Meteorological conditions and emissions responsible for creating high ozone design values in west Houston

David Allen and David Sullivan
Center for Energy and Environmental Resources and
The University of Texas at Austin

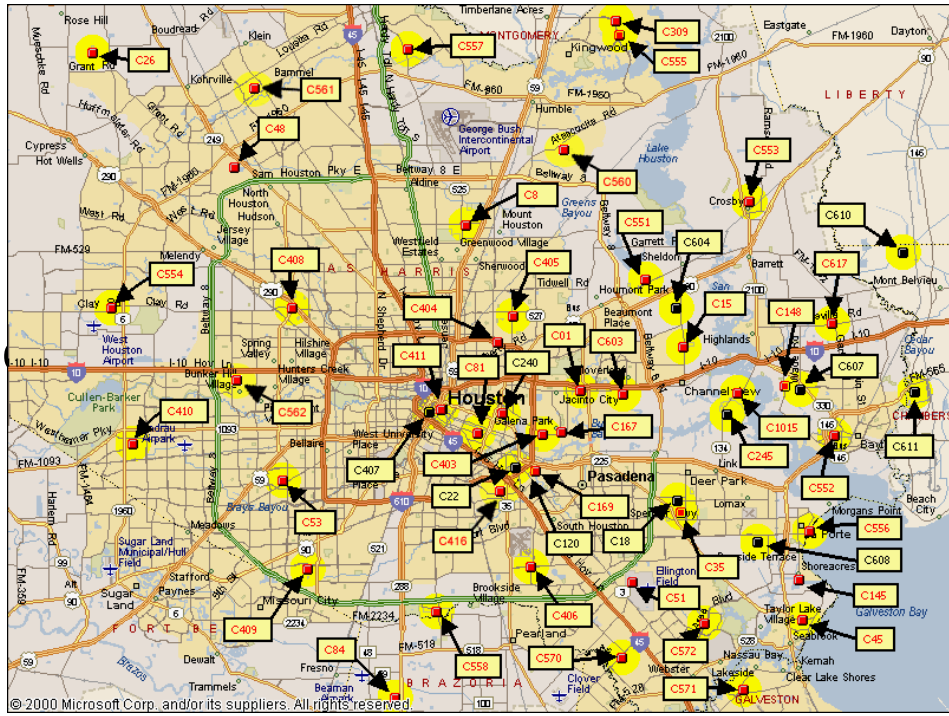
Which local emissions are responsible for the production of high ozone in Houston? Are different kinds of emissions responsible for transient high ozone and 8-hour-average high ozone?

- Proposed Finding: A characteristic meteorology leads to the highest 8-hour averaged ozone concentrations (and ozone design values) observed in west Houston; the ozone formation during these episodes is controlled by high morning HRVOC concentrations in the Ship Channel, followed by both VOC and NOx limited conditions as the air parcels advect to west Houston

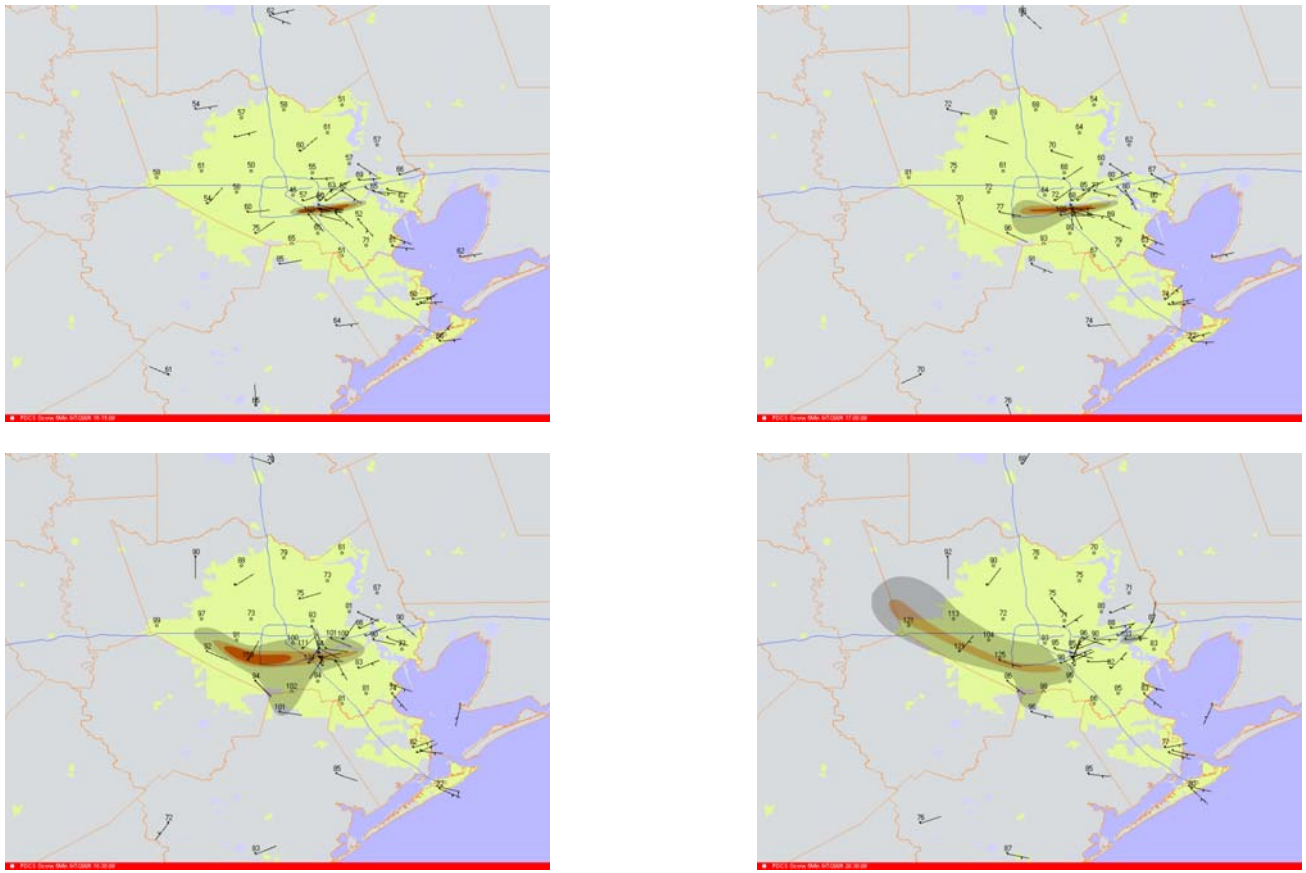
Highest ozone concentrations now observed on west side of Houston and on path between Ship Channel and west Houston

2006 data (through 10/11/2006)

- Bayland Park: High of 124; 4th highest of 106; 6 of 12 above 100 ppb
- Aldine: 4th highest less than 85 ppb
- Deer Park: High of 121; 4th highest 101
- Tom Bass: 4th highest of 108 ppb
- Park Place, West Houston, Bunker Hill Village and Katy Park have 4th highests of 111, 103, 107 and 108, respectively



Typical exceedance in west and southwest Houston, 9/7/2006

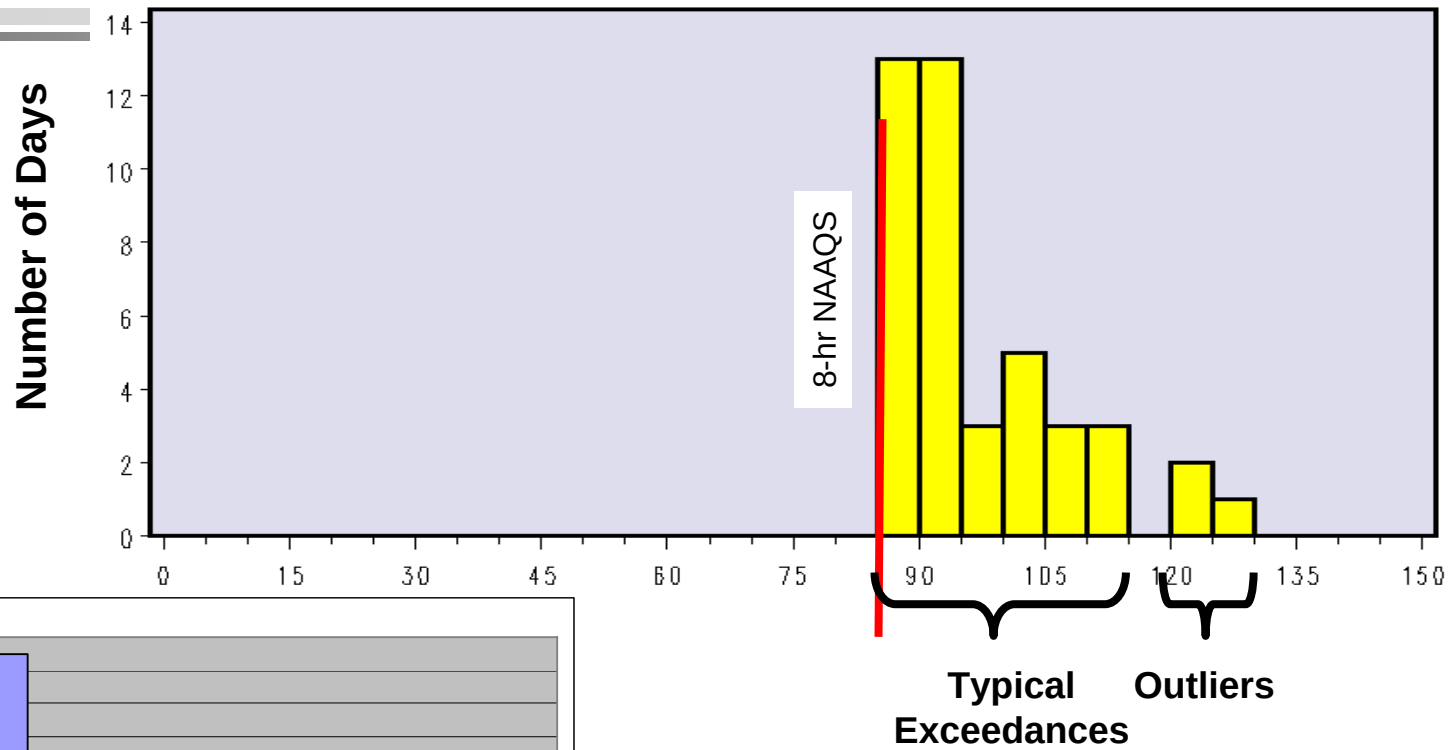


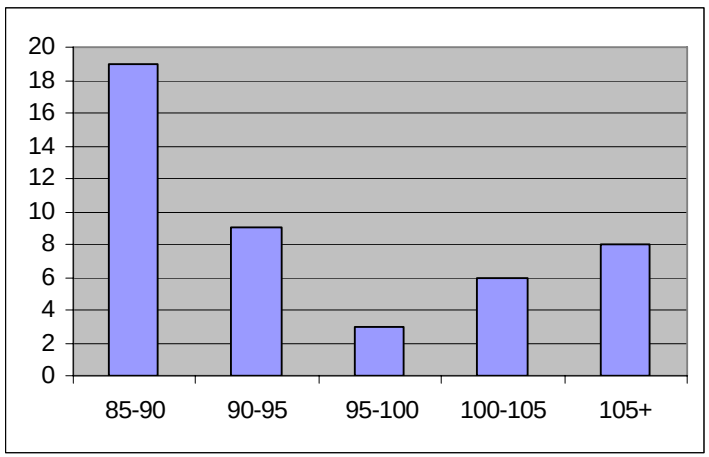
Same pattern on virtually <u>every</u> day above 100 ppb at Bayland Park in 2002-6

These types of days generate outliers in ozone concentrations, BUT these outliers determine the ozone design values

Bayland Park All Days 2002-2004

Number of Exceedance Days by Maximum 8 Hour Ozone





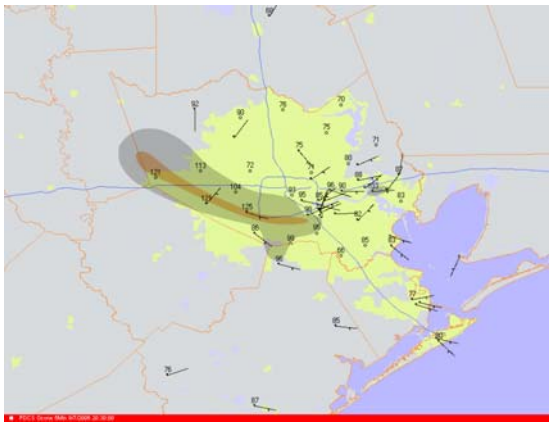
2003-2005 Daily Maximum 8 Hour Ozone (ppb)

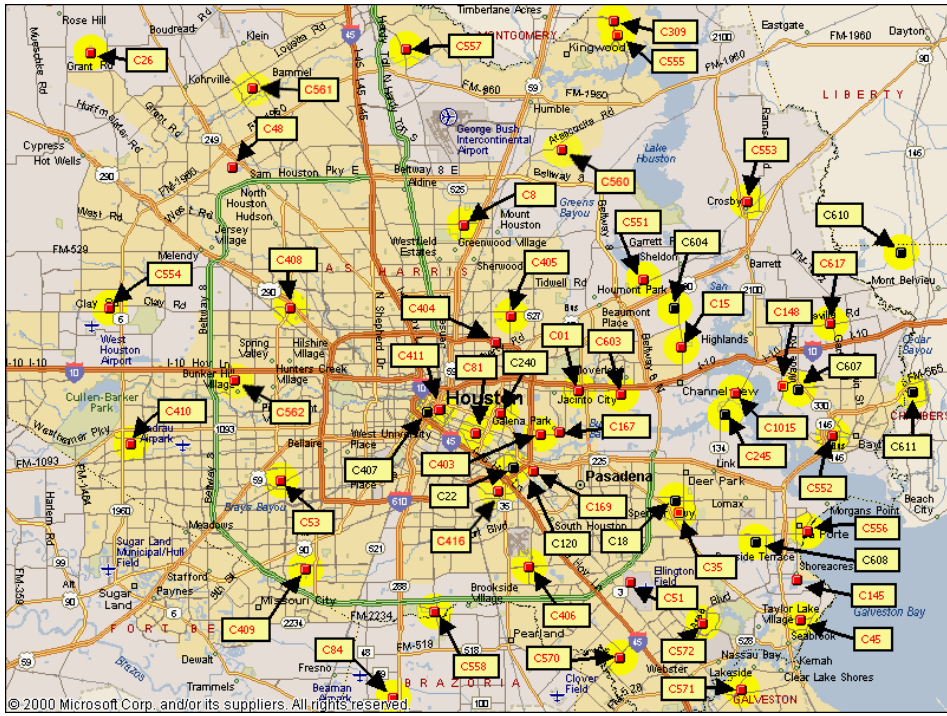
Bayland Park Monitor (through 2006)

- 2003-2005: 45 days>85 ppb
- 2006 (through 10/11): 12 days>85 ppb (6 days less than 100 ppb; 6 days >100 ppb; 4th highest = 106)
- 2005: 13 days >85 ppb (9 days 90 ppb or less; 4 days 100 ppb or more; 4th highest = 100)
- 2004 16 days>85 ppb (9 days 96 ppb or less; 7 days 102 ppb or more; 4th highest = 104)
- 2003 16 days>85 ppb (11 days 95 ppb or less; 5 days 100 ppb or more; 4th highest = 107)

Monitor by monitor strategies

- TCEQ can develop targeted, monitor specific control strategies in the SIP for 8-hour averaged ozone concentrations



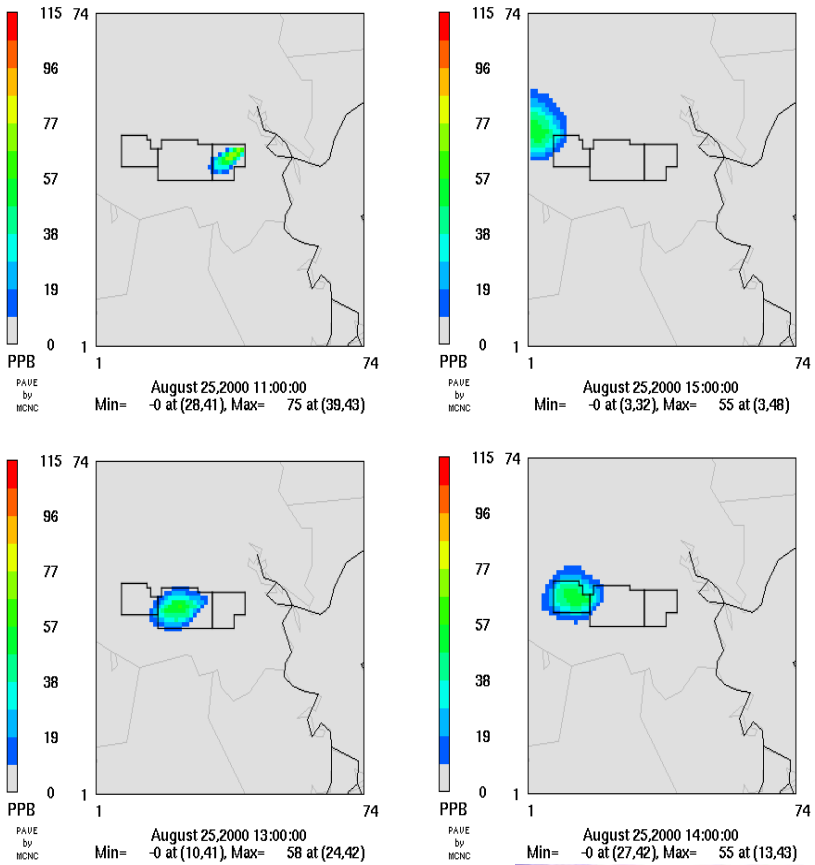


What emissions control ozone formation in these types of events?

- Modeling analyses of previous episodes during TexAQS 2000 (brief examination of August 25, 2000)
- Observational evidence from TexAQS II

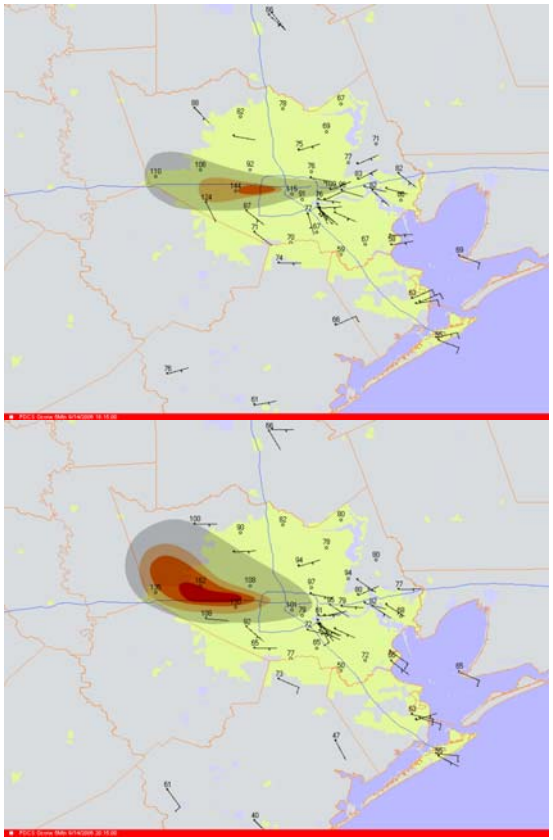
Trajectory of a modeled release from Deer Park, August 25, 2000

- Detailed process analysis by Vizuete and co-workers indicates rapid olefin reactions in source region, generating aldehydes, which serve as sources of free radicals; free radicals lead to rapid generation of ozone in source region and downwind



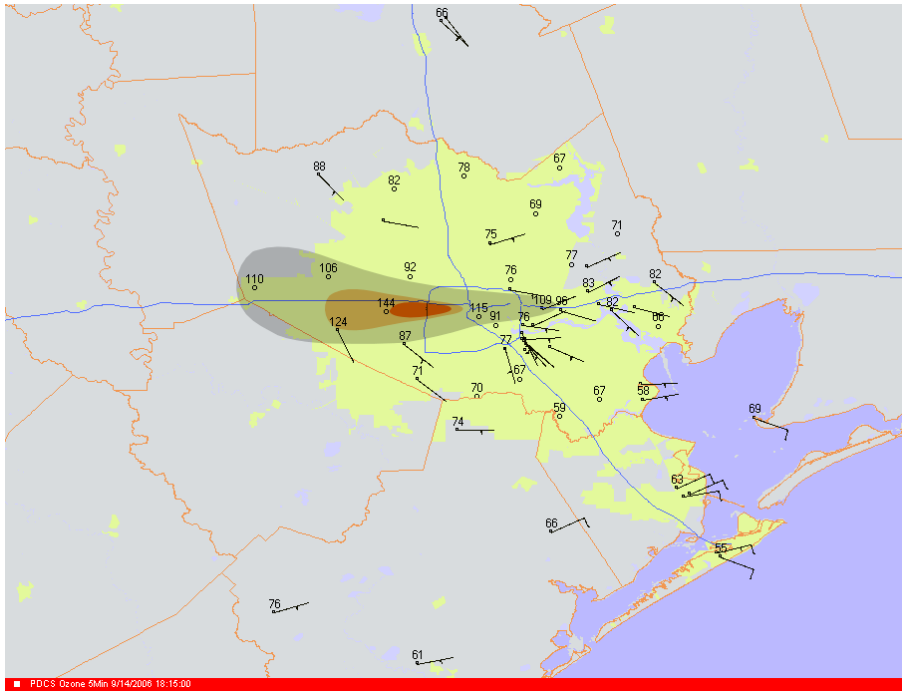
In 2006, much less NOx available than in 2000; conditions are likely different

- Need to analyze TexAQS II episodes of this type; potential Episode days:
  - August 4
  - August 17
  - August 31
  - September 7
  - September 14
  - September 20

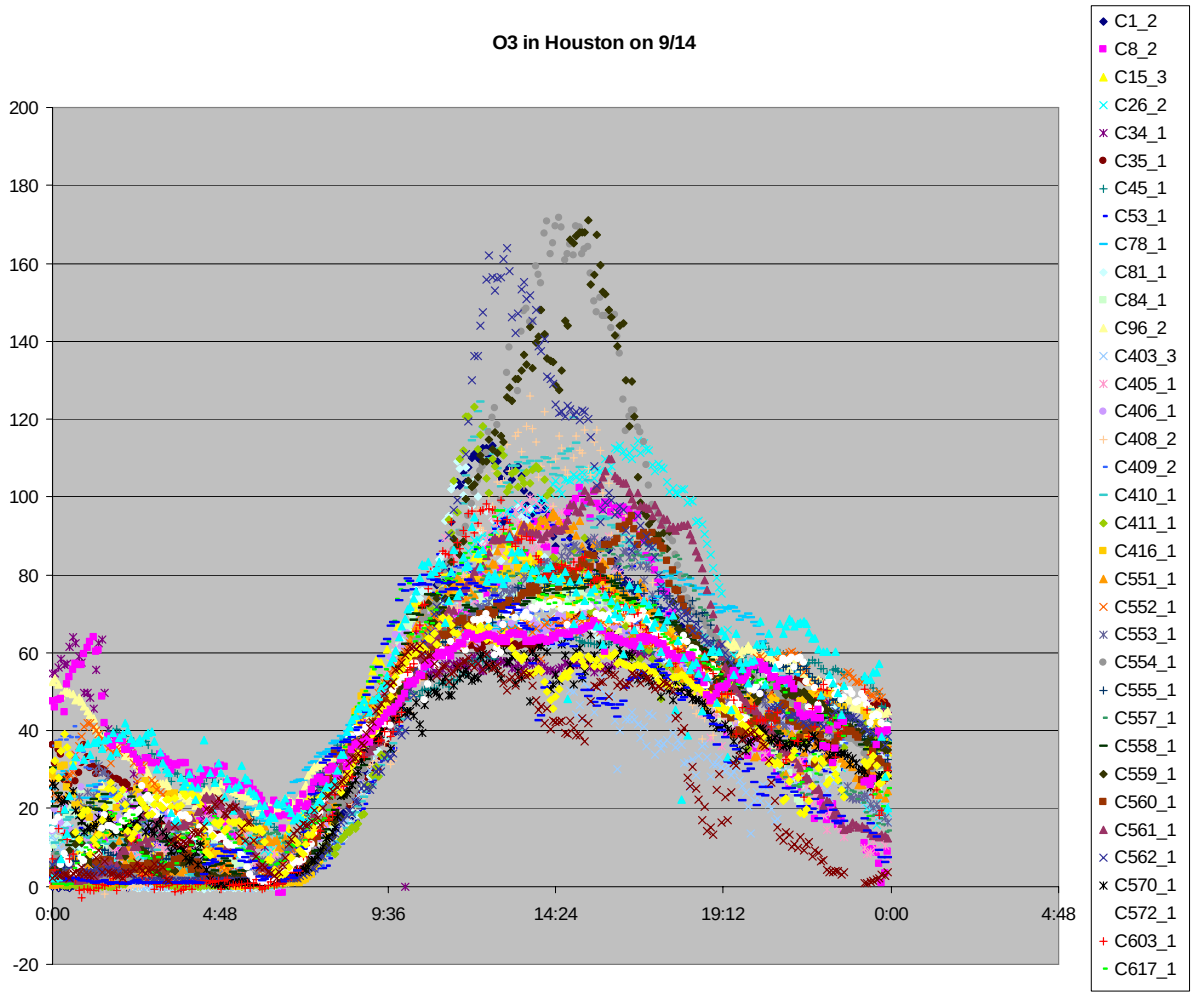


September 14 (Katy Park 120 ppb 8-hr avg.)

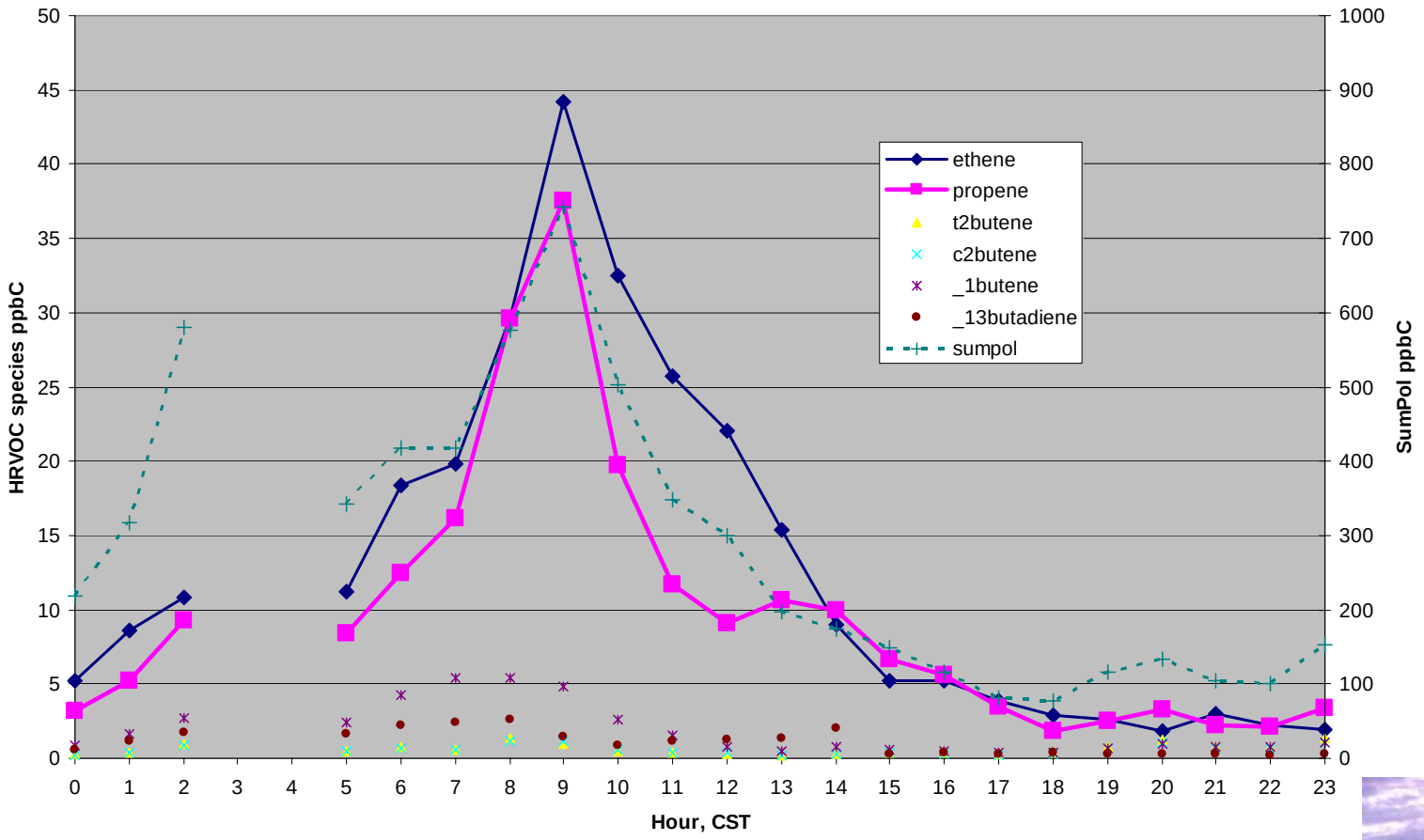
- Moderately high ethene and propene concentrations observed at approximately 9AM at Clinton
- Olefins unit flare in Deer Park –several thousand pounds olefins; Propylene in cooling water at Bayport;
- NOx at approximately 40 ppb at time of olefins plume passage
- Plume advects directly east



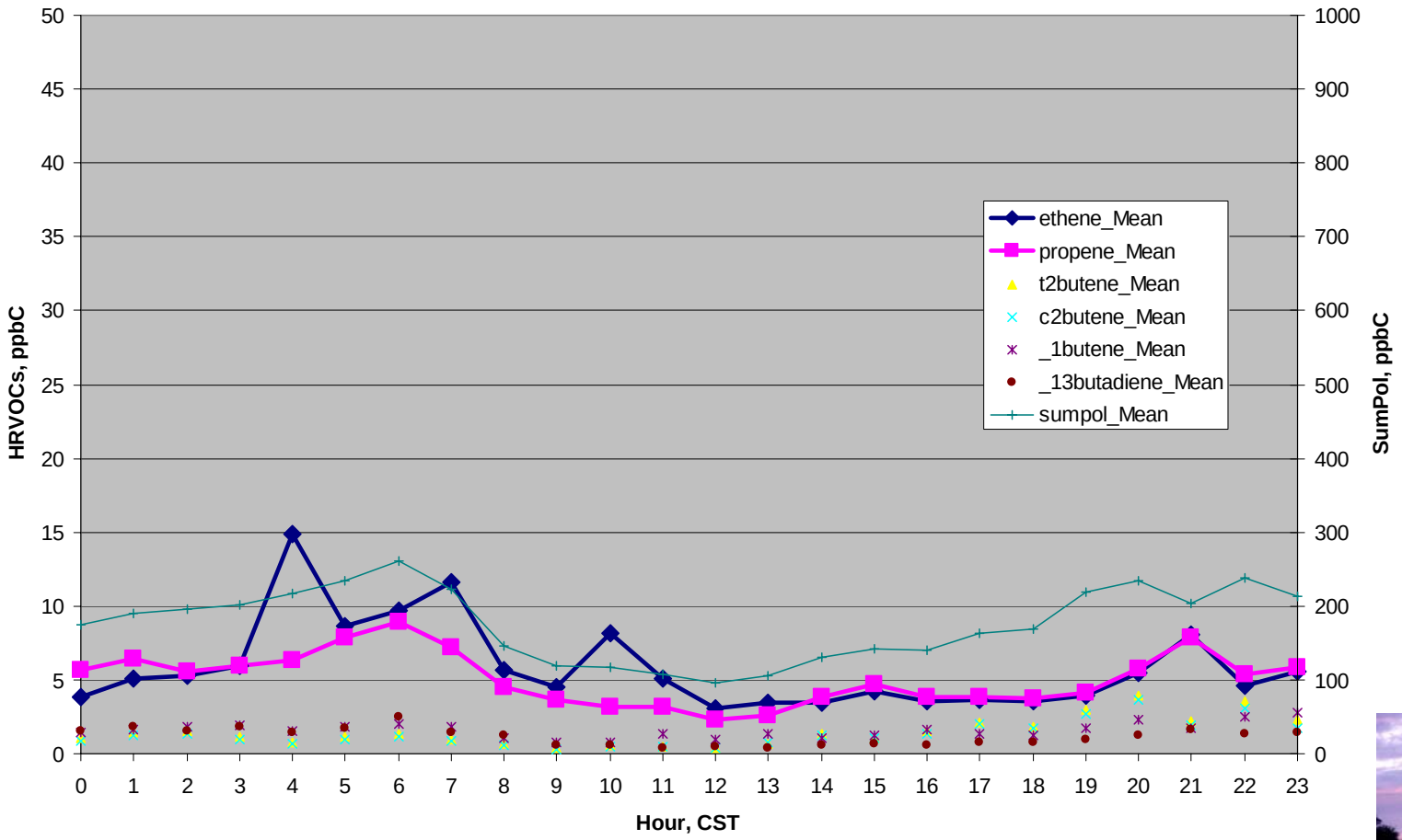
Ozone at CAM Stations 9/14/06



Sept. 14, 2006 Clinton Drive Auto-GC



Aug.-Sept. 2005-2006 Clinton Dr.



Next steps

- Need to obtain hourly inventory data for these dates
- Assemble available data from TexAQS II platforms
- Perform modeling using the forecast meteorologies to assess source contributions