

Houston SIP Modeling Update

Tank Landing Loss Emissions

Danielle Nesvacil

David Harper

Marvin Jones

Dick Karp



CAMx Ozone Modeling in SIP Development

The Big Picture

Base Case

Day-specific meteorology and emissions;
replicate what actually happened

Baseline Case

Day-specific meteorology and Typical emissions;
used in RRF to predict future design values

Future Base Case

Apply future growth + on-the-books controls
to estimate future ozone

Control Strategy Testing

Determine control strategies that will
effectively reduce ozone

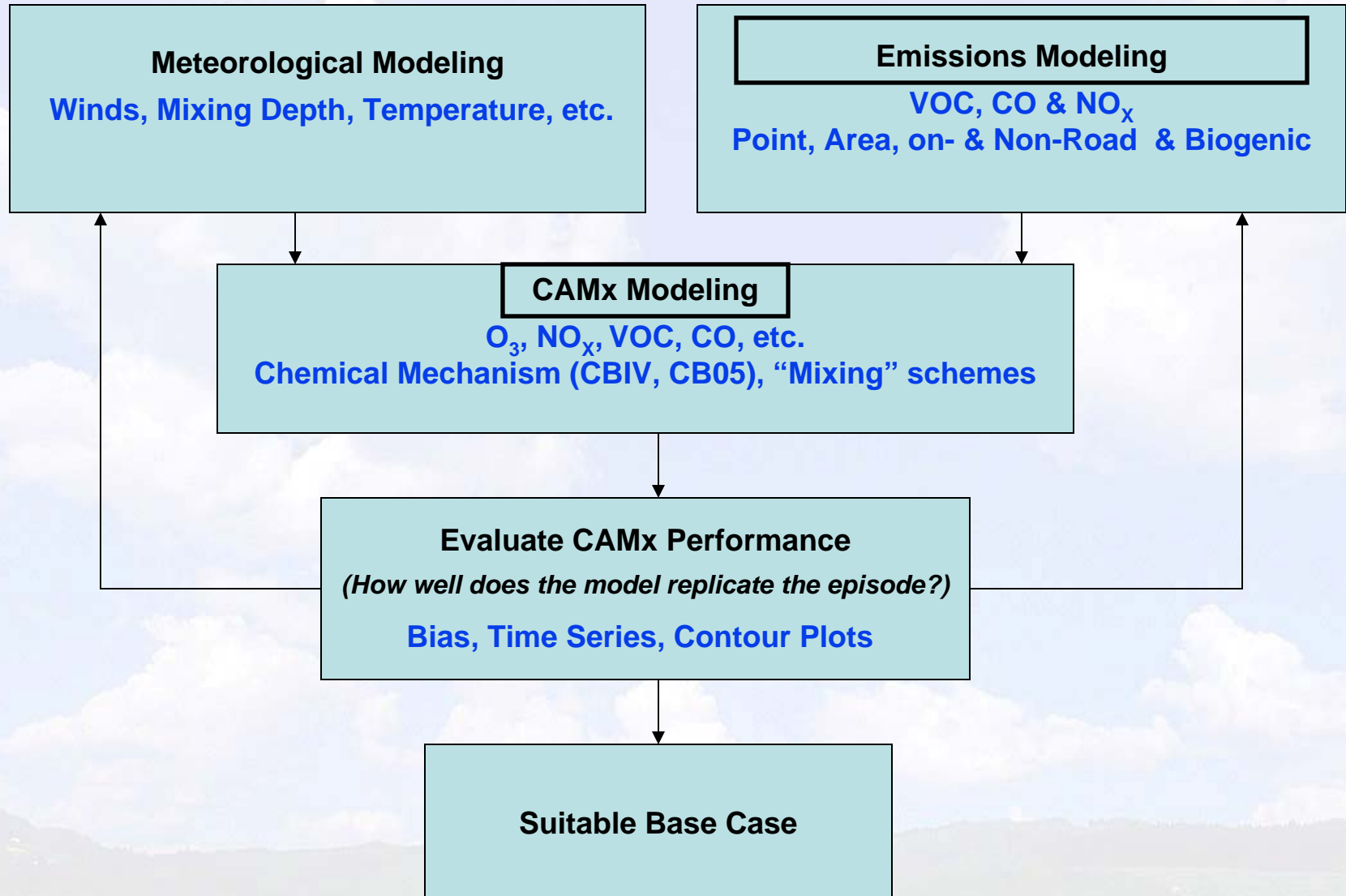
SIP

Document modeling procedures



CAMx Ozone Modeling in SIP Development

Base Case – Historical Episode Replication





Tank Landing Loss Emissions

- Emissions Inventory Revision Request: Background
- Development of Episodic Tank Landing Loss (TLL) Emissions
- Emissions Modeling: Reformat & Chemically Speciate
- CAMx Modeling: Ozone & Precursor Evaluation



Emission Inventory Revision Request: Background

- Remote Sensing Volatile Organic Compound (VOC) Project
 - Occurred in July 2005 as part of the second Texas Air Quality Study
 - Used passive infrared cameras to conduct aerial and ground surveys in the following industrial areas:
 - Houston Ship Channel
 - Texas City
 - Beaumont-Port Arthur
 - Observed large visible VOC plumes from storage tanks as well as other sources
 - Contacted regulated entities and requested information concerning emissions sources with visible plumes



Leak Surveys Inc.

*The HAWK
Leak Detection System*

*1-325-641-8147
www.LeakSurveysInc.com*



Emission Inventory Revision Request: Background

- As a result of the 2005 Remote Sensing VOC Project, landing loss emissions were identified as potentially under-reported emissions in the point source inventory
- Emissions Assessment Section requested emissions inventory revisions from 52 regulated entities in the Houston-Galveston-Brazoria (HGB) area
 - Focused on bulk terminals, tank leasing terminals, and pipeline terminals
- Results:
 - 7,000 to 8,000 ton annual VOC increase in HGB area
 - payments of back emissions fees
 - permitting actions
 - reductions in lost raw products



Emission Inventory Revision Request: Background

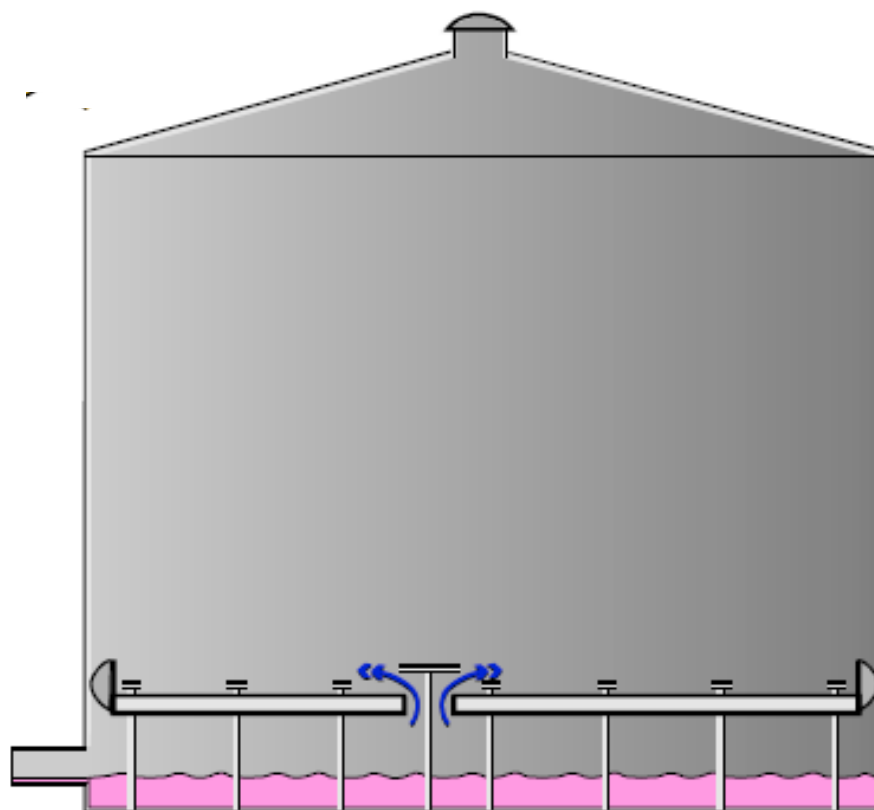
- Contributors from the Emissions Inventory Team:
 - Darron Blackburn
 - Adam Bullock
 - Mark Chambers
 - Rene Chavira
 - Evelyn Gutierrez
 - Stephanie Lane
 - Linda Martinez
 - Danielle Nesvacil
 - Alfred Reyes
 - Rafael Reyes
 - Rhonda Scott
 - Denise Zachary



Development of Episodic TLL Emissions

- Tank Landing Diagrams
- Project Goals
- Selected Facilities
- Information Processing

Standing Idle Losses – Floating Roof Tank with a Liquid Heel

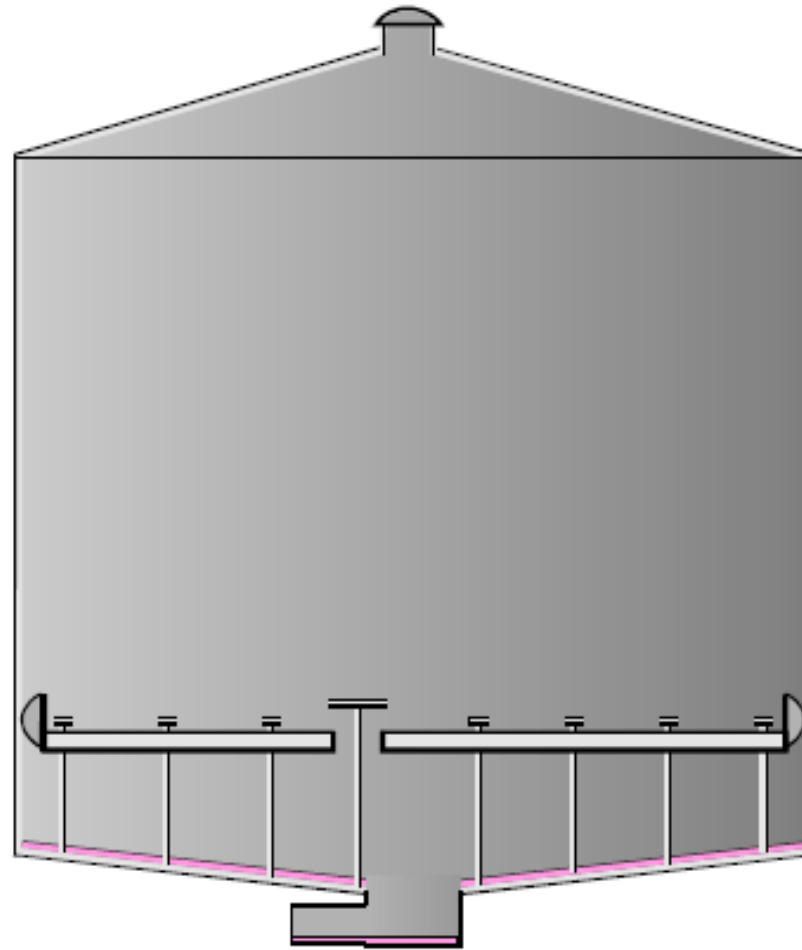


The headspace above the floating roof is either open to the atmosphere (in the case of an EFRT) or freely vented to the atmosphere (in the case of an IFRT).

Daily breathing expels vapors from under the floating roof.

Source: API, 2004

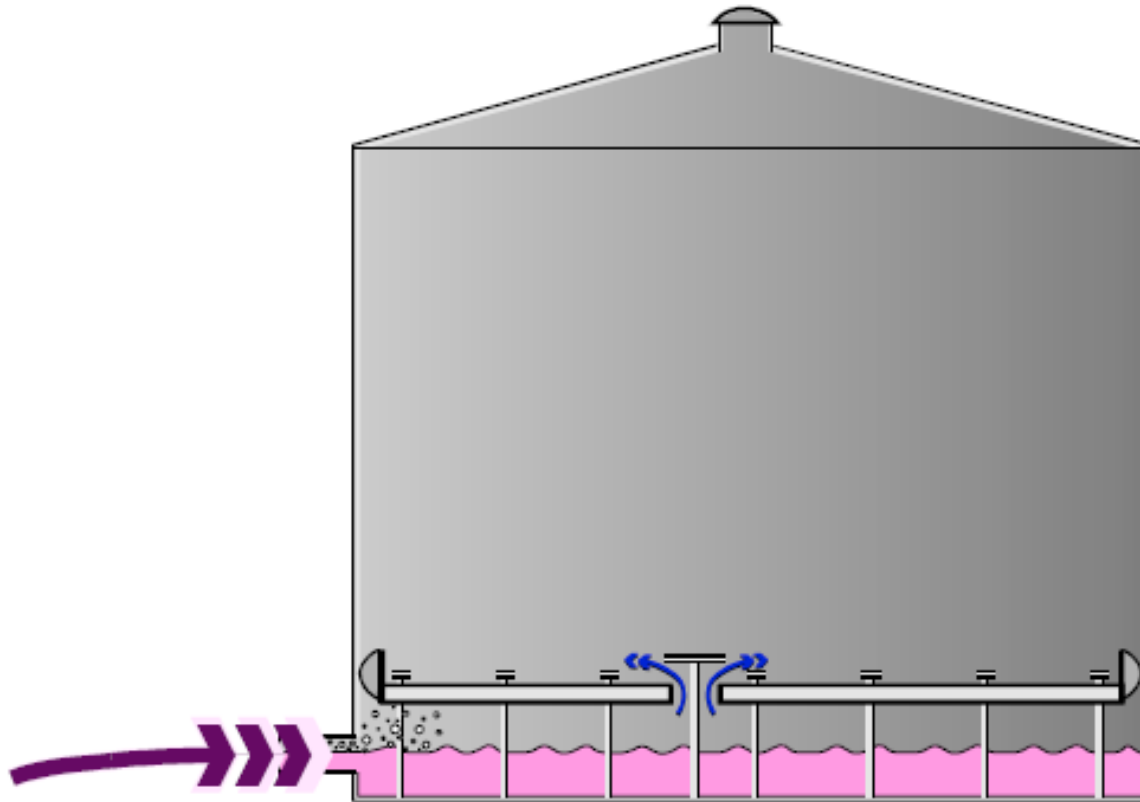
Standing Idle Losses – Floating Roof Tank - Drain Dry



The bottom of a drain-dry tank slopes to a sump, and the withdrawal line is in the sump.

Source: API, 2004

Filling Losses – Floating Roof Tank



When the tank is refilled, the incoming liquid displaces vapors from under the floating roof.

Source: API, 2004



Development of Episodic TLL Emissions

- Goal: Episodic landing loss emissions on a tank-specific basis for input to the HGB photochemical modeling
- Modeling and point source inventory staff met to discuss the specific information needed for the modeling
- Data were needed for tank landing events that fell within or overlapped with the 2005 and 2006 modeling episodes
- Previous screening of sources with highest landing loss emissions during 2002-2004 resulted in our focusing on 11 sites in the HGB area



Development of Episodic TLL Emissions

- Kinder Morgan Pasadena
- Kinder Morgan Galena Park
- Oil Tanking Houston
- Magellan Galena Park
- LBC Houston
- Intercontinental Terminals
- Marathon Ashland Pipe (no landings applicable to modeling episodes)
- Vopak Deer Park
- Teppco Seaway Jones Creek
- Teppco Baytown
- Teppco Seaway Galena Park



Development of Episodic TLL Emissions

- Point source inventory staff worked with company contacts to obtain electronic files of data for landed tanks
- Data were organized by point source inventory staff into spreadsheets having formats agreed upon with the modelers
- Information for each event included:
 - Tank contents
 - Speciation methodology
 - Landing/refloating/degassing start and end dates/times
 - Standing idle losses
 - Refilling losses
 - Degassing emissions if applicable
 - Emissions shown as event totals and as hourly rates



Development of Episodic TLL Emissions

- Not all needed data were available
- For example, if the start and end dates/times for refloating were not available, we assumed refloating occurred during early morning hours, which would be a conservative assumption for ozone formation
- So, if we calculated a refloat duration of 3 hours based on a known vapor space under the landed roof and an estimated refill rate, we would assign the refloating emissions to the period 6:00 – 9:00 a.m.



Development of Episodic TLL Emissions

- Contributors from Emissions Inventory Team:
 - David Harper
 - Perry Bedford
 - Martha Maldonado
 - Danielle Nesvacil
- Emissions Inventory Team management:
 - Kevin Cauble
 - Michael De La Cruz
 - Russ Nettles



Emissions Modeling

- Air modeling staff worked with emissions inventory staff to obtain the properly formatted spreadsheets, which were processed with SAS into the AFS file format compatible with EPS3
- EPS3 spatially and temporally distributes, and chemically speciates the emissions as per the information provided in the spreadsheets
- Chemical speciation is based upon typical chemical composition of various hydrocarbon fluids (e.g., crude oil, gasoline, etc.)



Emissions Modeling – Spreadsheet Excerpt

Company	Account #	FIN	EPN	Type of Floating Roof Tank	Landing Start Date and Time	Landing End Date and Time
TEPPCO	BL0571U	SW02TANK01	SW02TANK01	External Floating Roof Tank	6/27/2005 2:26	6/27/2005 11:08
TEPPCO	BL0571U	SW02TANK01	SW02TANK01	External Floating Roof Tank	6/27/2005 20:37	6/28/2005 14:03
Landing Product Contaminant Name	Refilling Start Date and Time	Refilling End Date and Time	Refilling Pollutant Contam Code	Refilling Vapors - Pollutant Name	Standing Idle Losses (lb/hr)	Refilling Losses (lb/hr)
Crude Oil	6/27/2005 11:08	6/27/2005 14:46	59001	Crude Oil	37.5197	1572.9691
Crude Oil	6/28/2005 14:03	6/28/2005 17:41	59001	Crude Oil	31.9739	1572.9691



Emissions Modeling

AFS Record Format

B 05 05 AC 48039 HGB 4612 40301132 131 1 1 S
05062711 05062712 446.07150 -1197.1010 15 0.915 298 0.003
25 25 25 25 24 7 7 8736 43104 0.786485
RN101948883 BL0571U SW02TANK01 SW02TANK01 N ST TANKS
EXT FL ROOF: DB TEPPCO Crude Pipelin Jones Creek
Terminal BRAZORIA JONES CREEK VOC 59001 Crude Oil (R
LAND

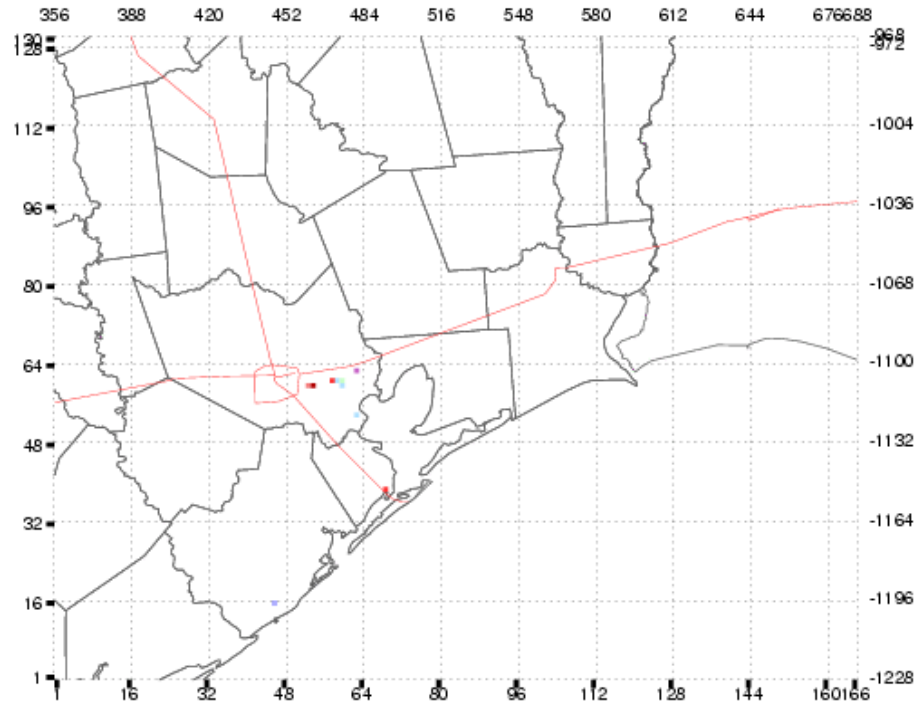
Sequential Records, Showing Hourly Emissions:

05062711 05062712 43104 0.786485 SW02TANK01 SW02TANK01 VOC Crude Oil
05062712 05062713 43104 0.786485 SW02TANK01 SW02TANK01 VOC Crude Oil
05062713 05062714 43104 0.786485 SW02TANK01 SW02TANK01 VOC Crude Oil
05062714 05062715 43104 0.786485 SW02TANK01 SW02TANK01 VOC Crude Oil

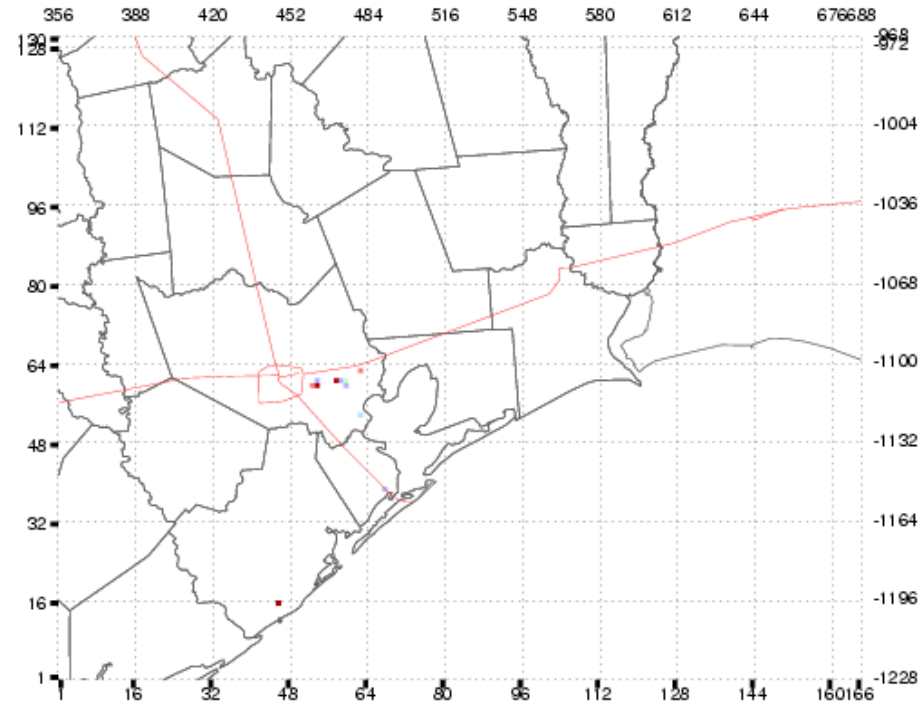


TLL Modeled Emissions (VOC)

June 23 and June 28, 2005

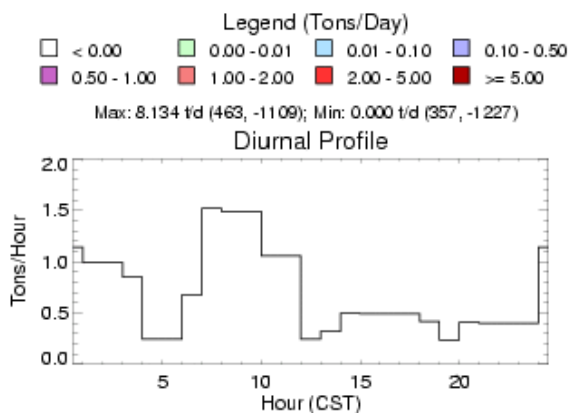


hgb8h2.by05a.hgbpa_02km Tank Landing Loss Emissions, 06/23/2005: VOC

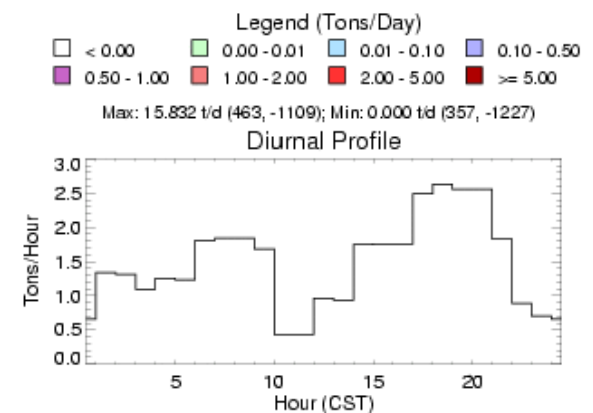


hgb8h2.by05a.hgbpa_02km Tank Landing Loss Emissions, 06/28/2005: VOC

Emissions Plotted	
County	Tons/Day
Brazoria	0.41
Chambers	0.00
Fort Bend	0.00
Galveston	2.42
Harris	13.72
Liberty	0.00
Montgomery	0.00
Waller	0.00
HGB SUBTOTAL:	16.54
Hardin	0.00
Jefferson	0.00
Orange	0.00
BPA SUBTOTAL:	0.00
MAP TOTAL:	16.54



Emissions Plotted	
County	Tons/Day
Brazoria	10.52
Chambers	0.00
Fort Bend	0.00
Galveston	0.20
Harris	25.04
Liberty	0.00
Montgomery	0.00
Waller	0.00
HGB SUBTOTAL:	35.76
Hardin	0.00
Jefferson	0.00
Orange	0.00
BPA SUBTOTAL:	0.00
MAP TOTAL:	35.76





CAMx Modeling Results

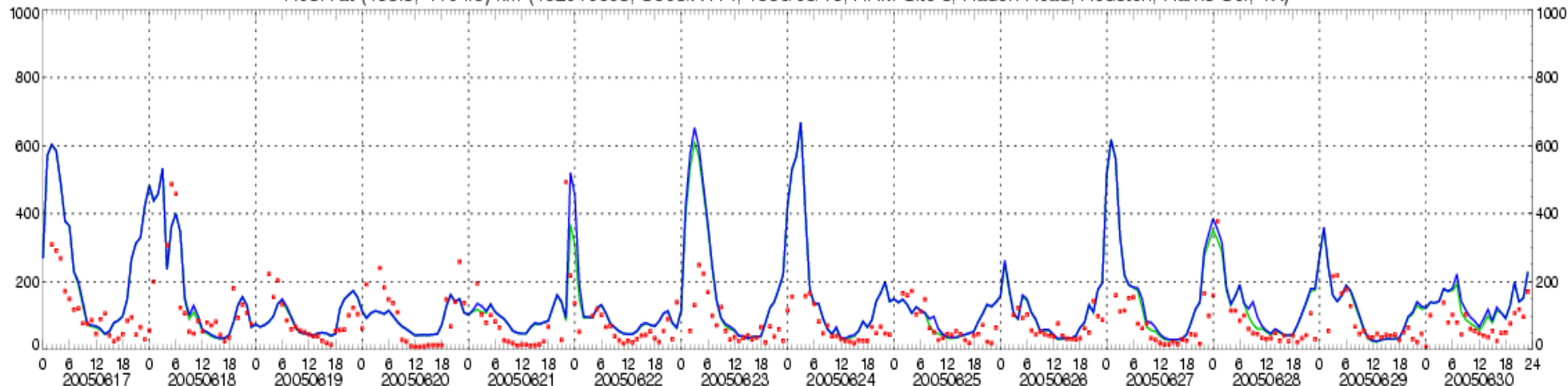
Time-Series Evaluation of Ozone and Precursors

- Time-Series of monitored versus modeled selected CB05 VOC species at selected sites (e.g., PAR=Paraffin, IOLE=Olefin w/internal double-bond)
- Time-Series of monitored versus modeled ozone at selected sites

PAR Concentration (ppb) at Layer 1 (20050617-20050630)

camx450_cb05.hgb8h2.bc05jun.reg7a.2005ep1_eta_dbemis_fddats_uhsst_utcsruluc.hgbpa_02km

H03H at (465.3,-1104.9) km (482010803, C603/A114, 1998/05/16, HRM Site 3, Haden Road, Houston, Harris Co., TX)



camx450_cb05.hgb8h2.bc05jun.reg6.2005ep1_eta_dbemis_fddats_uhsst_utcsruluc.hgbpa_02km

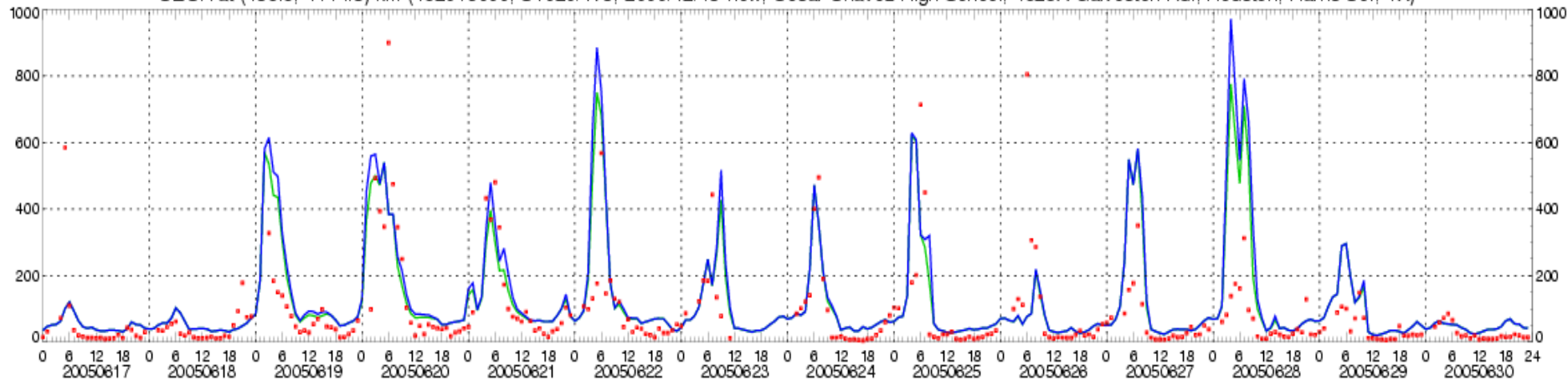
camx450_cb05.hgb8h2.bc05jun.reg7a.2005ep1_eta_dbemis_fddats_uhsst_utcsruluc.hgbpa_02km

Observed

PAR Concentration (ppb) at Layer 1 (20050617-20050630)

camx450_cb05.hgb8h2.bc05jun.reg7a.2005ep1_eta_dbemis_fddats_uhsst_utcsruluc.hgbpa_02km

CECH at (458.8,-1114.3) km (482016000, C1020/175, 2000/12/15-now, Cesar Chavez High School, 4829A Galveston Rd., Houston, Harris Co., TX)



camx450_cb05.hgb8h2.bc05jun.reg6.2005ep1_eta_dbemis_fddats_uhsst_utcsruluc.hgbpa_02km

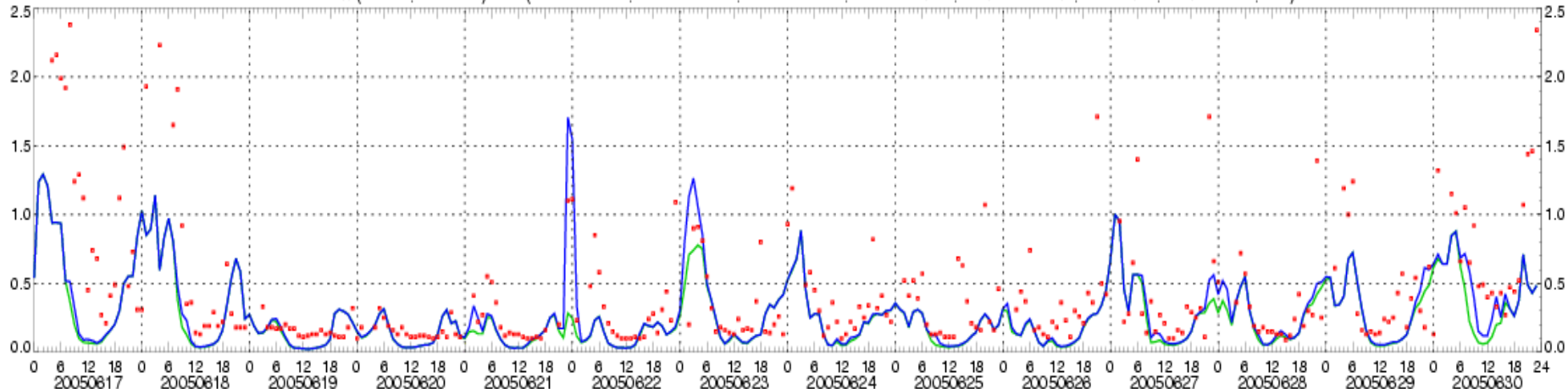
camx450_cb05.hgb8h2.bc05jun.reg7a.2005ep1_eta_dbemis_fddats_uhsst_utcsruluc.hgbpa_02km

Observed

IOLE Concentration (ppb) at Layer 1 (20050617-20050630)

camx450_cb05.hgb8h2.bc05jun.reg7a.2005ep1_eta_dbemis_fddats_uhsst_utcsruluc.hgbpa_02km

H03H at (465.3,-1104.9) km (482010803, C603/A114, 1998/05/16, HRM Site 3, Haden Road, Houston, Harris Co., TX)



camx450_cb05.hgb8h2.bc05jun.reg6.2005ep1_eta_dbemis_fddats_uhsst_utcsruluc.hgbpa_02km

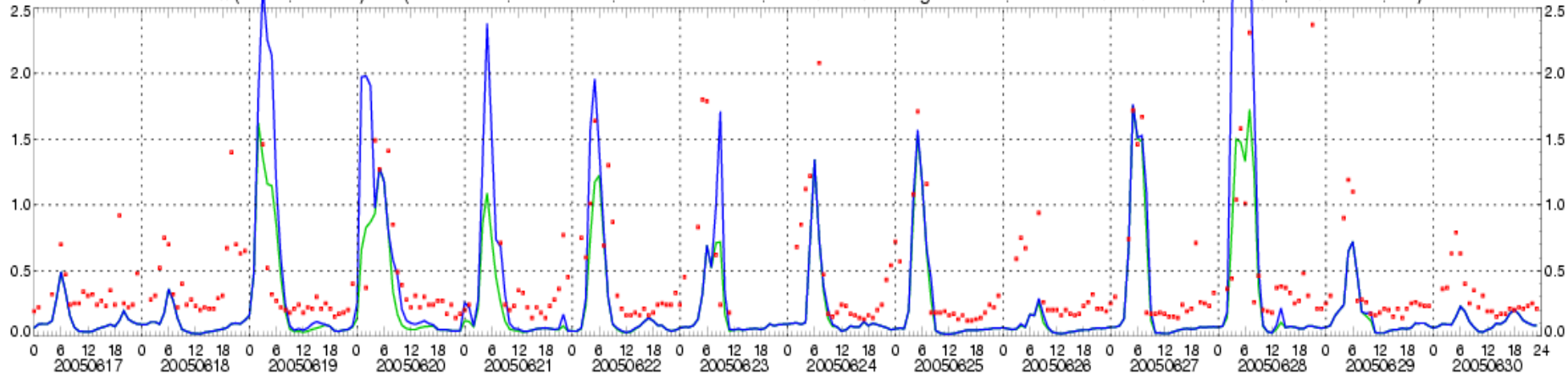
camx450_cb05.hgb8h2.bc05jun.reg7a.2005ep1_eta_dbemis_fddats_uhsst_utcsruluc.hgbpa_02km

Observed

IOLE Concentration (ppb) at Layer 1 (20050617-20050630)

camx450_cb05.hgb8h2.bc05jun.reg7a.2005ep1_eta_dbemis_fddats_uhsst_utcsruluc.hgbpa_02km

CECH at (458.8,-1114.3) km (482016000, C1020/175, 2000/12/15-now, Cesar Chavez High School, 4829A Galveston Rd., Houston, Harris Co., TX)



camx450_cb05.hgb8h2.bc05jun.reg6.2005ep1_eta_dbemis_fddats_uhsst_utcsruluc.hgbpa_02km

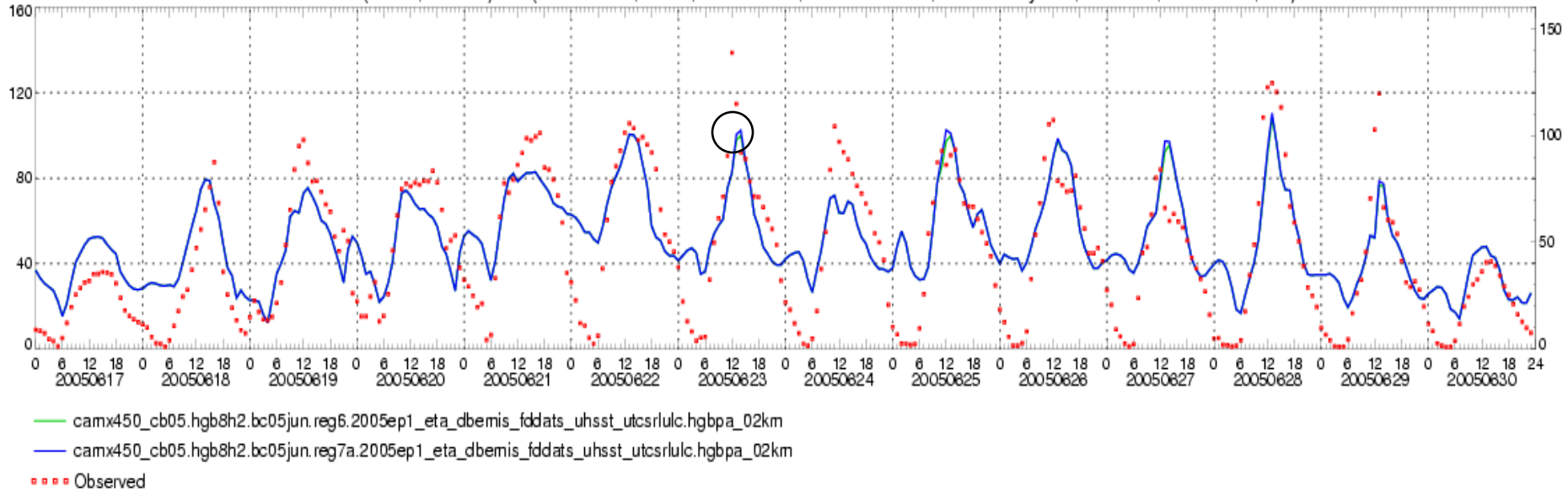
camx450_cb05.hgb8h2.bc05jun.reg7a.2005ep1_eta_dbemis_fddats_uhsst_utcsruluc.hgbpa_02km

Observed

O₃ Concentration (ppb) at Layer 1 (20050617-20050630)

camx450_cb05.hgb8h2.bc05jun.reg7a.2005ep1_eta_dbemis_fddats_uhsst_utcsruluc.hgbpa_02km

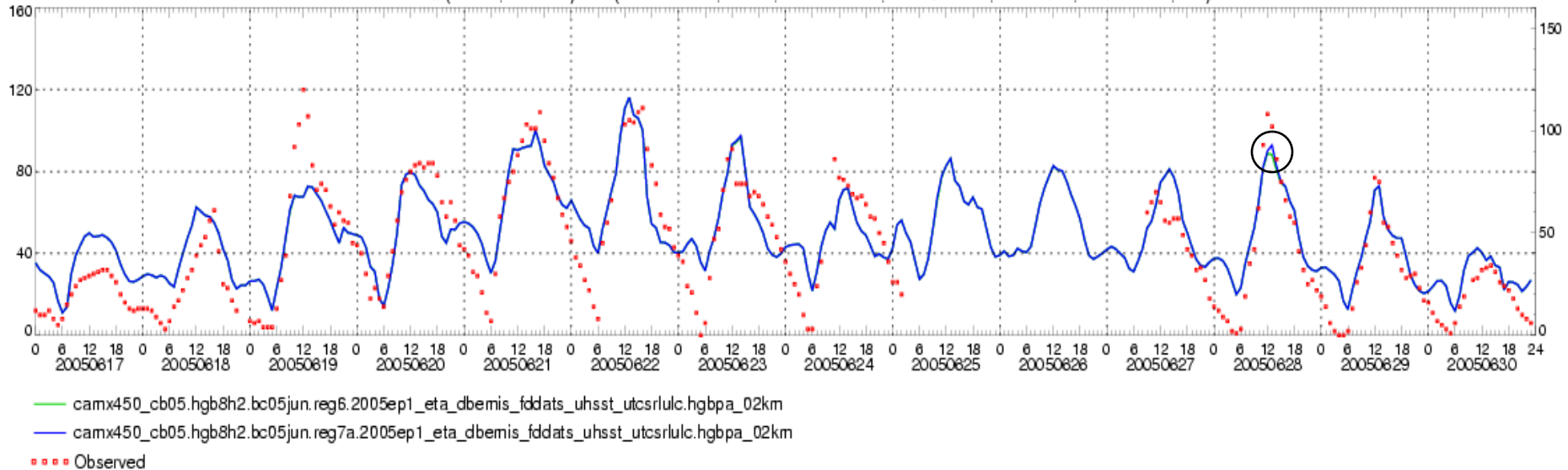
WHOU at (419.0,-1099.9) km (482010554, C554, 2003/12/31, West Houston, 16719 Clay Rd., Houston, Harris Co., TX)



O₃ Concentration (ppb) at Layer 1 (20050617-20050630)

camx450_cb05.hgb8h2.bc05jun.reg7a.2005ep1_eta_dbemis_fddats_uhsst_utcsruluc.hgbpa_02km

SHWH at (421.7,-1112.0) km (482010066, C410, 2000/03/07, Westhollow, Houston, Harris Co., TX)





CAMx Modeling Results

- **Generally the more detailed (i.e., temporally & spatially resolved) the input data, the more likely the model will appropriately replicate ozone episodes**
- **The addition of the more temporally resolved TTL to the modeling emissions assists in reconciliation with the monitored VOC species**
- **Most of the TTL emissions speciate to PAR, which is less reactive**
- **TTL VOC added (15 to 40 tpd, depending upon the day) to Harris County was less than 10% of the 2005 typical ozone-season-day VOC emissions of 550 tpd**
- **A slight ozone increase was modeled for some sites on some days**



Emissions and CAMx Modeling

- Emissions Modeling Staff:
 - Ron Thomas
 - Marvin Jones
 - Barry Exum
 - Jim MacKay
- CAMx Modeling Staff:
 - Jim MacKay
 - Weining Zhao