

# Houston Galveston Beaumont Problem Statement

**TERC Science Advisory  
Committee**

**November 14-15, 2005 Meeting**

**HARC/North Harris Montgomery  
Community College District**

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# Outline

- Houston - Not your typical urban area
- Houston Coastal Meteorology
- Transient High Ozone Events
- Future work
- Houston Control Strategy

# Houston-Galveston

Not your typical urban area



- Fourth Largest City in U.S. ~2 million people
- Largest International Port in U.S.
- Largest concentration of refinery and chemical plants in U.S.

# Houston-Galveston

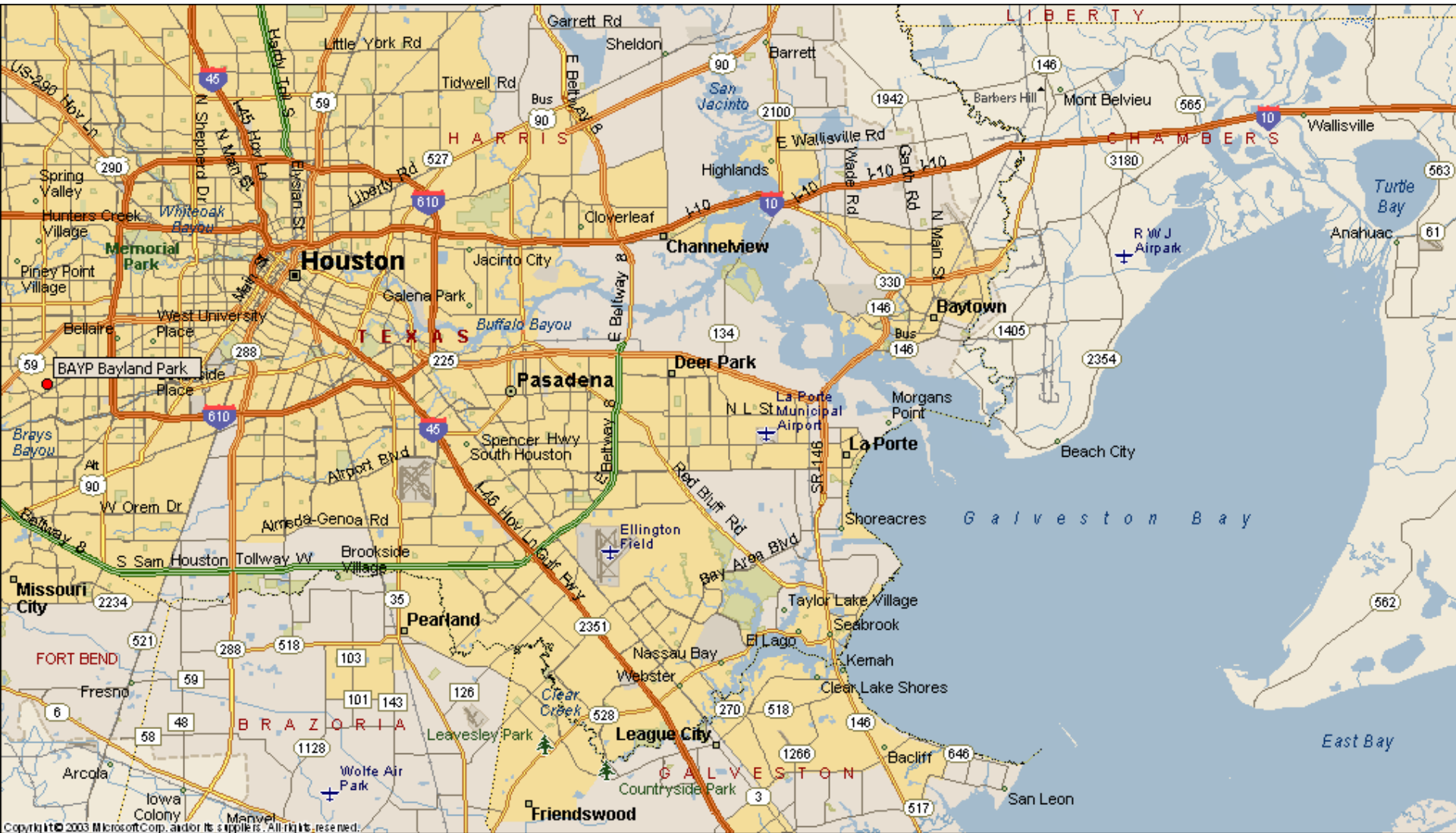
Not your typical urban area

- Conditions conducive to ozone formation
- Highly Reactive VOCs (HRVOCs)
- Close Proximity to NO<sub>x</sub> sources
- Sea breeze effects
- Transient High Ozone Events (THOE)

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# Houston Coastal Meteorology



**Rotating winds**

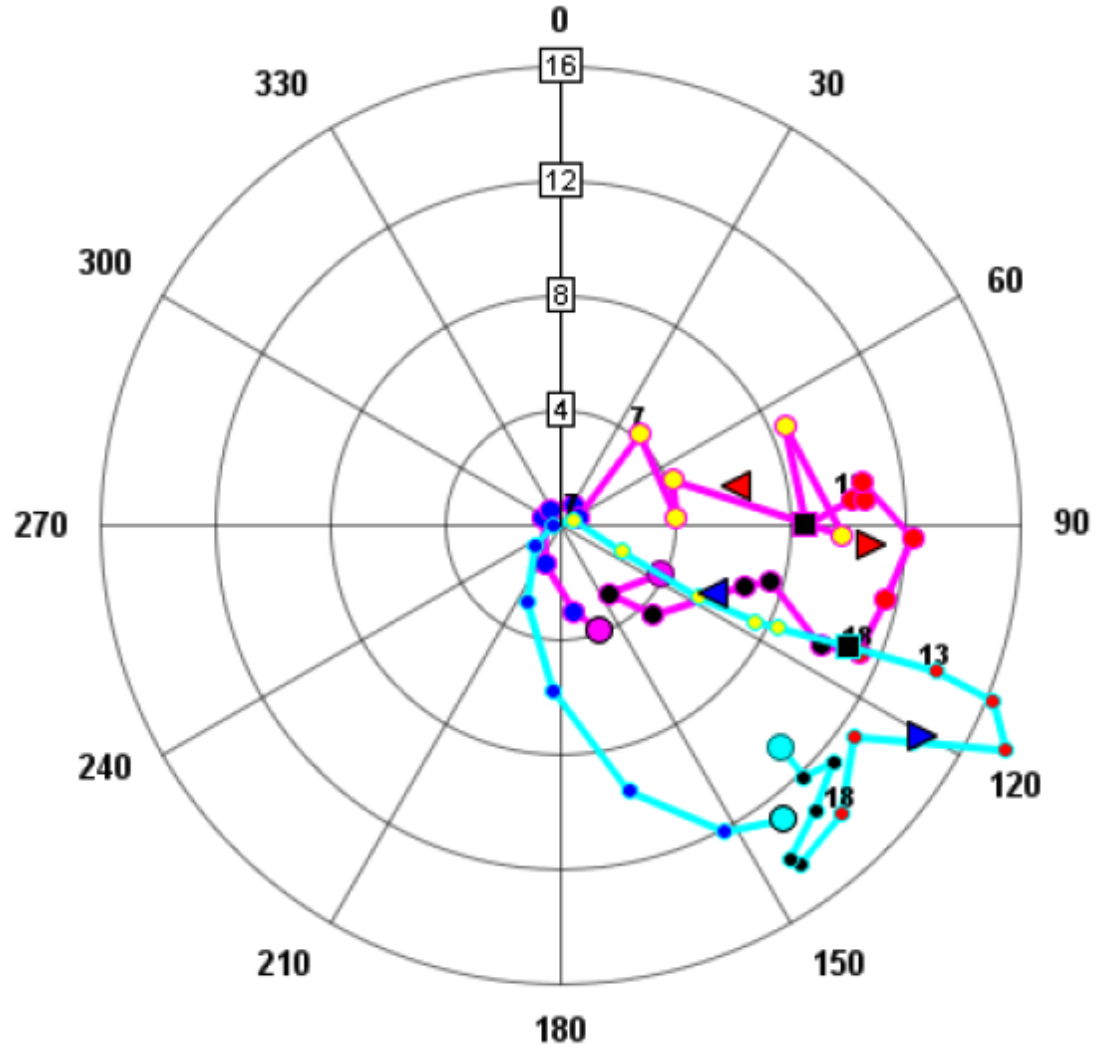
**Stalled Fronts**

# Houston Coastal Meteorology

## Rotating Winds

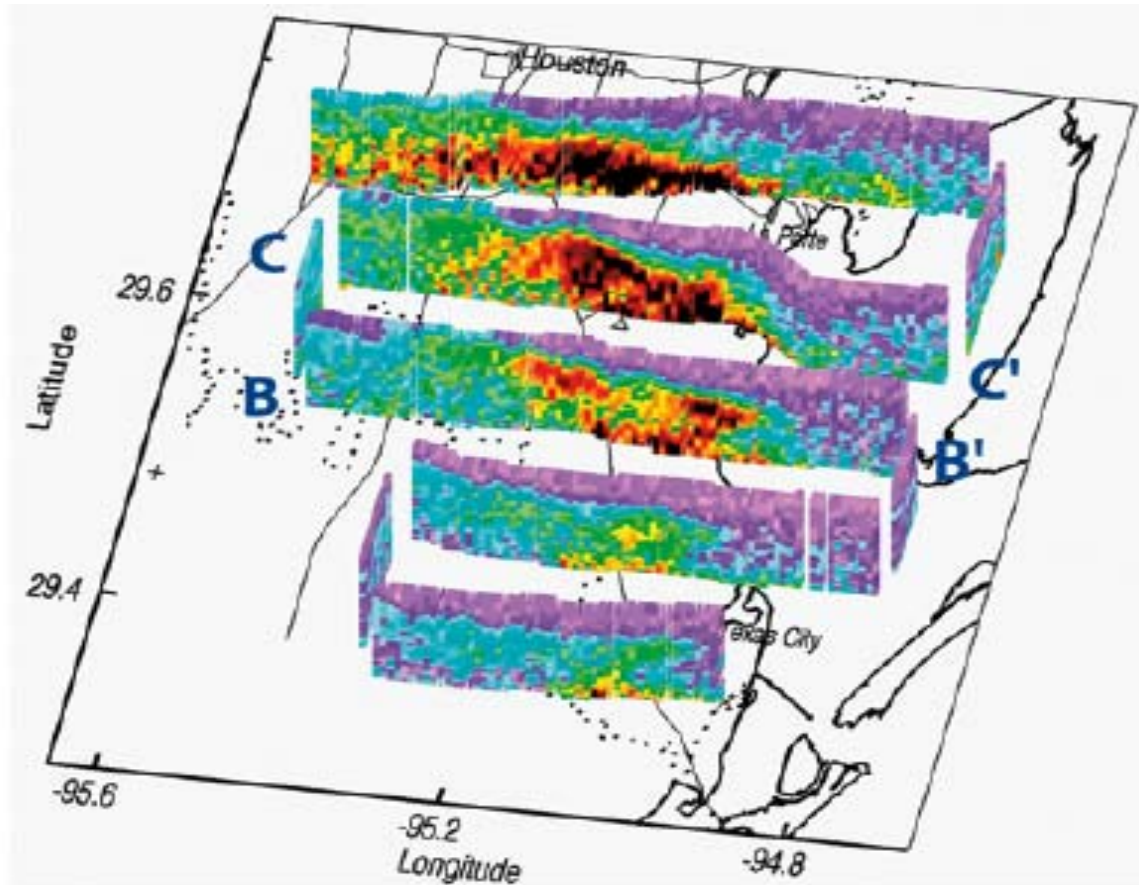
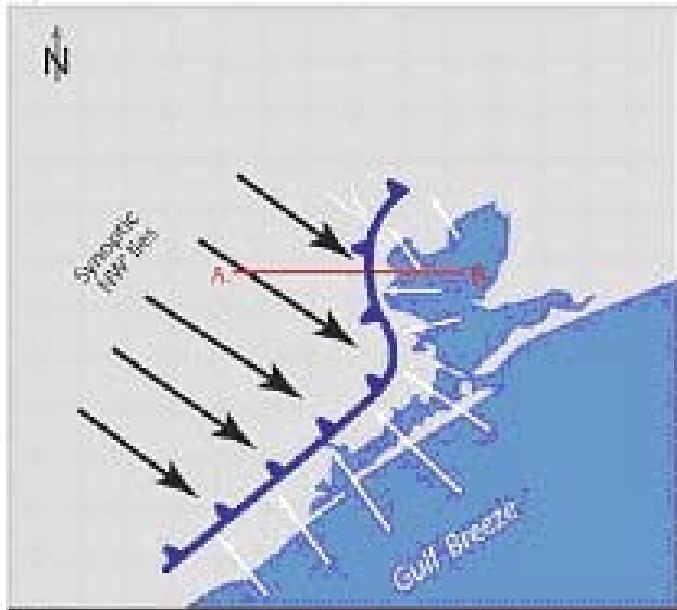
**BAYP, Bayland Park, C53/A146, 8/22**

—●— Obs WS, km/h    ● Obs MN    ▲ Obs RWM    ▲ Obs RWA  
—●— Mod WS, km/h    ● Mod MN    ▲ Mod RWM    ▲ Mod RWA



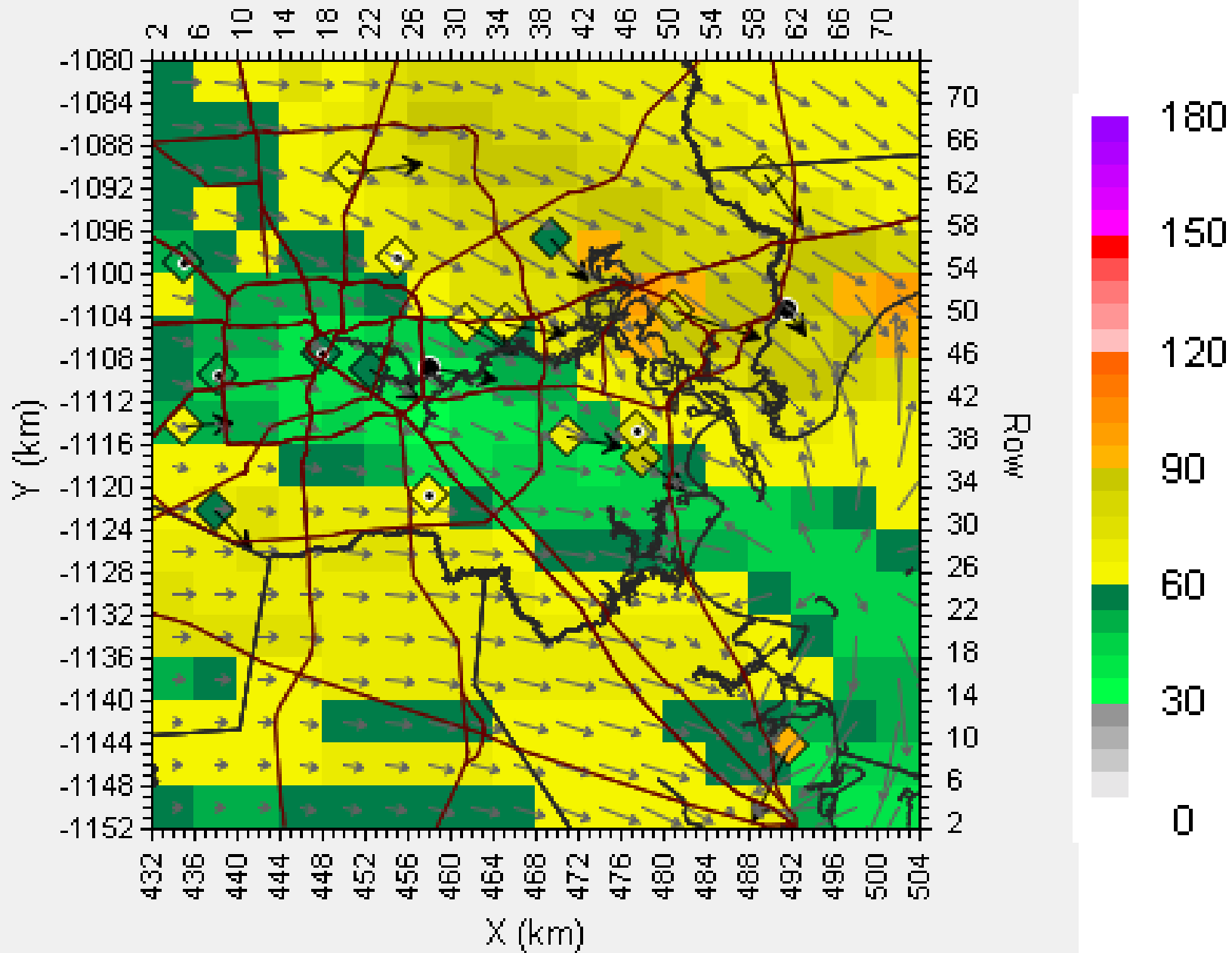
# Houston Coastal Meteorology

## Stalled Sea Breeze Fronts



O<sub>3</sub>, 1200, 08/30/00

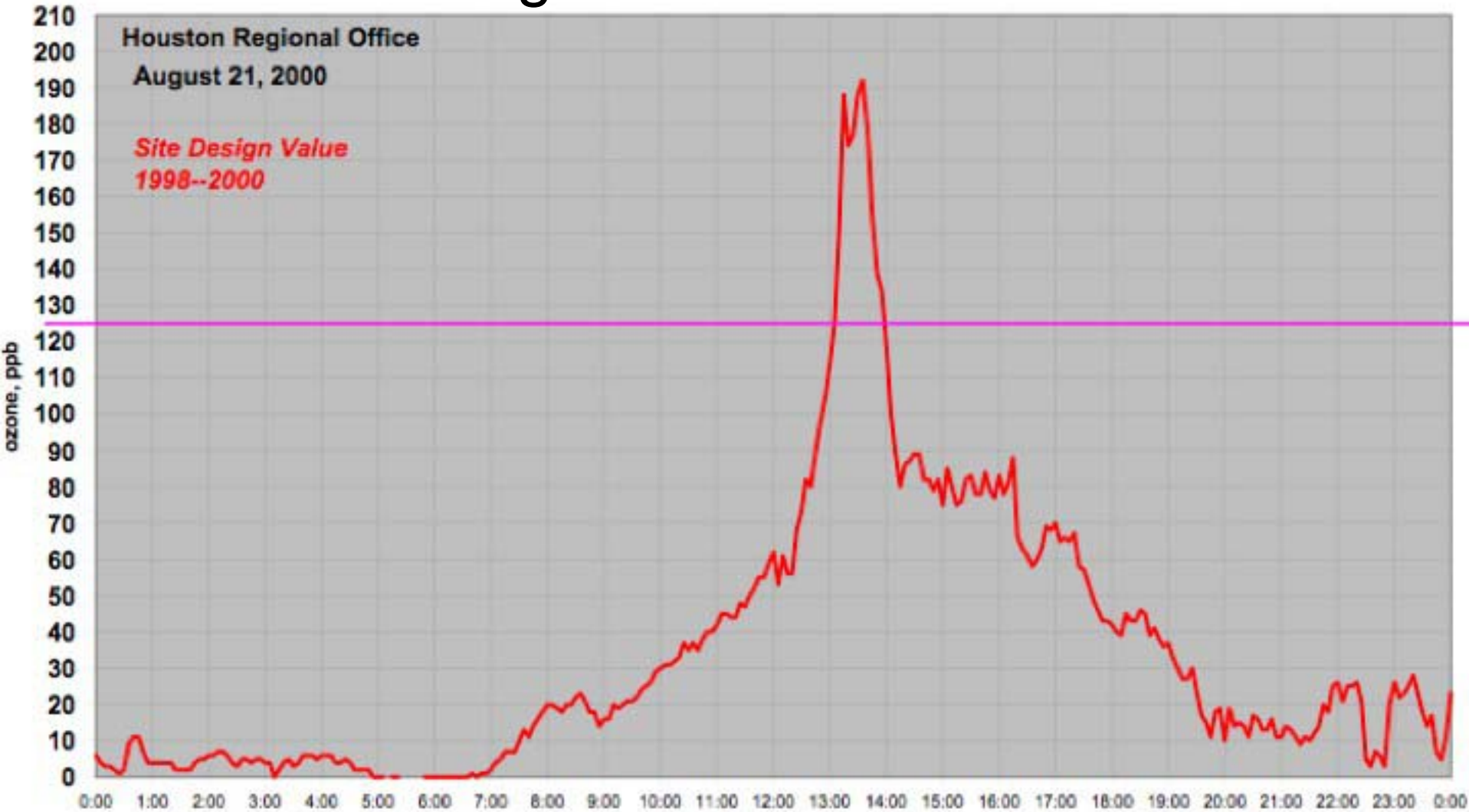
Column



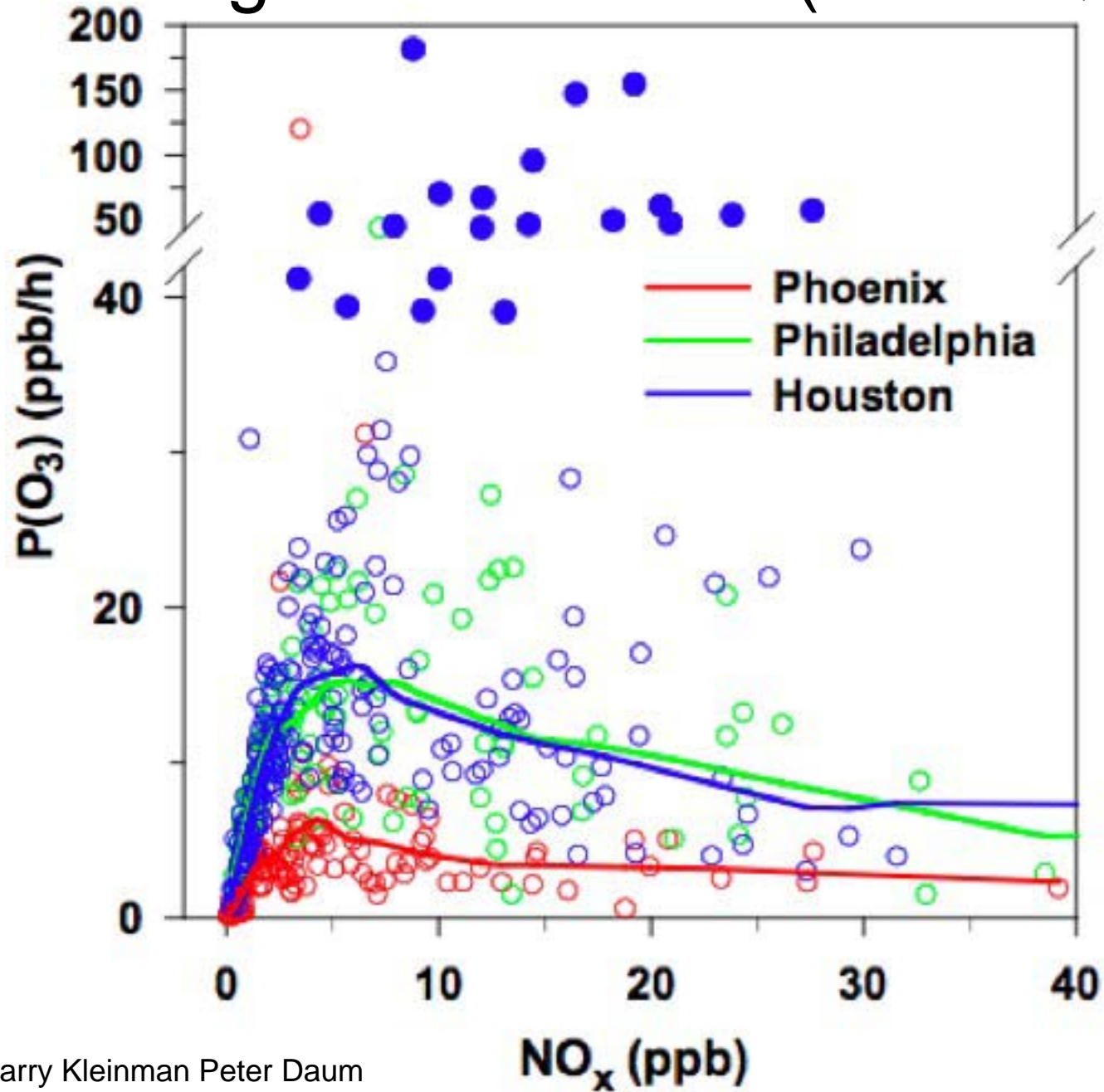
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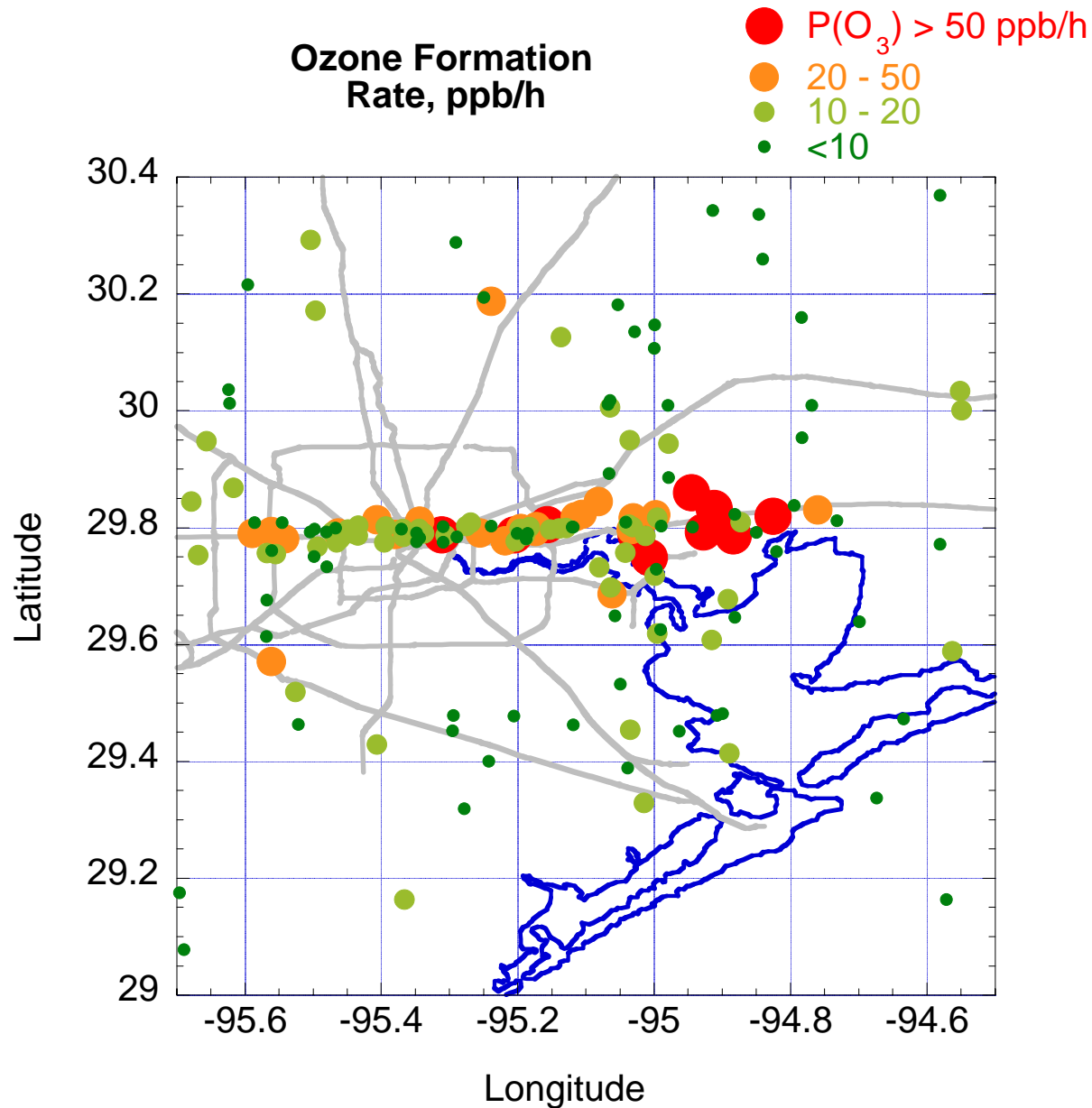
# Transient high ozone event ground monitor



# Transient high ozone event (TEXAQS 2000)

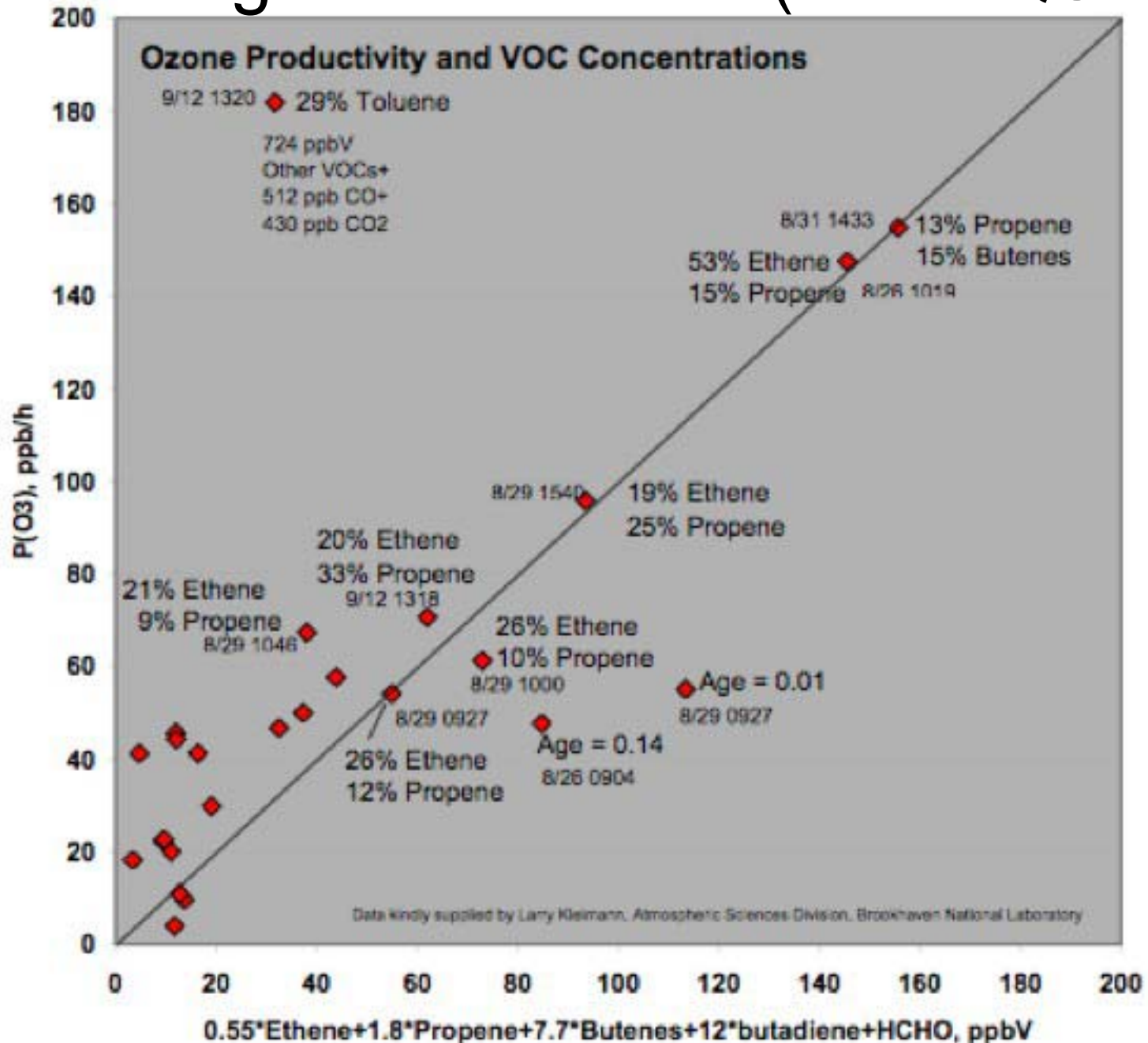


# Transient high ozone event (TEXAQS 2000)



*Geographic distribution of  $P(O_3)$  from G-1 measurements. (BNL)*

# Transient high ozone event (TEXAQS 2000)



# TCEQ HRVOC Control Strategy

- Annual HRVOC emission cap
- “Short-term cap” rule
  - Emission points  $>5\%$  HRVOC capped at 1200 lbs. per hour
- Reporting Requirements
  - Releases 100 lbs over daily permit maximum
  - Report Database

# TCEQ Air Emission Event Report Database

- Events with emissions >1000 pounds of HRVOCs occur several times per week, on average; >10,000 pounds several times a month
- Many are relatively short (well under one hour in duration)
- Ethylene and propylene dominate HRVOC
- Events occur primarily in Harris and Brazoria counties at chemical manufacturing facilities

# THOE Policy Implications

- Increased Accuracy and Resolution
  - Industrial Emissions
  - Meteorology
  - Ozone Chemistry
- Sizeable investment of resources is required
- Stochastic nature of THOE
  - Deterministic model
  - What is a typical inventory?
  - THOEs can represent 25-35% of 8 hour violation

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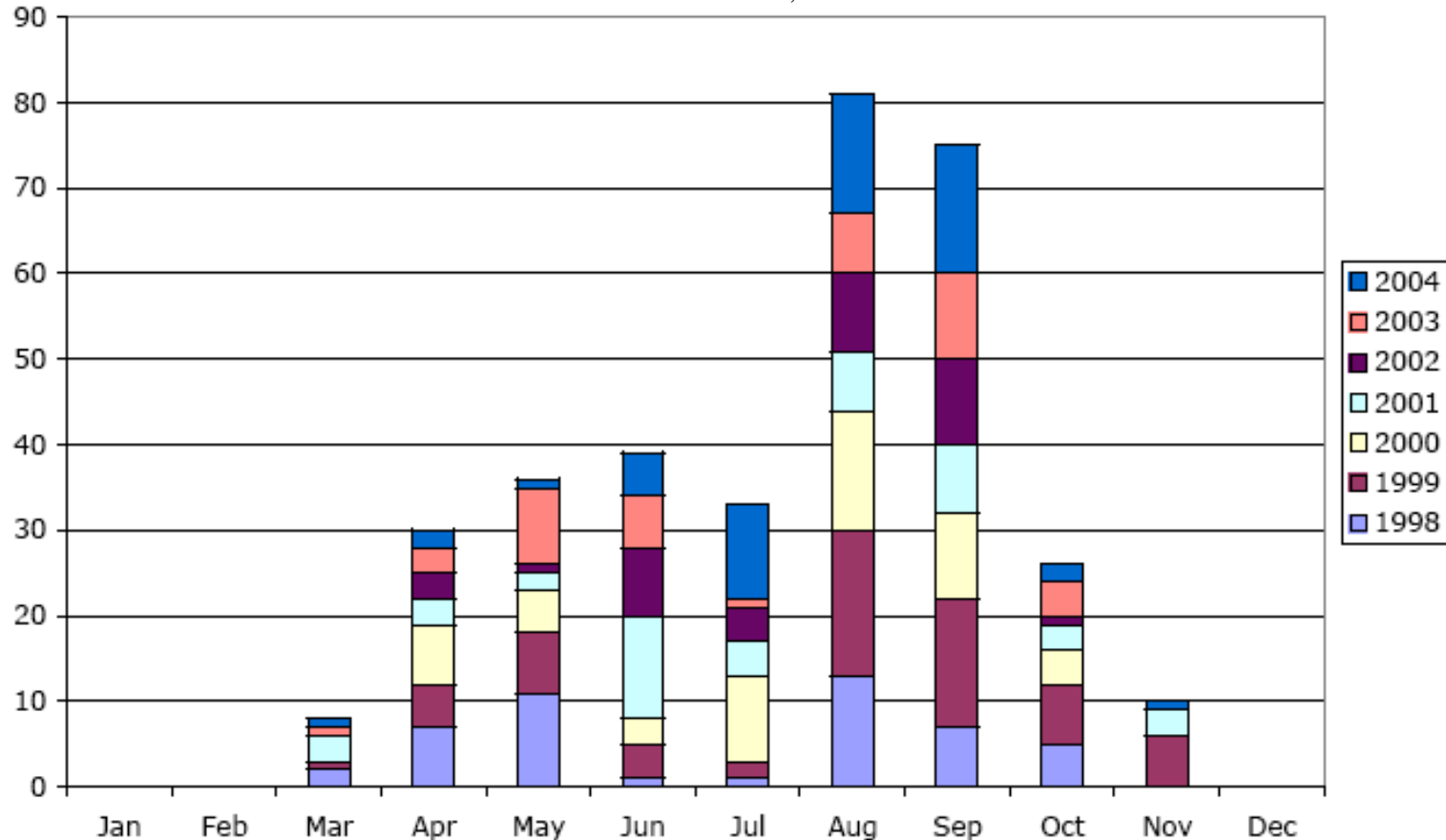
# Future Work

- Improve simulation of wind fields
- Improve Planetary Boundary Layer Evolution (Day and Night)
- Vertical mixing by turbulent diffusion
- Address uncertainty in emission inventory
  - HRVOC
  - NO<sub>x</sub>
- Newer Emission Models (MOBILE6, NCAR MEGAN, CEP Smoke reactivity)

# Future Work

## 8-h Ozone Exceedances, 1998-2004

Nielsen-Gammon et al., 2005b



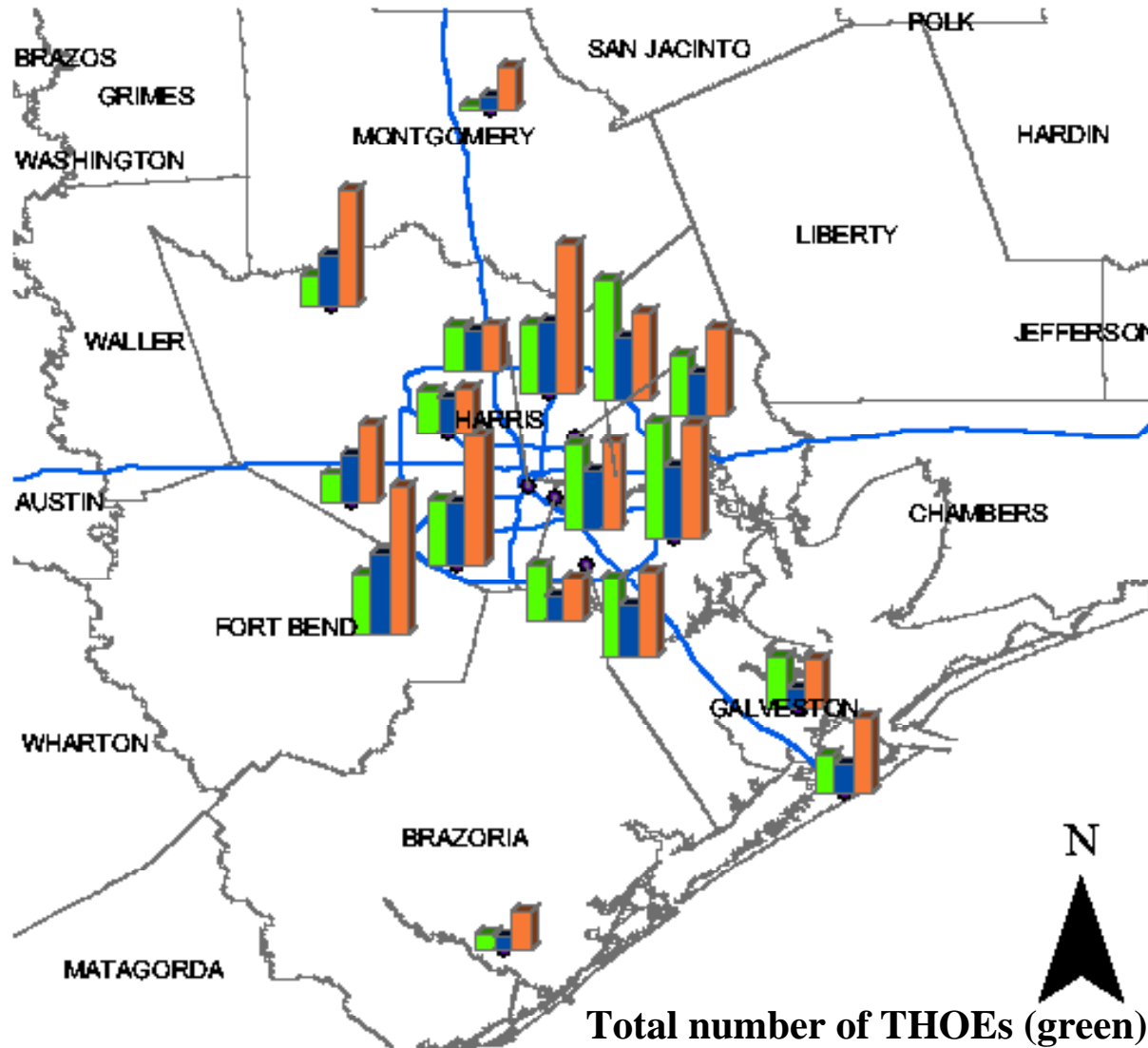
- Violations occur May/June
- Need for more meteorological episodes
- AG Post 2000 Modeling Episodes

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# Houston Control Strategy

1998-2002 in the HGB non-attainment area



Total number of THOEs (green)  
1-hr ozone exceedances (blue)  
8-hr ozone exceedances (orange)

# Houston Control Strategy

- 80% NOx emission reduction industrial sources
- Annual hourly caps on HRVOC emissions
- 49% NOx reduction on-road mobile sources
- 16% NOx reduction non-road/area sources

HGB NOx Budget (tpd) from the December 2004 SIP

<b>Source Category</b>	<b>2000 Base Case</b>	<b>2007 Controls</b>
On-road mobile sources	342 (33%)	175 (33%)
Area and non-road mobile sources	184 (18%)	155 (30%)
Point sources	492 (47%)	174 (33%)
Biogenic sources	21 (2%)	21 (4%)
<b>TOTALS</b>	<b>1039 (100%)</b>	<b>525 (100%)</b>

# Houston Control Strategy

- Current measures sufficient for one hour standard
- HRVOC controls maybe more effective than model predicts
- Current SIP measures may not be sufficient for attaining 8 hour standard (Carp, TCEQ)
- After 2008 NO<sub>x</sub> distribution closer to Dallas
- Future attainment of 8 hour standard require balanced reductions across all source categories (Neece, TCEQ)