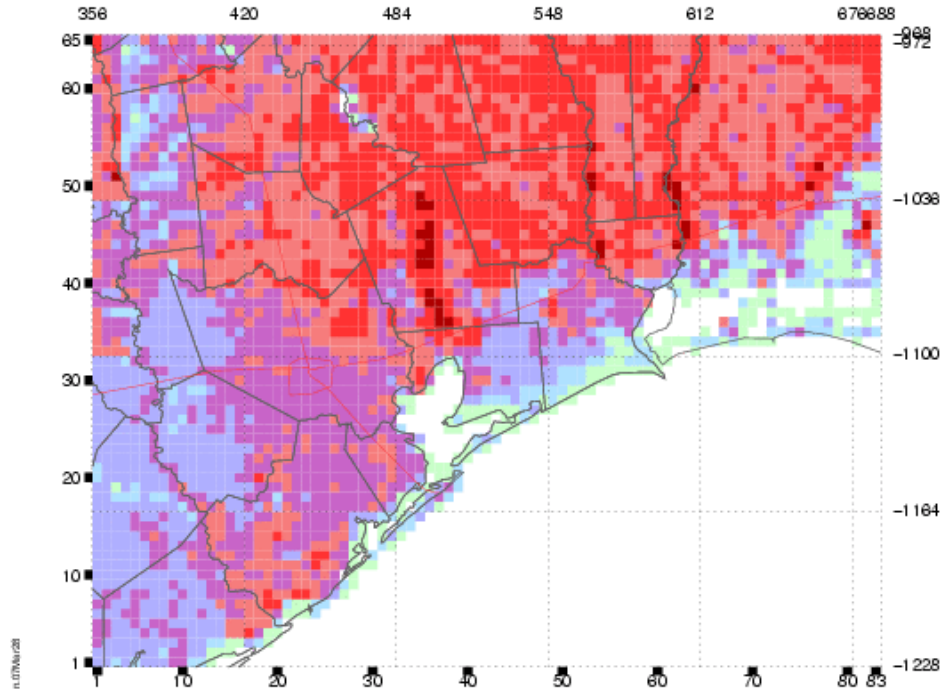
Emissions Plotted	
County	Tons/Day
Brazoria	169.26
Chambers	47.71
Fort Bend	94.36
Galveston	26.42
Harris	210.28
Liberty	330.25
Montgomery	321.74
Waller	62.61
<b>HGB SUBTOTAL:</b>	<b>1262.62</b>
Hardin	305.32
Jefferson	51.08
Orange	75.81
<b>BPA SUBTOTAL:</b>	<b>432.21</b>
<b>MAP TOTAL:</b>	<b>4241.25</b>





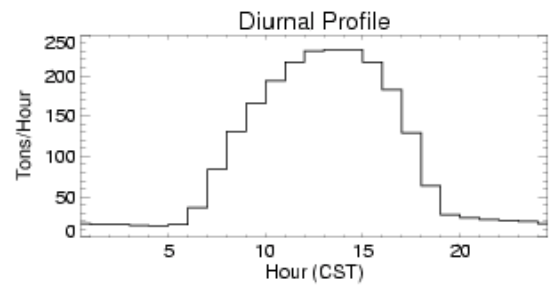
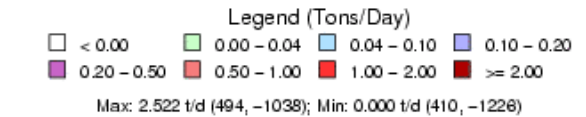
# 4km Biogenic VOC Emissions Tileplot for 6/21/05 using new UT-CSR Land Cover data

~ 50% less



T:\HOC\_3\HOC3AY\_0329\_2107\_18\_3313\_183\emissions\2005\bioc\_4km\_20050621\_csr\_4km.tn.07Mar26

Emissions Plotted	
County	Tons/Day
Brazoria	102.91
Chambers	37.48
Fort Bend	33.89
Galveston	22.17
Harris	141.90
Liberty	202.60
Montgomery	139.77
Waller	23.28
HGB SUBTOTAL:	703.95
Hardin	168.85
Jefferson	46.38
Orange	54.30
BPA SUBTOTAL:	289.51
MAP TOTAL:	2323.04





# Sample HGB-BPA 4km Domain Biogenic Emissions Data

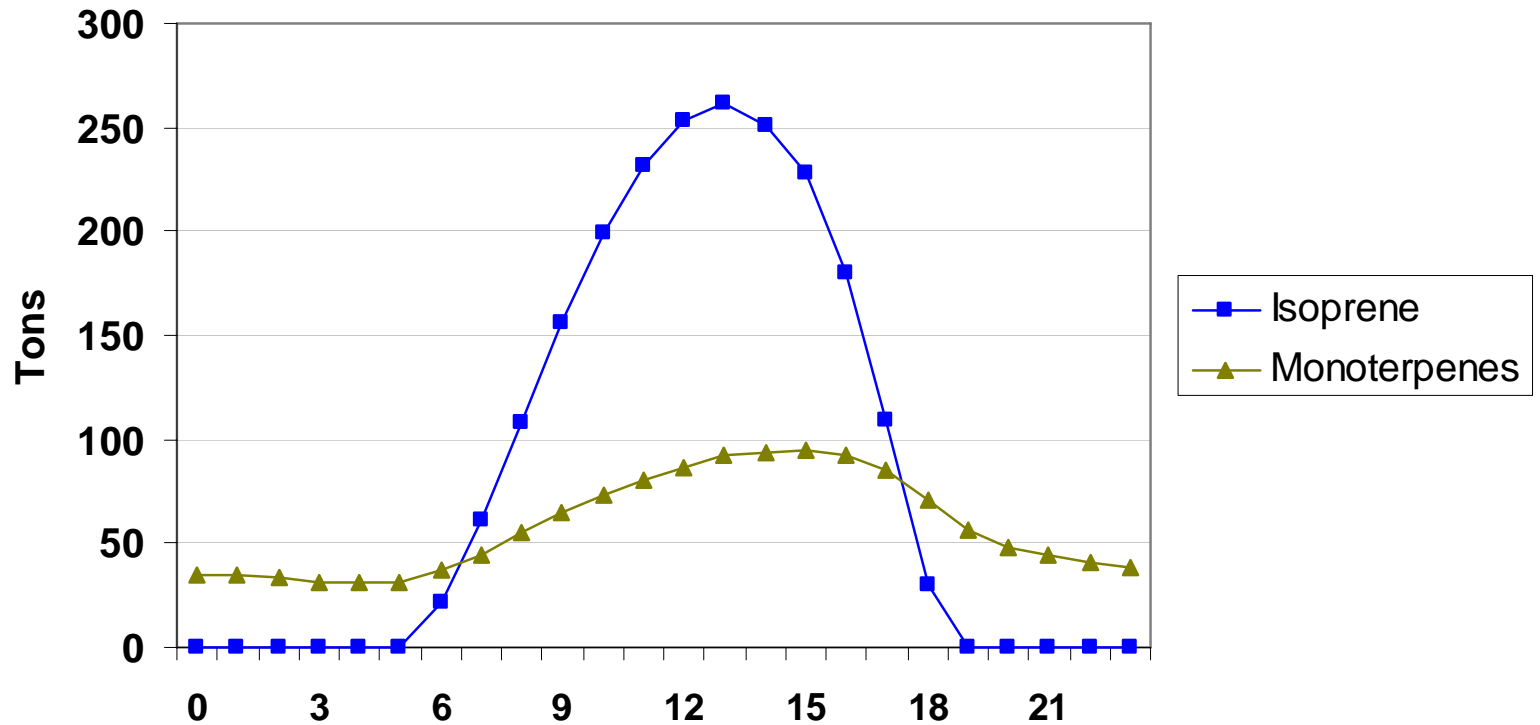
- Sample data for May 21, 2005

Hour	Isoprene (tons)	Monoterpenes (tons)	OVOC (tons)
0	0	34.47	43.8
1	0	34.21	43.32
2	0	33.01	41.86
3	0	31.7	40.29
4	0	31.03	39.46
5	0.27	30.78	39.13
6	22.05	36.66	46.11
7	61.09	44.86	56.1
8	107.93	54.78	68.38
9	155.48	64.46	80.4
10	199.4	73.52	91.92
11	231.97	80.93	101.27
12	253.41	86.78	108.76
13	261.74	92.09	115.22
14	250.68	93.02	116.81
15	227.85	95.26	119.55
16	180.09	92.7	116.56
17	108.69	84.92	107.06
18	29.77	71.22	90.34
19	0	56.87	72.8
20	0	48.5	62.53
21	0	44.53	57.53
22	0	40.92	53.01
23	0	38.44	49.59
Daily Total	2,090.42	1395.66	1761.8



# Sample HGB-BPA 4km Domain Biogenic Emissions Data

Biogenic VOC emissions, HGBPA domain at 4km,  
21 May 2005





# Overall 2005 & 2006 Modeling Episodes Status

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- “First cut” 2005 emissions inventory ready for initial photochemical modeling runs with CB-IV, then CB-05 for comparison
- Expect that CB-05 will completely replace CB-IV
- May-June 2005 episode first run with CB-IV, then CB-05, then 2km biogenics
- “First cut” 2006 emissions inventory development in progress
- Data Analysis for potential emissions imputation in progress (e.g. PSCF)
- Inventory refinements will be ongoing for both 2005 and 2006



# Staff by EI Category

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- **Point Sources**
  - Ron Thomas
  - Marvin Jones
  - Barry Exum, Jocelyn Mellberg
- **Area & Non-road Mobile**
  - Jim MacKay
- **On-road Mobile**
  - Chris Kite
- **Biogenics**
  - Mark Estes
  - Clint Harper



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# Questions