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TCEQ Lamar SEP Project (Task 2B)

CAMx Modeling on Flare Speciation

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For Presentation at the TCEQ June SETPMTTC Meeting

June 29, 2011





Background and Objective

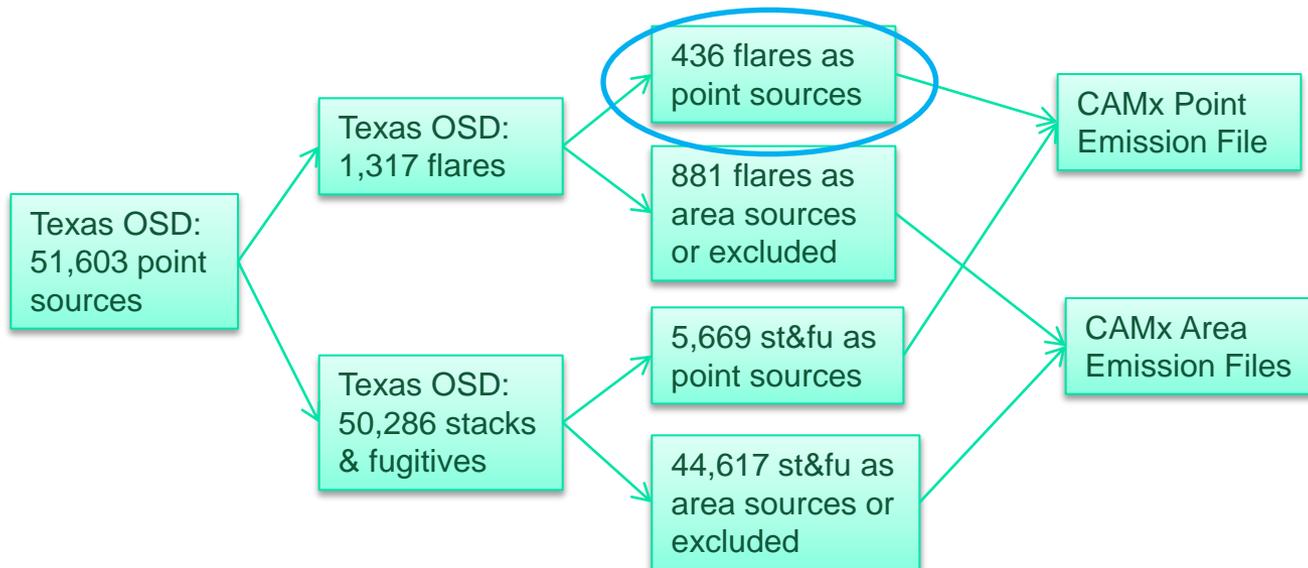
- **Background**
 - **Current Flare EI Assume 98% CE and with Fixed Speciation**
 - **May Not Be Appropriate Under All Flaring Conditions**
 - **Being Investigated Under the Current Flare Speciation Project**
- **Objective in CAMx Modeling**
 - **To Simulate the Effect of Flare Speciation on Ozone Formation**
 - **Task 1: Worst Case Scenarios (Various CE of 98% down to 70%)**
 - **Task 2: Specific Effects Based on the Flare Speciation Study**
- **Approach in Worst Case Scenarios**
 - **Modification of Flare EIs in Point Sources**
 - **Simulation Using HGB June 2006 Episode (5/31 – 6/15, 2006)**





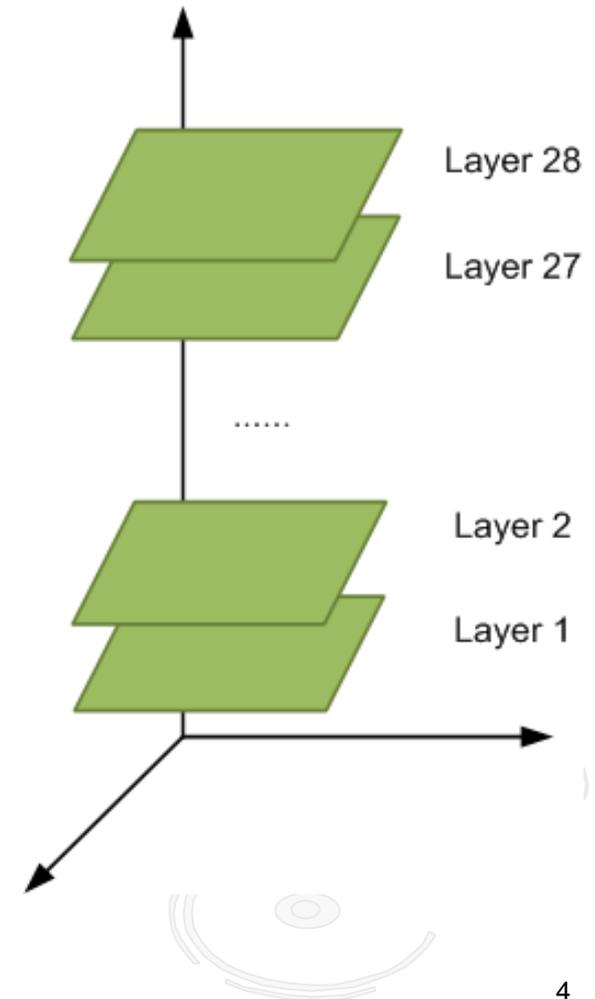
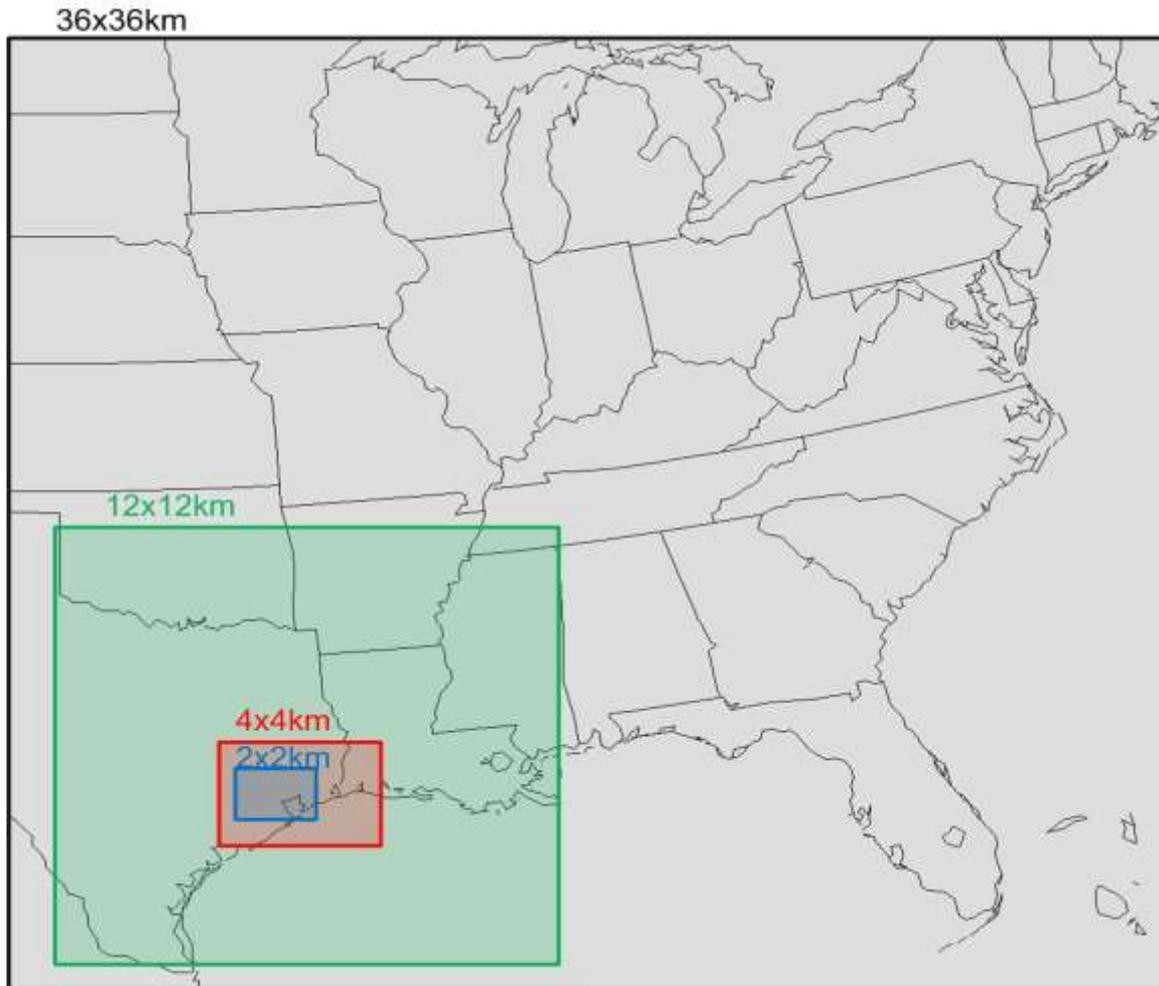
Modification of Flare EI

- **436 Flare EIs in the Texas OSD Point Sources**
 - **Ozone Season Daily (OSD) from Texas STARS (afs.osd.2006.STARS)**
 - **436 Treated as Elevated Point Sources**





CAMx Modeling Domain (June 2006 Episode)





Calculations of EI Modifications

● Formula for EI Calculations

$$F^{VOC} = (1 - \lambda) F^{Vent}$$

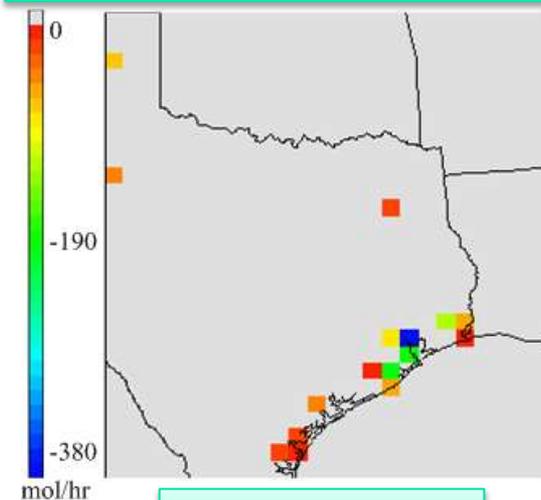
$$F^{NOX} = \eta^{NOX} \lambda F^{Vent} HV^{Vent}$$

- λ : Combustion Efficiency
- F^{VOC} , F^{NOX} : Emissions of VOC and NO_x
- F^{Vent} , HV^{Vent} : Flowrate and LHV of Vent Gas
- η^{NOX} : Parameter for NO_x Formation

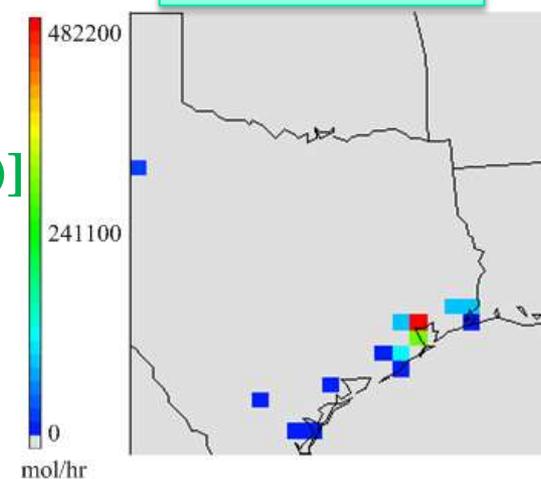
● Changes of EI from CE=98% to 70%

- VOC EI Increases to 15.0 Times $[(1-0.7)/(1-0.98)]$
- NO_x EI Decreases to 0.714 Times $[0.7/0.98]$

NO_x Difference between the Base Case and Case 6



VOC Difference





Cases Simulated

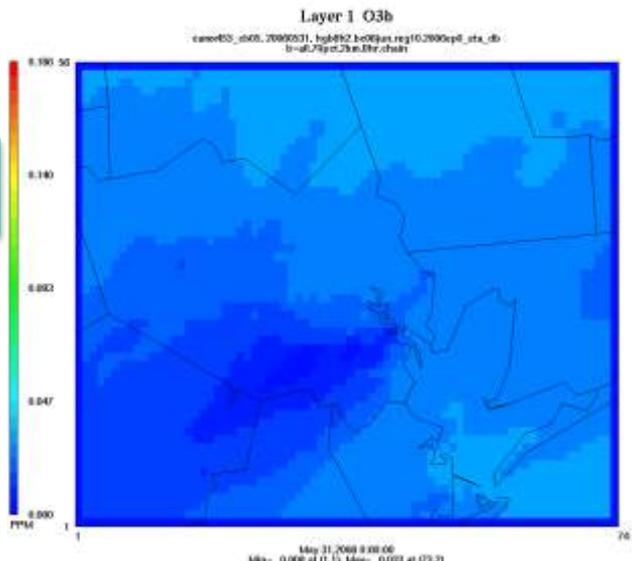
- **Base Case: CE = 98%**
- **Case 1: CE = 95%**
- **Case 2: CE = 90%**
- **Case 3: CE = 85%**
- **Case 4: CE = 80%**
- **Case 5: CE = 75%**
- **Case 6: CE = 70%**



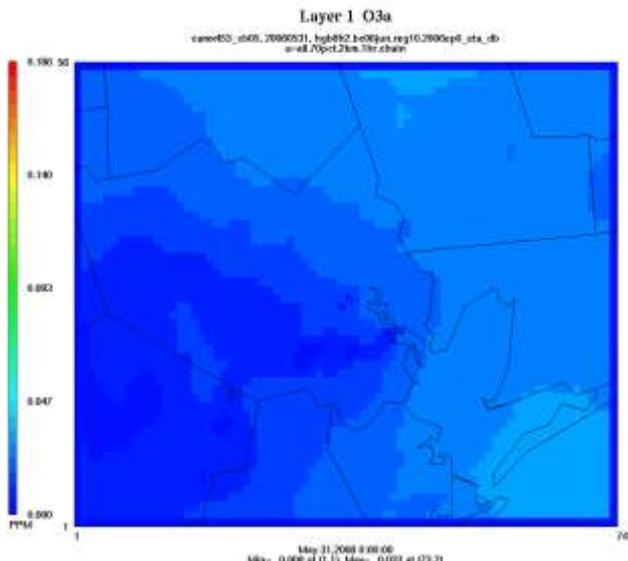


8-Hr and 1-Hr Ozone and Increment Plots for Case 6 in the 2x2 km Grids

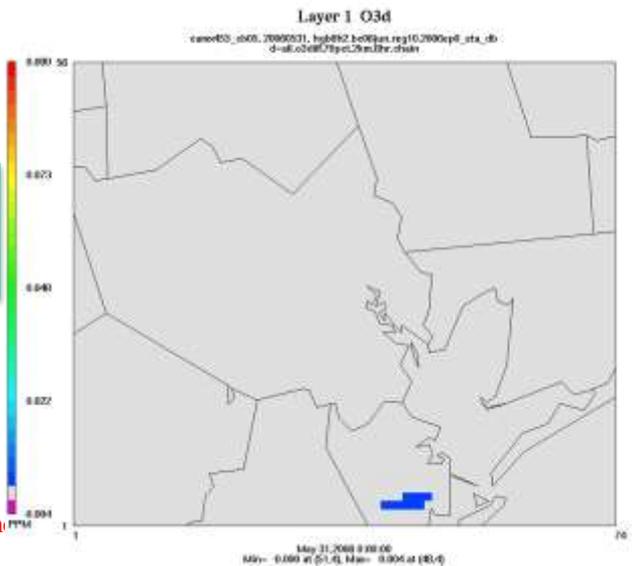
8-hr ozone



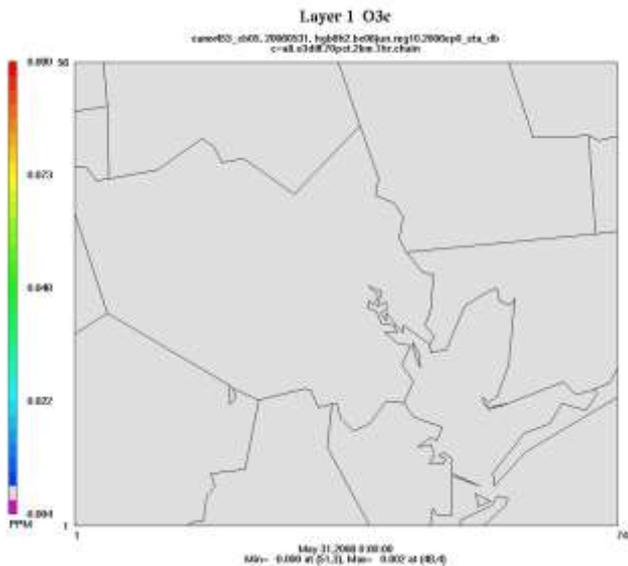
1-hr ozone



8-hr ozone increment

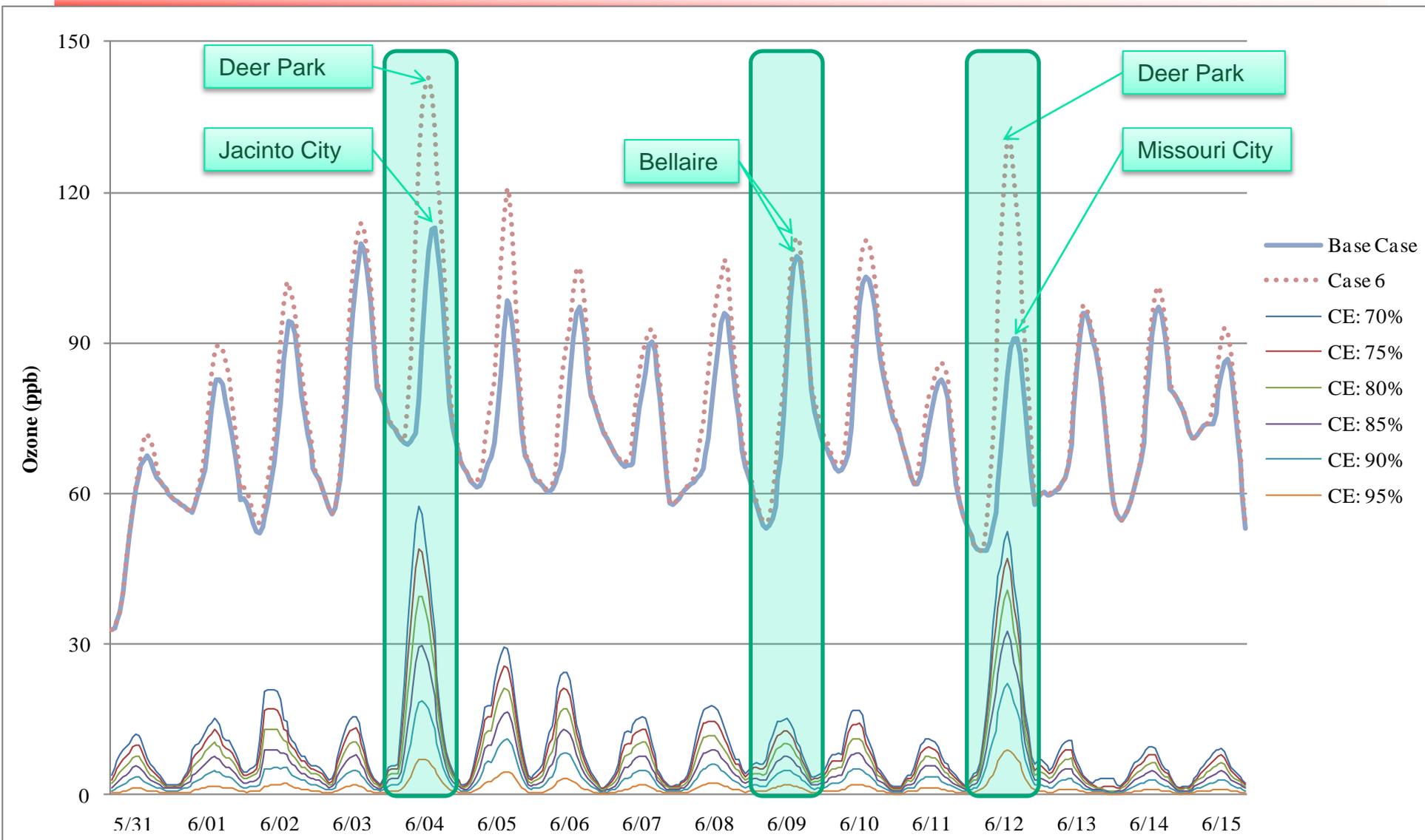


1-hr ozone increment





8-Hr Ozone Concentration and Maximum Ozone Increments in the 2x2 km Grids





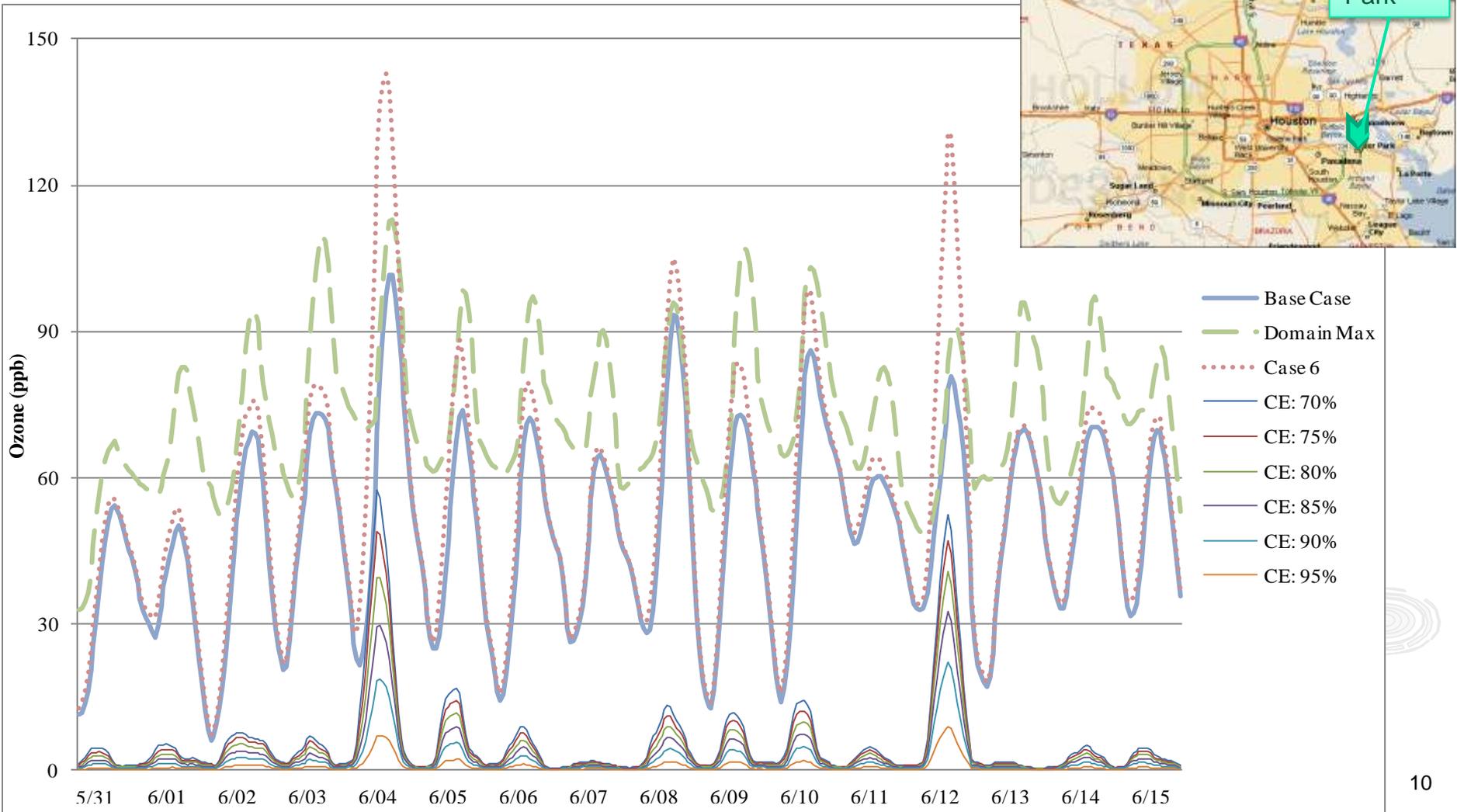
8-Hr and 1-Hr Ozone Increments

(Domain Maximum and 3 Peak Locations in Case 6)

	5/31-6/15 Domain Maximum		6/4/2006 Deer Park		6/9/2009 Bellaire		6/12/2006 Deer Park	
	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr
Case 1 (95%)	8.9	14.9	7.0	12.4	0.5	1.2	8.9	14.2
Case 2 (90%)	22.0	34.4	18.7	30.8	1.3	2.9	22.0	32.7
Case 3 (85%)	32.4	50.8	29.5	44.7	2.0	4.4	32.4	45.8
Case 4 (80%)	40.6	66.9	39.6	61.6	2.6	5.8	40.6	56.6
Case 5 (75%)	48.9	84.1	48.9	76.3	3.2	6.9	47.1	66.7
Case 6 (70%)	57.4	99.1	57.4	88.4	3.8	8.0	52.4	74.6



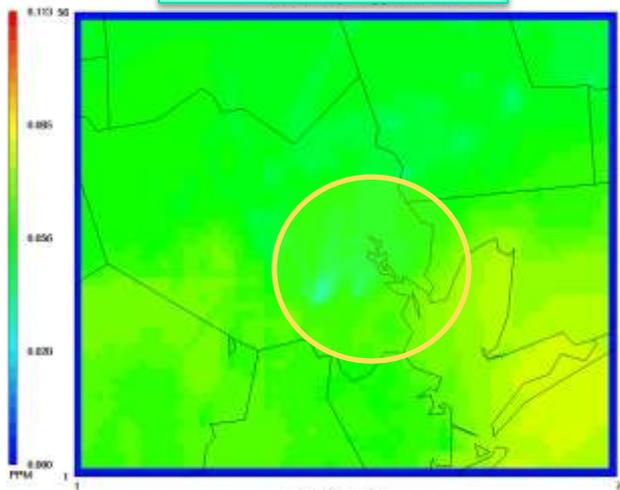
8-Hr Ozone for the Deer Park Site (Base Case, Case 6, and Ozone Increments)



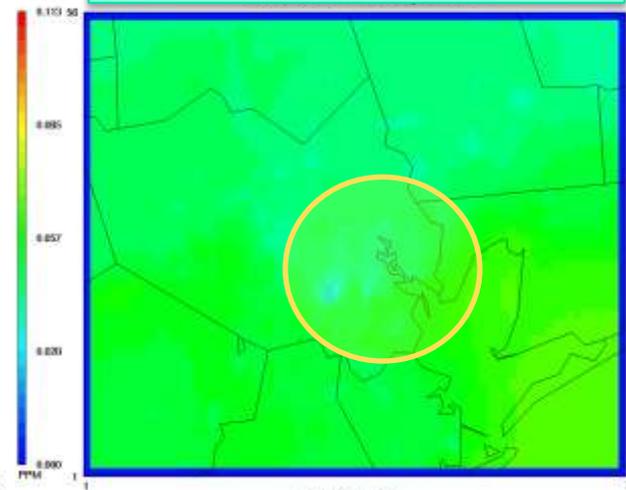


Ozone Animation for June 4th

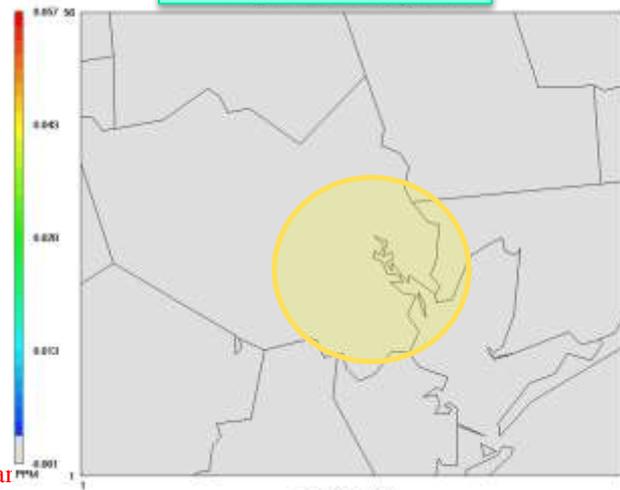
Base Case Ozone



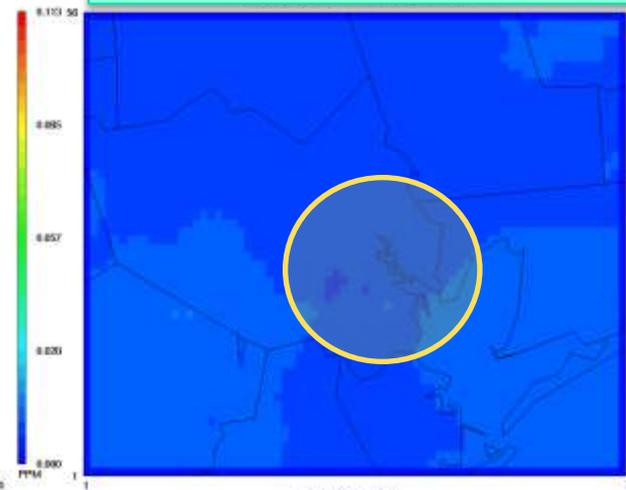
Base Case NO_x-Limited Ozone



Ozone Increment



Base Case VOC-Limited Ozone



Max 8-hour
Ozone

Value

Base Case

112.8
ppb

VOC-Limited
Ozone

57.0
ppb

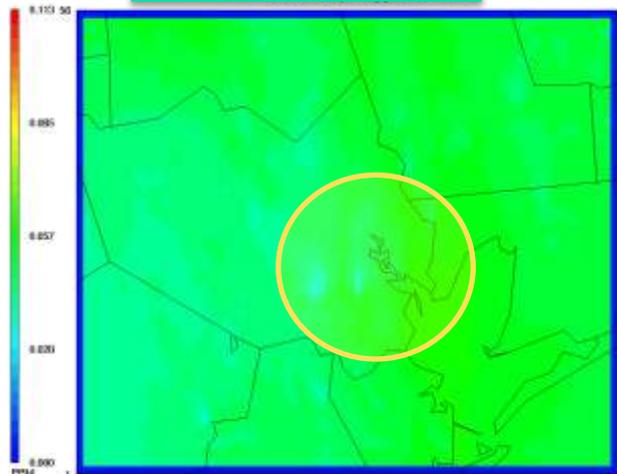
Case 6 Ozone
Increment

57.4
ppb

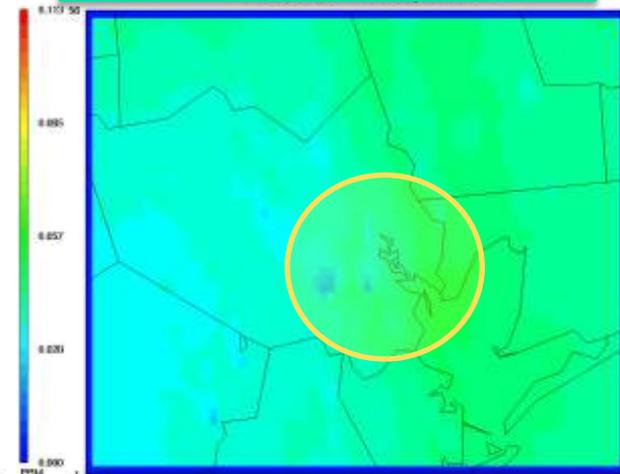


Ozone Animation for June 12th

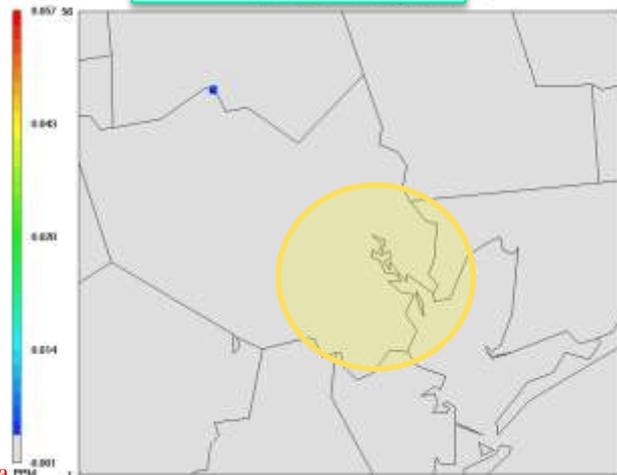
Base Case Ozone



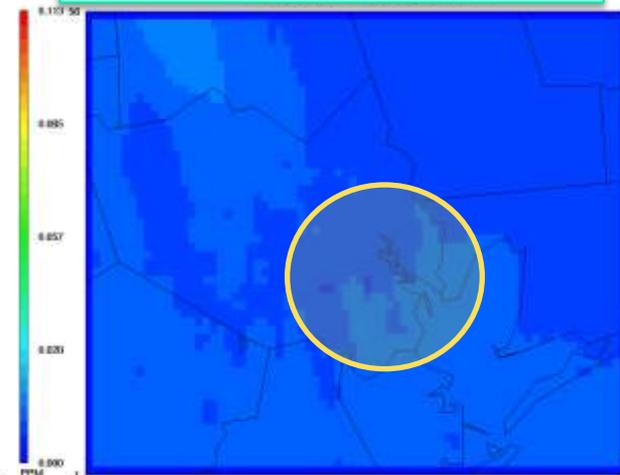
Base Case NO_x-Limited Ozone



Ozone Increment



Base Case VOC-Limited Ozone



Max 8-hour
Ozone

Value

Base Case

91.0
ppb

VOC-Limited
Ozone

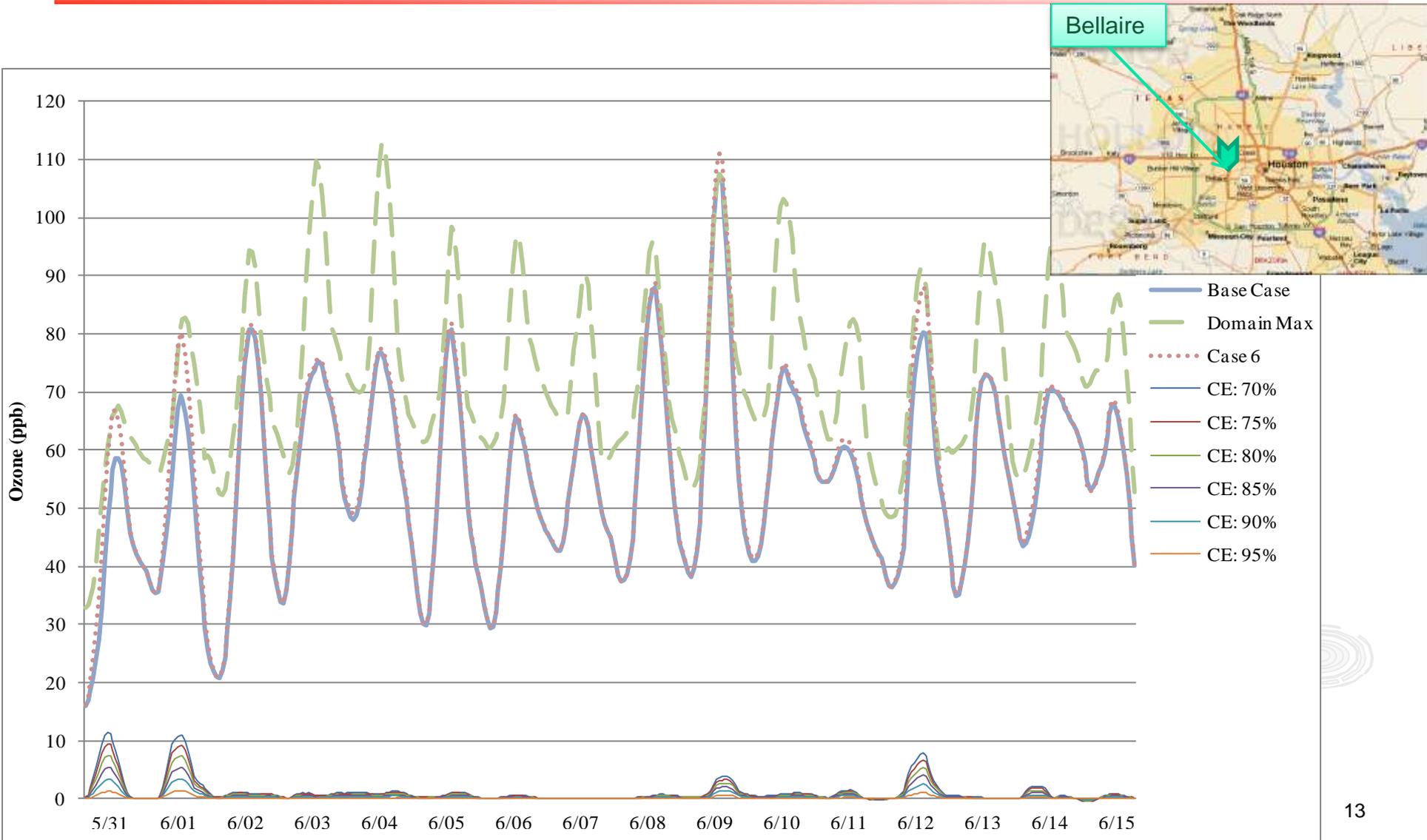
54.0
ppb

Case 6 Ozone
Increment

52.4
ppb



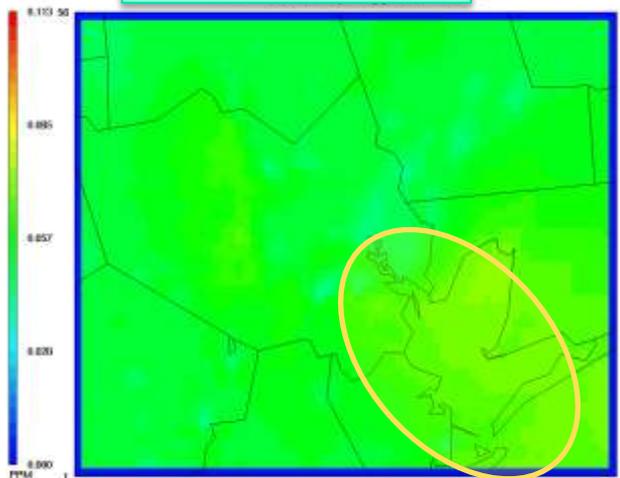
8-Hr Ozone for the Bellaire Site (Base Case, Case 6 and Ozone Increments)



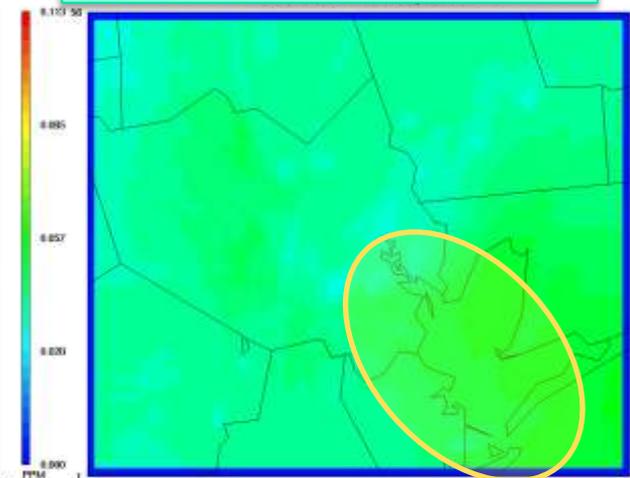


Ozone Animation for June 9th

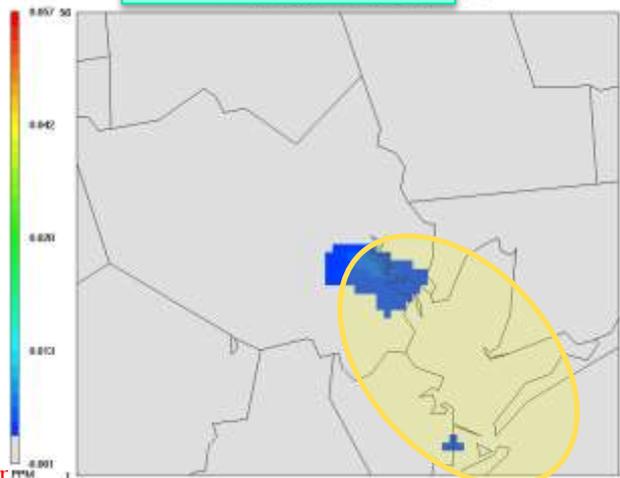
Base Case Ozone



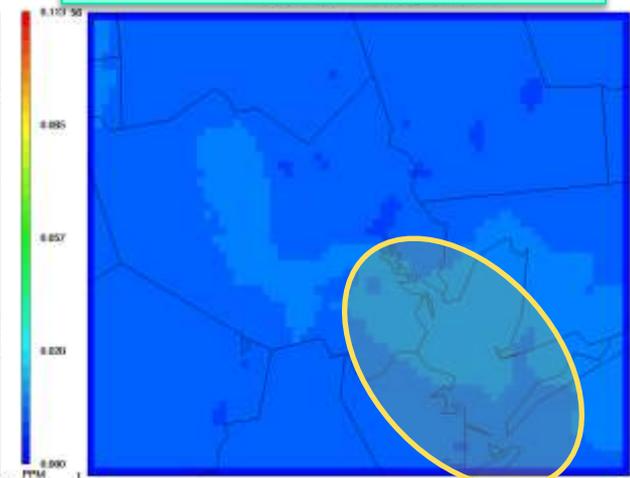
Base Case NO_x-Limited Ozone



Ozone Increment



Base Case VOC-Limited Ozone



Max 8-hour Ozone	Value
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Base Case	107.4 ppb
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VOC-Limited Ozone	54.0 ppb
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Case 6 Ozone Increment	14.9 ppb
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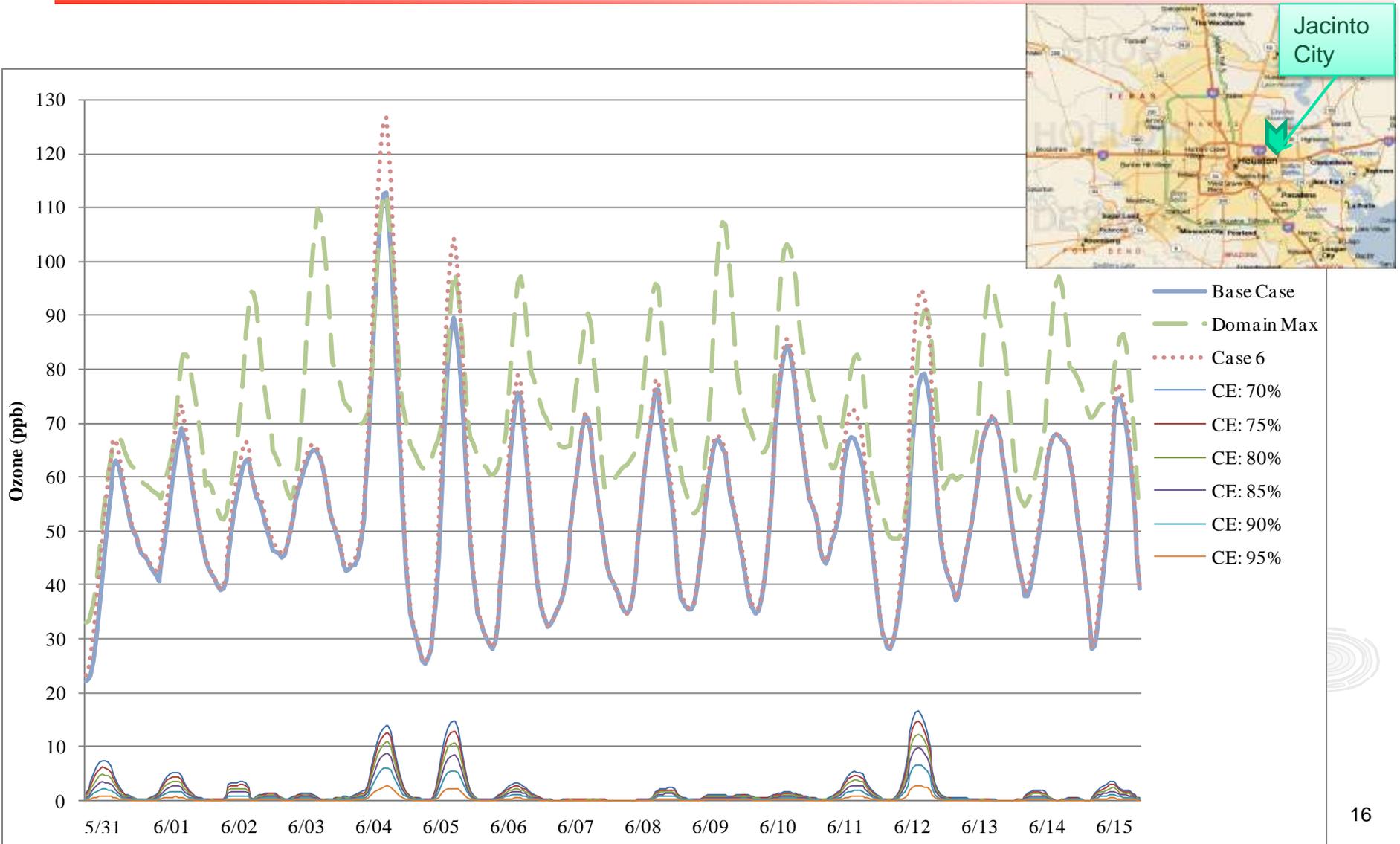
8-Hr and 1-Hr Ozone Increments

(Domain Maximum and 3 Peak Locations in Base Case)

	5/31-6/15 Domain Maximum		6/4/2006 Jacinto City		6/9/2006 Bellaire		6/12/2006 Missouri City	
	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr	8-hr	1-hr
Case 1 (95%)	8.9	14.9	2.6	4.9	0.5	1.2	0.2	0.3
Case 2 (90%)	22.0	34.4	6.1	11.7	1.3	2.9	0.4	0.7
Case 3 (85%)	32.4	50.8	8.8	16.7	2.0	4.4	0.7	1.1
Case 4 (80%)	40.6	66.9	10.8	20.3	2.6	5.8	0.9	1.5
Case 5 (75%)	48.9	84.1	12.5	23.2	3.2	6.9	1.2	1.9
Case 6 (70%)	57.4	99.1	13.9	25.6	3.8	8.0	1.4	2.3

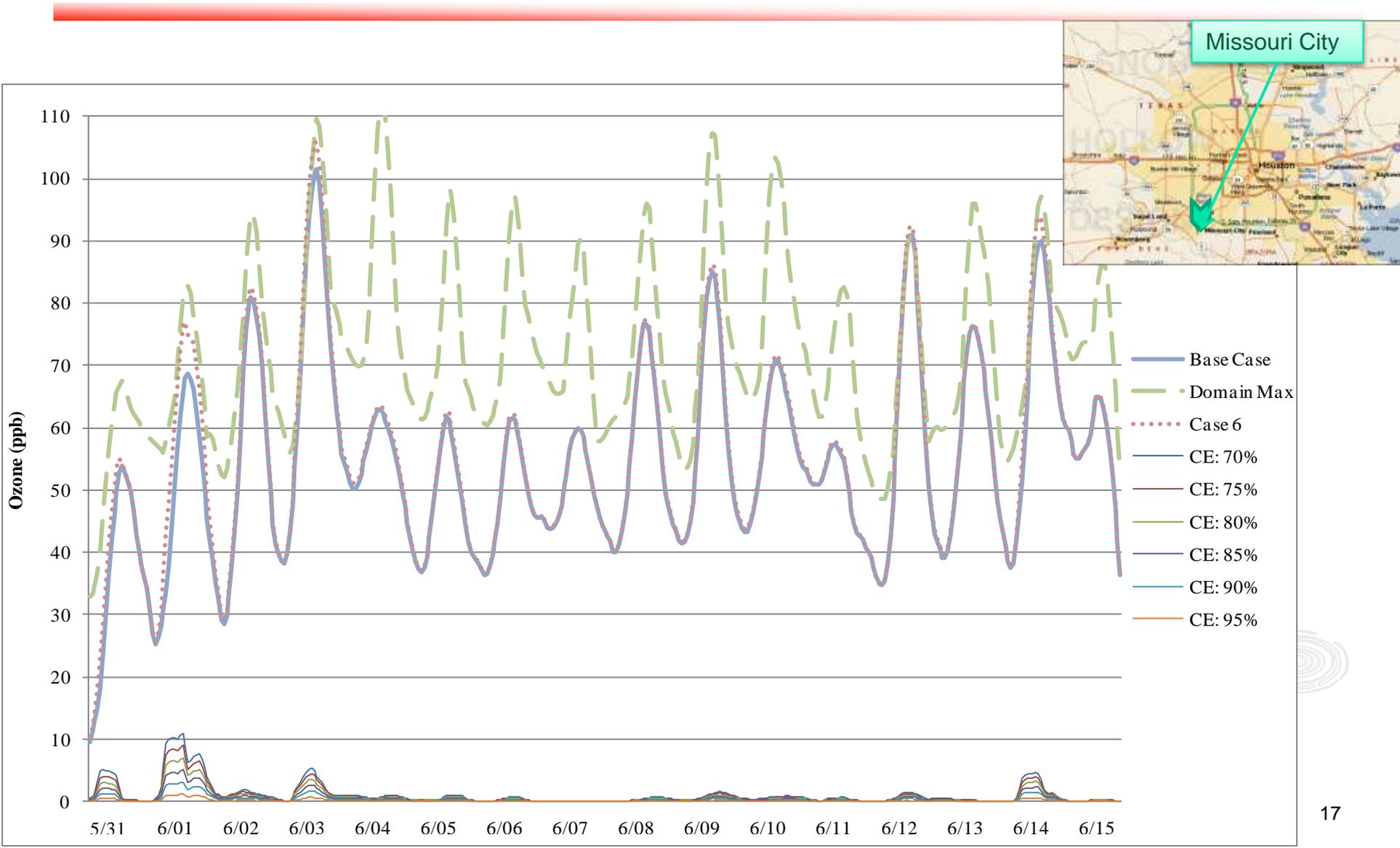


8-Hr Ozone for the Jacinto City Site (Base Case, Case 6 and Ozone Increments)





8-Hr Ozone for the Missouri City Site (Base Case, Case 6 and Ozone Increments)





Concluding Remarks

- **Flaring CE Affects Ozone Concentration**
- **Lower Flaring CEs correspond to Higher Ozone Increments**
- **Maximum 8-hr Ozone Increments at CE=0.7 Could Be as High as 57.4 ppb during June 2006 Episode**
- **Maximum Ozone Increments Occur Near Flaring Sources**
- **Maximum Ozone Increments Occur in VOC-Limited Area**

