

# Rapid Synthesis of TexAQS II Data

“Emissions: Questions A, C, D, and E”

T. Ryerson et al.

- $\text{NO}_x$  and  $\text{SO}_2$  emissions

  - Electric utility power plants

  - Ship Channel industrial sources

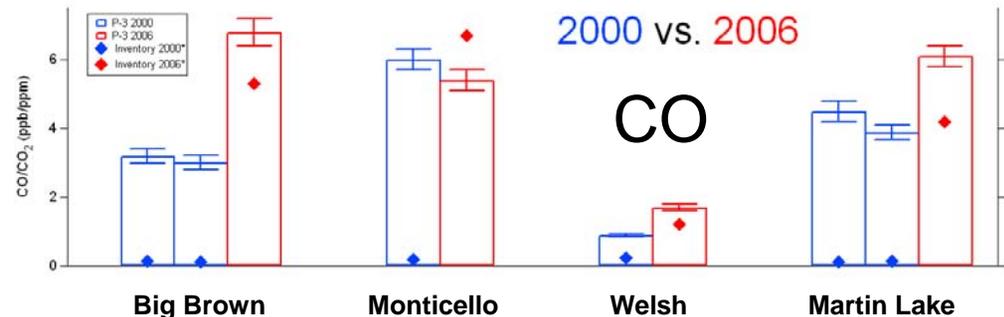
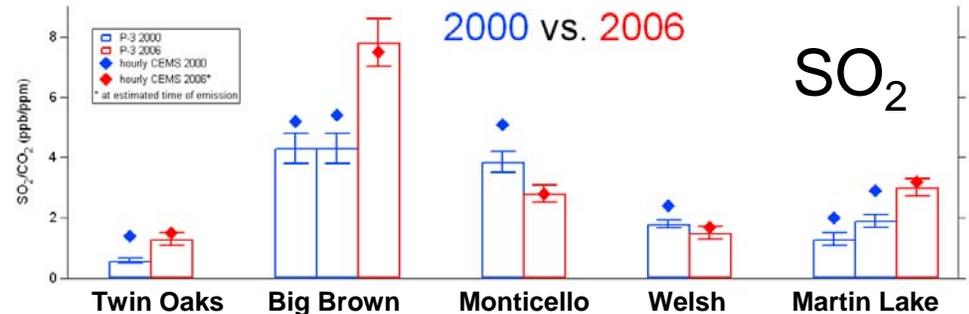
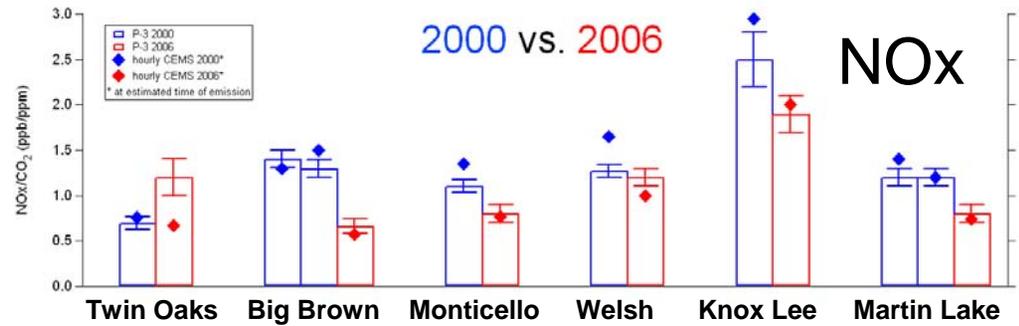
  - Shipping

- $\text{NH}_3$  and Hg emissions

# NO<sub>x</sub>, SO<sub>2</sub>, and CO emissions (Questions A, C, and D)

## Rural electric utility power plants:

- NO<sub>x</sub> emissions have decreased by 25 to 80% since TexAQS 2000
- Annual SO<sub>2</sub> emissions appear to be largely unchanged since 2000
- discrepancy in CO reconciled by large increases in inventory CO emissions between 2000 and 2006 (revision to Finding D1)
- Emissions ratios from aircraft and hourly CEMS agree to ±10% on average in 2006



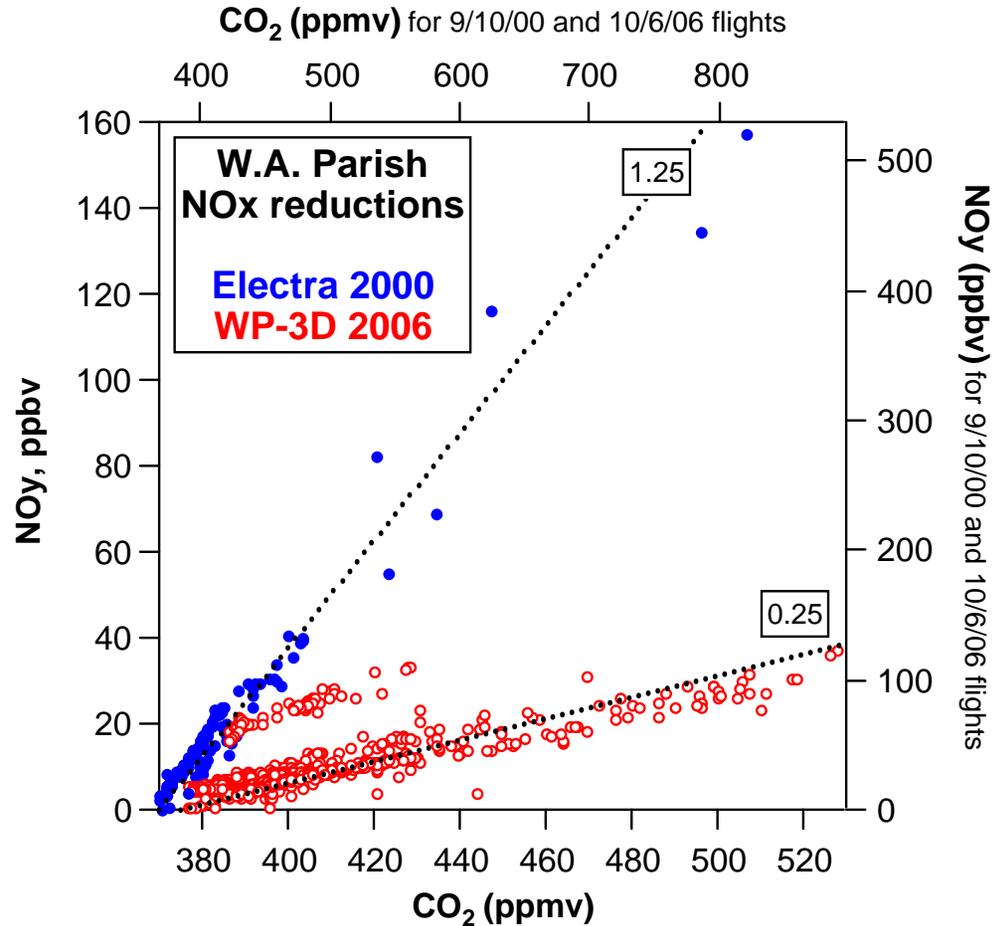
# NO<sub>x</sub>, SO<sub>2</sub>, and CO emissions (Questions A, C, and D)

## Rural electric utility power plants:

### W.A. Parish

- **2000:** four transects, avg. 1.25
- **2006:** sixteen transects, avg. 0.25

Average decrease since 2000:  
measured from aircraft: 80%  
measured by CEMS: 79%

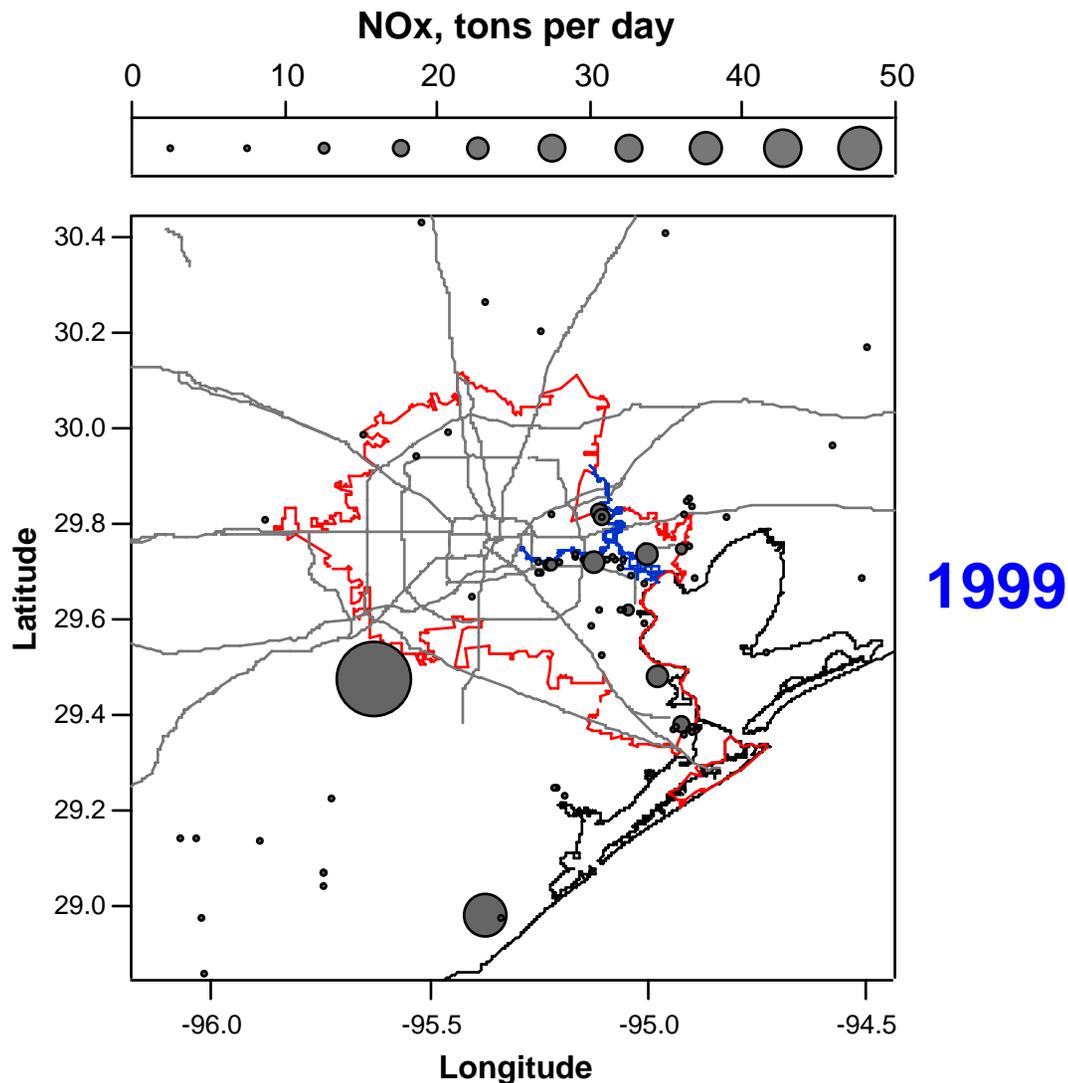


# NO<sub>x</sub>, SO<sub>2</sub>, and CO

## Ship Channel:

Inventories for NO<sub>x</sub> point sources equipped with CEMS appear to be relatively accurate.

Substantial NO<sub>x</sub> reductions in the Ship Channel are suggested by the inventories ...



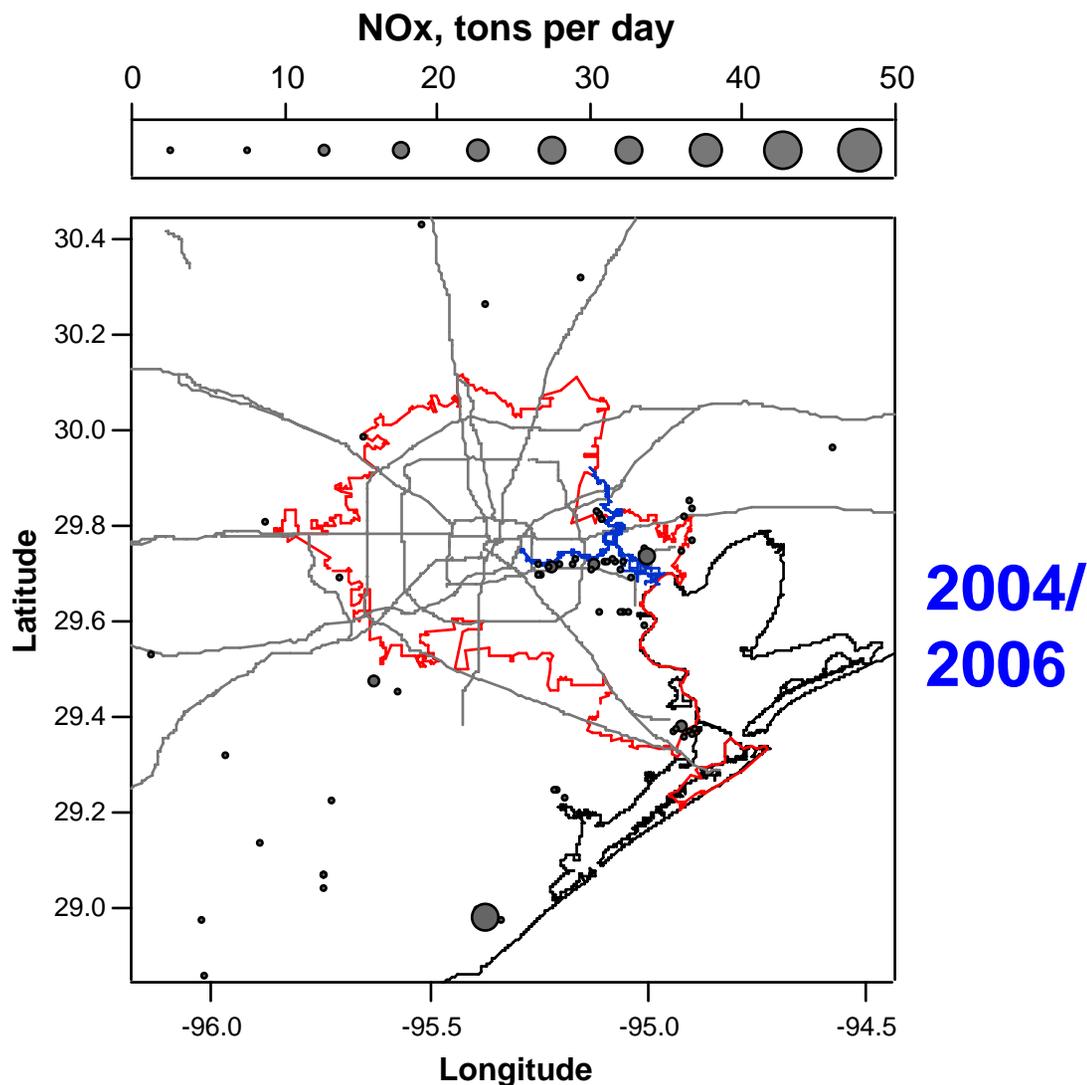
(Sources greater than 0.5 tons per day are shown)

# NO<sub>x</sub>, SO<sub>2</sub>, and CO

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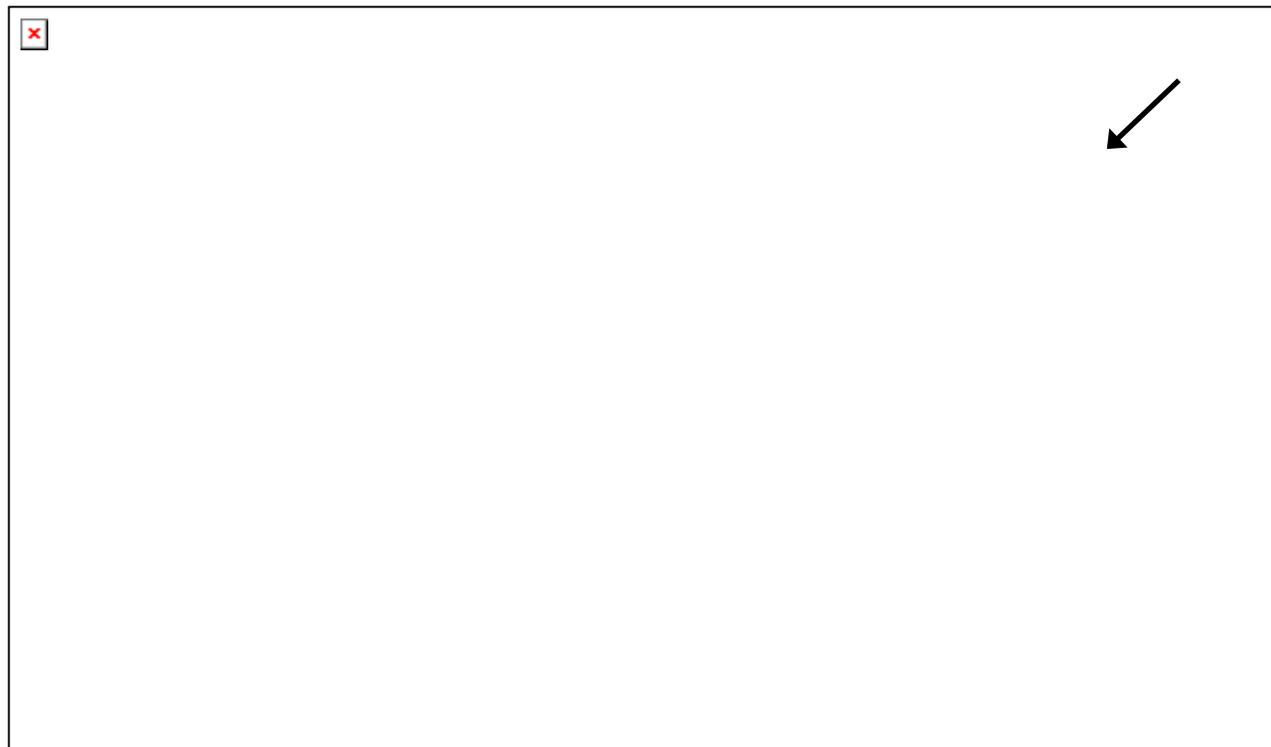
## NO<sub>x</sub>, SO<sub>2</sub>, and CO Ship Channel:

WP-3D data from Ship Channel transect  
Sept. 27, 2006

Inventories for NO<sub>x</sub>  
point sources equipped  
with CEMS appear to  
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... and **preliminary**  
comparison to aircraft  
data ...



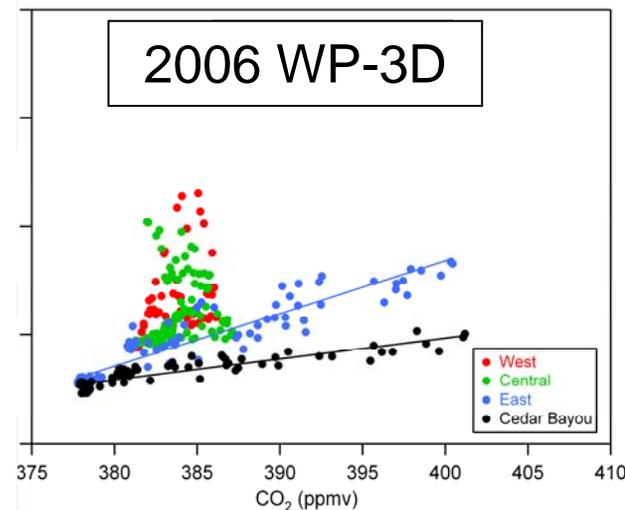
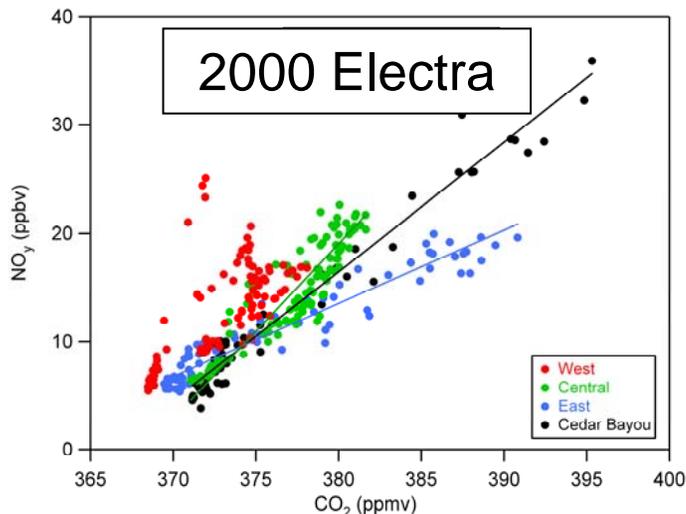
## NO<sub>x</sub>, SO<sub>2</sub>, and CO Ship Channel:

Inventories for NO<sub>x</sub> point sources equipped with CEMS appear to be relatively accurate.

Substantial NO<sub>x</sub> reductions in the Ship Channel are suggested by the inventories ...

... and **preliminary** comparison to aircraft data ...

... is qualitatively consistent with NO<sub>x</sub> reductions in the inventories.



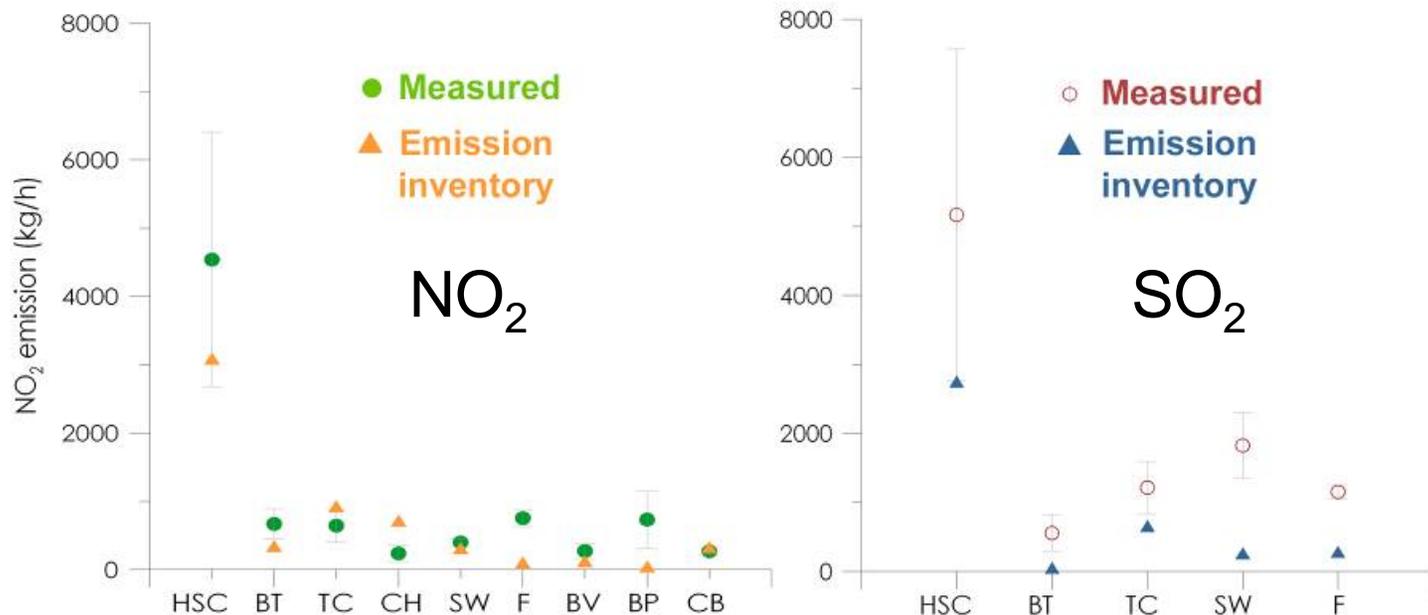
NO<sub>x</sub>/CO<sub>2</sub> ratio:

**West Ship Channel**  
**Central Ship Channel**  
**East Ship Channel**  
**Cedar Bayou plant**

**2000**      **2006**

-                      -  
**1.62**                -  
**0.68**                **0.49**  
**1.19**                **0.19**

## NO<sub>x</sub>, SO<sub>2</sub>, and CO Ship Channel:



- SOF data suggests industrial SO<sub>2</sub> is under-estimated in inventories
- This inventory underestimate is qualitatively consistent with analyses of Electra (2000) and WP-3D (2006) data

*J. Mellqvist, Chalmers University, Sweden;  
R. Washenfelder and M. Trainer, NOAA ESRL*

## NO<sub>x</sub>, SO<sub>2</sub>, and CO emissions (Questions A, C, and D)

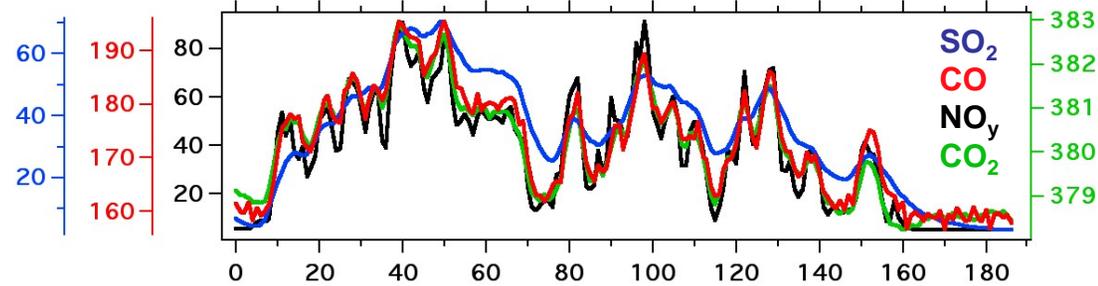
### Emissions from shipping:

Inventories of NO<sub>x</sub>, SO<sub>2</sub>, and CO large vessel emission factors are accurate to roughly  $\pm 25\%$

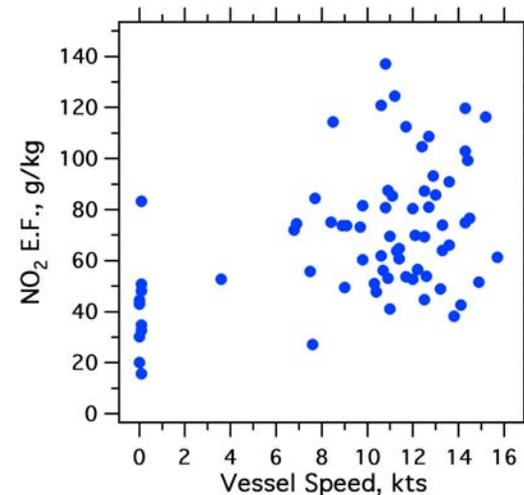
Ship NO<sub>x</sub> emission factors show no trend with vessel speed, consistent with literature data  
(revision to Finding D3)

Fractional contributions from ship NO<sub>x</sub> emissions are expected to increase over time

Ship plume data observed from R/V *Brown*



NO<sub>x</sub> vs. vessel speed



## Ammonia (NH<sub>3</sub>) emissions (Question E)

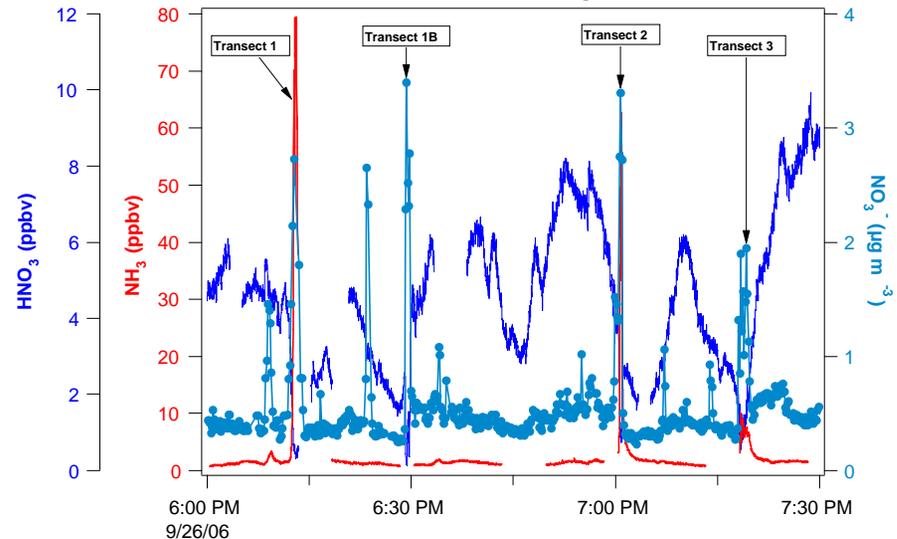
“are there sources of ozone and aerosol not represented in the reported emissions inventories?”

**Narrow and concentrated plumes of NH<sub>3</sub> observed (in HSC, BPA, and LA)**

**Sufficient to deplete ambient HNO<sub>3</sub> and enhance aerosol NO<sub>3</sub><sup>-</sup> in spatially narrow plumes**

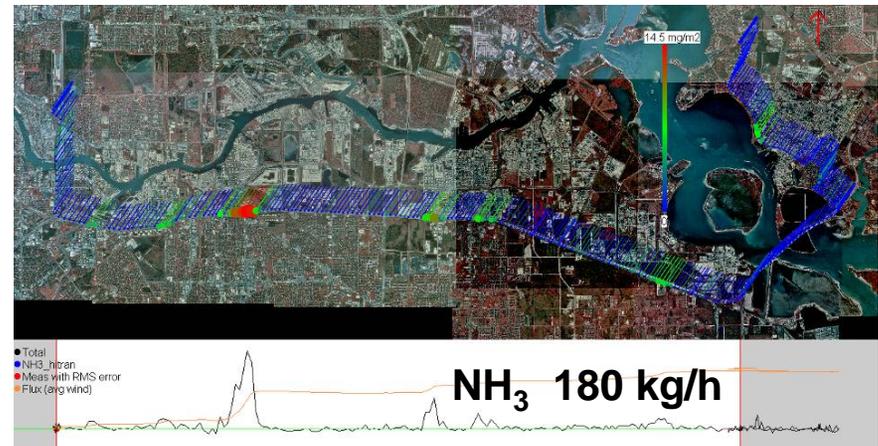
**Not consistent with the (very few) known sources in the available inventories**

## WP-3D NH<sub>3</sub> data



- No observable NH<sub>3</sub> “slip” from SCR units

## SOF NH<sub>3</sub> data



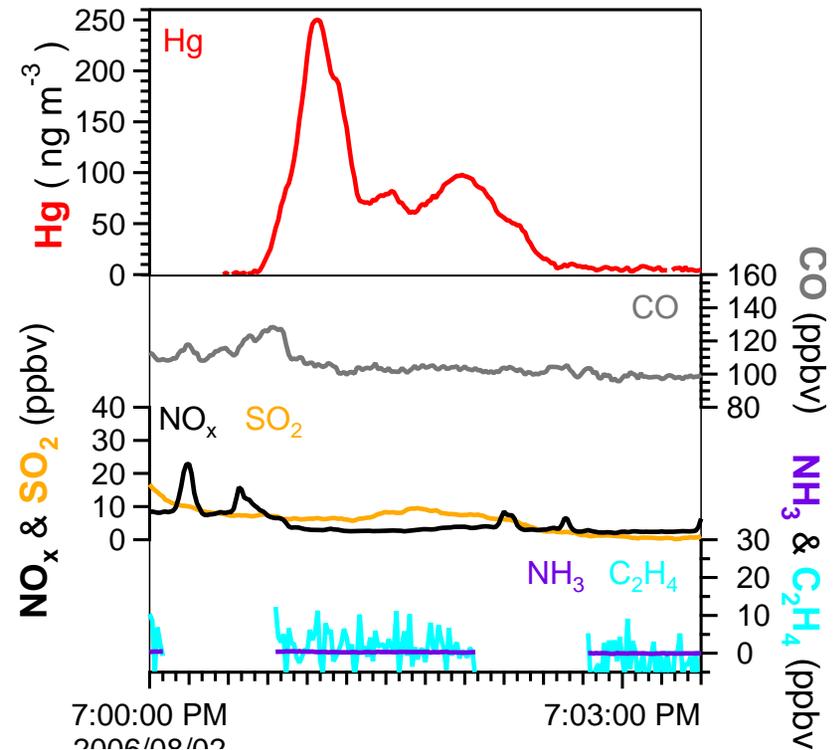
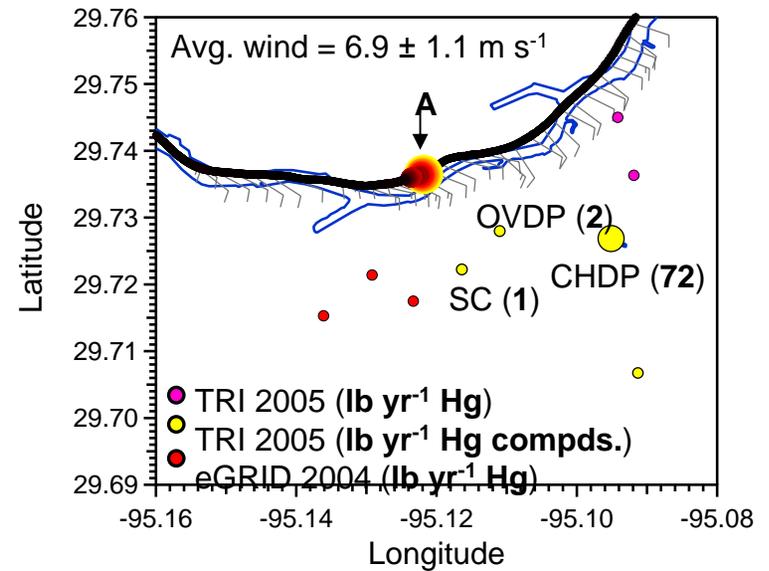
## Elemental mercury ( $\text{Hg}^0$ ) emissions (Question E)

Elemental mercury data from R/V *Brown* show a persistent, narrow plume of  $\text{Hg}^0$  in HSC (up to  $250 \text{ ng/m}^3$ )

$\text{Hg}^0$  was uncorrelated with all other chemical species measured on R/V *Brown*

Not attributable to any known Hg source in current inventories

Other, smaller  $\text{Hg}^0$  plumes seen in BPA and elsewhere in HSC



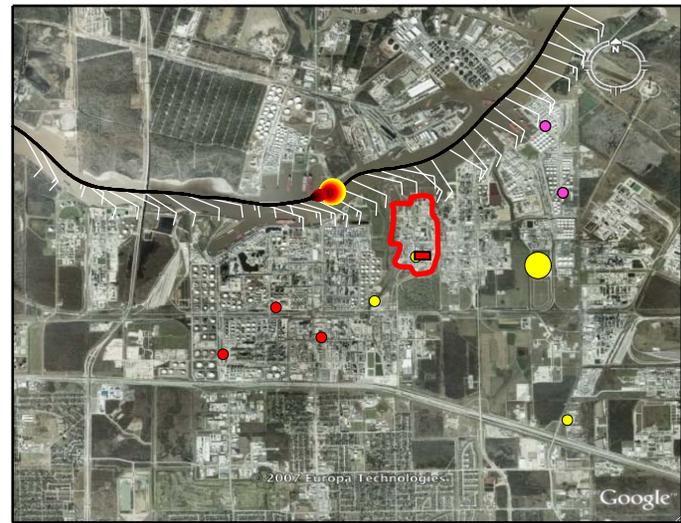
## Elemental mercury ( $\text{Hg}^0$ ) emissions (Question E)

$\text{Hg}^0$  observations are consistent with re-emission from soil, contaminated in the past, during soil remediation efforts occurring during the TexAQS 2006 study

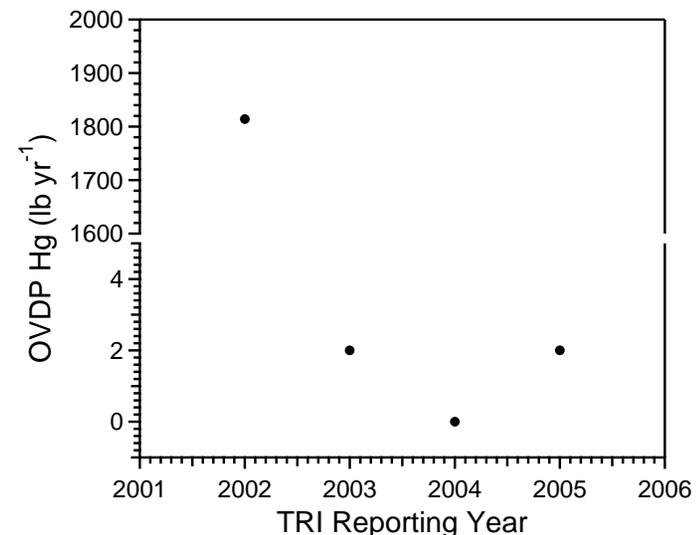
This site location is provisionally identified as Oxyvinyls Deer Park, which last reported substantial  $\text{Hg}^0$  emissions in 2002

This speculation is very preliminary and needs careful additional work to rule in or out

*T. Fortin, NOAA ESRL*



## Oxyvinyls Deer Park $\text{Hg}$ emissions reported in the Toxics Release Inventories from 2002 - 2005



## **Substantial additional work needs to be done**

- More careful evaluation of, e.g., WP-3D, NASA HSRL, and SOF data will better define uncertainties in preliminary RSST estimates of VOCs, NO<sub>x</sub>, SO<sub>2</sub>, and NH<sub>3</sub> from Houston area industrial facilities
- CO<sub>2</sub> emissions data for 2006 would greatly reduce uncertainties for industrial emissions of VOCs, NO<sub>x</sub> and SO<sub>2</sub> derived from observational data
- Conclusions from many of the RSST questions may yet be overturned, in the coming months and years, as a result of more careful (and time-consuming) analysis