Modeling of the 2006 HGB SIP Basecase Episodes

Presented to

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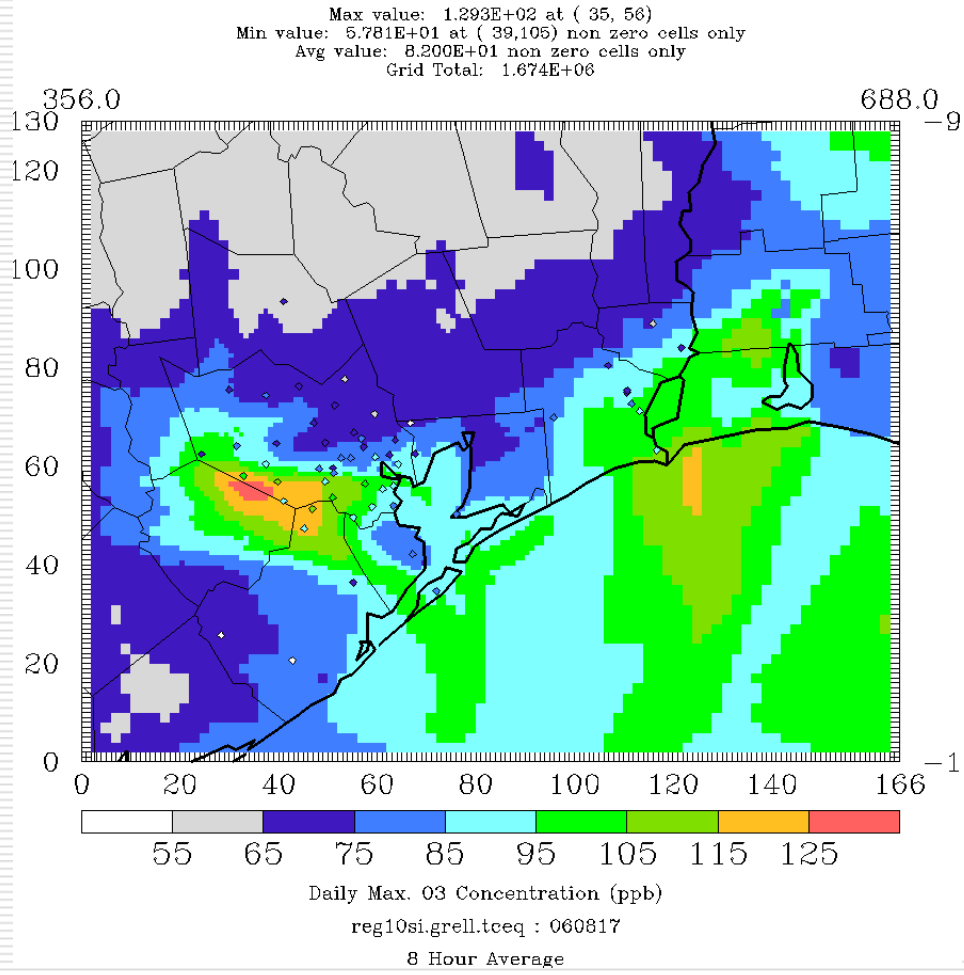
Acknowledgement

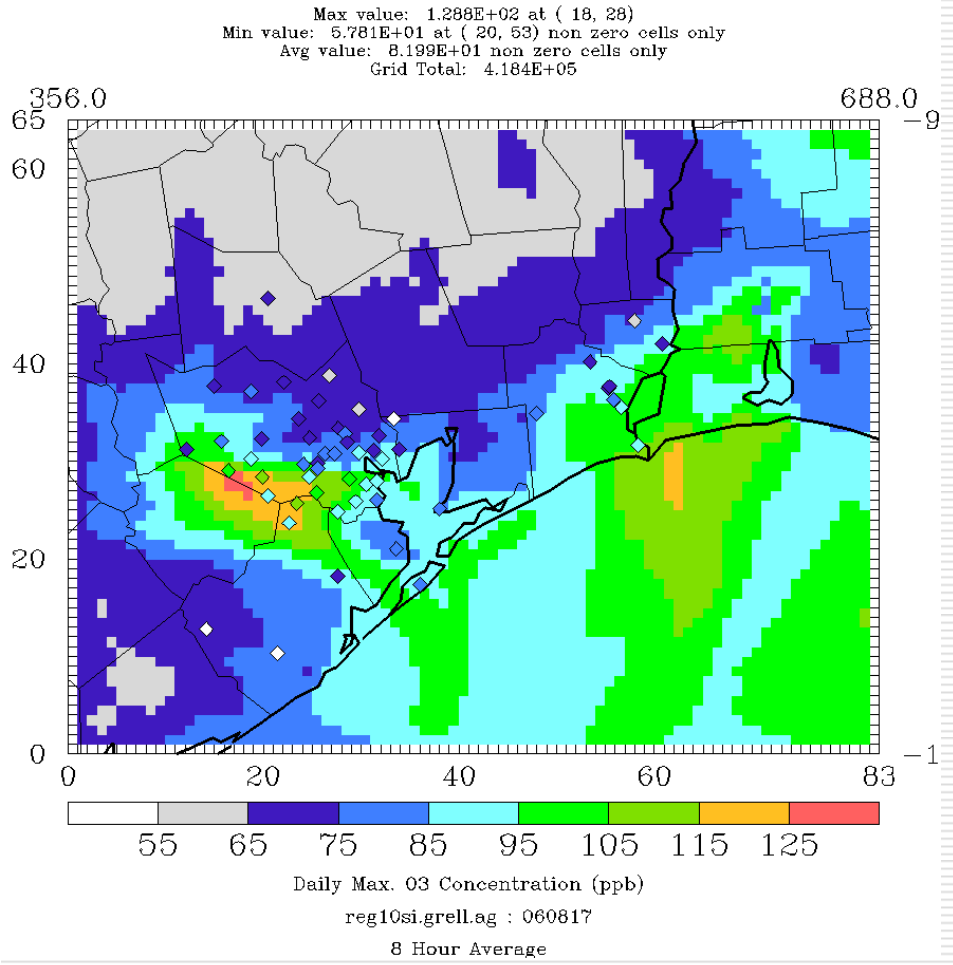
- Thank you to TCEQ Staff for their time and effort in delivering modeling files and answering questions.

General Summary

- Ongoing emissions and ozone modeling analyses will inform public comments on the proposed HGB SIP submitted this autumn.
- Corroborative modeling indicates that we can replicate TCEQs basecase ozone results using agency CAMx input files.
- Emissions differences (mass, speciation, temporal/spatial allocation) between EPS and SMOKE are generally small.
- There are several unresolved and potentially important emissions concerns with the TCEQ 2006 basecase data.
- Discontinuous grid nesting, when compared with standard full-nest (36/12/4/2) modeling for all 2006 episode days, reveals unusually large and unexplained ozone differences. This suggests model replicates high ozone periods better than lower ozone periods.
- Sensitivity experiments reveal that CAMx basecase peak 8-hr ozone estimates are sensitive to changes in emissions and model configuration (e.g. grid nesting scheme)

CAMx Base10 Corroboration





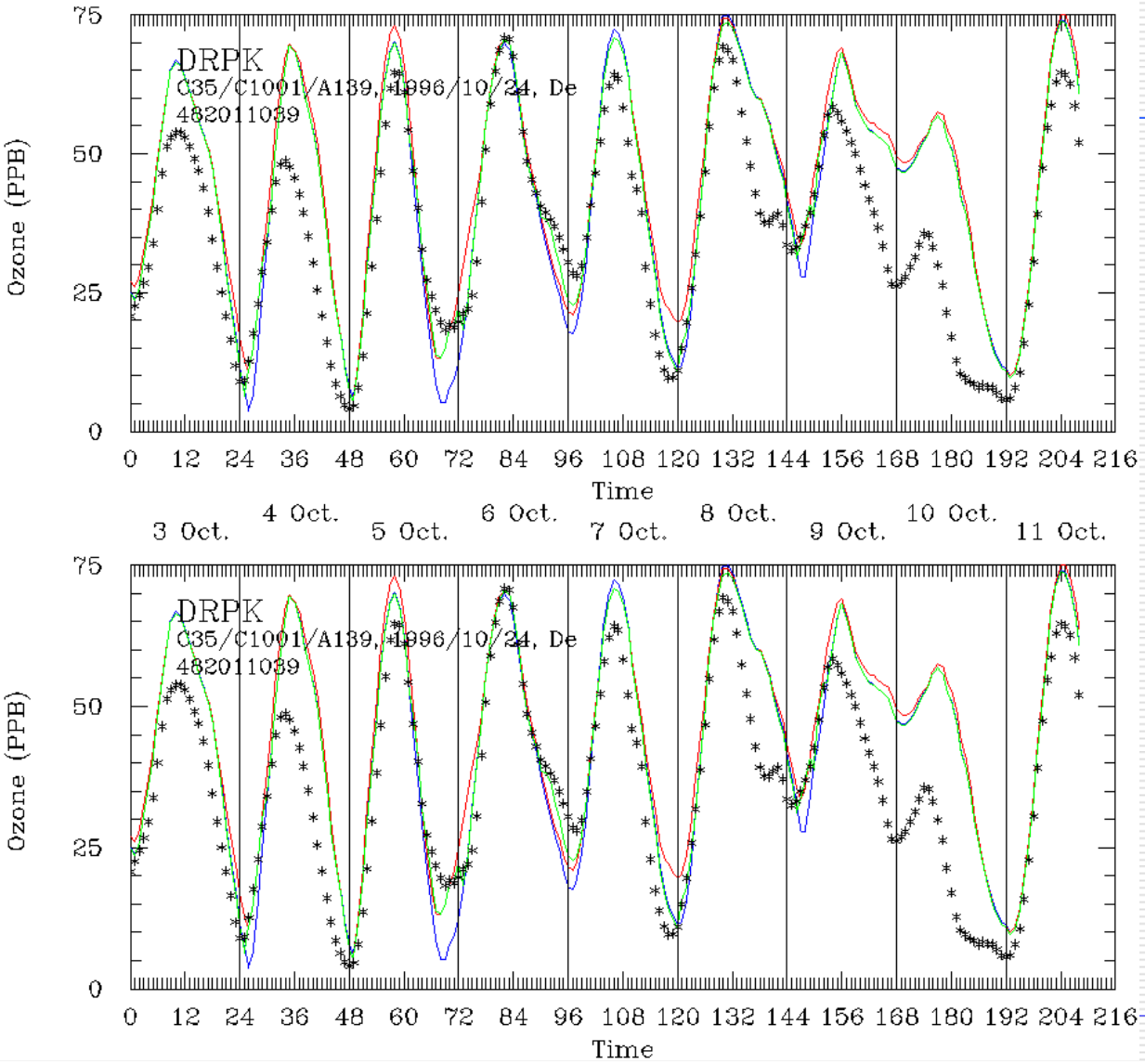
LEFT: base10\06aug15-06aug22\reg10si.grell.tceq\O3.AQS\tommap\02\8hr\060817.99

RIGHT: base10\06aug15-06aug22\reg10si.grell.ag\O3.AQS\tommap\04\8hr.060817.99

TCEQ (2 km; 130x166)

AG (4 km;65x83)

CAMx Base10 Corroboration



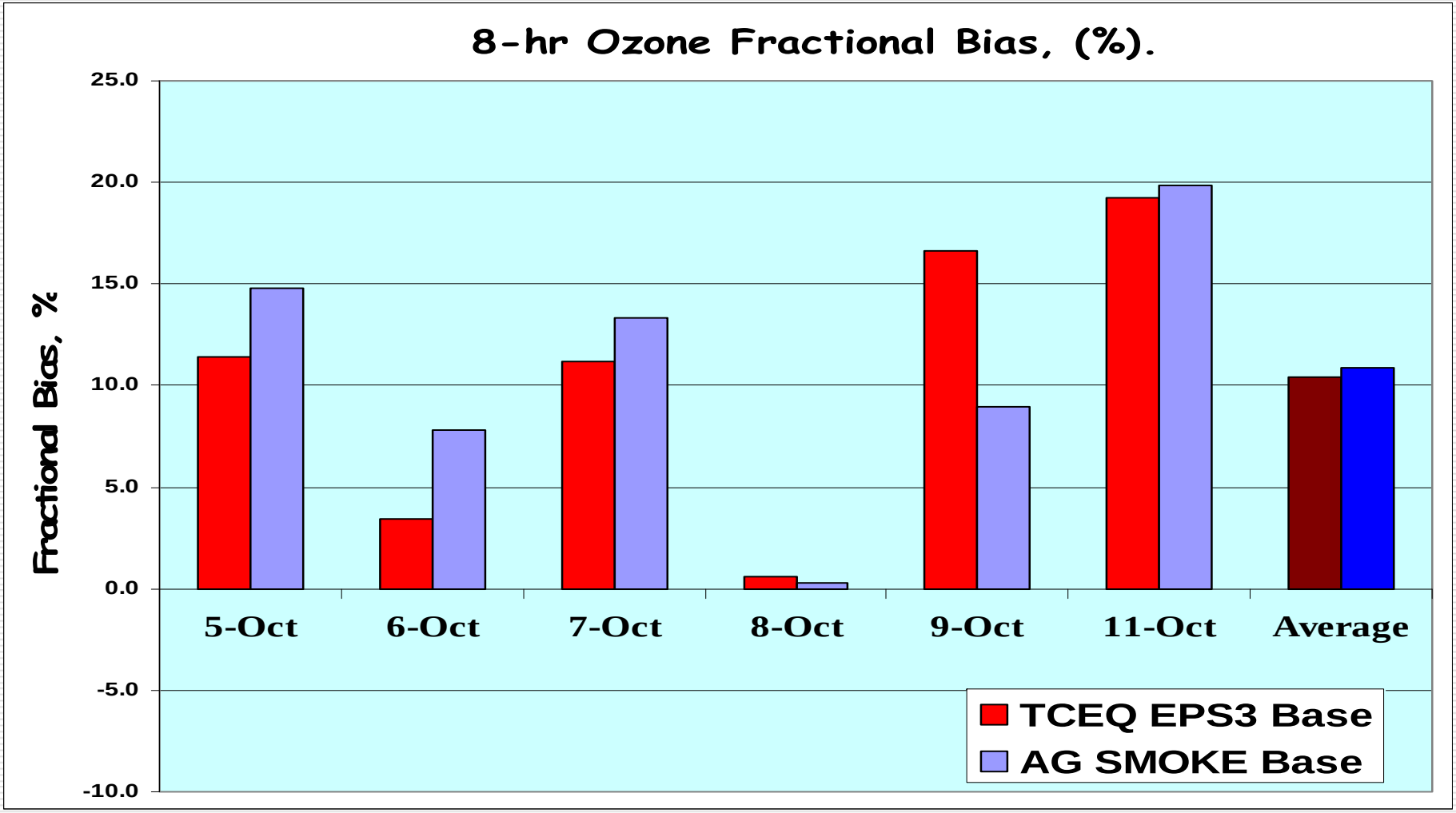
TCEQ 2 km

AG 2 km

Top: base10\06oct03-06oct11\reg10si.grell.tceq\O3.AQS\maps\02\8hr\CHANNEL

Bottom: base10\06oct03-06oct11\reg10si.grell.ag\O3.AQS\maps\02\8hr\CHANNEL

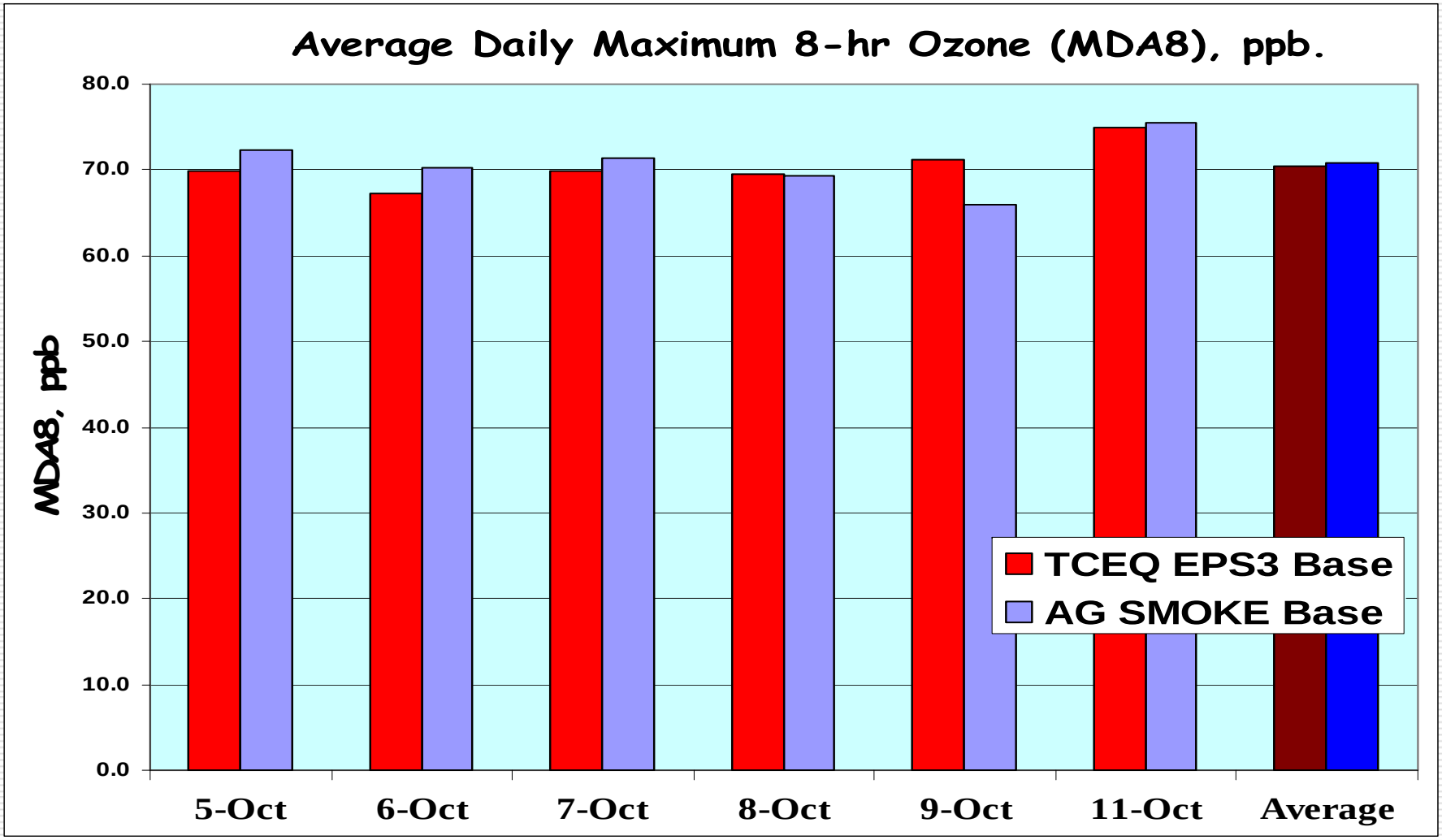
Emissions Model Comparisons



TCEQ Results: reg10si.tceq 3-11 Oct '06_o3.AQS.2km.8hr.CHANNEL.60.allhrs.allsite.oneday

AG Results: reg10si.2006BCa1a.ag 3-11 Oct '06_o3.AQS.2km.8hr.CHANNEL.60.allhrs.allsite.oneday

How is O_3 Affected by Choice of Emissions Model?



TCEQ Results: reg10si.tceq 3-11 Oct '06_o3.AQS.2km.8hr.CHANNEL.60.allhrs.allsite.oneday

AG Results: reg10si.2006BCa1a.ag 3-11 Oct '06_o3.AQS.2km.8hr.CHANNEL.60.allhrs.allsite.oneday

Example of Emissions Issues

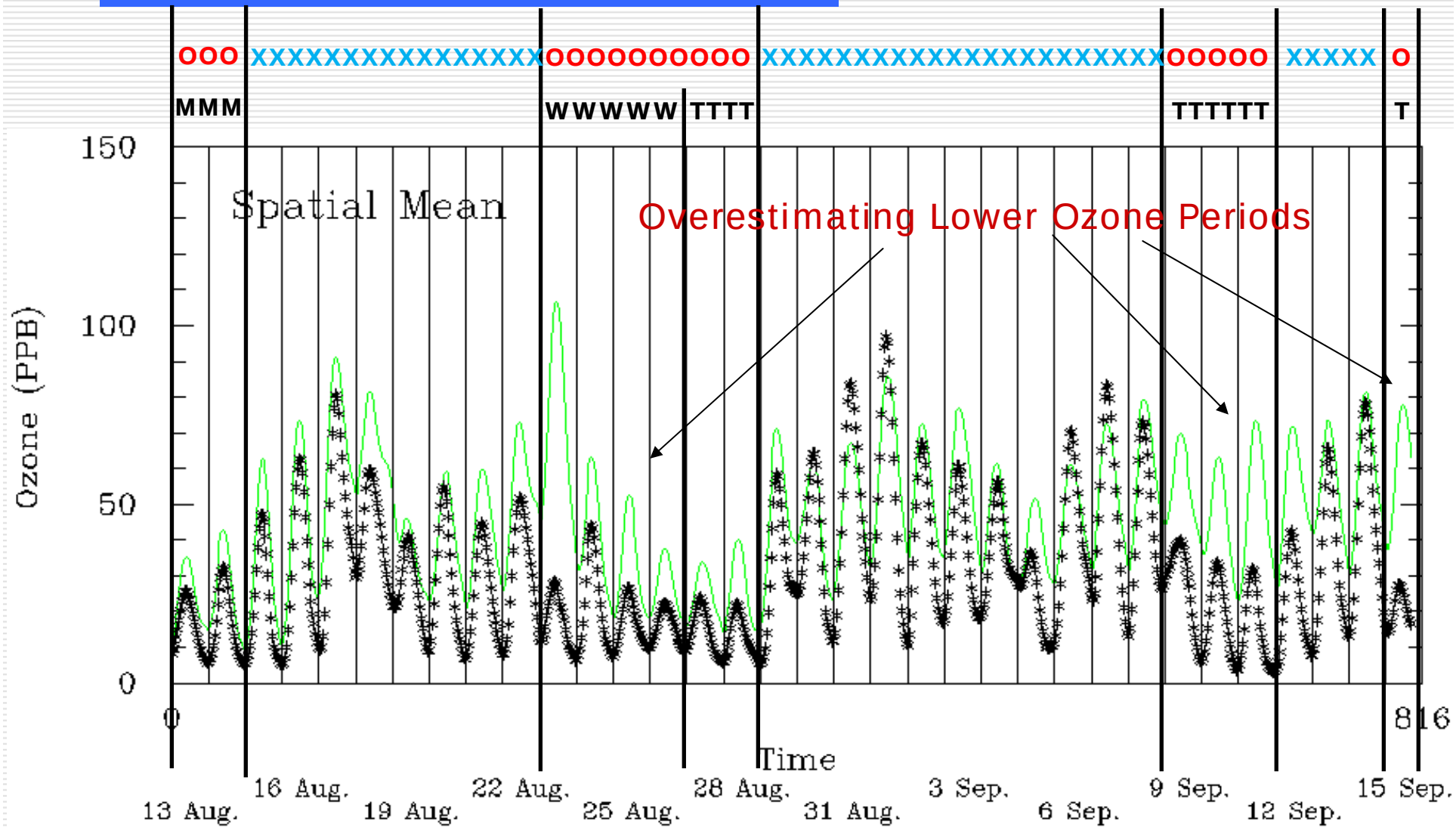
- EPS vs. SMOKE – two different models with same emissions inputs should result in only minor differences in emissions mass, which we do see
- Greater concerns are not in emissions masses, but in the underlying data themselves:
  - Where are fire emissions outside TX?
  - Why 24/7 temporal profile for railroad?
  - Why differences in Plume in Grid (PinG) outcome using same criteria (i.e., 240+ TCEQ vs. 1,077 AG PinG sources)?

Discontinuous Modeling versus Full-nest Modeling

- Examine differences in day to day 8-hr peak ozone mixing ratios due to discontinuous use of the 4 km and 2 km fine nests versus continuous CAMx modeling with full 36/12/4/2 km nesting of all days
- Continuous versus discontinuous nesting can increase or decrease daily maximum ozone concentrations.

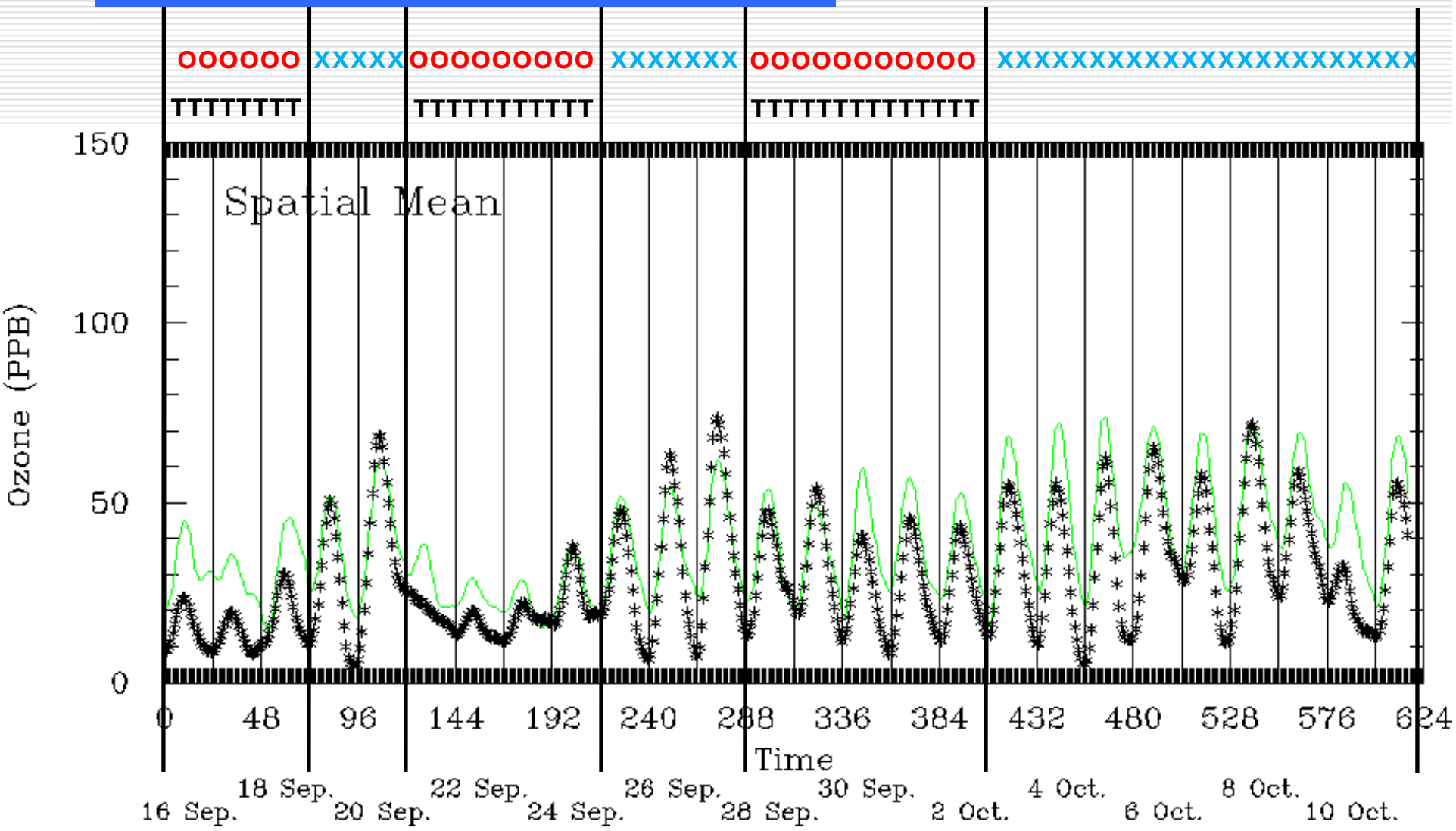
Full-nest Spatial Mean Ozone (08Aug-15Sep)

***Observed
--- Modeled
XXXX TCEQ analysis period
OOO TCEQ does not model
MMM TCEQ did not use 04 km met
TTTT Use of TCEQ 04 km met
WWW Flexi-nest of TCEQ 12km met

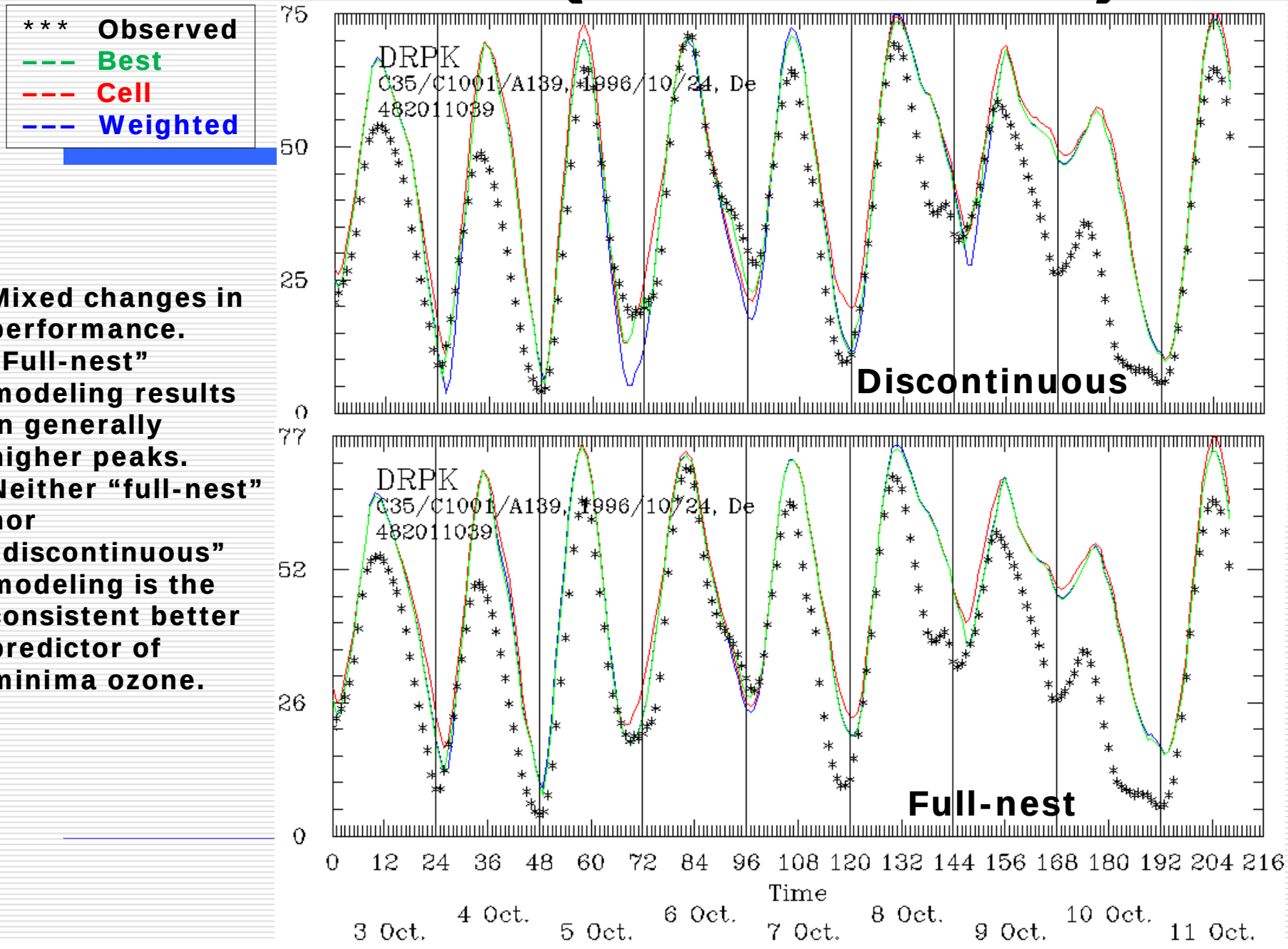


Full-nest Spatial Mean Ozone (16Sep-11Oct)

***Observed
--- Modeled
XXXX TCEQ analysis period
OOO TCEQ does not model
MMM TCEQ did not use 04 km met
TTTT Use of TCEQ 04 km met
WWW Flexi-nest of TCEQ 12km met

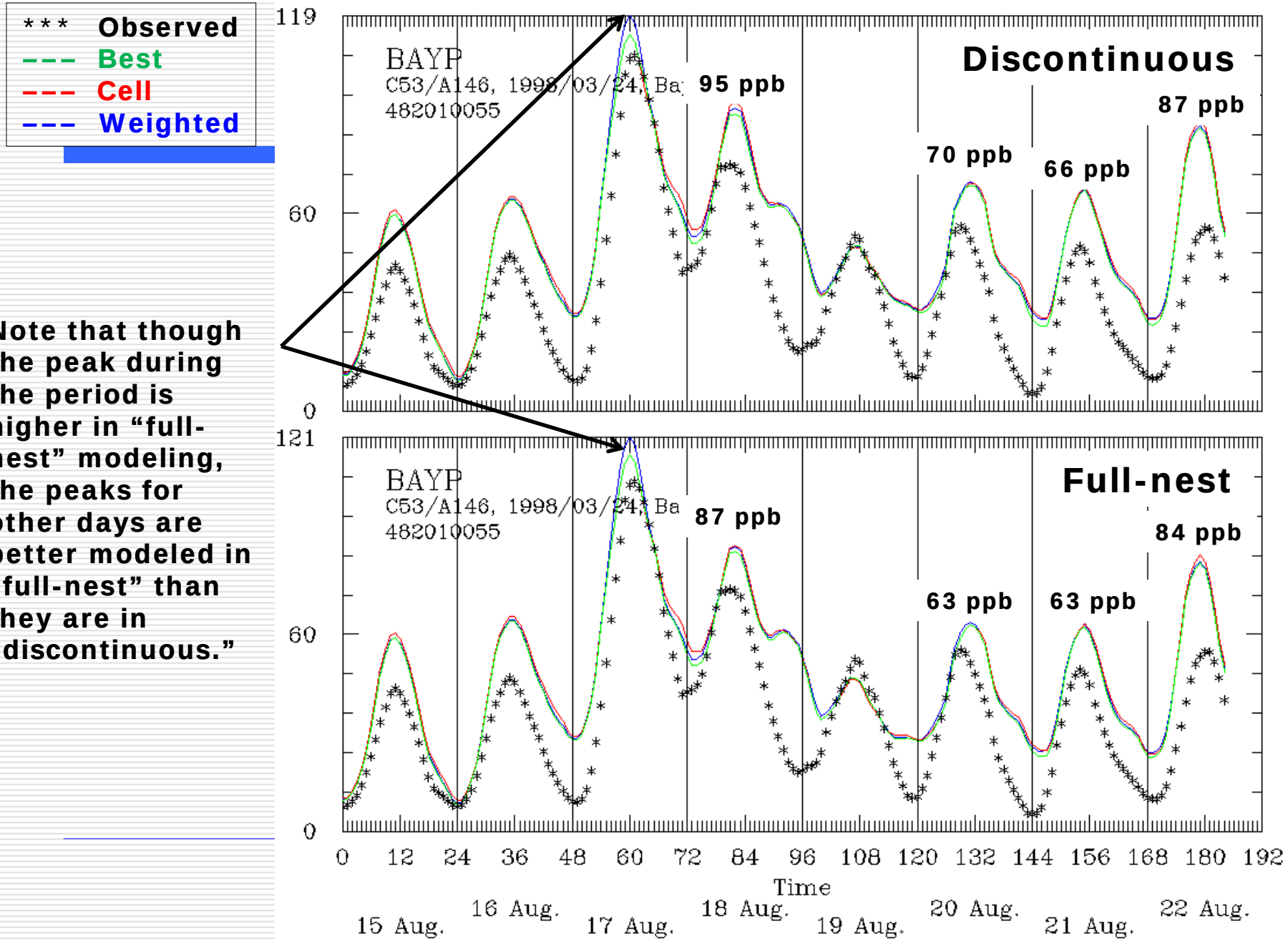


Deer Park (AG 2 km CAMx)



Mixed changes in performance. "Full-nest" modeling results in generally higher peaks. Neither "full-nest" nor "discontinuous" modeling is the consistent better predictor of minima ozone.

Bayland Park (AG 2 km CAMx)

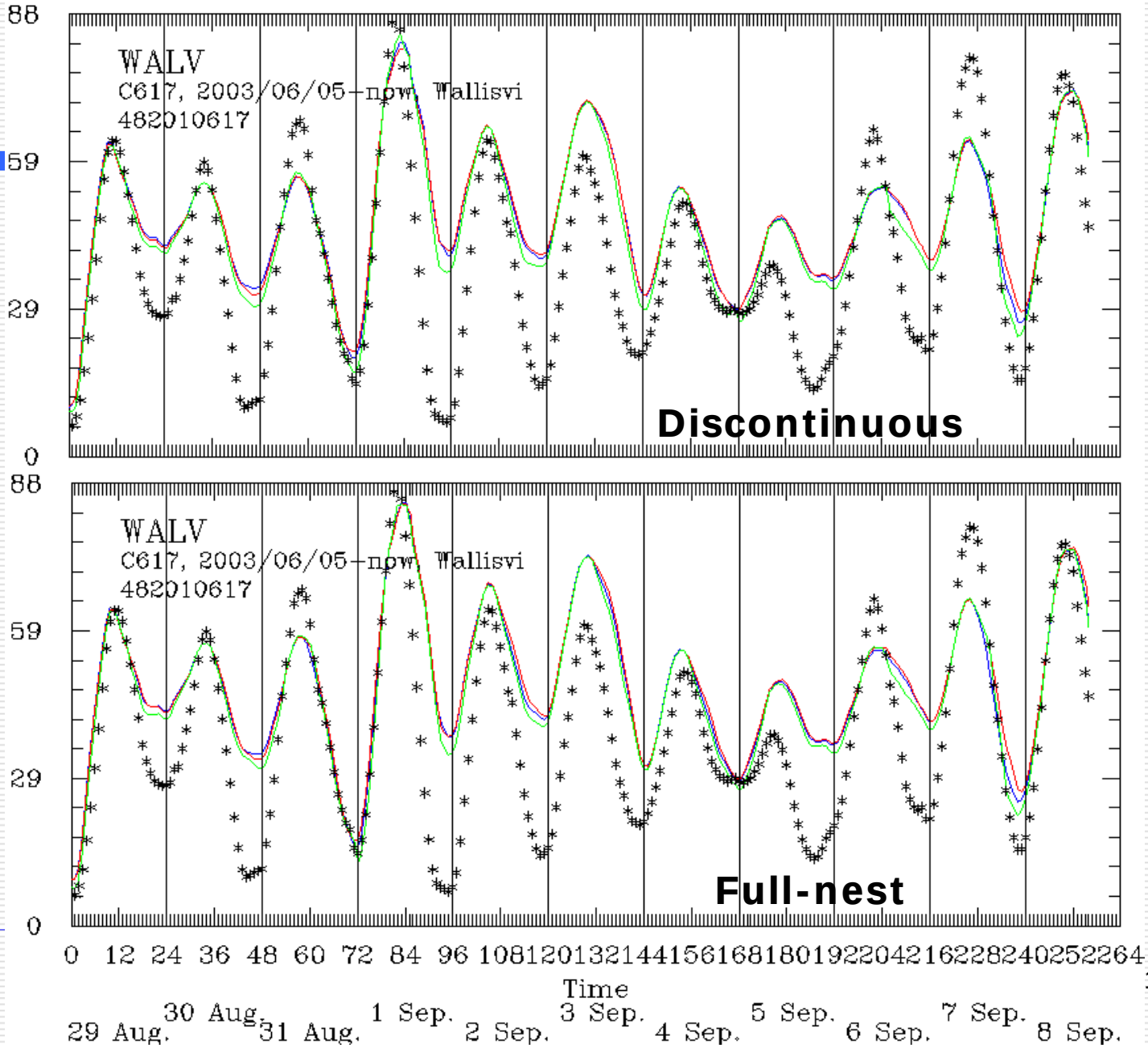


Note that though the peak during the period is higher in "full-nest" modeling, the peaks for other days are better modeled in "full-nest" than they are in "discontinuous."

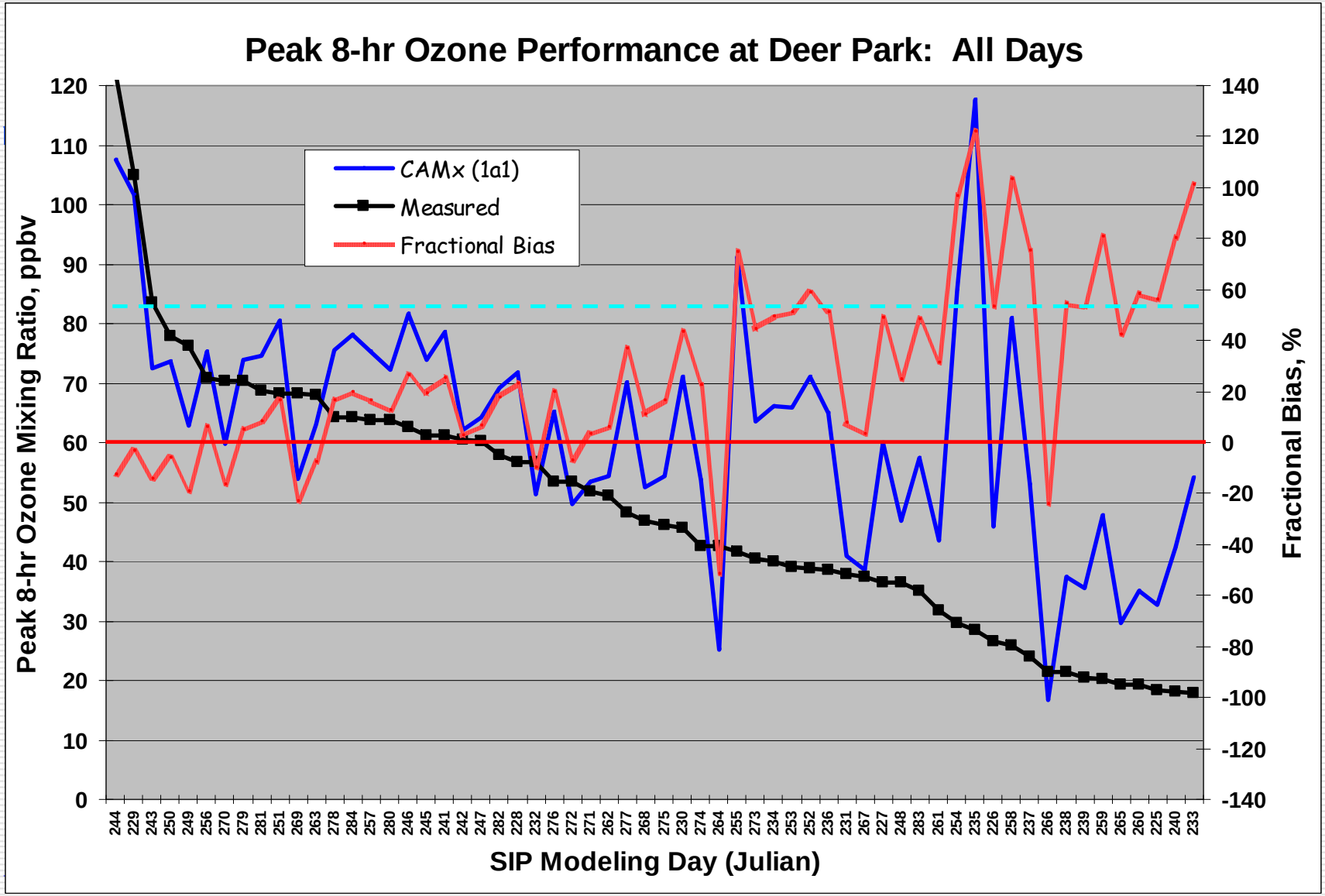
Wallisville (AG 2 km CAMx)

*** Observed
--- Best
--- Cell
--- Weighted

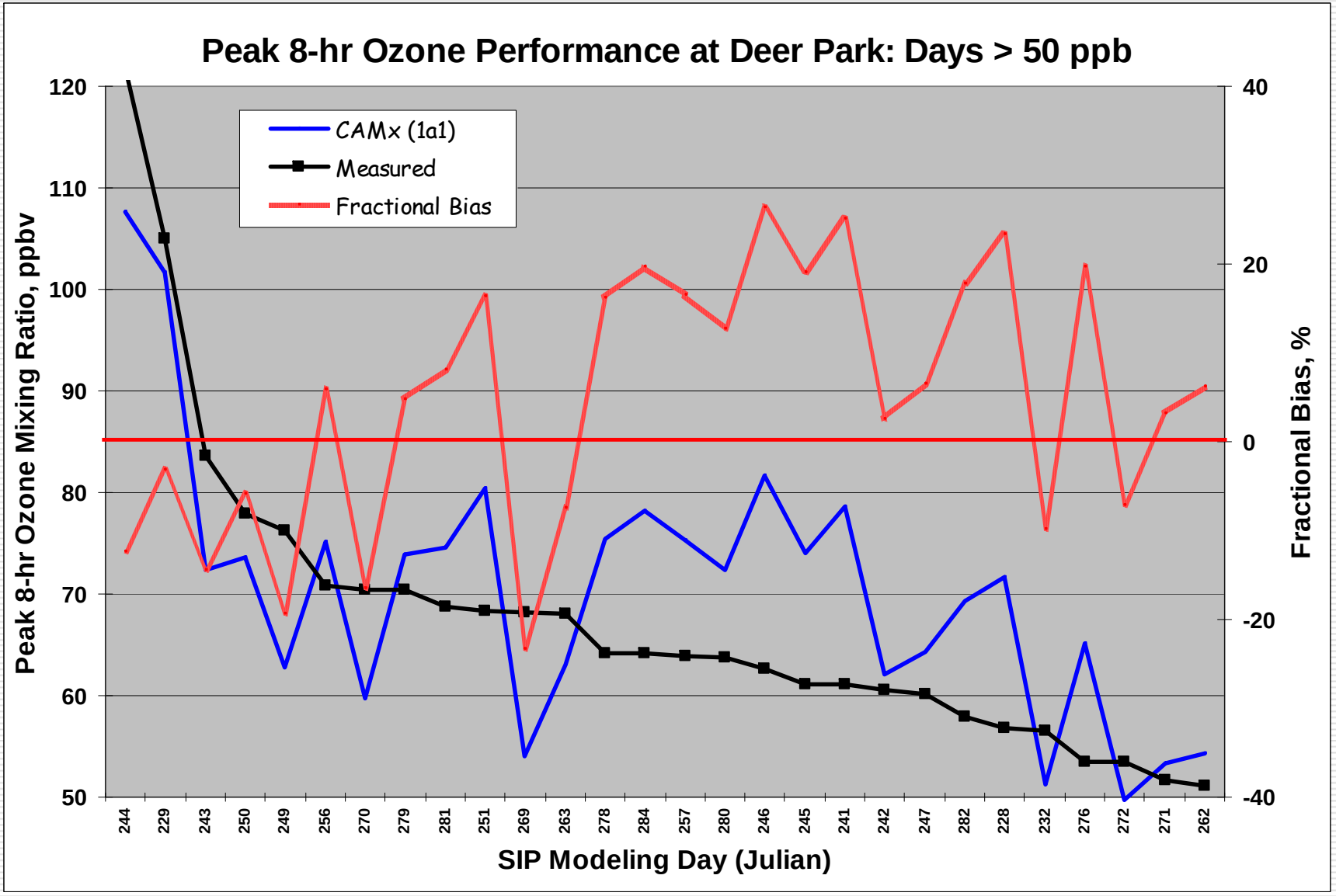
"Full-nest" modeling results in slightly better peak prediction and definitely better prediction of minima ozone.



Sensitivity & Bias at Deer Park

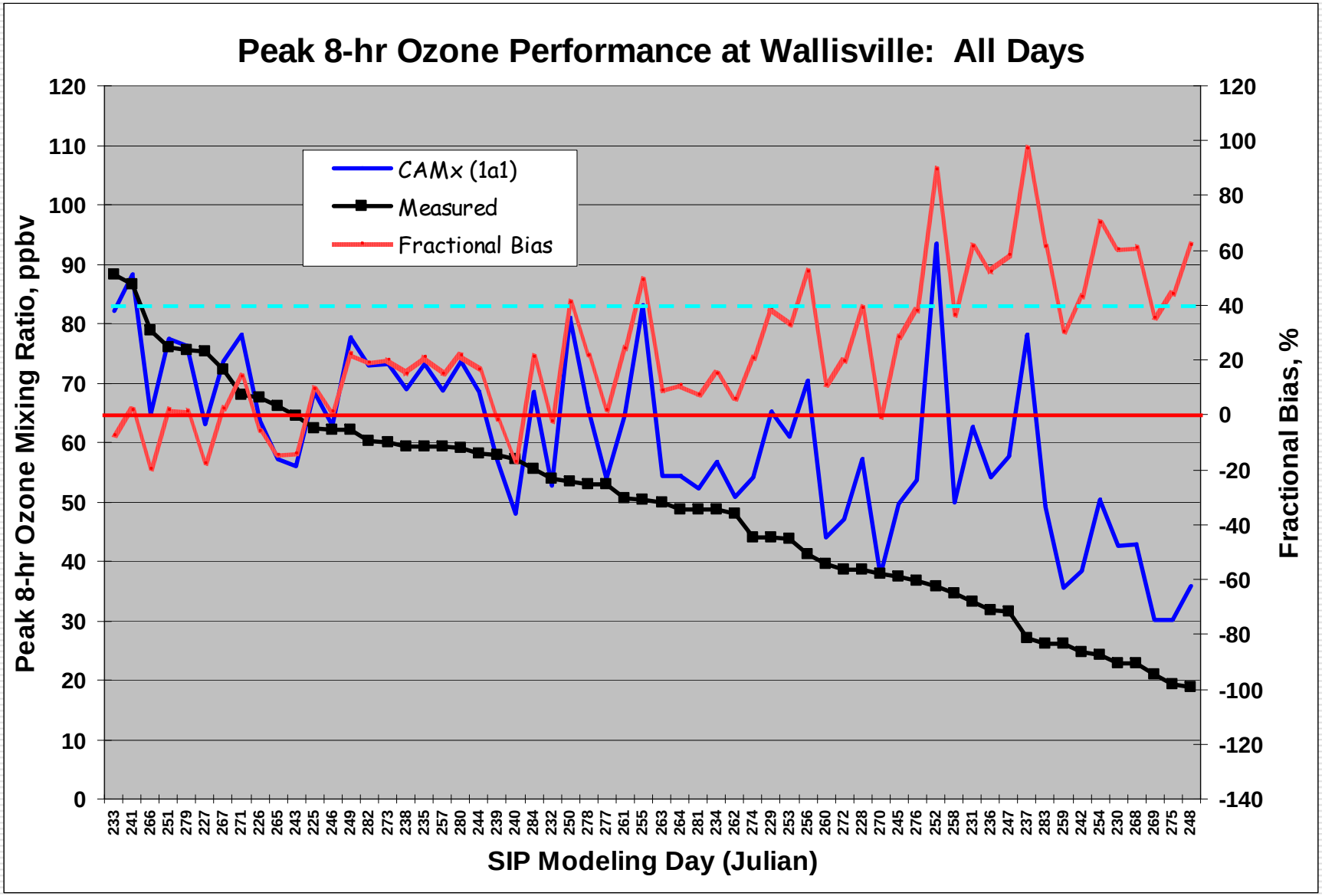


Sensitivity & Bias at Deer Park

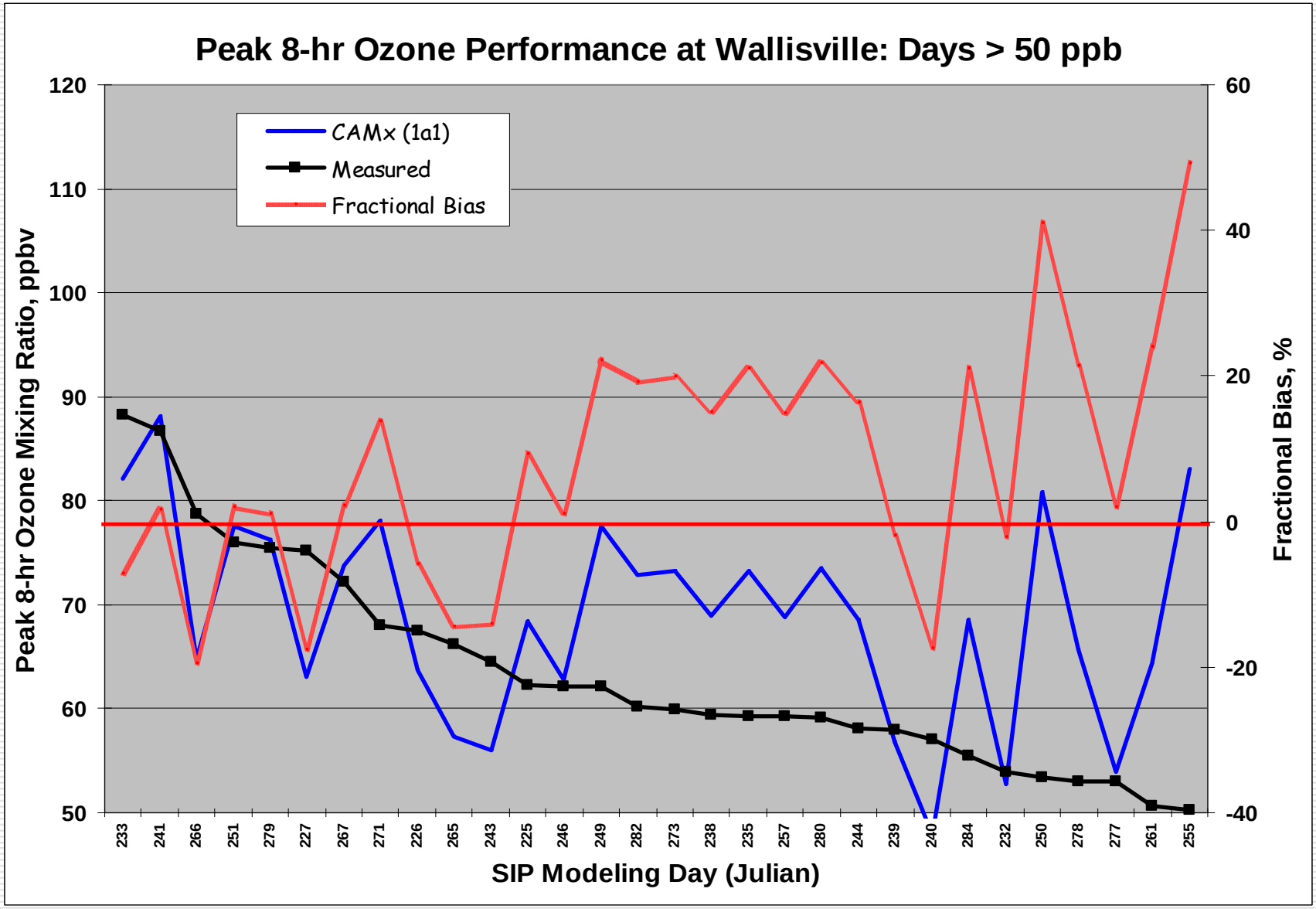


At Deer Park, daily fractional bias ranges from -31.2% to 37.1% (mean of 8.2%)

Sensitivity & Bias at Wallisville



Sensitivity & Bias at Wallisville



At Wallisville, daily fractional bias ranges from -10.8% to 57.5% (mean of 16.1%)

CAMx Sensitivity Experiments

- Incremental emissions
  - 2006BCa1a – Initial 2006 basecase emissions
  - 2006BCa1-moblidlea – Addition of idling emissions from HDDV
  - 2006BCa1-landlossa – Addition of tank landing loss emissions
  - 2006BCa1-pscfa – Addition of emissions from PSCF analysis
- No change in CAMx inputs (e.g., meteorology, BC/IC) other than in emissions
- Purpose of experiments
  - To ascertain changes in predicted ozone due to incremental additions of emissions from specific sources
  - Does CAMx model performance change?

Summary of Emissions Over 2 km Domain by Sensitivity Experiment

Basecase

	NOX	CO	VOC
area	33.6	116.0	435.7
nonroad	81.6	629.1	50.7
offroad	36.6	22.3	3.2
offshore	0.1	0.0	0.0
onroad	201.9	1089.2	92.2
point	95.3	107.9	199.5
biogenics	4.9	32.6	451.9
Total	453.9	1997.1	1233.3

2006BCa1-moblidlea: Basecase + Mobile Idle (included in onroad)

	NOX	CO	VOC
area	33.6	116.0	435.7
nonroad	81.6	629.1	50.7
offroad	36.6	22.3	3.2
offshore	0.1	0.0	0.0
onroad	204.5	1089.7	92.3
point	95.3	107.9	199.5
biogenics	4.9	32.6	451.9
Total	456.5	1997.6	1233.4

2006BCa1-landloss: Basecase + Mobile Idle + Landing Loss (included in point)

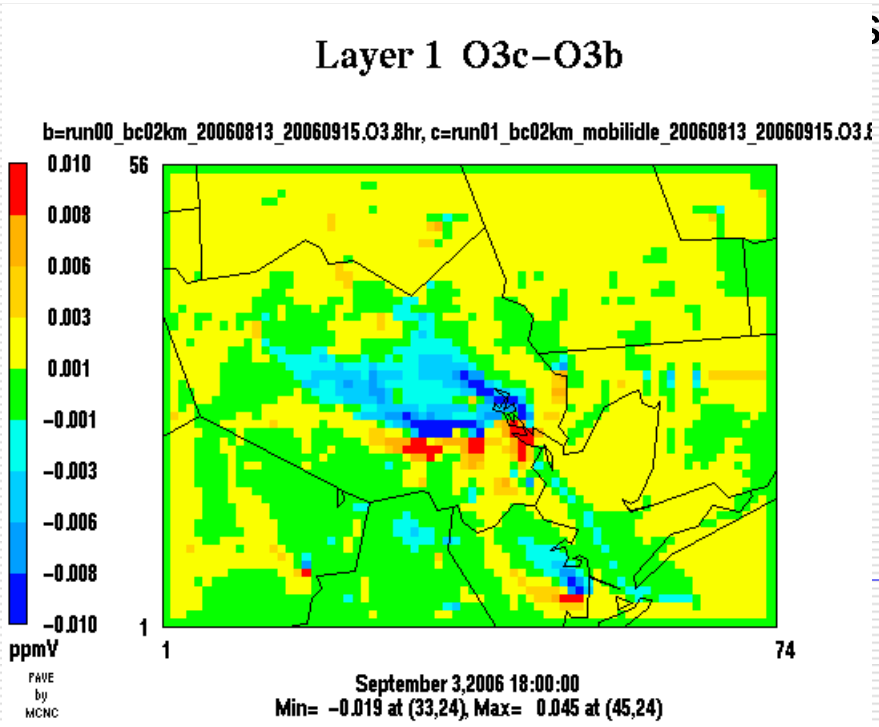
	NOX	CO	VOC
area	33.6	116.0	435.7
nonroad	81.6	629.1	50.7
offroad	36.6	22.3	3.2
offshore	0.1	0.0	0.0
onroad	204.5	1089.7	92.3
point	95.3	107.9	207.8
biogenics	4.9	32.6	451.9
Total	456.5	1997.6	1241.7

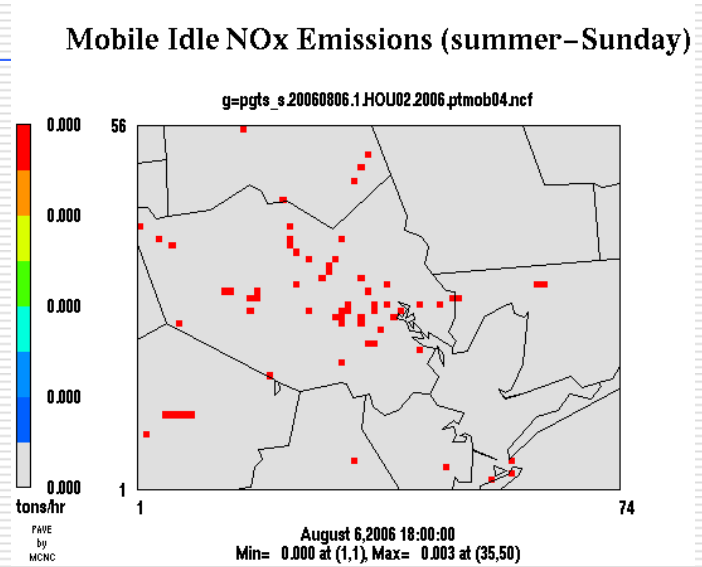
2006BCa1-pscfa: Basecase + Mobile Idle + Landing Loss + PSCF (included in point)

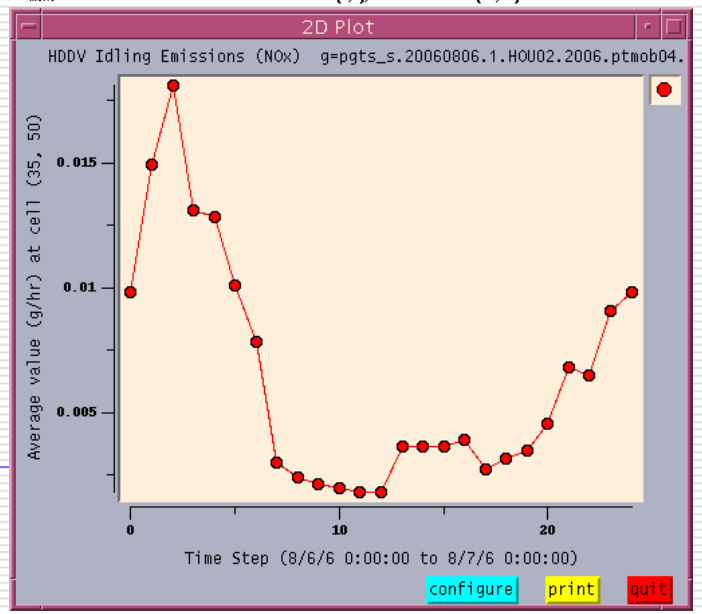
	NOX	CO	VOC
area	33.6	116.0	435.7
nonroad	81.6	629.1	50.7
offroad	36.6	22.3	3.2
offshore	0.1	0.0	0.0
onroad	204.5	1089.7	92.3
point	95.3	107.9	228.1
biogenics	4.9	32.6	451.9
Total	456.5	1997.6	1262.0

2006BCa1-moblidlea: Mobile Idle (HDDV) minus Basecase

- Showing hour of maximum impact
- Other days/hours show ±3 ppb difference
- Impact is unexpectedly large

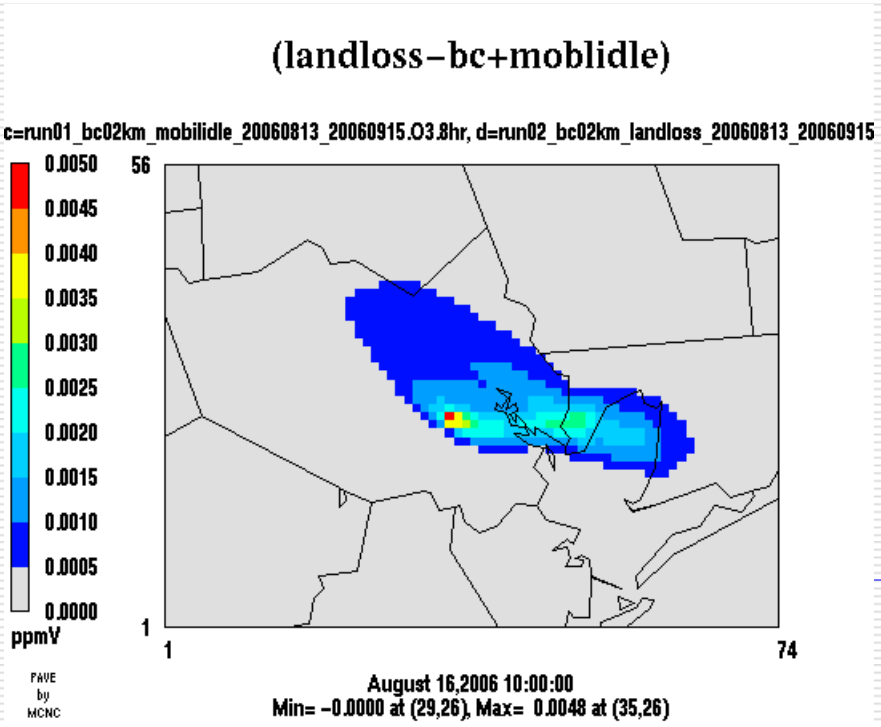


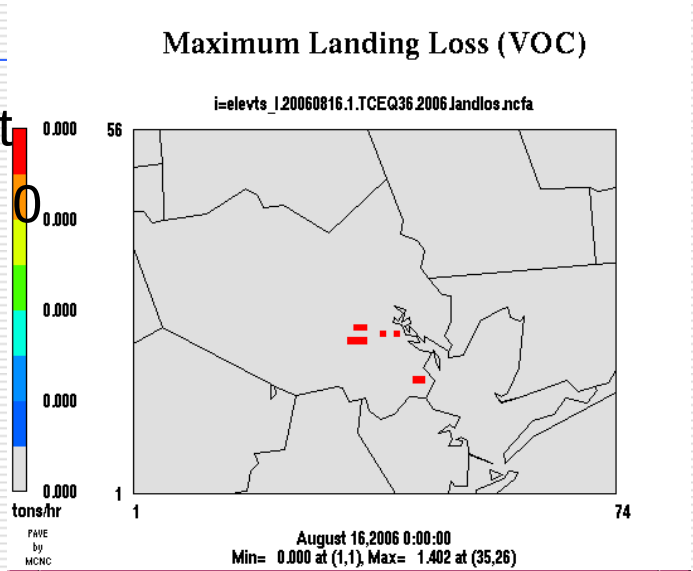


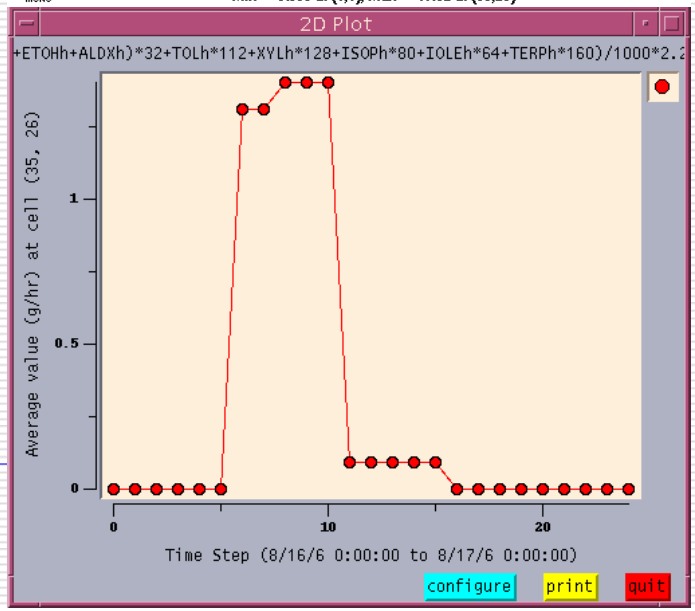


2006BCa1-landloss: Landing Loss minus Basecase + Mobile Idle

- Showing hour of maximum impact
- Other days/hours no impact (i.e., 0 ppb)

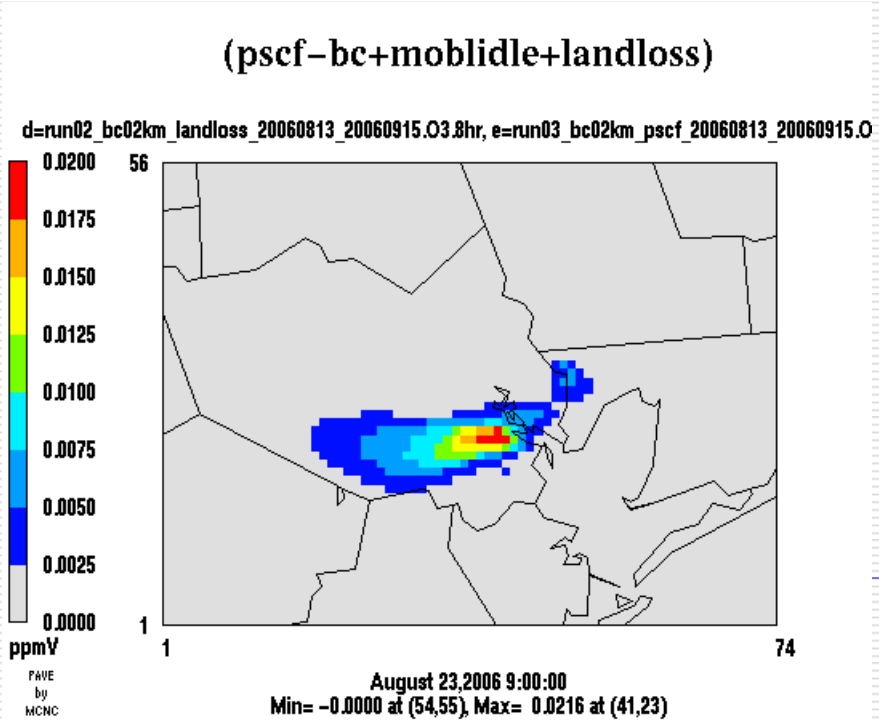


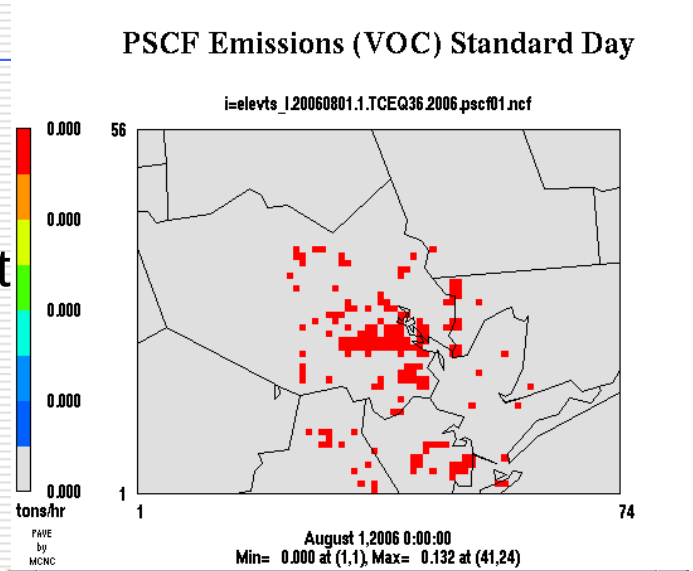


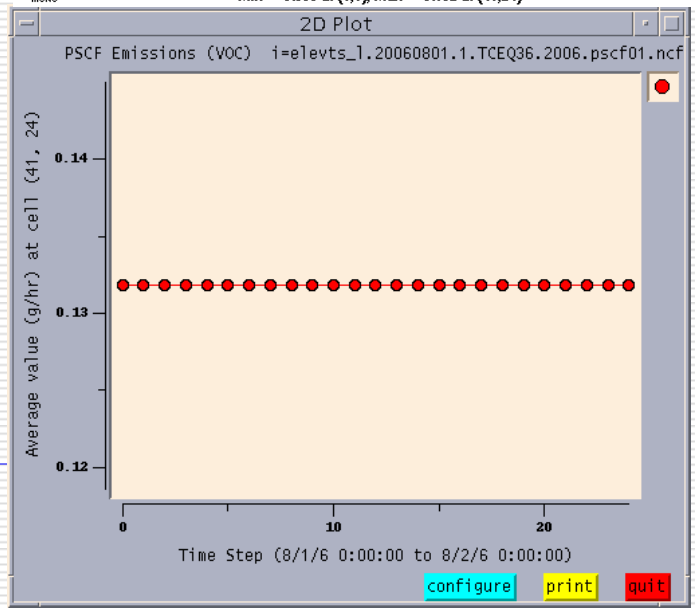


2006BCa1-pscfa: PSCF minus Basecase+Mobile Idle+Landing Loss

- Potential Source Contribution Factor (PSCF) emissions
- Showing hour of maximum impact
- Other days/hours no impact (i.e., 0 ppb)







Specific Summary

- Baseline CAMx Performance Testing Shows:
  - Full-nest modeling results suggest model better able to replicate high ozone periods, but overestimates lower ozone periods. Neither "full-nest" nor "discontinuous" modeling is the consistent better predictor of minima ozone.
    - Understanding the model at all ozone levels increases confidence the model is getting the right concentrations for the right reasons.
    - This becomes increasingly important as ambient ozone levels continue to decrease.

Specific Summary (con't)

- **Substantial over-prediction bias exists in the SIP model at the key 2018 nonattainment monitors. For days with measured O_3 > 50 ppb:**
  - At Lynchburg, daily fractional bias ranges from -36.7% to 24.5% (mean of 1.8%)
  - At Deer Park, daily fractional bias ranges from -31.2% to 37.1% (mean of 8.2%)
  - At Wallisville, daily fractional bias ranges from -10.8% to 57.5% (mean of 16.1%)

Specific Summary (cont.)

- CAMx Sensitivity Experiments Reveal
  - SMOKE produces *4.5 times* as many PinG sources (1,077) across the 36 km SIP modeling domain compared to EPS2 (~240).

Recommendations 1 & 2

- The unresolved and potentially important emissions concerns with the TCEQ 2006 basecase data warrant additional scrutiny.
- The implications of and justification for discontinuous grid nesting in the SIP model warrants investigation of why modeling system can better replicate high ozone periods than lower ozone periods.

Recommendation 3

- Reliance on ozone increments in the range of 'a few tenths of a ppb' to a 'few ppbs' should be examined because of inherent uncertainties in the model.

- Therefore, other relevant analyses must be used to support and enhance the usefulness of modeling results.

Science Team Activities

- The Coalition will continue science activities relevant to current and future SIPs. Areas of investigation include:
  - OSAT and related analyses to assist with a monitor-by-monitor approach
  - Approaches to include emissions from the 2006 special EI in the future case
  - Analysis of ozone effects of the IR camera and other emission reduction programs