TCEQ

Preliminary 2012 Modeling

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Air Modeling and Data Analysis Section
Air Quality Division

Southeast Texas Photochemical Modeling Technical Committee Meeting
April 13, 2015

Today's Presentation

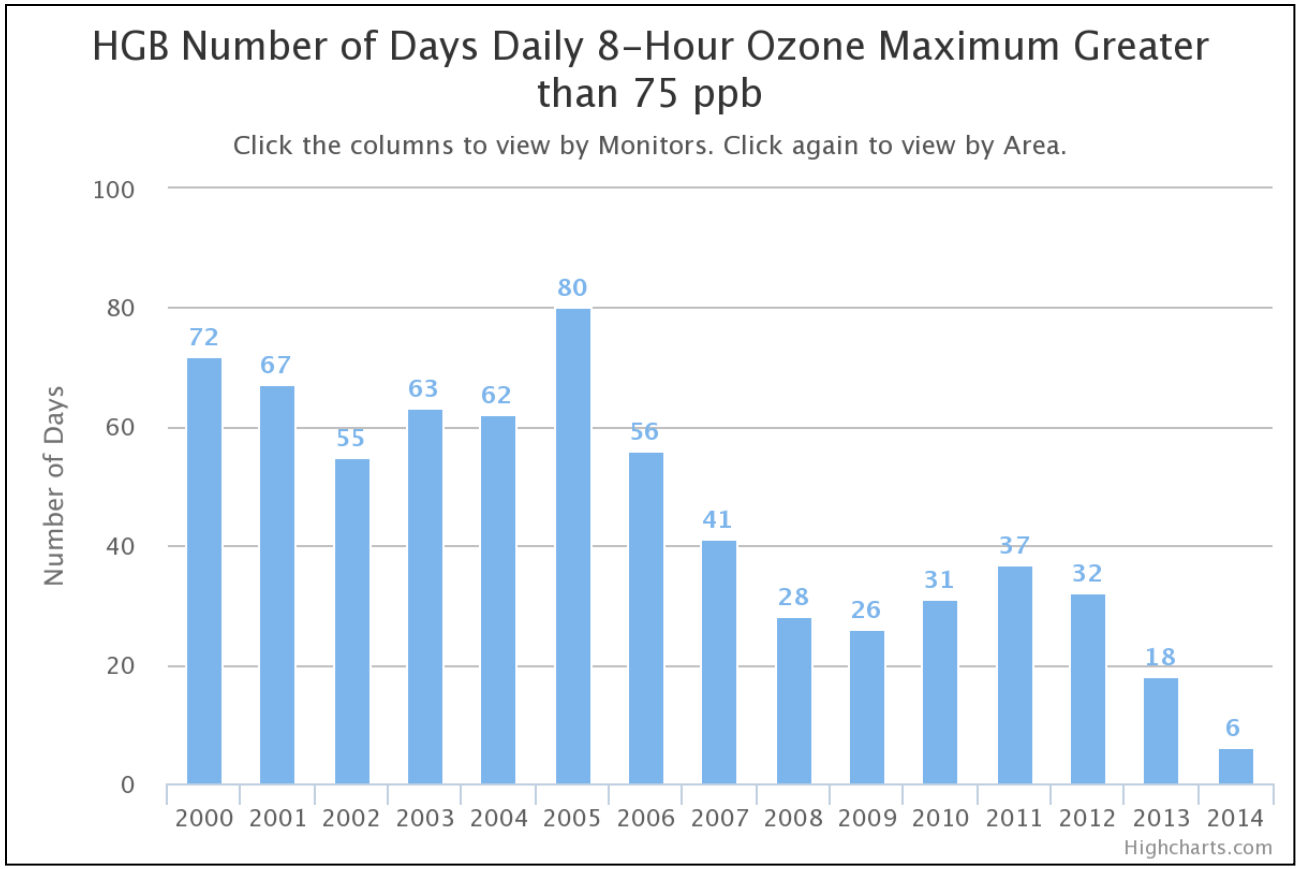
- Why 2012?
- Overview of the 2012 Ozone Season
- Overview of Base Case Development
- Where can modeling data be found?
- What have we modeled so far?
- What are some of the tests for Model Performance?
- How well is the 2012 Base Case performing?
- Next Steps

CAMx Ozone Modeling in SIP Development
The Big Picture

Base Case	Day-specific emissions and meteorology; replicate what actually happened
Baseline Case	Typical emissions and day-specific met; used in RRF to predict future design values
Future Case	Apply future growth + on-the-books controls to estimate future ozone precursor emissions
Control Strategy Testing	Determine control strategies that will effectively reduce ozone
SIP	Document modeling results and procedures

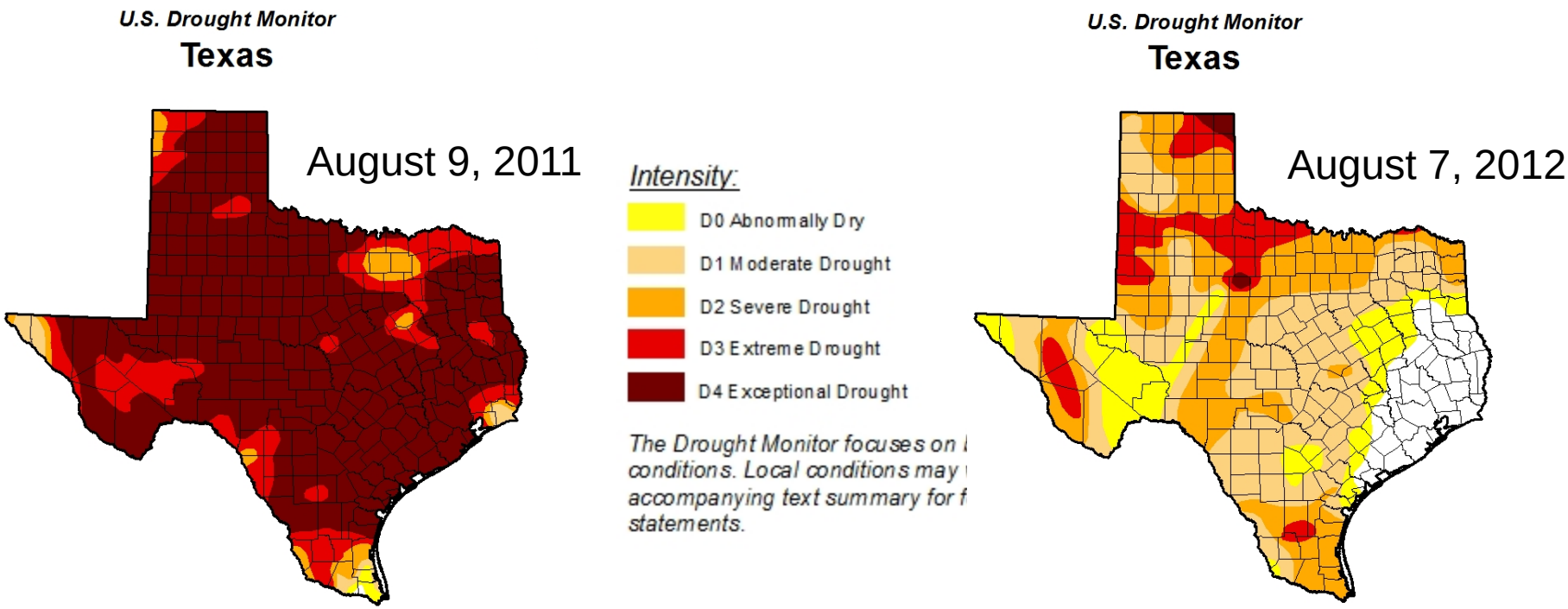
Why 2012?

- More recent than 2006
  - Emission sources and population changes
  - Precursor concentrations have decreased
  - 2006 used in last 3 AD SIPs (2010 HGB AD, 2011 DFW AD, current 2015 DFW AD SIPs)

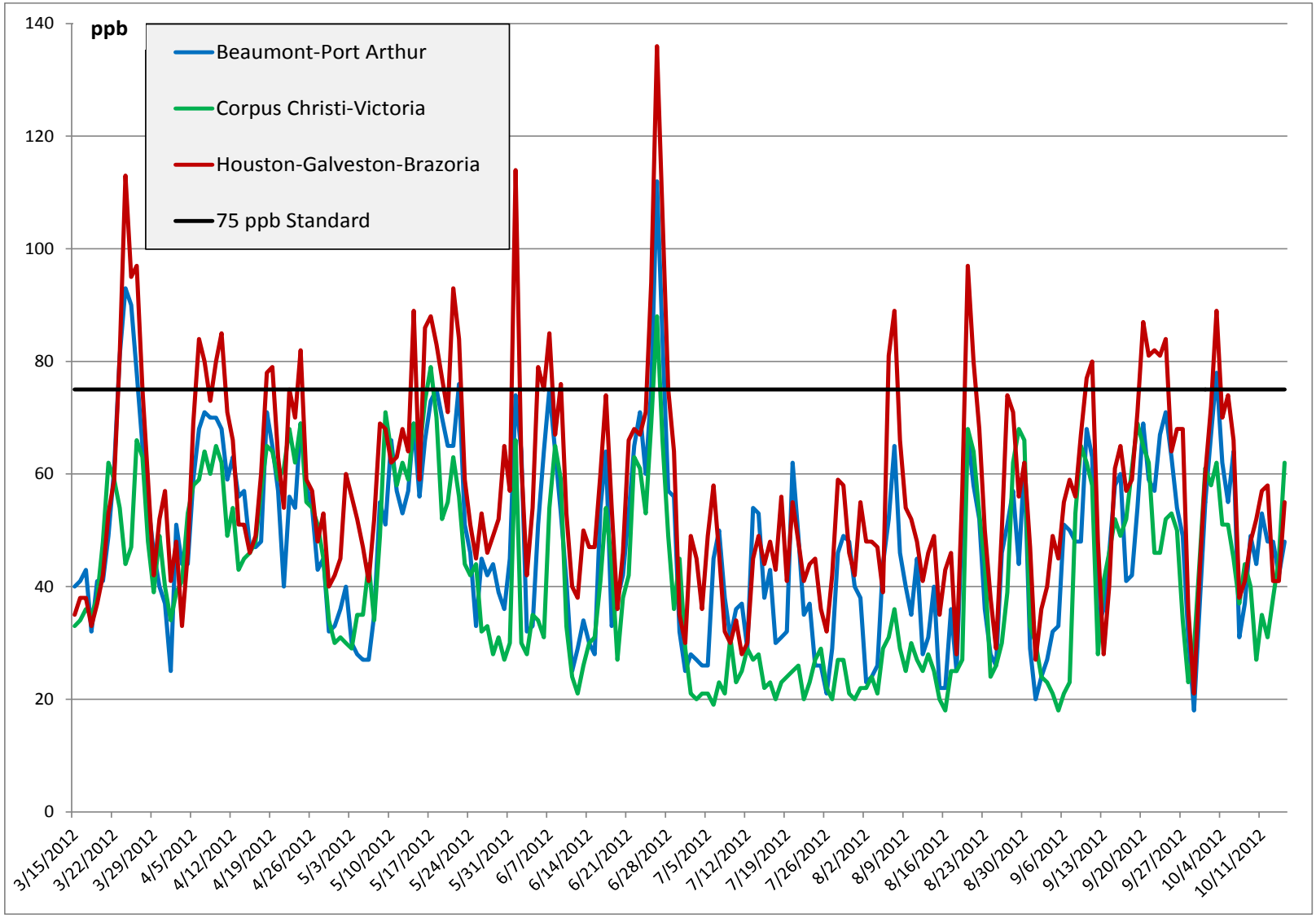


Why not 2011?

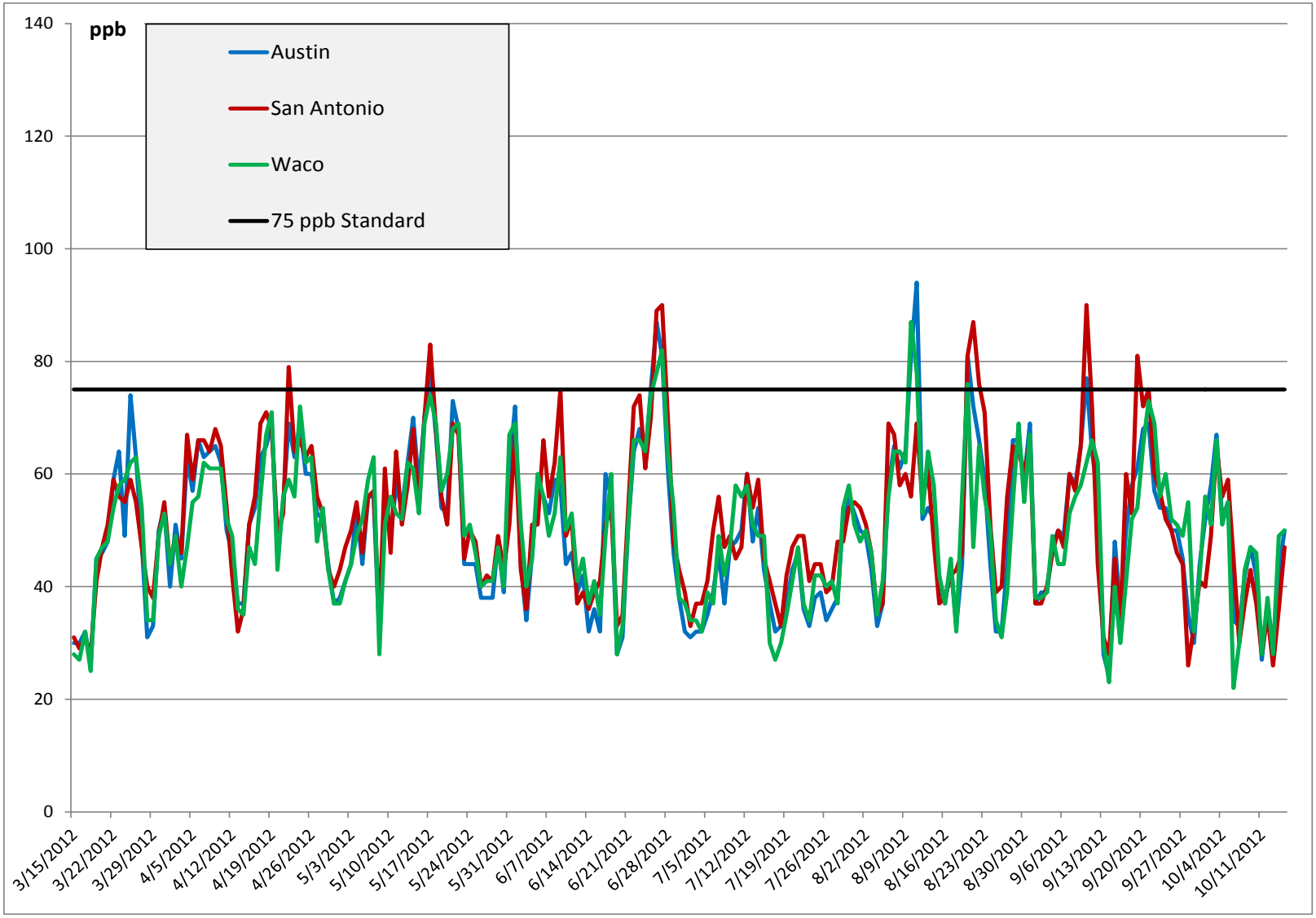
- 2011-based EPA Modeling Platform
  - Includes 2011 NEI emissions
- 2011 was an exceptional drought year in Texas and other areas of the southwest US



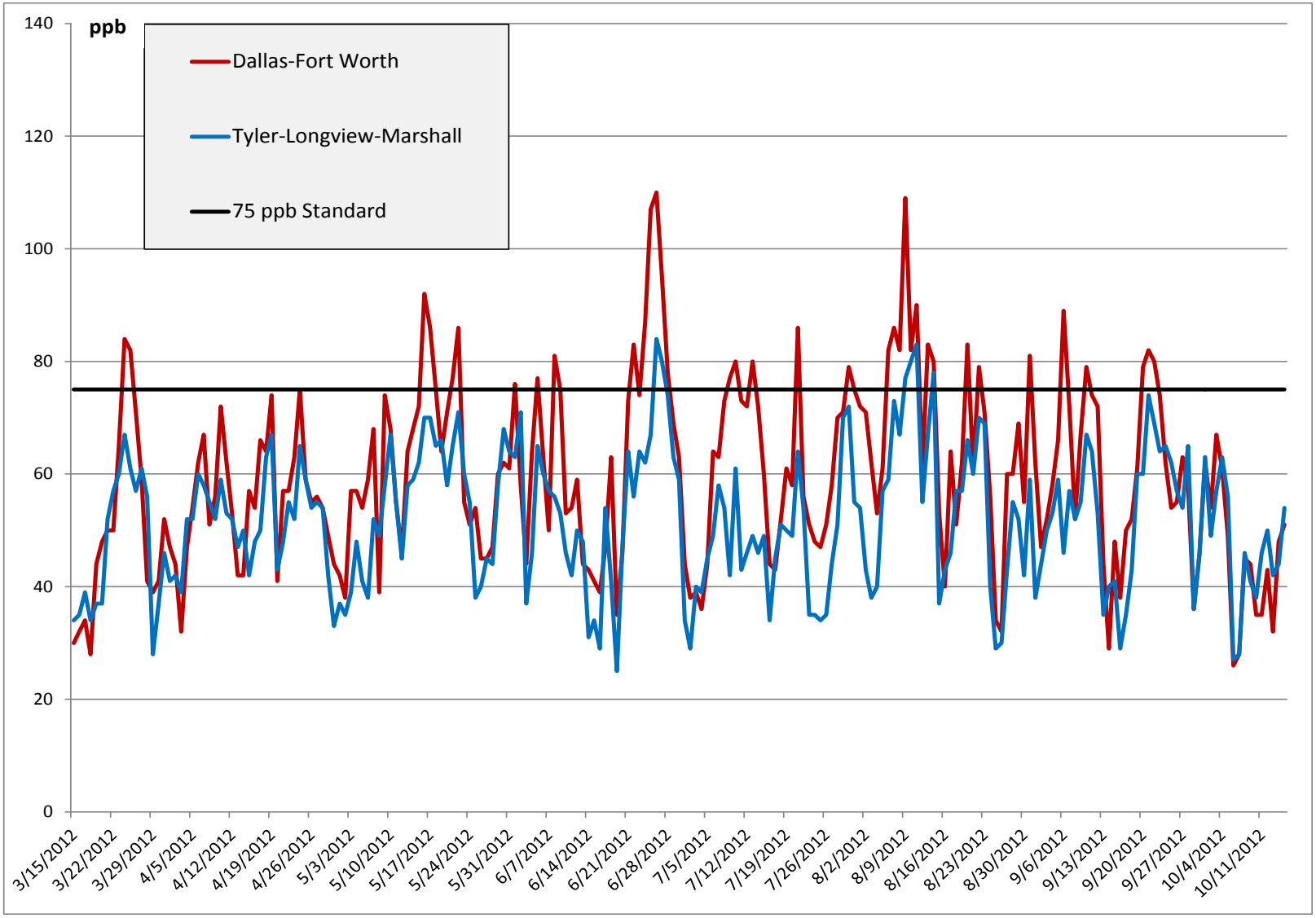
Highest Eight-Hour Ozone Monitored in 2012 Coastal Texas Areas from March 15-October 15



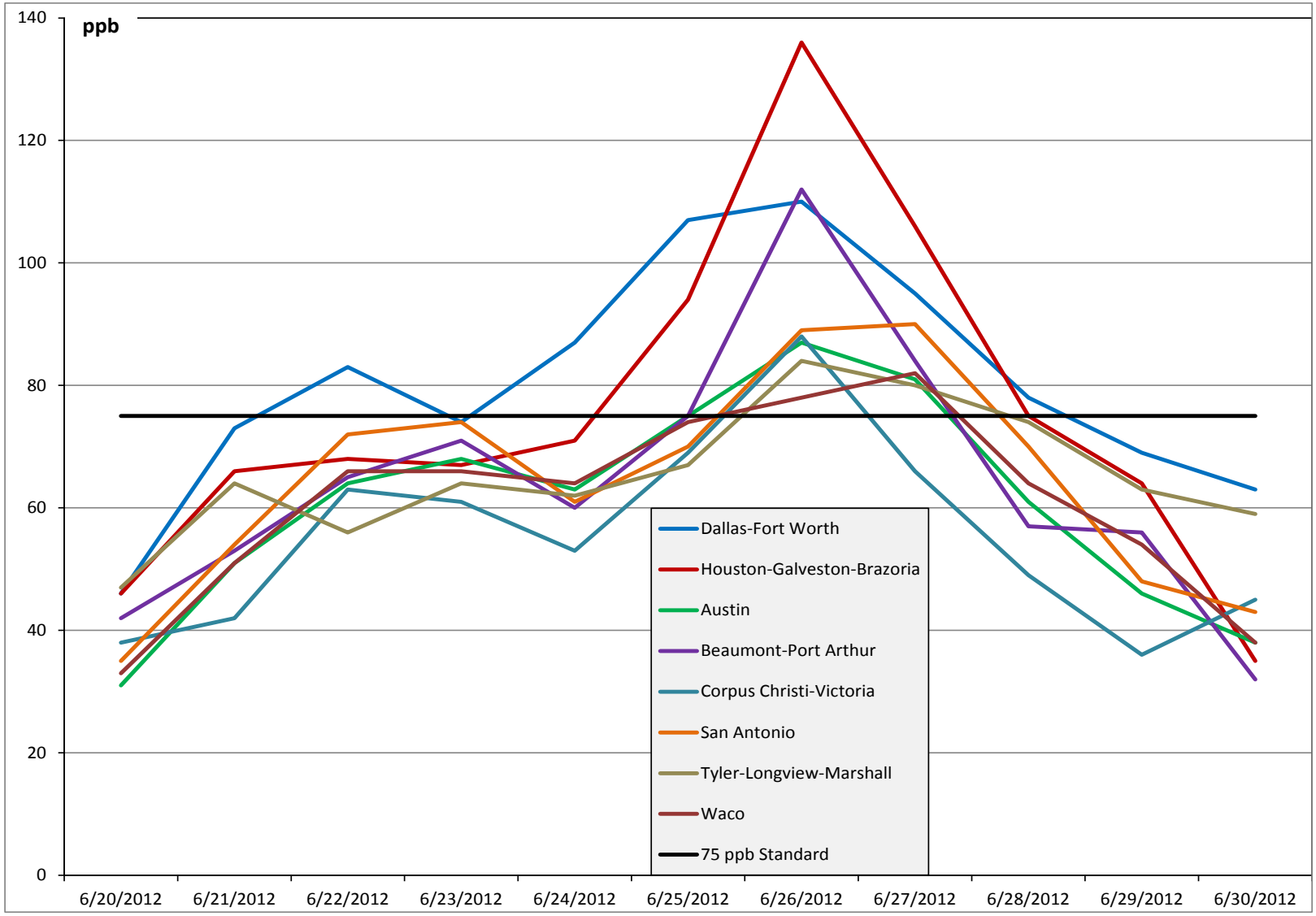
Highest Eight-Hour Ozone Monitored in 2012 Central Texas Areas from March 15-October 15



Highest Eight-Hour Ozone Monitored in 2012 North Texas Areas from March 15-October 15



Highest Eight-Hour Ozone Monitored from June 20-30, 2012 by Metropolitan Area



Base Case Episode Development in Ten Time-Consuming and Not-So-Easy Steps

Step	Description
1	Develop or update existing conceptual model
2	Select a time period to model (June, others?)
3	Develop meteorological inputs and run the mesoscale model (WRF)
4	Develop inputs for and run the biogenics model (MEGAN, others?)
5	Develop anthropogenic emission inputs for area, on-road, non-road, oil and gas, off-road, and point source categories plus Canada, Mexico, and Gulf of Mexico
6	Process emissions to obtain speciated and temporally allocated inputs by grid cell
7	Develop initial conditions, boundary conditions, and land cover fractions
8	Aggregate all inputs and run the photochemical model
9	Evaluate performance by comparing modeled output to observations
10	Investigate problems, update input with new data, and redo steps 3-9 (ongoing)

Use Our 2012 Modeling Files

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›› Questions or Comments: amda@tceq.texas.gov

Texas Air Quality Modeling - Files and Information (2012 Episodes)

Air quality modeling files and technical information from TCEQ's photochemical modeling program (2012 episodes)

Modeling Domains, Results, and Monitoring Sites

Modeling Domains
(ArcGIS shape files and KML files)

Model Compared to Observations

CAMS Monitoring Sites

Modeling Files

Files provided here are undergoing quality assurance and peer review and are subject to change. Visit this Web page frequently to check for updates. If you have any questions regarding these files, please e-mail us at amda@tceq.texas.gov with "Texas State and Local Ozone Modeling Files" in the subject line.

The modeling data files are available on Texas Ozone Modeling Directory on TCEQ Air Modeling FTP site.

2012 observed air quality and meteorological data and baseline ozone design values (updated on Mar 5, 2015)

CAMx modeling files:

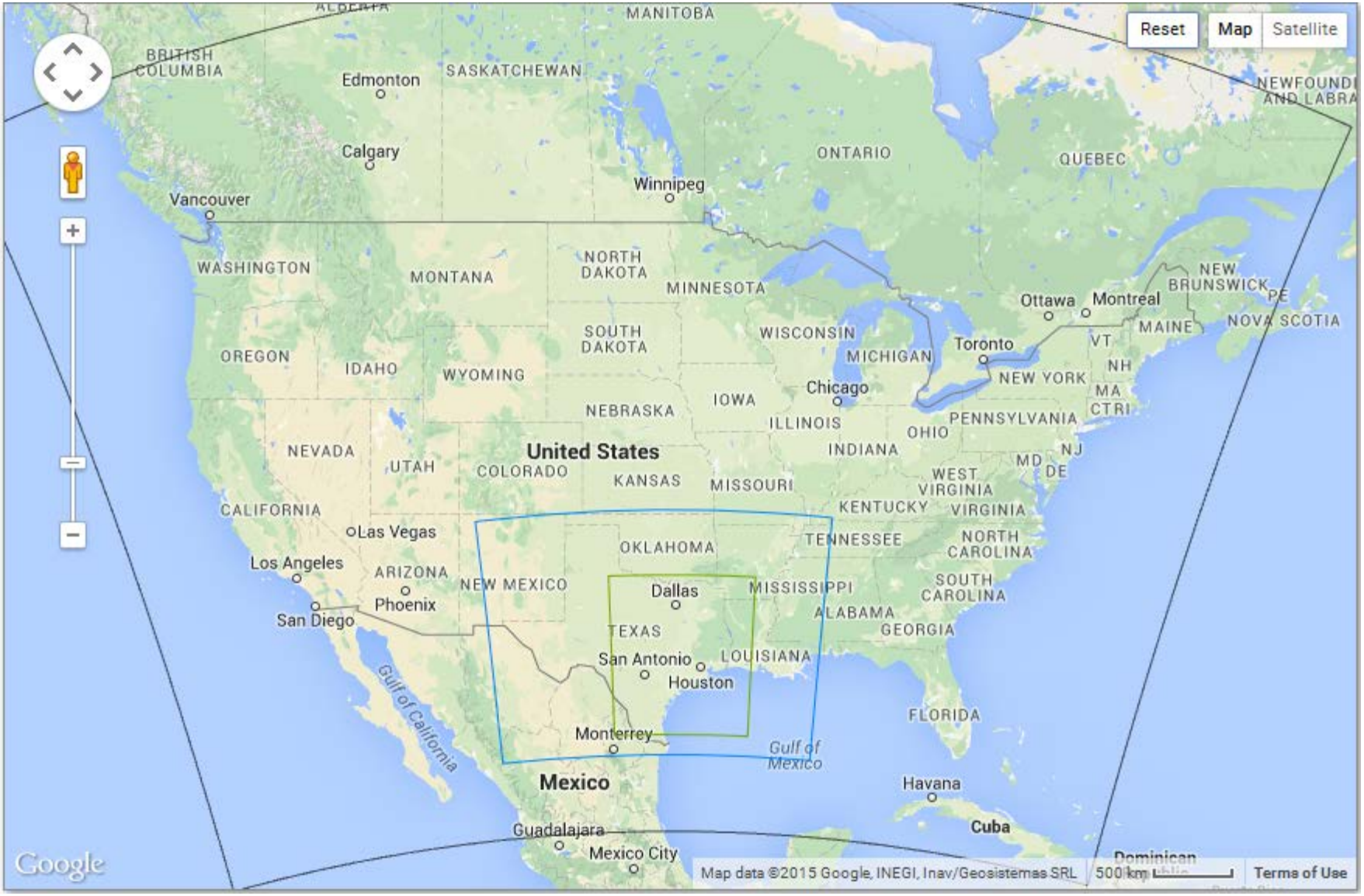
Run Name	Model	MET Input	EI Input	BC/IC Input	Other Input	Job Control	Output	MPE[1]	Release Date
June 2012 episode									
Base Case bc12_12jun.reg3a. 2012_wrf361_p2a_i2_a	CAMx 6.11 CB6 r2	go	go	go	go	go	go	go	Mar 5, 2015

1. CAMx Model Performance Evaluation (MPE) graphic and data files.

Pre-CAMx Component Emissions Inventory Data for 2012 Episodes

https://www.tceq.texas.gov/airquality/airmod/data/tx2012

Modeling Domains



2012 Model Runs (Tests and Improvements so far)

Texas Ozone Modeling Base Case and Baseline Model Performance Evaluation (MPE)

06jun | 06aqs1 | 12apr | 12may | 12jun | 12jul | 12aug | 12sep | 12oct | 13sep

12jun: June 1 - 30, 2012 Episode

Run Name (click to view the run log)	CAMx Version	Ozone Statistics	Time Series	Site Daily Max	CDF Plot	Scatter Plot	Vertical Profile	Daily Max Map	Hourly Map	O3 SA	More	Files	Run Date
bc12_12jun.reg3_ss_bcseoO3m10.2012_wrf361_p2a_i2_kvCMAQ_2wkIC	6.10m3 CB6r2h	view	view	view	view	view	view	view	view			go	2015-02-04
bc12_12jun.reg3_ss_bc050seo.2012_wrf361_p2a_i2_kvCMAQ_2wkIC	6.10m3 CB6r2h	view	view	view	view	view	view	view	view			go	2015-01-23
bc12_12jun.reg3_ss.2012_wrf361_p2a_i2_kvCMAQ_2wkIC	6.10m3 CB6r2h	view	view	view	view	view	view	view	view			go	2015-01-23
bc12_12jun.reg3.2012_wrf361_p2a_i2_kvCMAQ_2wkIC	6.10p1 OSAT CB6r2	view	view	view	view	view	view	view	view	view	view	go	2015-01-21
bc12_12jun.reg3_bc050seo.2012_wrf361_p2a_i2_kvCMAQ_2wkIC	6.10p1 OSAT CB6r2	view	view	view	view	view	view	view	view	view	view	go	2015-01-21
bc12_12jun.reg3_ss.2012_wrf361_p2a_i2_kvCMAQ	6.10m3 CB6r2h	view	view	view	view	view	view	view	view			go	2014-12-19
bc12_12jun.reg3.2012_wrf361_p2a_i2_kvCMAQ	6.10p1 CB6r2	view	view	view	view	view	view	view	view			go	2014-12-19
bc12_12jun.reg2i_Bwrf2.2012_wrf361_p2_i2_kvCMAQ	6.10p1 CB6r2	view	view	view	view	view	view	view	view			go	2014-12-05
bc12_12jun.reg2i_Bwrf1kf.2012_wrf361_p1_i1KF	6.10p1 CB6r2	view	view	view	view	view	view					go	2014-12-05
bc12_12jun.reg2i_Bwrf1crf.2012_wrf361_p1crf_i1KFcrf	6.10p1 CB6r2	view	view	view	view	view	view	view	view			go	2014-12-04
bc12_12jun.reg2i_Bwrf2.2012_wrf361_p2_i2	6.10p1 CB6r2	view	view	view	view	view	view	view	view			go	2014-12-04
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bc12_12jun.reg2h_fires.2012_5layer_YSU_WSM6_3dsfc1h_fdda_gqsfc0	6.10pa PA CB05	view	view	view	view	view		view	view			go	2014-09-12
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Major Tests and Improvements

- Started with the 2006 DFW model setup
  - EI upgrades, MEGAN biogenics, Oil&Gas, MOVES2014, explicit wildfires
  - Improvements we made for 2006 DFW also went into 2012; initial runs showed modeled ozone concentrations too high everywhere
- Chemical Process Analysis (CPA), Anthropogenic Precursor Culpability Analysis (APCA), and sensitivity runs to investigate sources of model bias:
  - Original version of CB6 too “hot”
  - MEGAN isoprene emissions appear too
  - Too much ozone transport from Gulf of Mexico
  - Issues with vertical mixing

Major Tests and Improvements - cont'd -

- Carbon Bond Chemical Mechanism versions: CB6, CB05 (previous version), CB6r2, and CB6r2h [includes ozone destruction over salt water via reaction with halogens (iodine, bromine)]

- WRF meteorology: combos of model versions, cumulus parameterizations, land-surface models, and vertical mixing schemes

- Evaluated response of model to large reductions: biogenic isoprene emissions, boundary condition concentrations over Gulf and Atlantic

Major Tests and Improvements - cont'd -

- Current working configuration includes CB6r2h chemistry, a selected WRF configuration, and a 50% reduction to Gulf/Atlantic Boundary Conditions.
- Model performance is comparable with that of other model applications, but there are still opportunities for improvement:
  - Test BEIS and MEGAN biogenic emissions
  - Improve marine boundary conditions (instead of arbitrary reduction)
  - Additional WRF testing/improvements

Model Performance Evaluation (MPE)

MPE to answer the question:

"How well does the model replicate historical episodes?"

- Subjectively → "Looks Pretty Good"
- Objectively → Use graphical representations and/or statistical tests to compare model output to observations
- Judge "success" of successive incremental changes in model runs by looking for improvements in the statistics
- For 2012, we are comparing to observations statewide

Model Performance Evaluation (MPE)

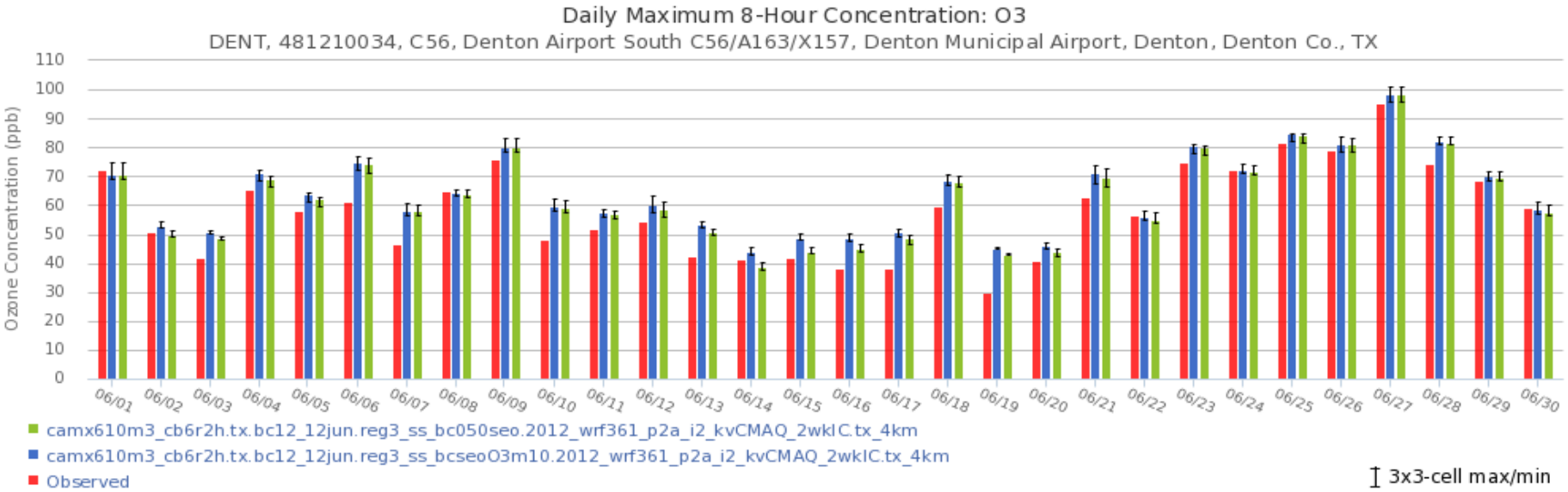
- Create graphical displays of hourly modeled output versus observed data
  - time series
  - contour plots and animations
  - scatter plots

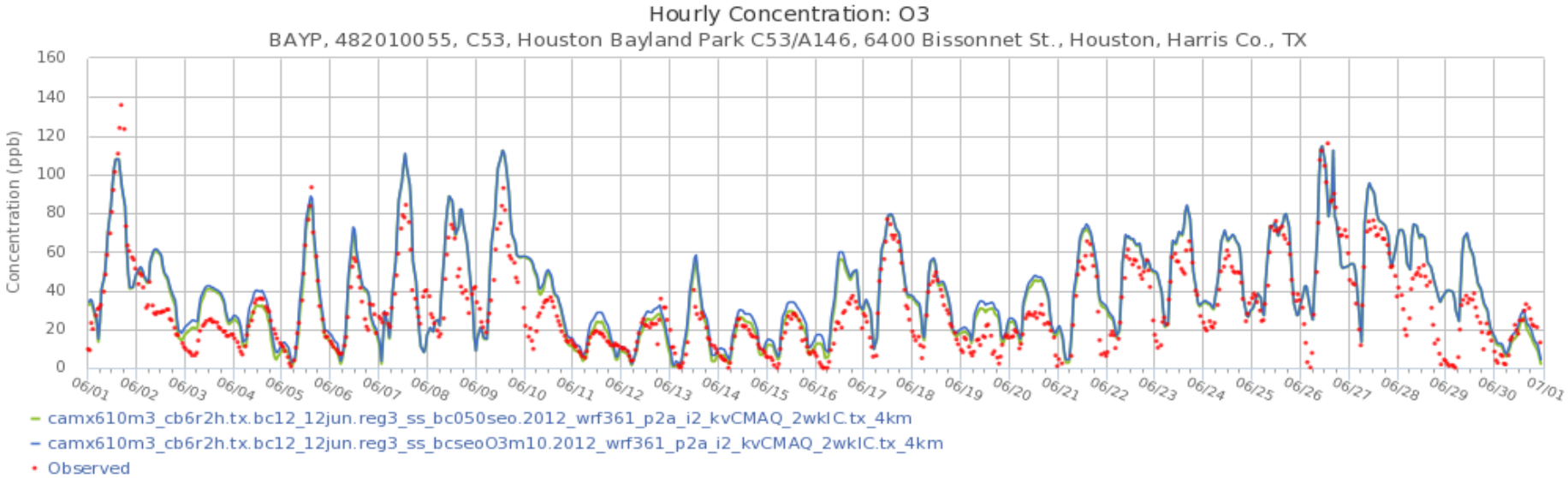
- Calculate operational evaluation statistics recommended by EPA guidance, including:
  - MDA8 = Max Daily 8-hr Avg.
  - normalized mean bias
  - normalized mean gross error

$$NMB = \frac{\sum_{1}^{n}(P-O)}{\sum_{1}^{n}(O)} * 100,$$

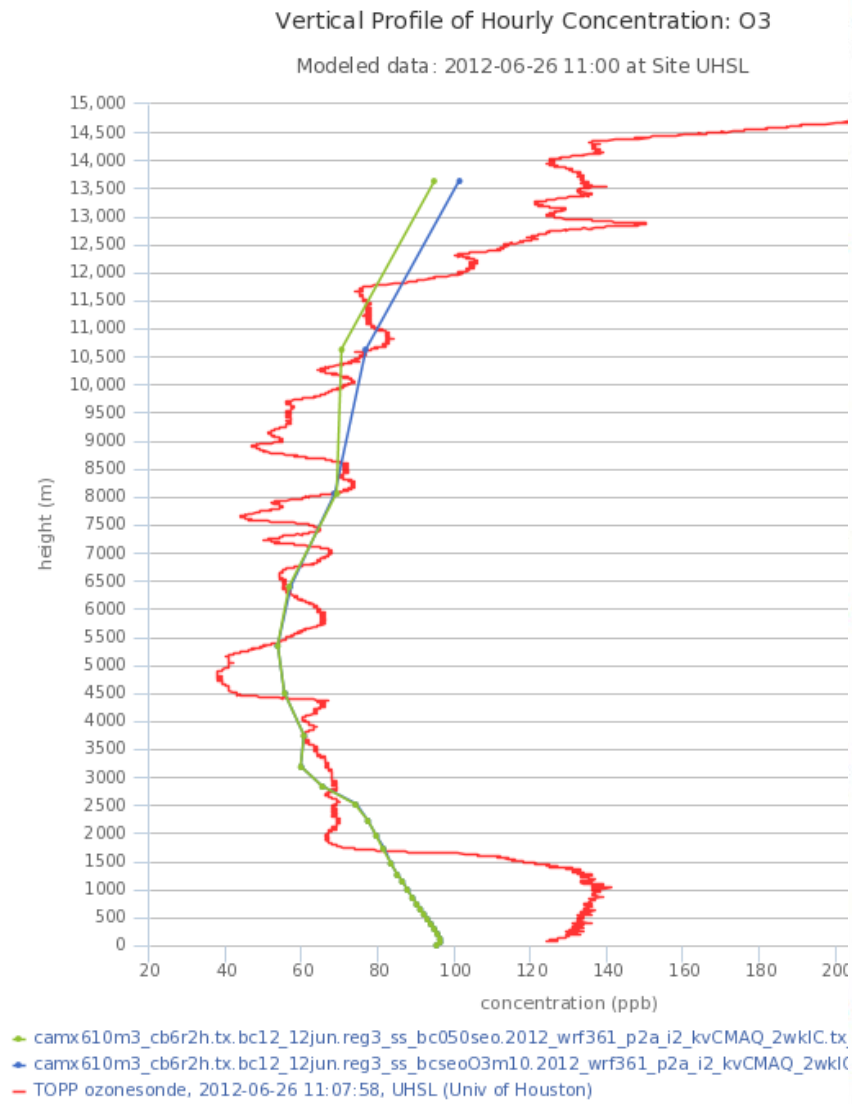
$$NME = \frac{\sum_{1}^{n}|P-O|}{\sum_{1}^{n}(O)} * 100,$$

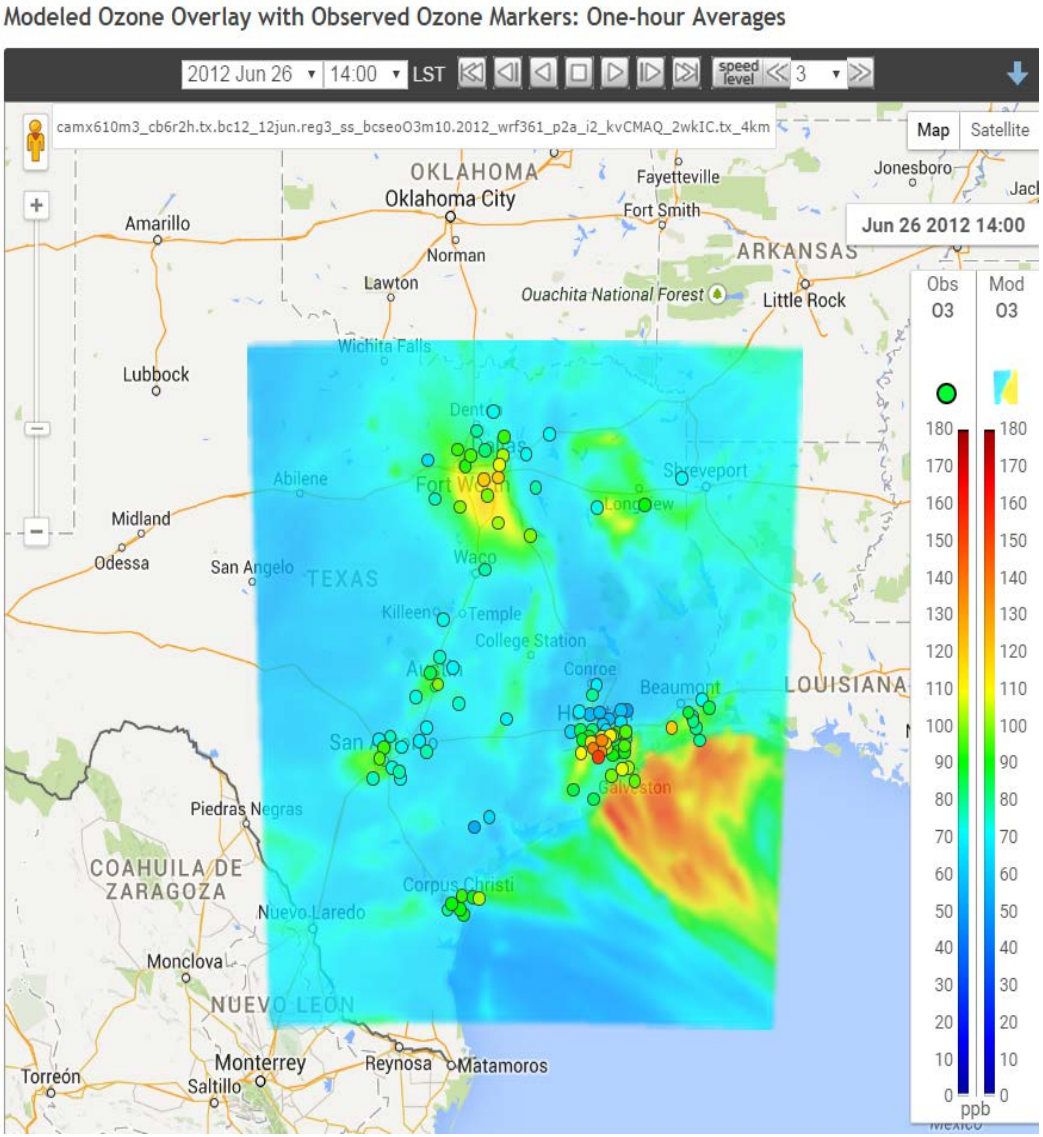
Examples of Graphical MPE



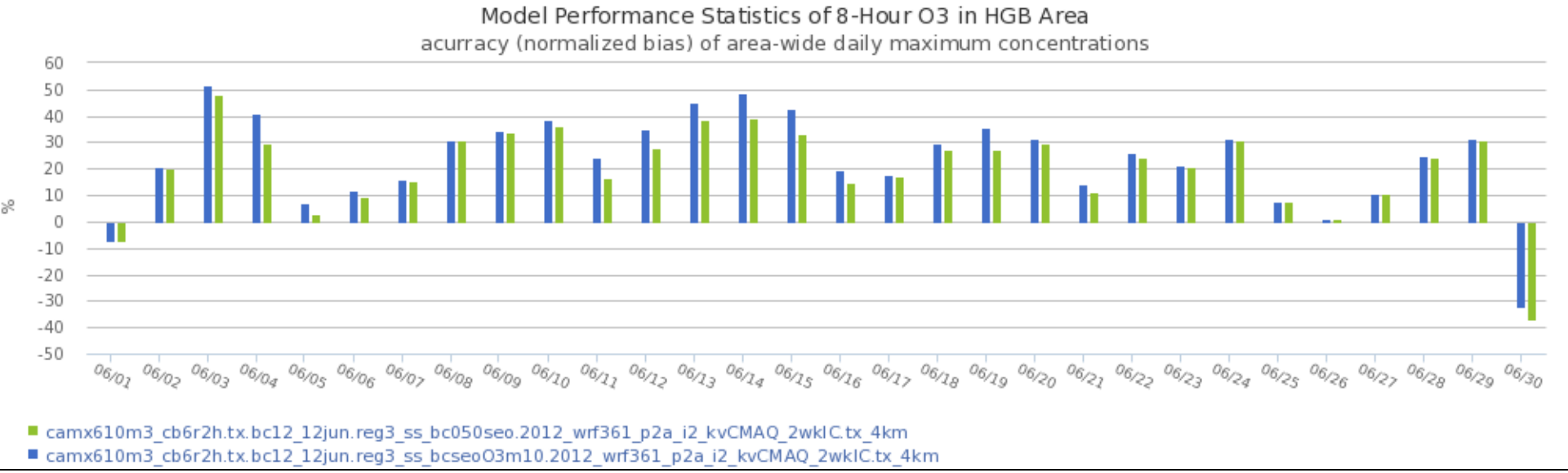


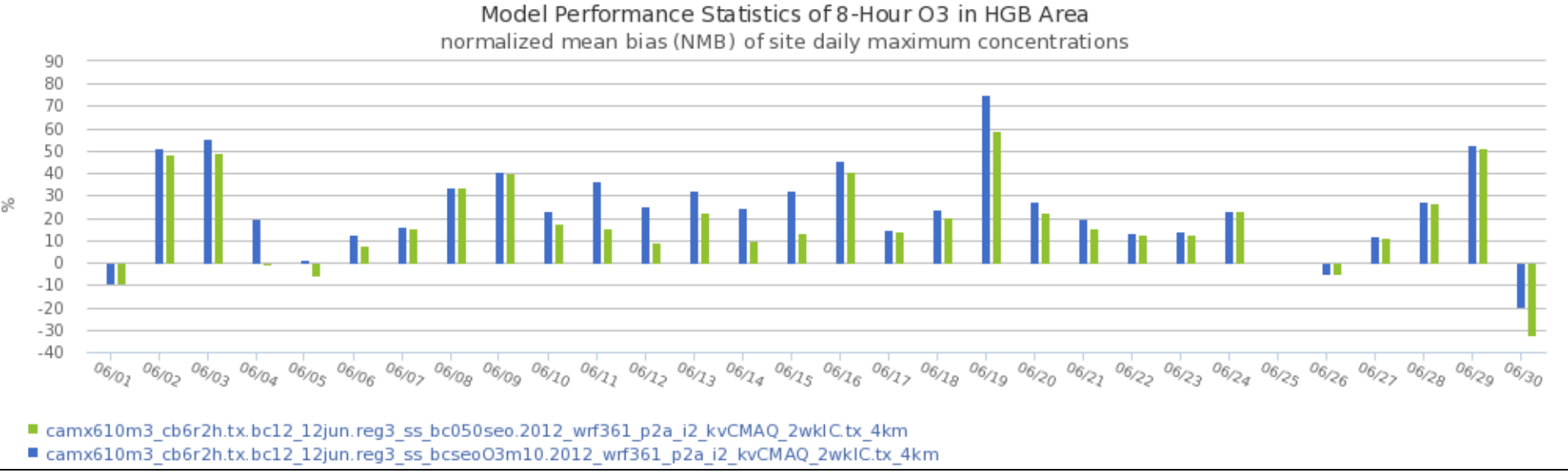
Examples of Graphical MPE - cont'd -





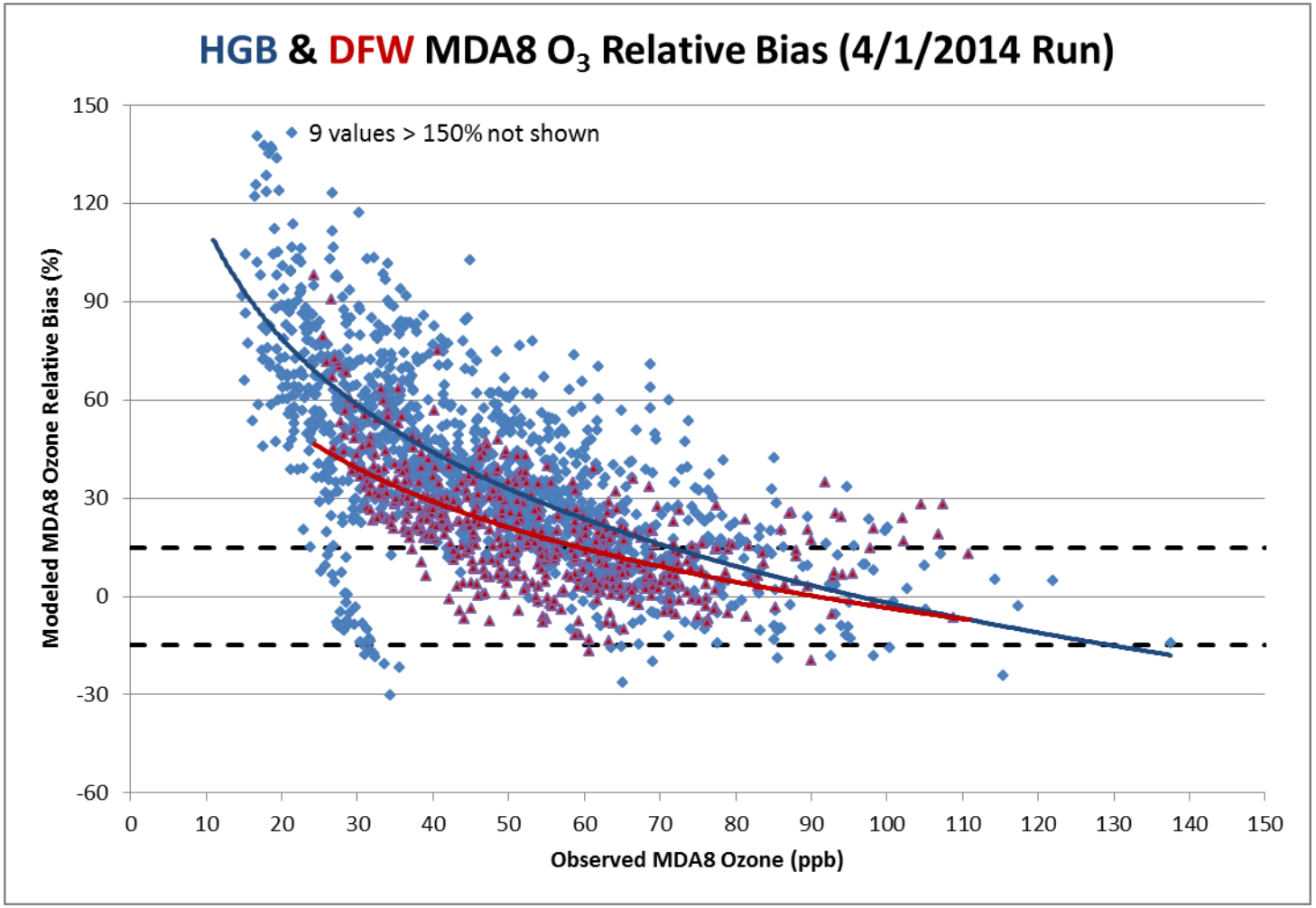
Examples of Statistical MPE





2012 Bias Scatter Plots Comparing HGB and DFW

Progression of Improvements



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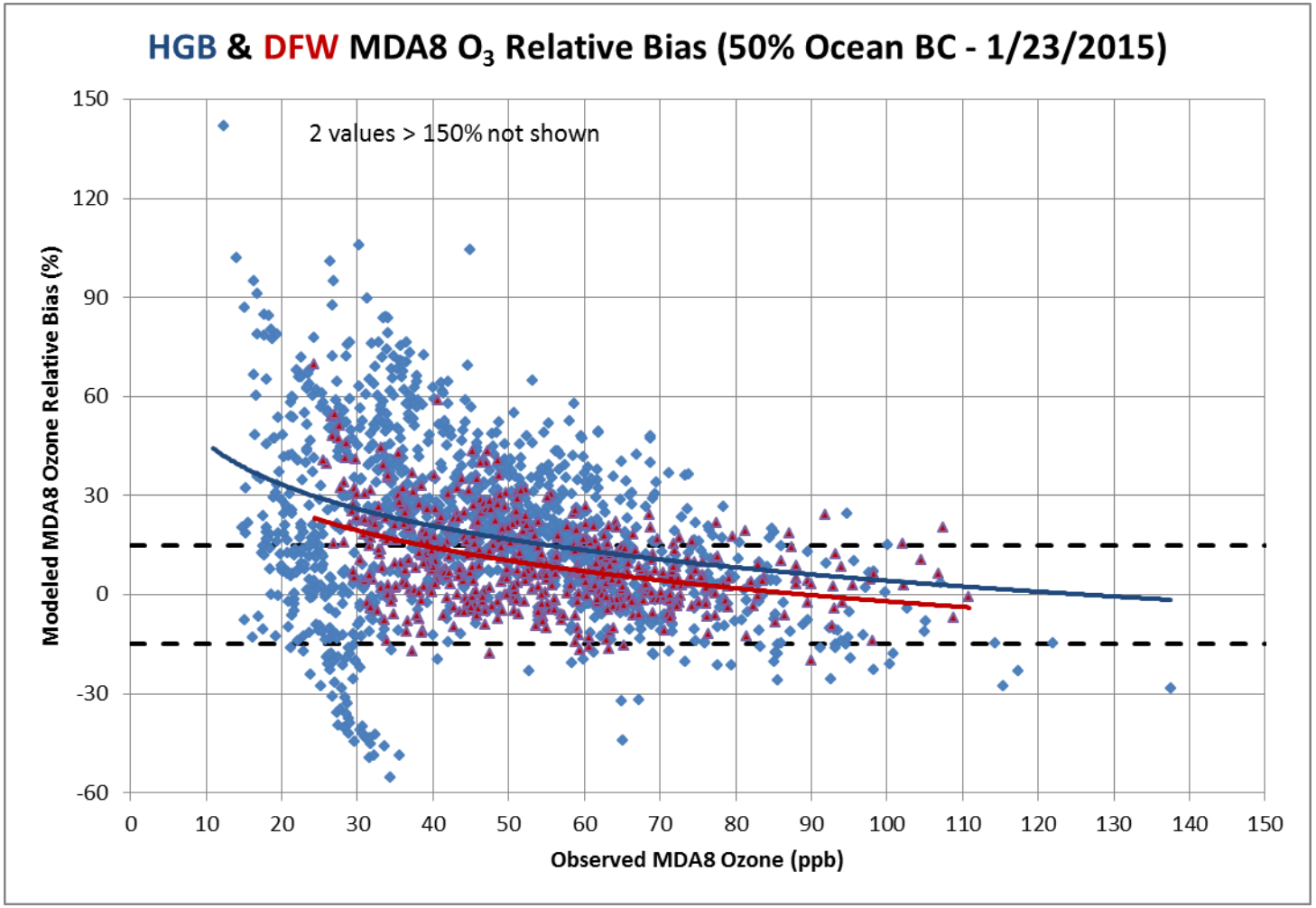

Summary and Next Steps

- June 2012 performance has improved considerably in 9 months (while working on DFW AD SIP)
- DFW performance is better than HGB

- Plan to expand to full 2012 ozone season
- Evaluate biogenic emission models
- Evaluate EPA's new Modeling Guidance

Modeling Web Sites

- SET PMTC: Presentations and past meeting information
  http://www.tceq.state.tx.us/airquality/airmod/committee/pmtc_set.html

- Interactive Air Quality Modeling Results (2012 modeling added)
  http://www.tceq.texas.gov/airquality/airmod/data/results

- Current Eight-Hour Ozone SIP Modeling Details
  https://www.tceq.texas.gov/airquality/airmod/data

- Current Modeling File FTP Site
  ftp://amdaftp.tceq.texas.gov/pub/TX/

- HGB: Latest Ozone Planning Activities
  http://www.tceq.texas.gov/airquality/sip/hgb/hgb-latest-ozone

Questions?

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air modeling data analysis