



# Interactive Model Performance Evaluation Tools

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Texas Commission on Environmental Quality

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# Modeling Power

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# Model Output Post-processing

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## Minimal

**manpower, time, data size ...**

## Automated

**let computer programs do the job**



# Model Output Post-processing

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- Extract surface **time series** data at monitoring sites
- Extract **vertical profile** data at ozonesonde launch sites



# Interactive MPE Platform

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- **Web service:**  
HTML, CSS, Javascript, PHP
- **MySQL database**
- **Python:**  
PsuedoNetCDF
- **Javascript libraries:**  
HighCharts, Google Maps API



# Interactive MPE Tools

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- **Performance statistic bar chart and map**
- **Site time series data-based charts:**
  - hourly concentration line plot
  - daily maximum concentration bar plot
  - modeled vs observed scatter plot
  - ...
- **Vertical profile plot**
- **Concentration maps**
- **OSAT/APCA “wavy bacon” plot**



# Interactive CAMx MPE Platform

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Let's take a look at the MPE tools on our web site.

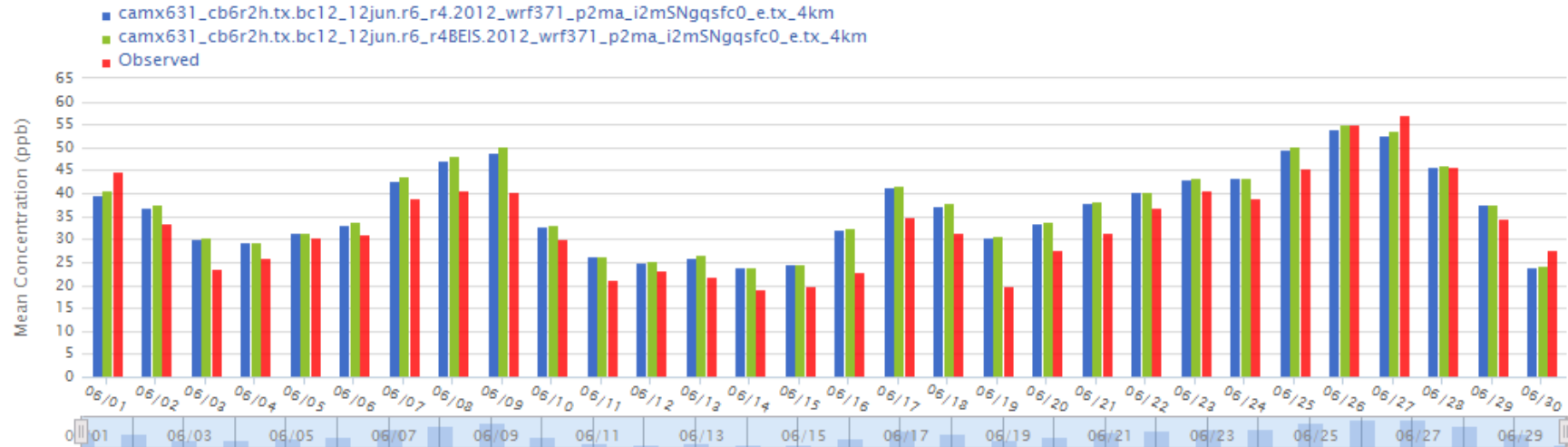


# Ozone Performance Statistic Bar Chart

Model Run: 2016-06-27: camx631\_cb6r2h.tx.bc12\_1 | Compare to: 2016-06-21: camx631\_cb6r2h.tx.bc12\_1 | Data Type: All Data | Statistic Metric: Mean Modeled | Spatial Option: 2x2-cell bi-l | Temporal Option: hourly average | Area: tx\_4k | Chemical: O3

## Model Performance Statistics of Hourly O3 Concentrations in tx\_4km Domain

Mean Modeled (Mm) and Observed (Mo) of All Data (2x2-cell bi-linear interpolated values)



## Model Performance Statistics of Hourly O3 Concentrations in tx\_4km Domain (2x2-cell bi-linear interpolated values)

camx631\_cb6r2h.tx.bc12\_12jun.r6\_r4.2012\_wrf371\_p2ma\_i2mSNgqsfco\_e.tx\_4km

Show 10 entries

Search:

Episode Date	All Data											Data with Observed ≥ 60 ppb								
	Valid Data	Mo ppb	Mm ppb	MB ppb	ME ppb	RMSE ppb	NMB %	NME %	FB %	FE %	R <sup>2</sup>	Valid Data	Mo ppb	Mm ppb	MB ppb	ME ppb	RMSE ppb	NMB %	NME %	FB %
20120601	2604	44.96	39.56	-5.39	10.26	13.4	-11.99	22.83	-5.89	31.06	0.73	671	74	60.1	-13.9	14.24	18.01	-18.78	19.24	-20.61
20120602	2568	33.68	37.03	3.35	9.8	12.52	9.96	29.1	11.25	30.81	0.437	152	64.91	60.17	-4.74	5.81	7.89	-7.3	8.96	-8
20120603	2636	23.62	30.18	6.56	9.07	10.94	27.78	38.41	23.37	34.85	0.422	0								
20120604	2620	26.15	29.44	3.28	7.04	8.83	12.56	26.92	8.35	27.64	0.673	33	66.48	69.68	3.2	5.67	7.3	4.81	8.53	4.35
20120605	2576	30.48	31.5	1.03	8.15	10.42	3.37	26.74	11.22	38.99	0.754	235	71.11	65.9	-5.21	8.74	11.3	-7.32	12.29	-8.03



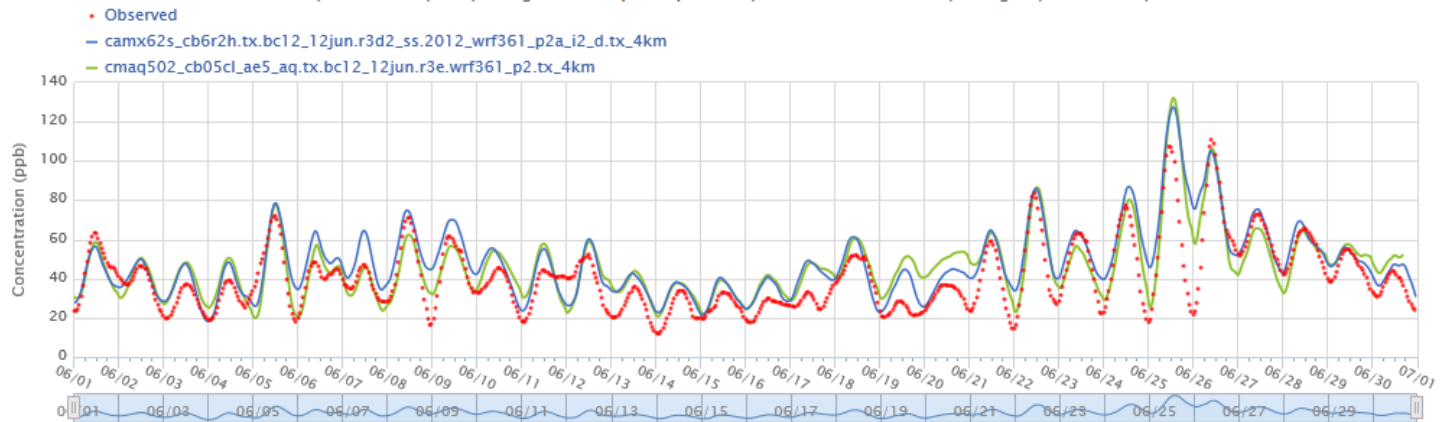


# Eight-Hour Ozone Time Series

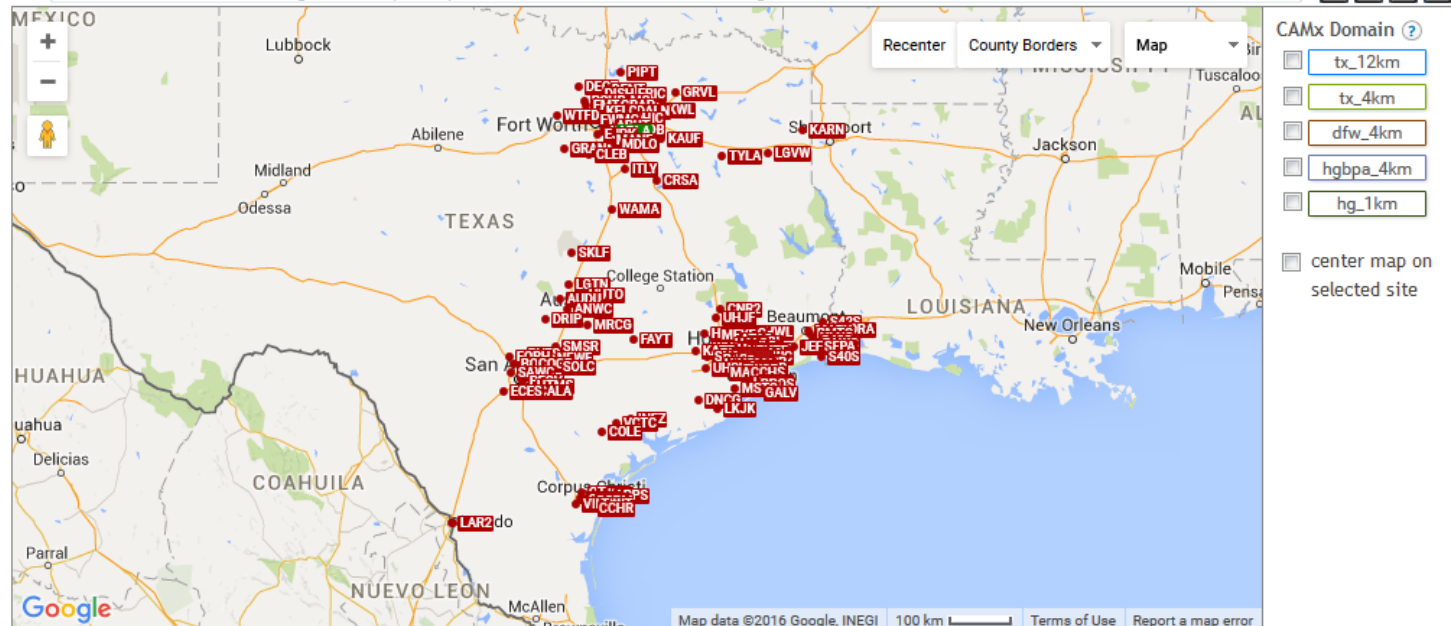
Model Run: 2015-11-20: camx62s\_cb6r2h.tx.bc12\_12jun.r3c  
Compare to: 2015-11-07: cmaq502\_cb05cl\_ae5\_aq.tx.bc12\_12jun.r3e  
Chemical: O3  
Temporal Option: 8-hour average  
Spatial Option: 2x2-cell bi-linear interpolated

## O3 8-Hour Concentration (2x2 bi-linear interpolated value)

ARLA, 484393011, C61, Arlington Municipal Airport C61, 5504 South Collins St., Arlington, Tarrant Co., TX



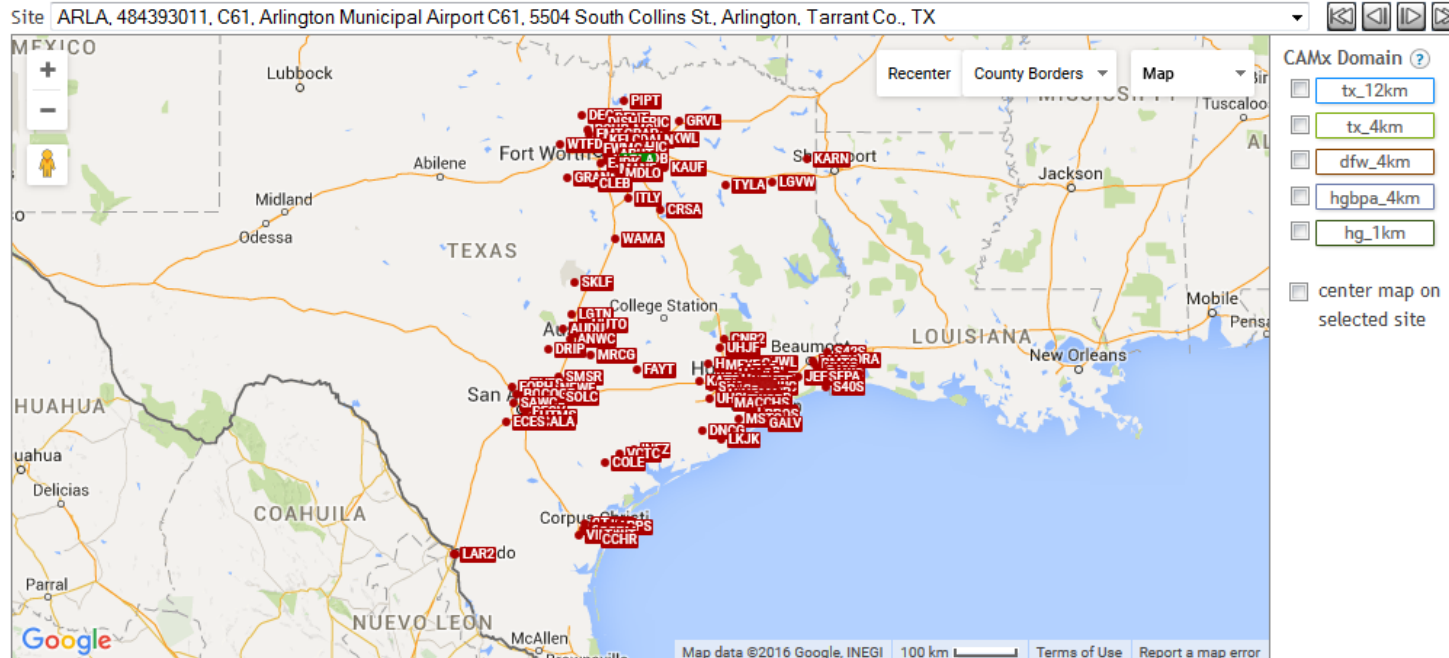
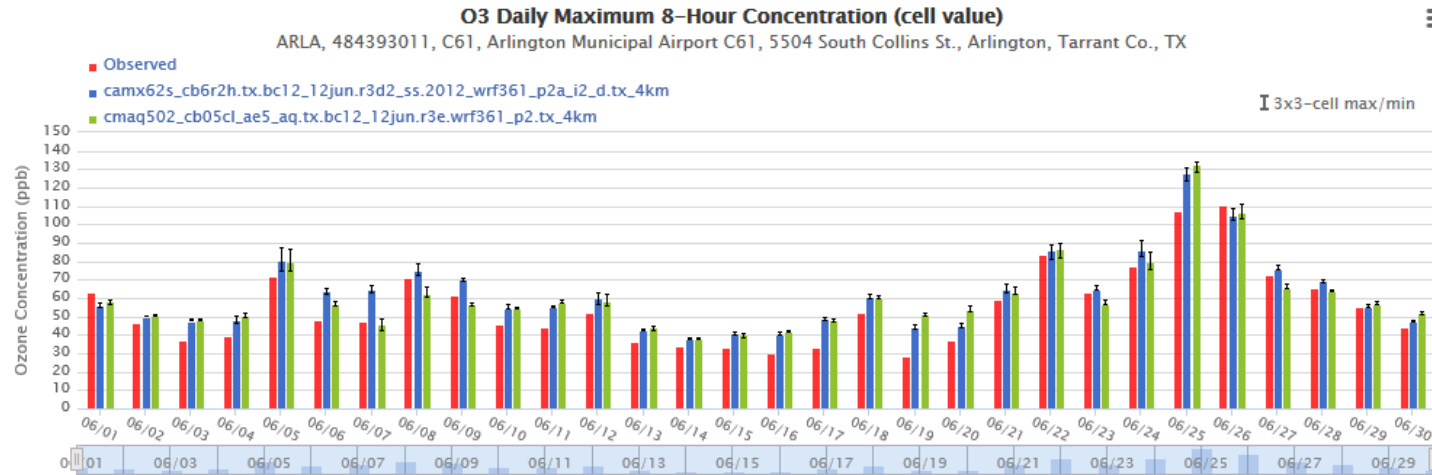
Site: ARLA, 484393011, C61, Arlington Municipal Airport C61, 5504 South Collins St., Arlington, Tarrant Co., TX





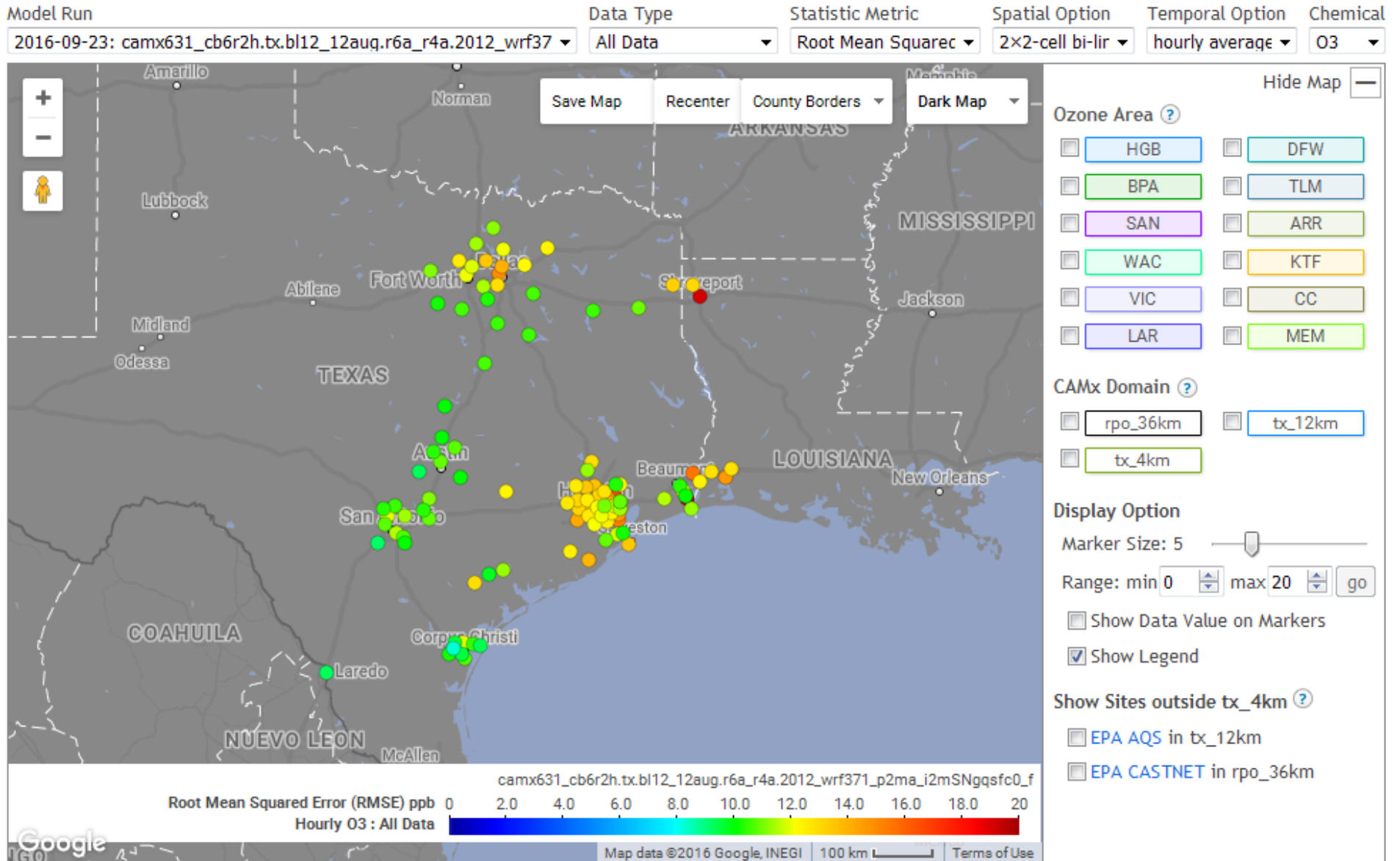
# Daily Maximum Eight-Hour Ozone Bar Chart

Model Run: 2015-11-20: camx62s\_cb6r2h.tx.bc12\_12jun.r3c  
Compare to: 2015-11-07: cmaq502\_cb05cl\_ae5\_aq.tx.bc12  
Chemical: O3  
Temporal Option: 8-hour average  
Spatial Option: cell value





# Statistic by Monitor on Google Maps





# Hourly NO<sub>x</sub> Scatter Plot

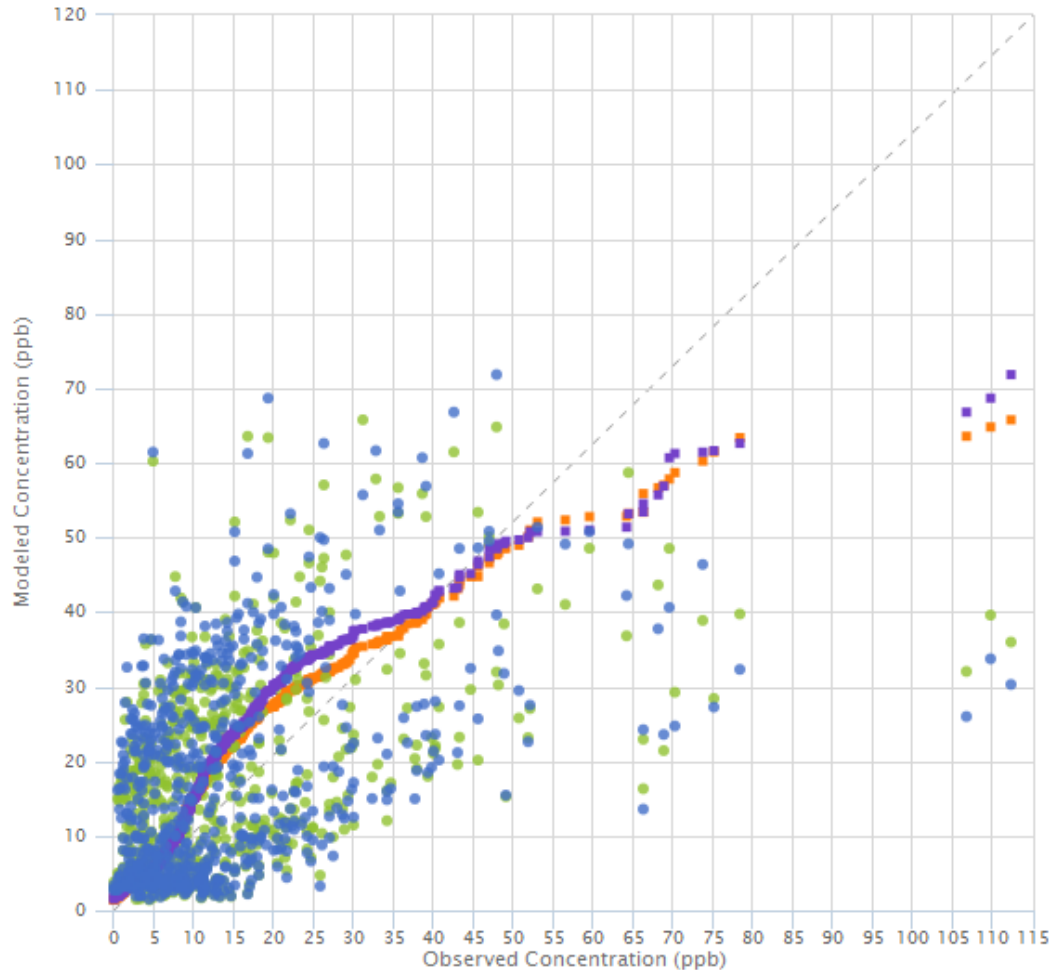
modeled vs observed

variable vs variable

modeled vs modeled

## Hourly Concentration: NO<sub>x</sub> (20120601-20120630 0:00-23:00)

HOEA, 482011034, C1, Houston East C1/G316, 1262 1/2 Mae Drive, Houston, Harris Co., TX



Model run

2015-11-20: camx62s\_cb6r2h.tx.bc12\_12jun.r3d

Compare to

2016-02-26: cmaq502\_cb05cl\_ae5\_aq.tx.bc12\_1

Chemical

NO<sub>x</sub>

Temporal Option

hourly values

Spatial Option

2x2-cell bi-linear interpolated value

Date range

06/01 06/30

Hour range

invert hour range ?

0 23

Daily max values

redraw

Show Q-Q plot

cmaq502\_cb05cl\_ae5\_aq.tx.bc12\_12jun.r3f\_r3d2ndpnf.wrf361\_p2.tx\_4km (Q-Q)

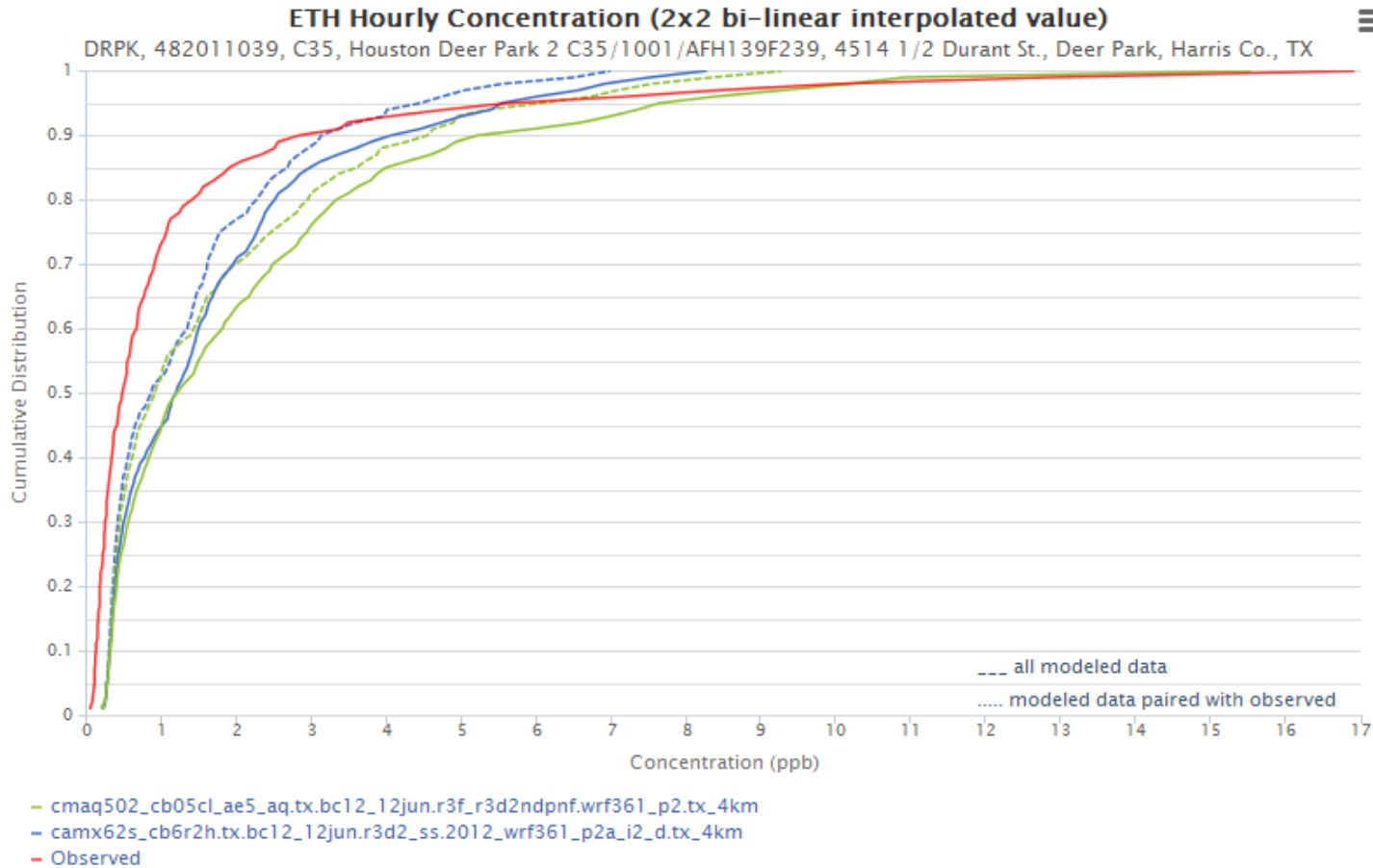
camx62s\_cb6r2h.tx.bc12\_12jun.r3d2\_ss.2012\_wrf361\_p2a\_i2\_d.tx\_4km(Q-Q)



# Ethylene

## Cumulative Distribution Function Plot

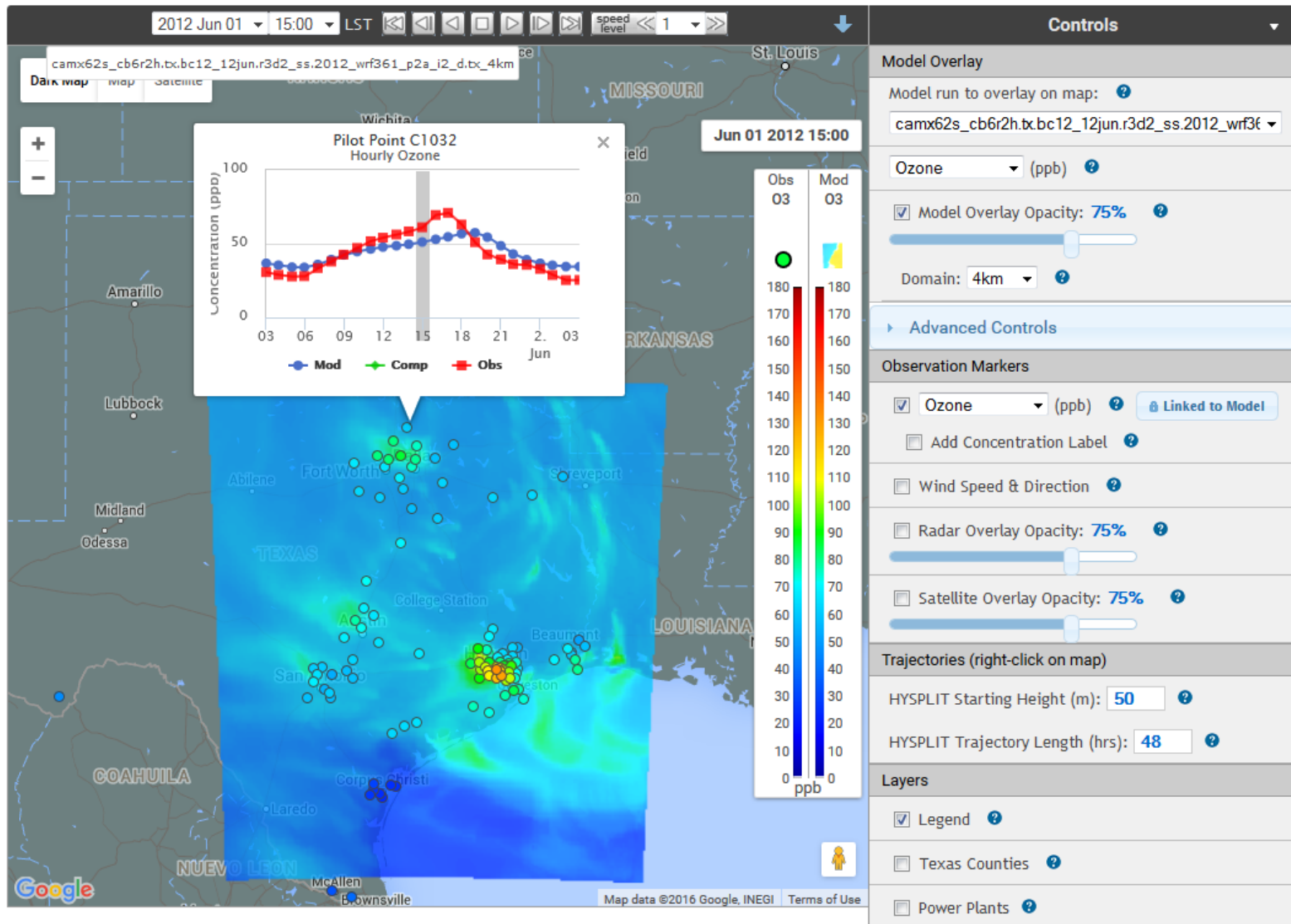
Model Run: 2015-11-20: camx62s\_cb6r2h.tx.bc12\_12jun.r3  
Compare to: 2016-02-26: cmaq502\_cb05cl\_ae5\_aq.tx.bc12\_  
Chemical: ETH  
Temporal Option: hourly average  
Spatial Option: 2x2-cell bi-linear interpolated





# Concentration Map on Google Maps

Modeled Ozone Overlay with Observed Ozone Markers: One-hour Averages

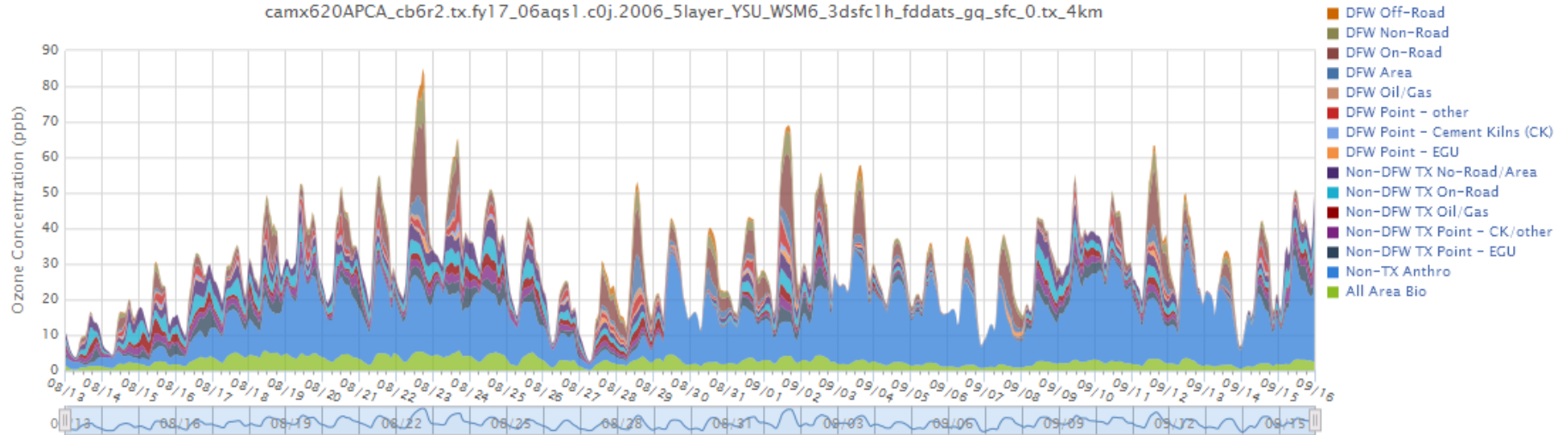




# Source Apportionment

Model Run: 2015-09-04: camx620APCA\_cb6r2.tx.fy17\_06ac  
 Temporal Option: hourly average  
 Spatial Option: 3x3-cell mean  
 Layer Stacking Option: stacked concentrations  
 Show Total Concentration Line  
 line color:   line style: •••• dots

**Hourly Ozone Source Apportionment: APCA (3x3-cell mean)**  
 camx620APCA\_cb6r2.tx.fy17\_06aqs1.c0j.2006\_5layer\_YSU\_WSM6\_3dsfc1h\_fddats\_gq\_sfc\_0.tx\_4km



## OSAT/APCA category grouping options

category code info   
  group builder instruction   
 [export group definition](#)   
 [redraw chart](#)   
    
 [search](#)   
 [clear](#)

## Load predefined groups into the group definition table:

  
 sa.group.2006.0.txt

## Group definition table:

#	Color ?	Group Label ?	Category List ?	
15	<span style="background-color: #8B4513; width: 15px; height: 15px; display: inline-block;"></span>	DFW Off-Road	NOx DFW Off-Road    VOC DFW Off-Road	<a href="#">+</a>
14	<span style="background-color: #6B8E23; width: 15px; height: 15px; display: inline-block;"></span>	DFW Non-Road	NOx DFW Non-Road    VOC DFW Non-Road	<a href="#">-</a>
13	<span style="background-color: #A52A2A; width: 15px; height: 15px; display: inline-block;"></span>	DFW On-Road	NOx DFW On-Road    VOC DFW On-Road	<a href="#">-</a>



# TCEQ Modeling Web Sites

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- Current Eight-Hour Ozone SIP Modeling Details  
<https://www.tceq.texas.gov/airquality/airmod/data>
- Interactive Modeling Map Results  
<https://www.tceq.texas.gov/airquality/airmod/data/results?year=2012>
- Interactive Modeling Time Series  
<https://www.tceq.texas.gov/airquality/airmod/data/ts?eps=20120501-20120531>
- Current Modeling File FTP Site  
<ftp://amdaftp.tceq.texas.gov/pub/TX/>





# Questions?

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512 239-1523

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The Air Modeling & Data Analysis Section  
contributed to these results.

Contact: [amda@tceq.texas.gov](mailto:amda@tceq.texas.gov)





# Model Run Log Database

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## Purpose:

- record keeping
- part of our web-based MPE tools

## Logged information:

- run name
- run date
- input description
- CAMx job control file
- post-processing check list
- ...



# Model Run Log Database

## Air Quality Modeling Log Database Manager - Edit

\* required.

### Log Entry and Quality Control (Log ID: 1838)

Run Staff:  \* Run Date:   
 QC Staff:  QC Date:  Update Date:

### Run Information

\* Main Project:   
 Associated Project(s):  AMS  CSAPR  DFW8H3  HGBMCR  RIDER8  SO2  DFW8H2  HGB8H2  
 \* Episode:   
 \* AQ Model Type:  (e.g. CAMx)  
 \* AQ Model Version:  (e.g. 4.53)  
 \* AQ Model Chemistry:   
 \* Run Case:   
 \* Run Scenario:  (or n/a)  
 Elevated EI Name:   
 Low-level EI Name:   
 Supper-Fine Cell Domain:  hg\_1km  hg\_2km

### Model Performance Analysis Check List

Site Time Series Data   
 Vertical Profile Data   
 Daily Max Ozone Tile Plot  compare to:  

1847: CAMx 6.31 cb6r2h, bc12_12jun.r6a_r4a.2012_wrf371_p2ma_i2mSNgqsf0_fnoTC
1843: CAMx 6.31 cb6r2h, fy17_12jun.c0m_c0m.2012_wrf371_p2ma_i2mSNgqsf0_f
1832: CAMx 6.31 cb6r2h, bl12_12jun.r6a_r4a.2012_wrf371_p2ma_i2mSNgqsf0_f
1831: CAMx 6.30 cb6r2h, bc12_12jun.r5_r3g_ss.2012_wrf371_p2ma_i2m_e1

 Hourly Ozone Tile Plot  compare to:  

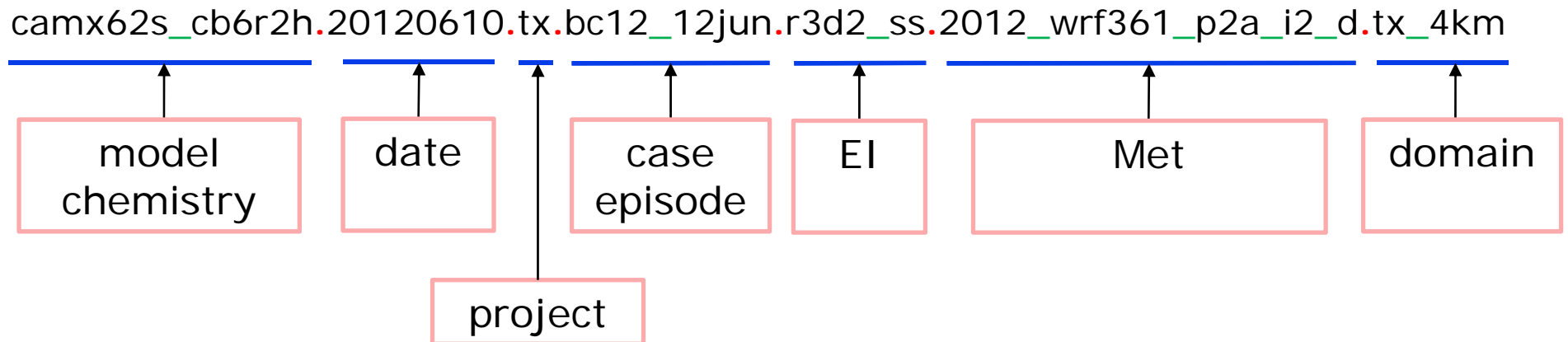
1847: CAMx 6.31 cb6r2h, bc12_12jun.r6a_r4a.2012_wrf371_p2ma_i2mSNgqsf0_fnoTC
1843: CAMx 6.31 cb6r2h, fy17_12jun.c0m_c0m.2012_wrf371_p2ma_i2mSNgqsf0_f
1832: CAMx 6.31 cb6r2h, bl12_12jun.r6a_r4a.2012_wrf371_p2ma_i2mSNgqsf0_f
1831: CAMx 6.30 cb6r2h, bc12_12jun.r5_r3g_ss.2012_wrf371_p2ma_i2m_e1

 Source Apportionment   
 Other MPE Items



# Model output files and directories

## File naming convention



## Directory structure

**Output:** `/aq/tx/output/bc12_12jun/r3d2_ss.2012_wrf361_p2a_i2_d/camx62s_cb6r2h/`

**Analysis:** `/ftp/pub/CAMx/tx/bc12_12jun/r3d2_ss.2012_wrf361_p2a_i2_d/Time_Series`