# TexAQS II

# NOAA's Plans for the 2006 Intensive


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Air Quality Focus Group Workshop

Silver Spring, MD

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# Outline

NOAA's regional air quality assessments

- Motivation and Strategy

TexAQS II

- Rationale and overall objectives
- NOAA's objectives
- Science plans
- Assets and schedule
- Collaborators

# Regional Air Quality Assessments

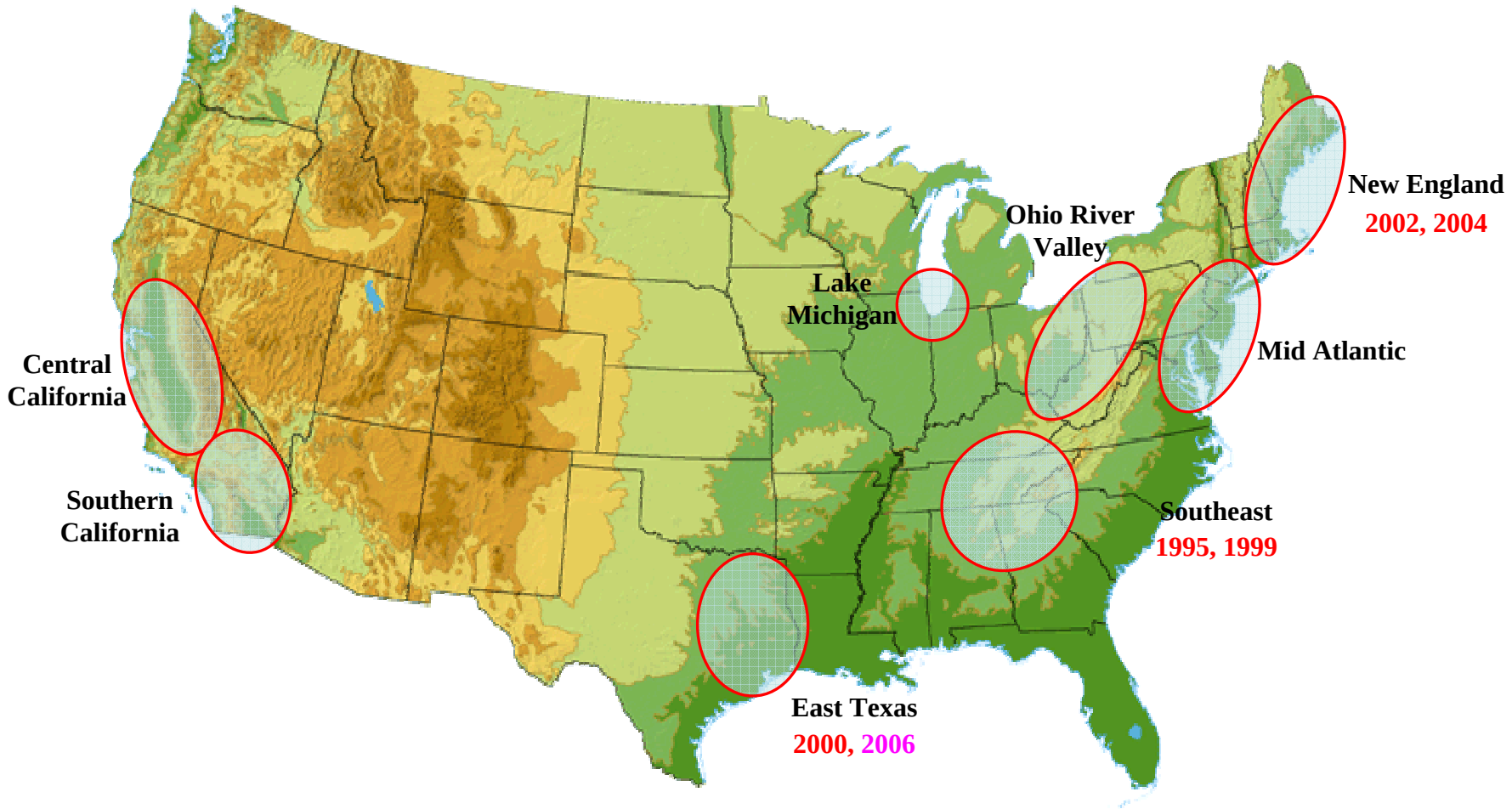
## Strategy:

*National program to address **information gaps** that are **limiting effectiveness** of National policy development and **efficiency** of regional mitigation strategies. Provide a series of comprehensive data sets to aid in the **development**, **diagnostic evaluation**, and **improvement** of air quality forecast models.*

- ***Regional Selection Criteria***
  - Severity of the problem
  - Emission mix
  - Meteorology / topography
  - AQ forecaster needs
- ***Collaborators***
  - EPA, State and Local AQ Managers, Industry, other agencies
  - University Scientists
- ***Coordination***
  - NOAA Climate Program (combined field intensives that maximize benefits while minimizing deployment costs)
- ***Schedule***
  - Every two years (2004, 2006, 2008, 2010, etc.)

# Areas with the Most Serious* Air Quality Problems

***Chemically and Meteorologically Diverse***




***Designated by EPA as "serious", "extreme", or "severe" for ozone and/or PM**

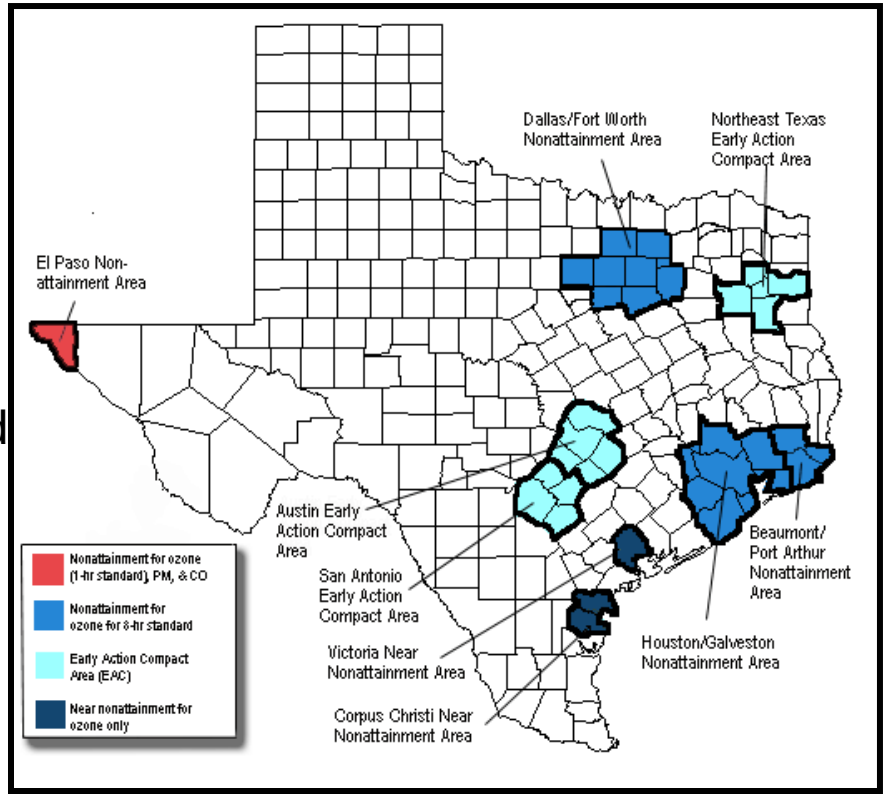
# Why TexAQS II?

- $NO_X$ and VOC (?) emissions have been reduced in Houston area

- New Federal Standards and SIP requirements
  - Regional Haze
  - 8-Hour Ozone Standard

- Higher Number of Non-attainment areas

- Transport is a major issue
  - Larger area must be studied
    - Eastern Half of Texas
  - Longer Period of time to document and analyze transport
    - 18 months instead of 1 month
    - May 2005 to October 2006



# TexAQS II Area of Study

TexAQS 2000 Study Area

TexAQSII Study Area

# NOAA's Objectives In TexAQS II

## NOAA's Focus is on Climate Change and Air Quality

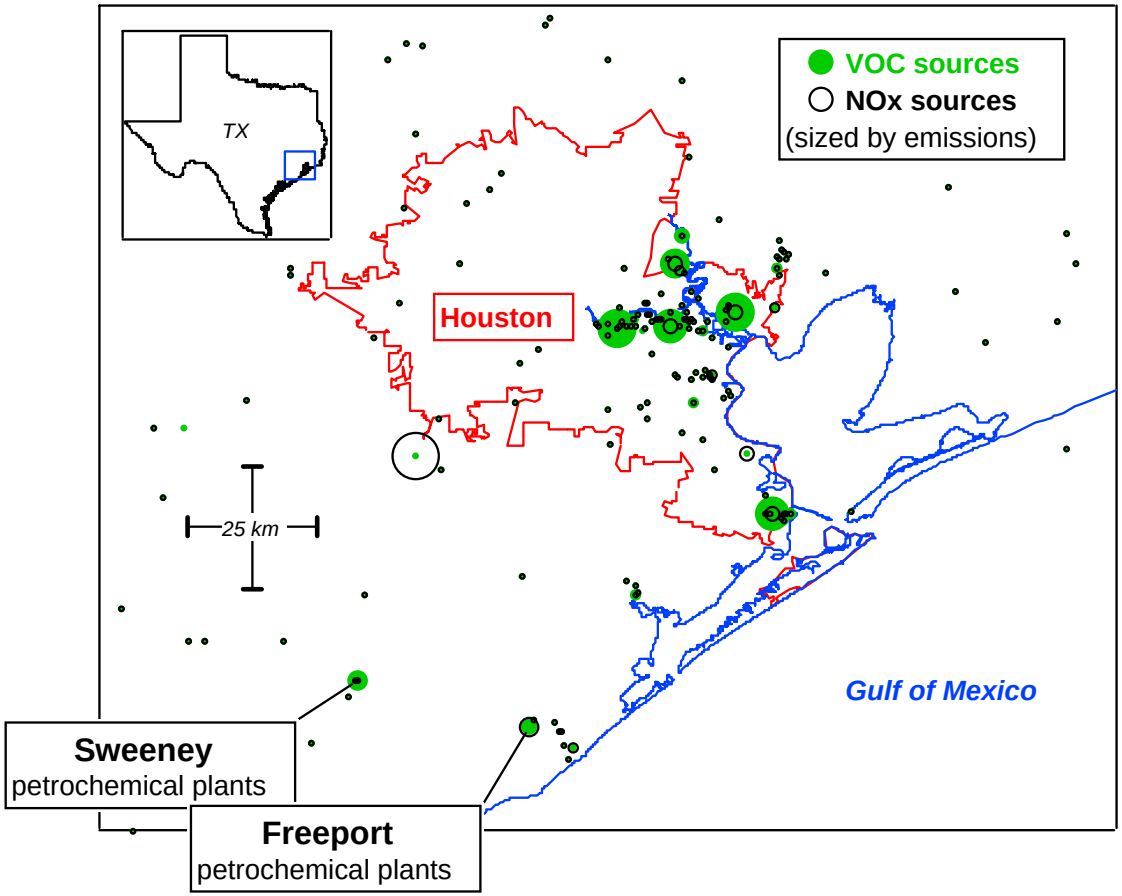
**During TexAQSII NOAA Will Focus on:**

- **Emissions Verification** - petrochemical, urban, power plant, marine
- **Transport and Mixing** - intra- and inter-regional transport, boundary layer/free Troposphere
- **Chemical Transformation** - $O_3$ and PM, Day and Night
- **Aerosol Properties and Radiative Effects** - Regional haze, direct and indirect effect, satellite validation
- **Forecast Models** - Diagnostic evaluation, chemical data assimilation

**For More Information http://www.al.noaa.gov/2006/**

# Rapid and efficient formation of ozone in plumes from petrochemical industries

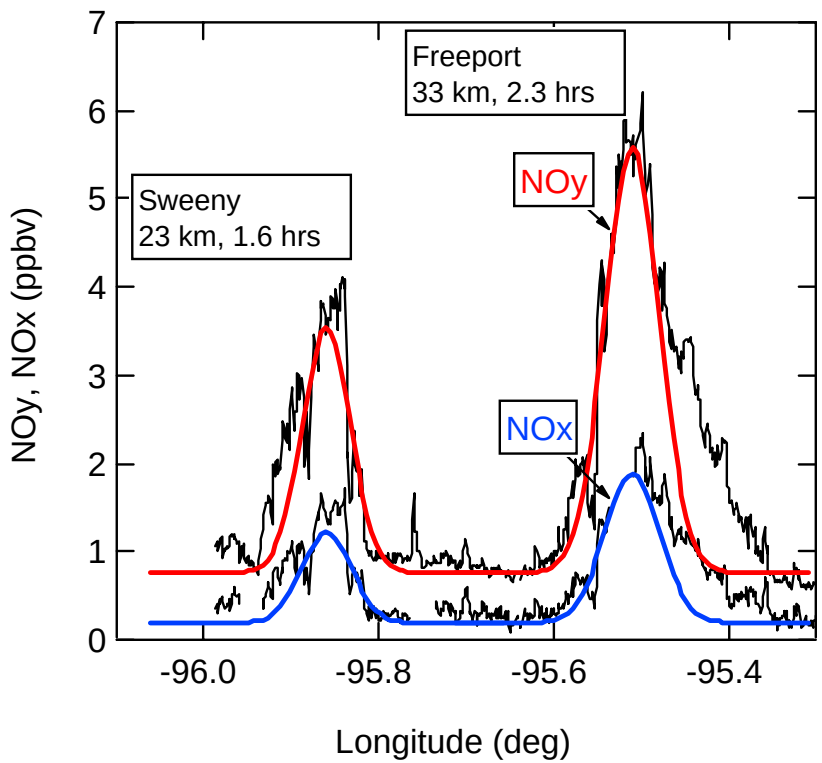
Co-located anthropogenic $NO_x$ and alkene emissions



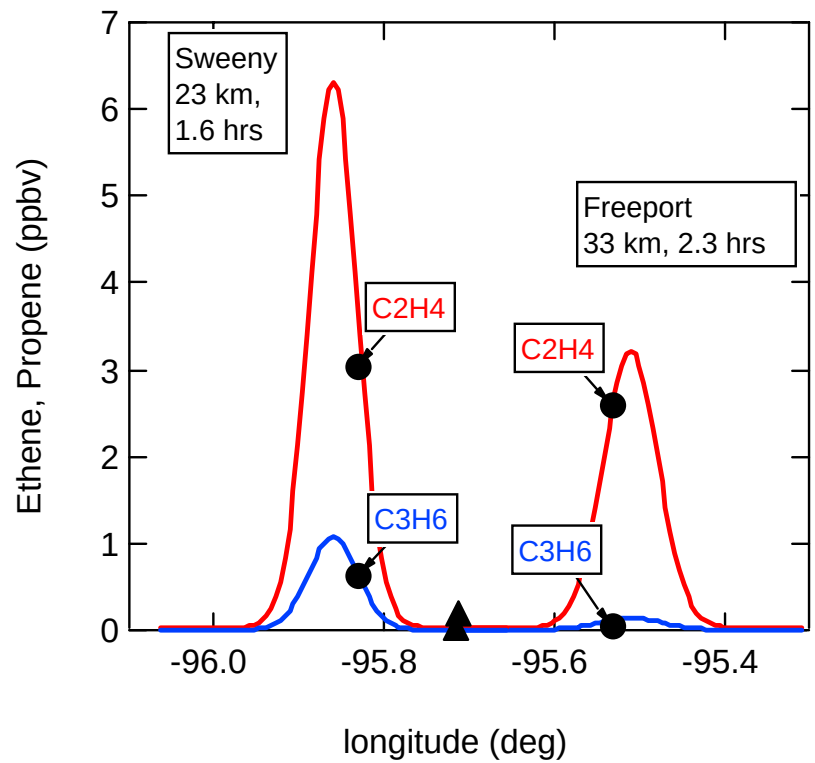

Aircraft data from the 2000 Texas Air Quality Study, TexAQS

# Sources and Processes

- ***Do ambient measurements of pollutant mixing ratios (e.g., CO/NOx, VOC/NOx, $CO/CO_2$, LAC/CO, $NH_3$/CO) reflect the temporal variation of urban emission ratios through diurnal cycles and weekday/weekend contrasts?***

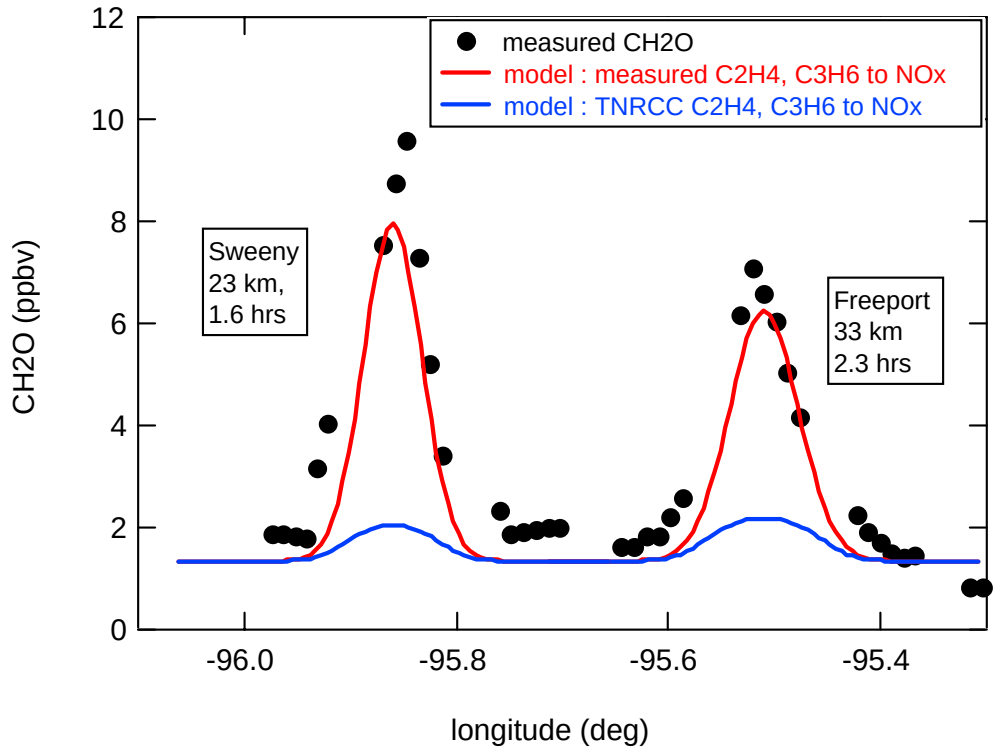



**Model $NO_x$ emissions agree with inventory and captures rapid NOx oxidation.**




**Inventory under predicts Alkene/$NO_x$ molar ratios by factors of 50 to 200.**

# Sources and Processes

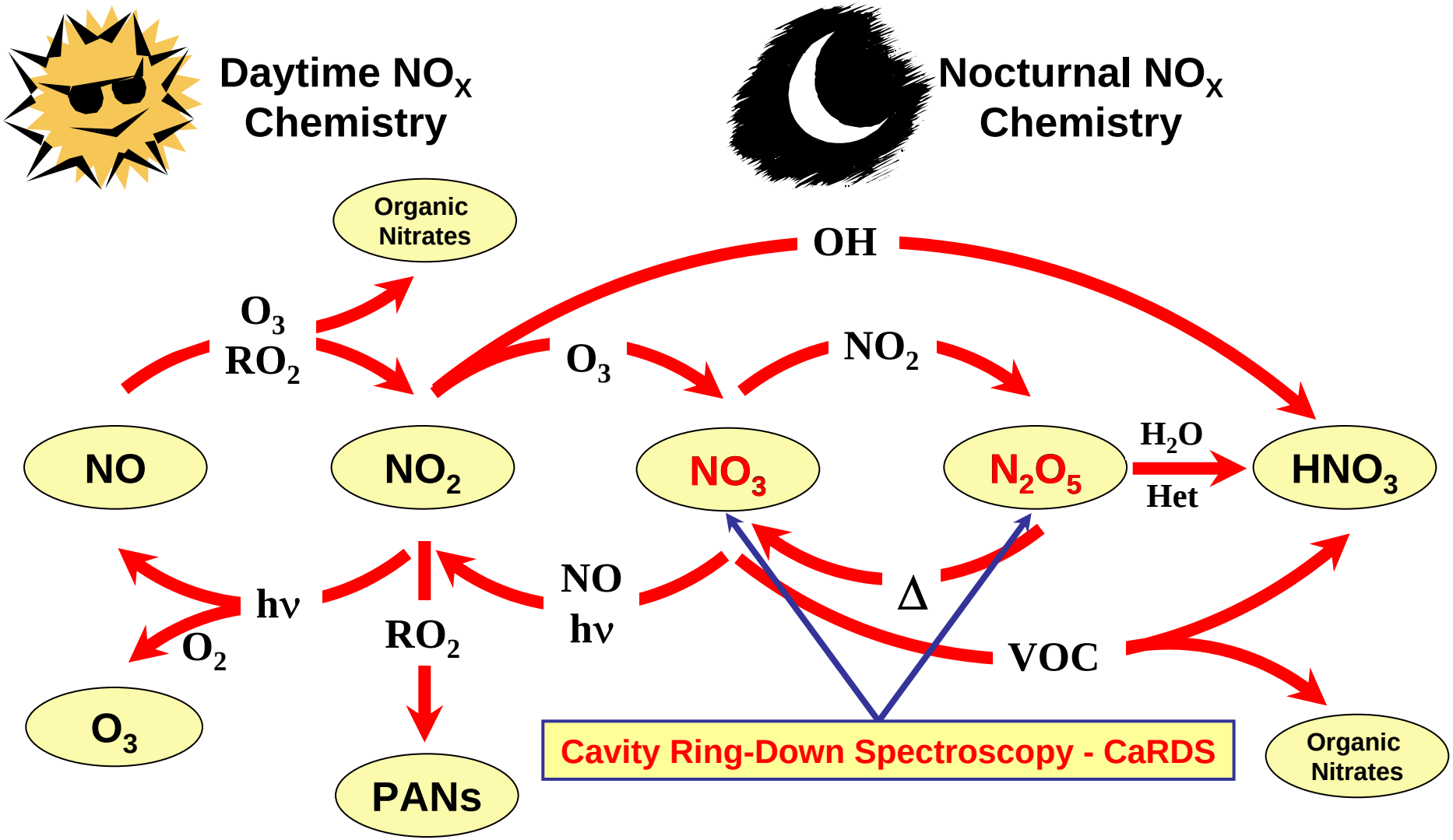



Model with measured Ethene, propene to NOx Emission ratios
Reproduces measured CH2O as well as Ozone, CH3CHO, PAN

Reactivity is due to petrochemical emissions of light alkenes

**Questions in 2006:**
Have the VOC and NOx emissions changed since 2000?
How have the changes affected $O_3$ and PM formation?
What are the important VOC sources?
Are they intermittent or continuous sources?

# Processes - The Role of Nighttime Chemistry



# Processes - The Role of Nighttime Chemistry

$NO_3$ + $N_2O_5$ can be a significant contributor to the nocturnal $NO_X$ budget

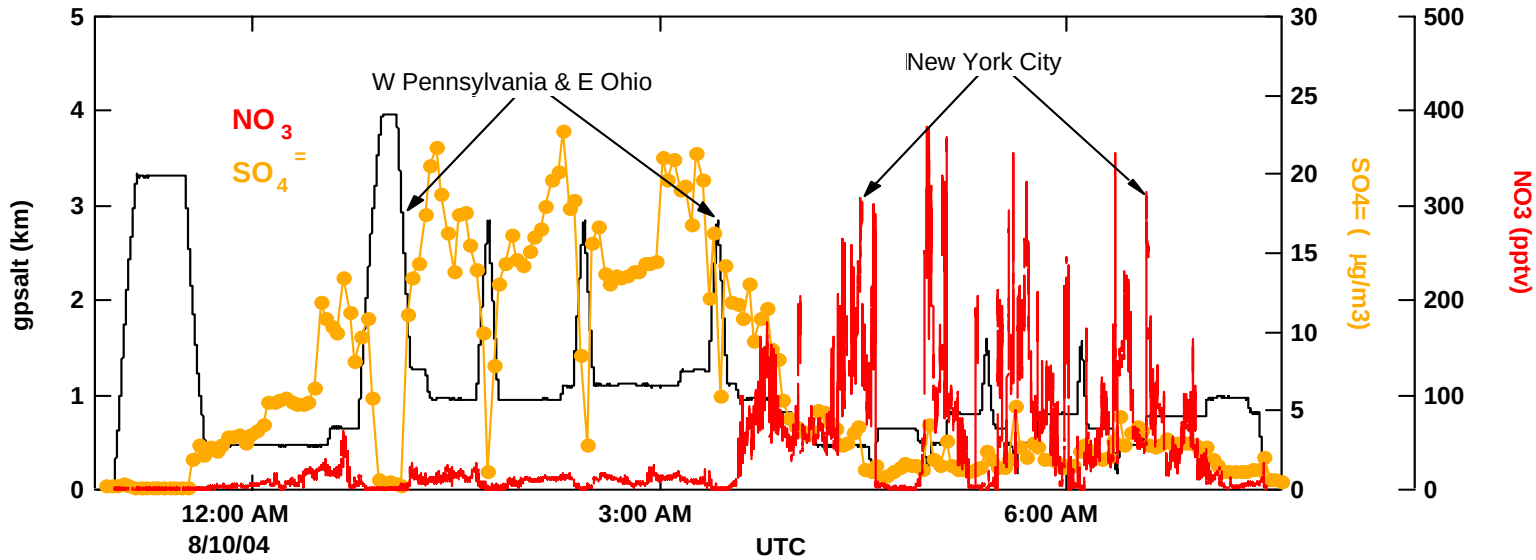
- $NO_3$ Measured in excess of 0.4 ppb
- $N_2O_5$ Measured in excess of 3 ppb

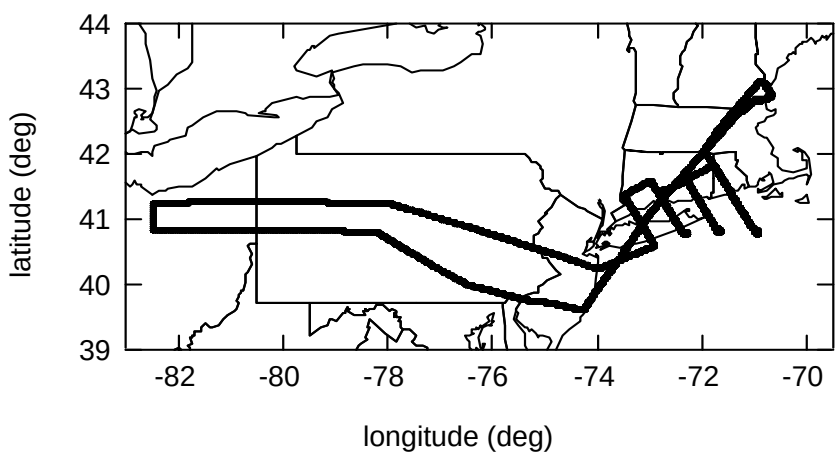
$NO_3$ anticorrelated with reactive "organics"

- Over land - isoprene
- Over water - DMS

**Nocturnal $NO_X$ Chemistry key factor in next day's air quality**

# Processes - The Role of Nighttime Chemistry



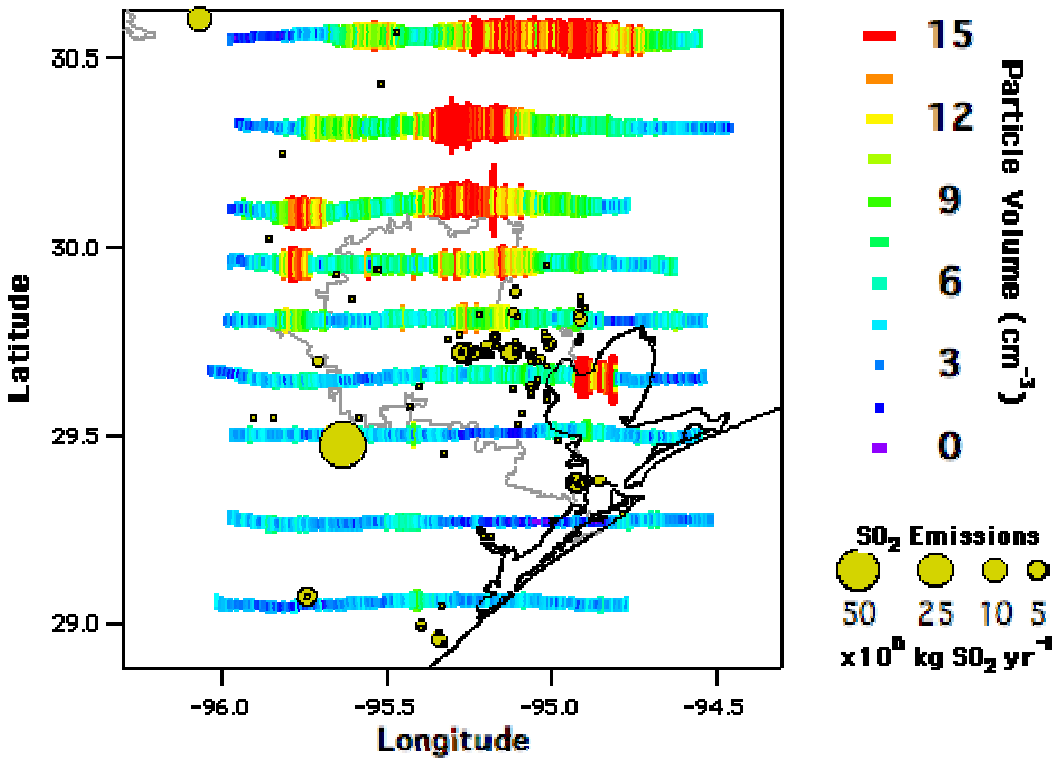

Sulfate aerosols effectively remove $N_2O_5$ at night

Linkage between sulfur emissions and regional $O_3$

What about Texas?

# Sources and Processes

- ***Characterize the growth and composition of the aerosol distributions well as their radiative properties.***

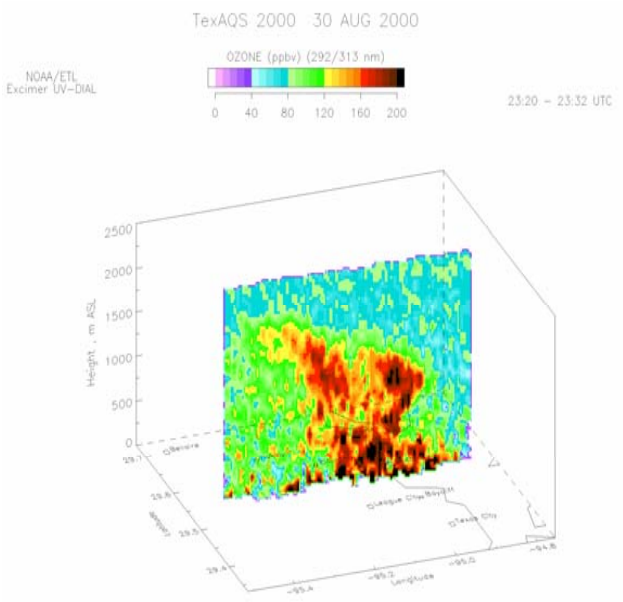



**Electra Flight 28 August 2000, Evolution of aerosols downwind of power plant, urban area and urban/industrial emissions**

# Transport and Mixing

## Atmospheric Boundary Layer

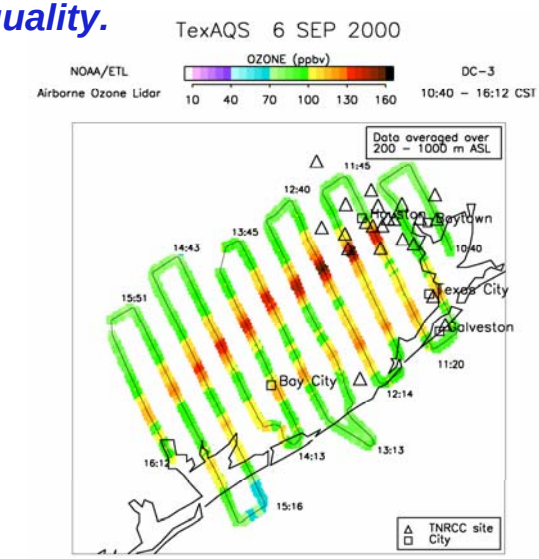
- *Mixing and layering within the boundary layer*
- *Transport at the land-sea interface*
- *Import to and export from the boundary layer*




**Time-height cross-section showing high ozone concentration air transported vertically within the sea breeze front at the western edge of Galveston Bay.**

## Regional (within Texas)

- *Determine how source regions inside Texas interact to influence air-quality.*



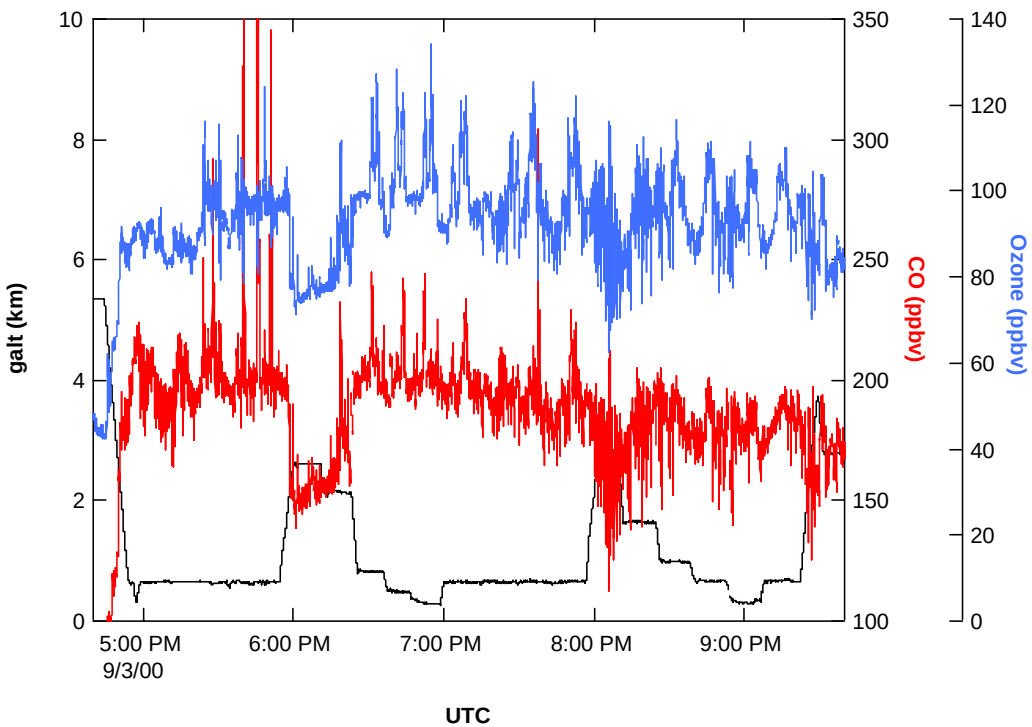

**Flight track of ozone plume tracked downwind from Houston during the 2000 experiment. Ozone values are averaged over the layer *between 200 and 1000 m AGL*. Flow is from northeast to southwest. One site southwest of Houston registered hourly ozone concentrations of > 125 ppb.**

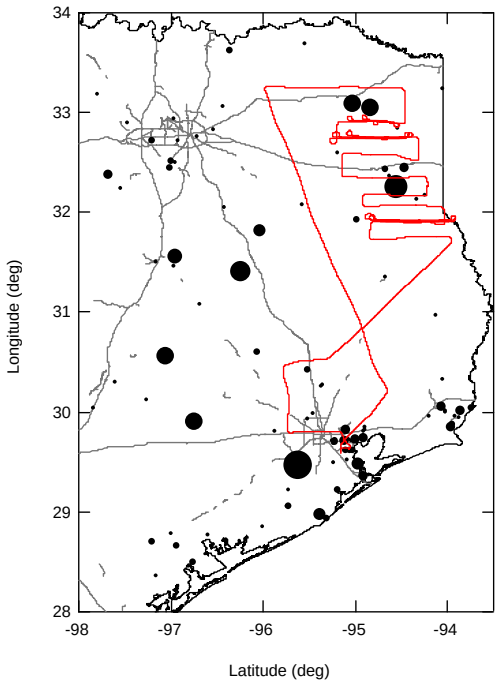
# Transport and Mixing

**Regional (outside Texas)**

- ***Determine how source regions outside Texas influence air-quality.***

**9/3/00: Regional Transport to Northeast Texas**
***High regional CO and Ozone concentrations higher than 80 ppbv.***

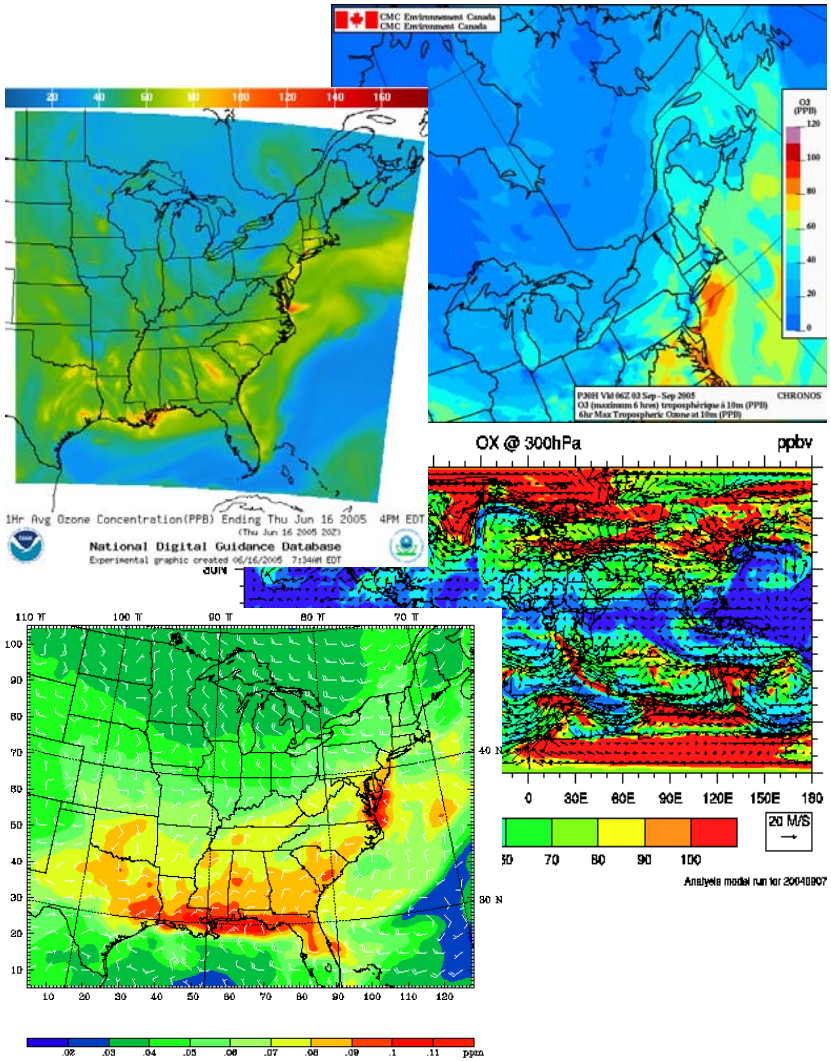


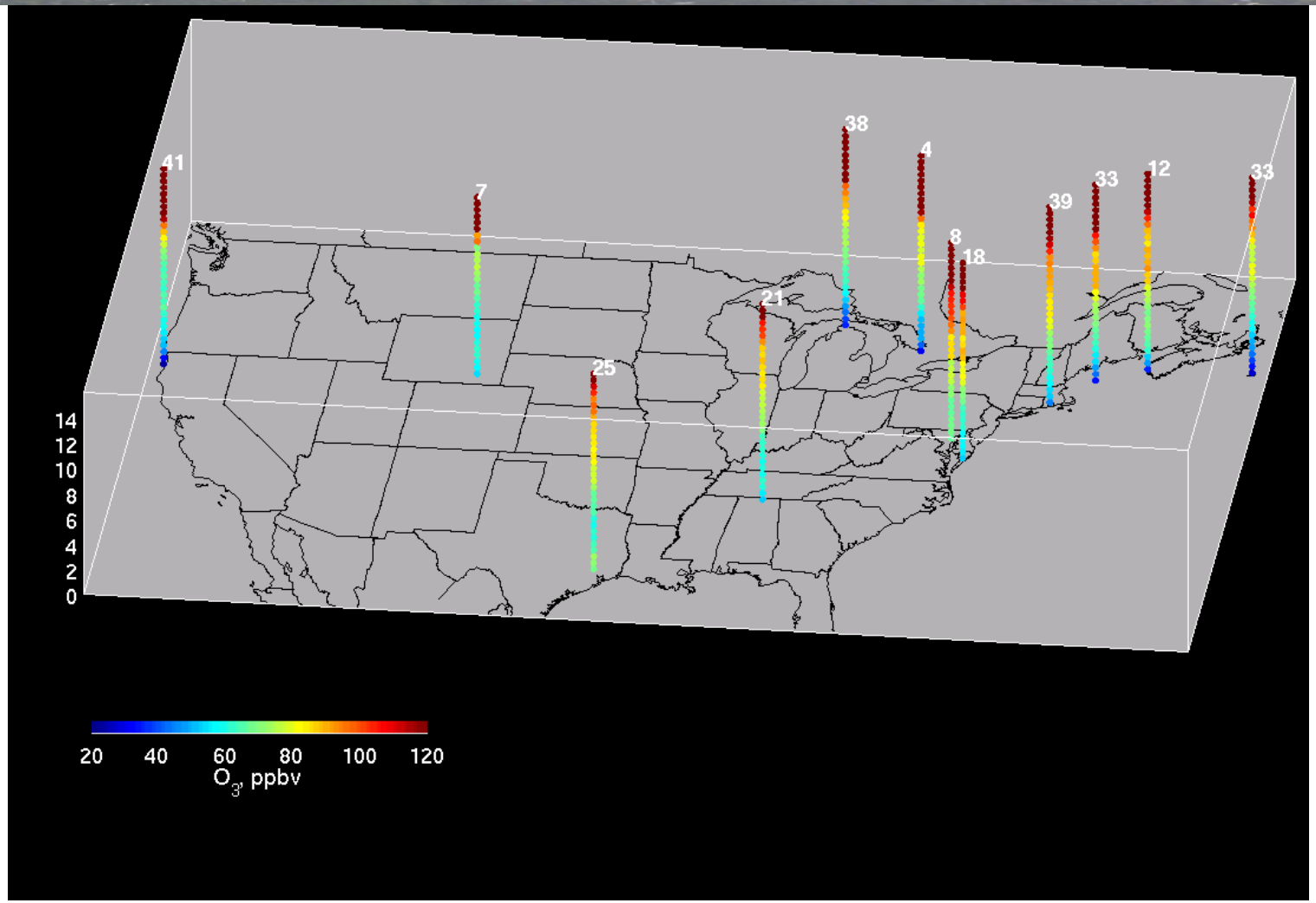
# Air Quality Forecast Model Diagnostic Evaluation

## Output from a number of models will be available during the intensive period

- Global and regional models will be used for platform (aircraft and ship) deployment.
- Opportunity for near real-time evaluation by comparing forecasts with observations.
- Evaluation of data assimilation techniques
- Ensemble forecasts

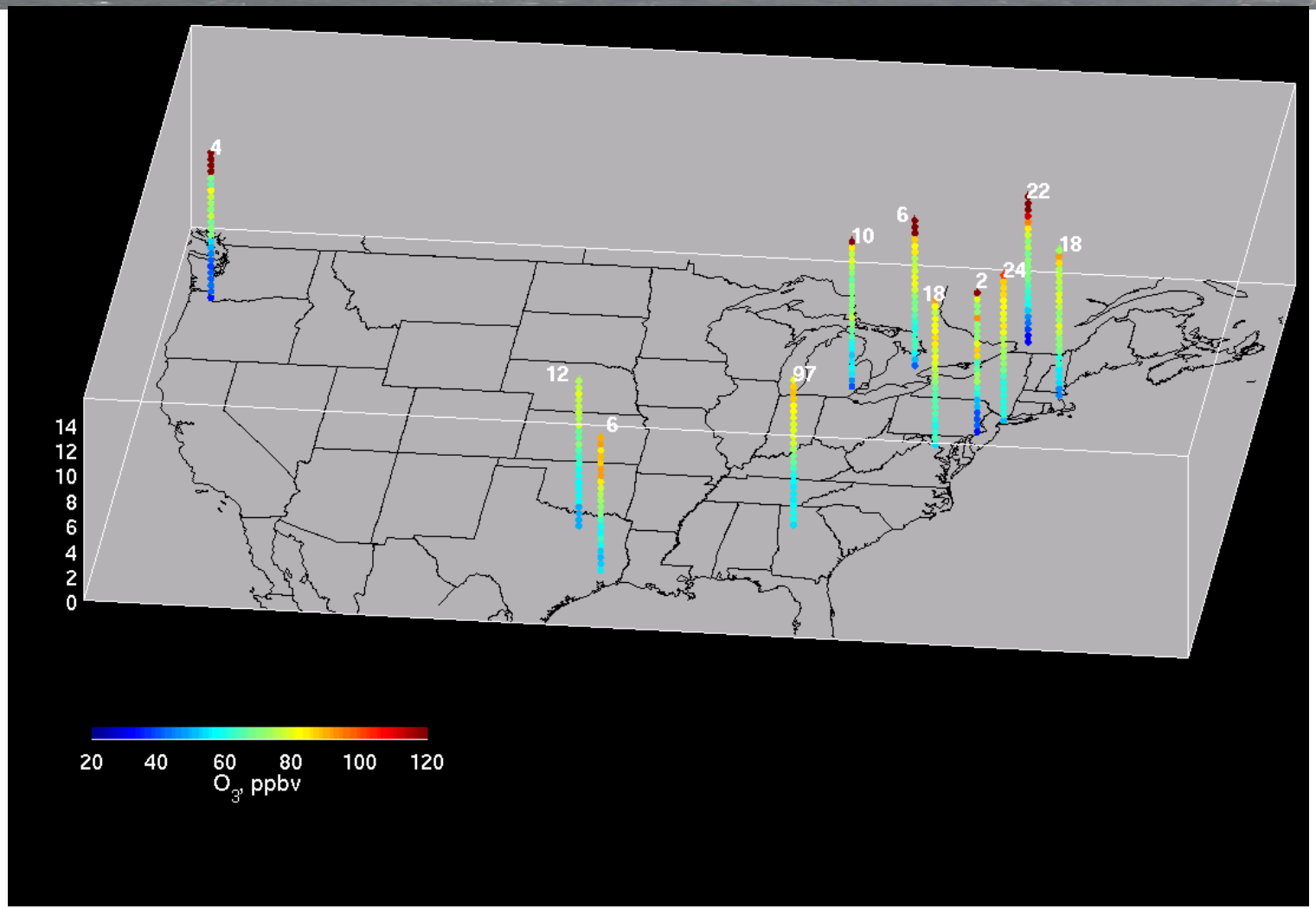


# IONS - The ICARTT Ozonesonde Network



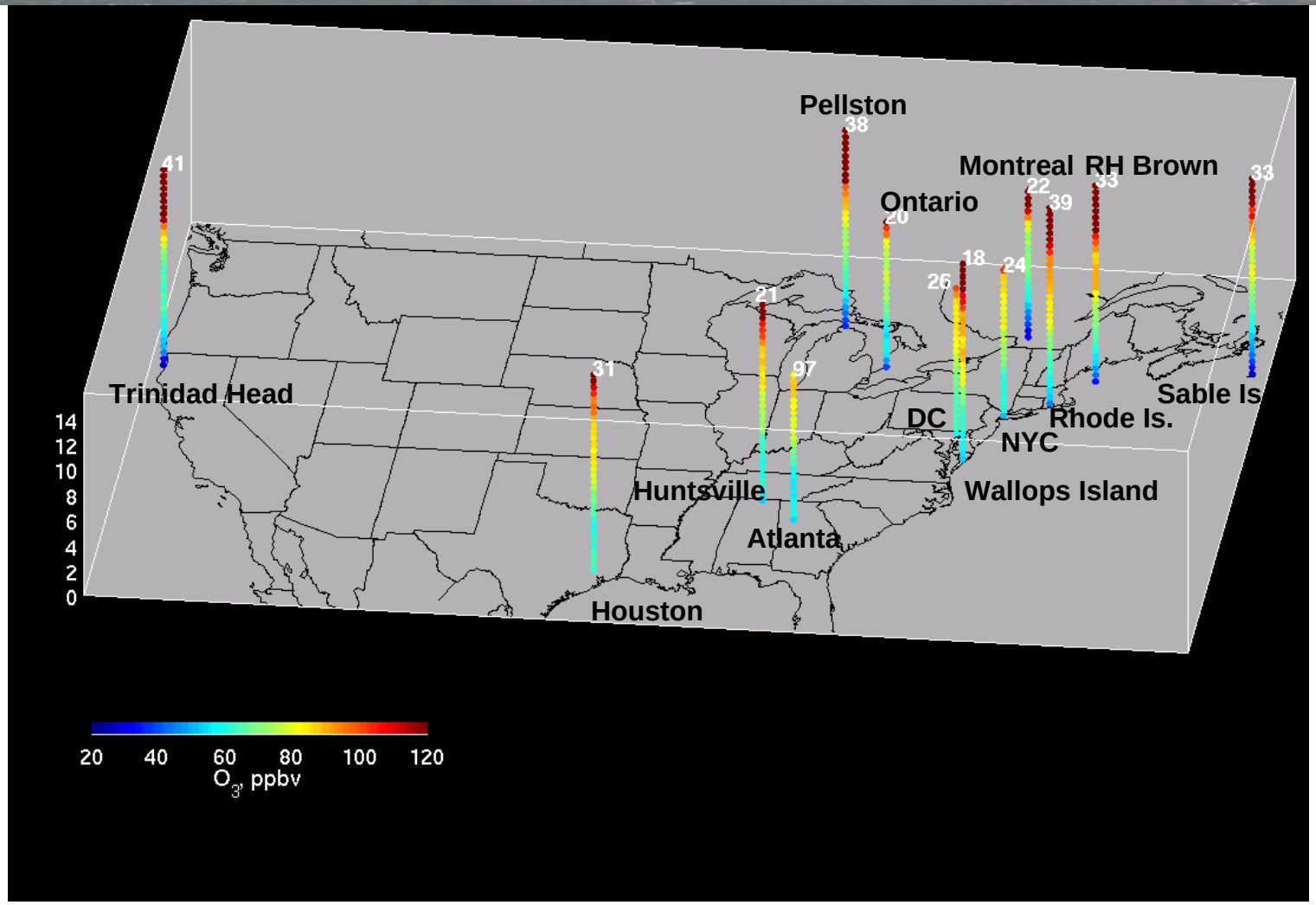

Median ozone profiles at all IONS sites, July 1 – August 15, 2004

# MOZAIC - Ozone Profiles from Commercial Aircraft



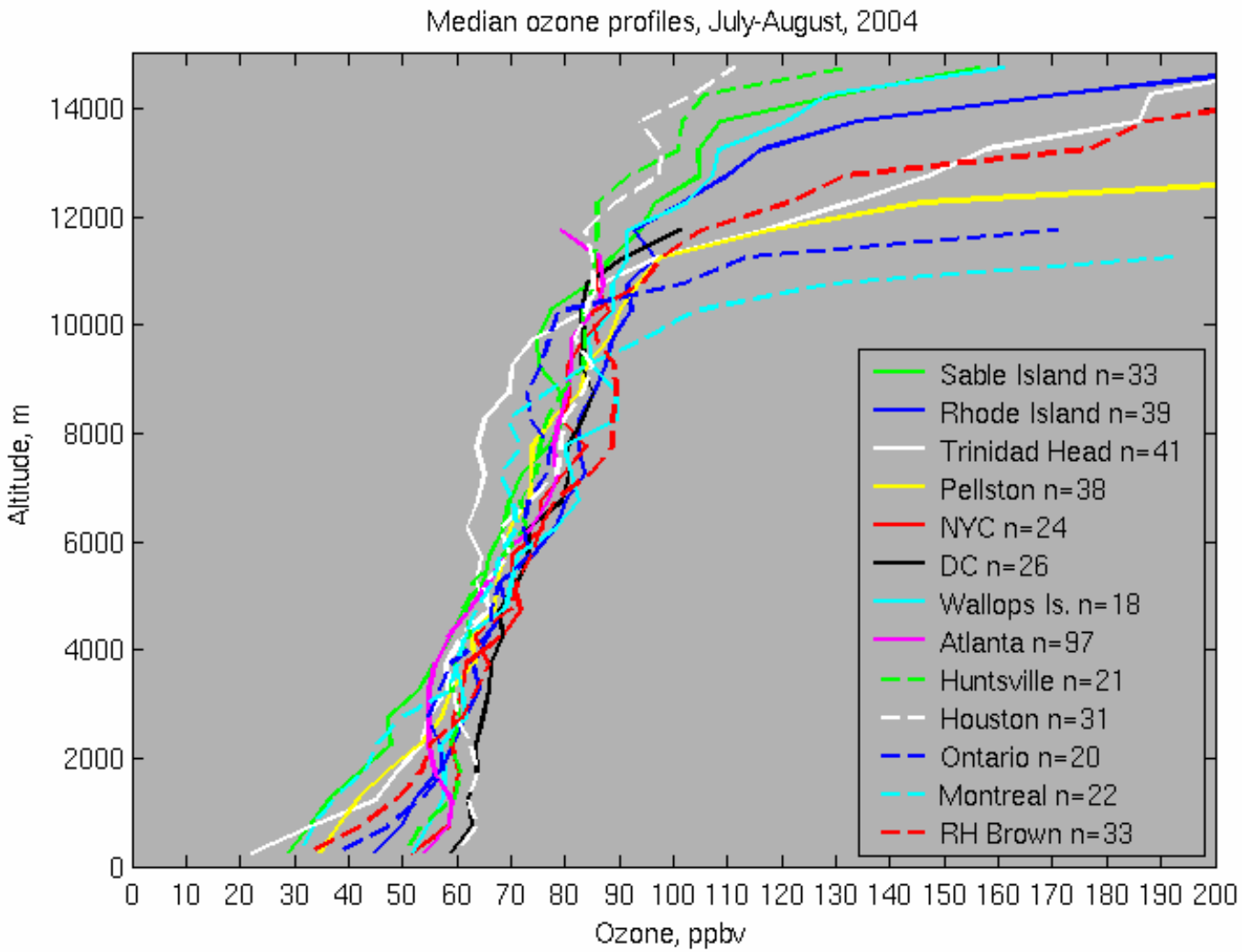

Median ozone profiles at all MOZAIC sites, July 1 – August 15, 2004

# Combined IONS/MOZAIC Sites

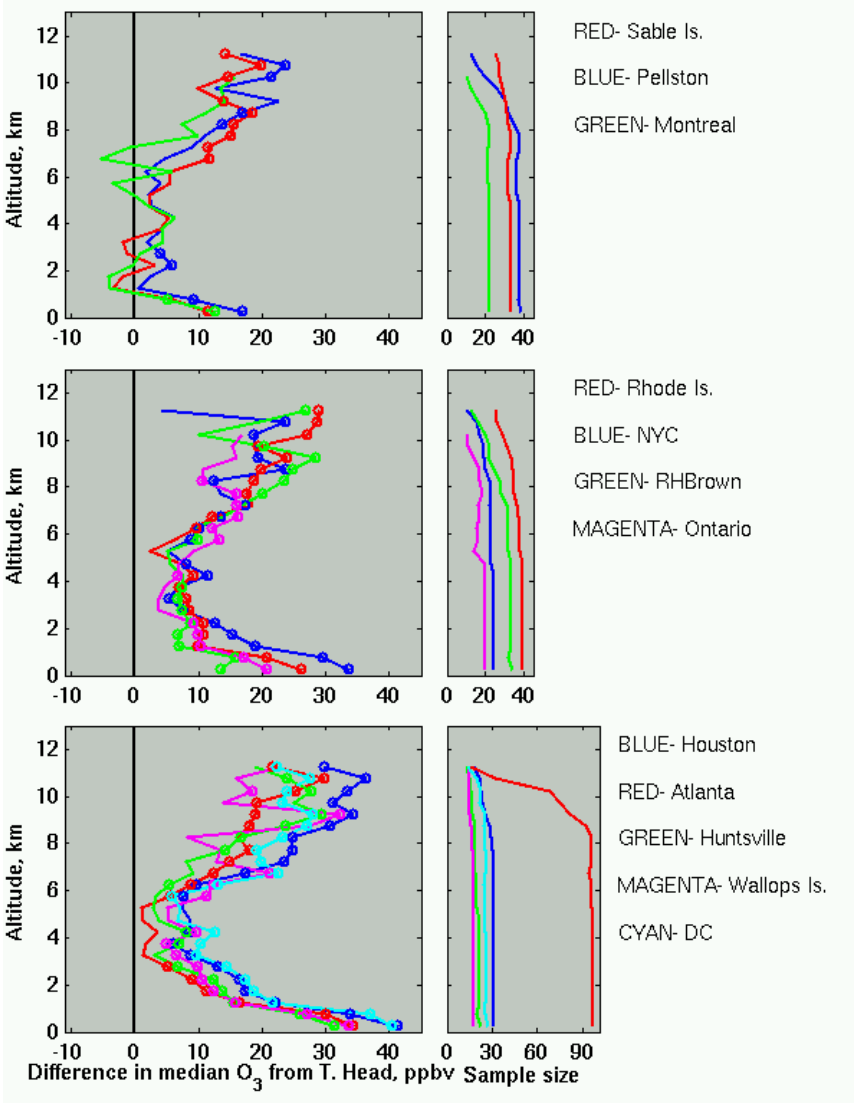



IONS and MOZAIC sites to be used in determining the trans-North America ozone distribution, July 1 – August 15, 2004

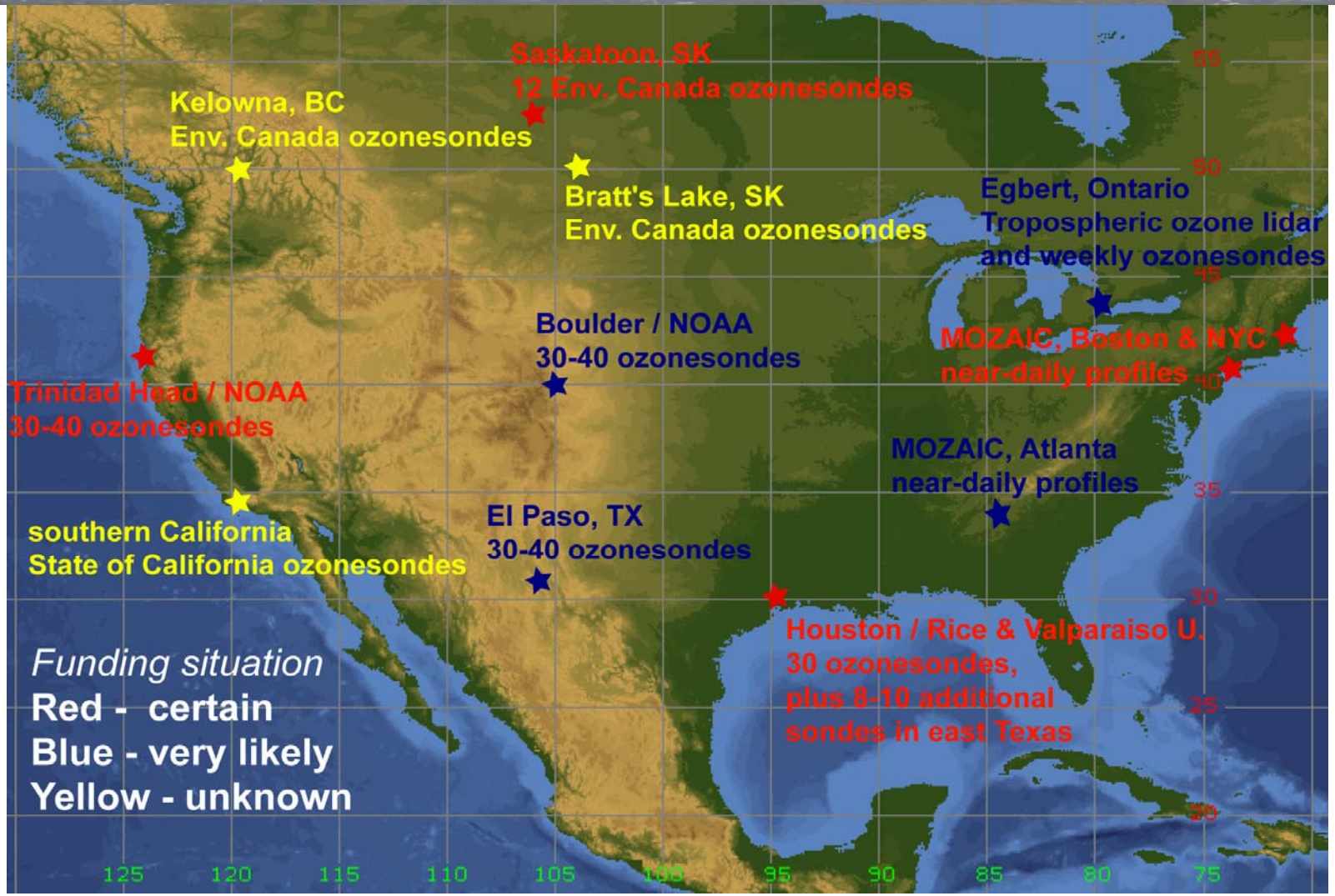
# IONS/MOZAIC Ozone Profiles



# Δ Ozone Profiles - Relative to California



# Measurement of Ozone across mid-latitude North America Experiment (MONA)



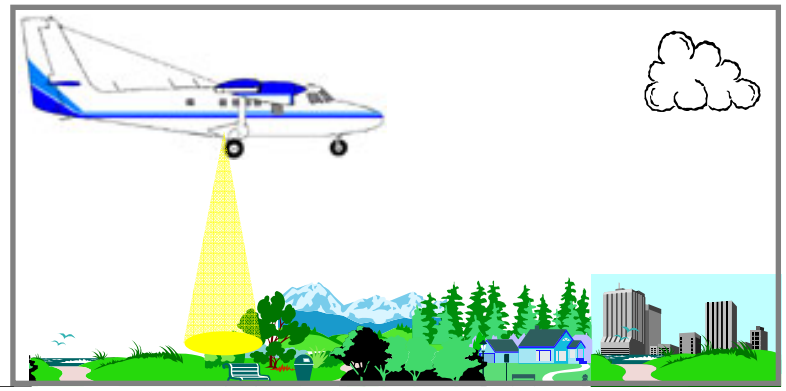

Proposed $O_3$ profile sites - August 2006

# NOAA's Assets In TexAQS II

**NOAA WP-3D Aircraft** - urban and power plant plume studies, emissions verification, regional and inter-regional transport, day/night $O_3$/PM chemistry, aerosol optics

**NOAA R/V Ronald H. Brown** - marine chemistry, marine emissions, chemistry in the land/bay/sea breeze recirculation, coastal emissions, satellite validation, aerosol physics, chemistry, optics.

**NOAA LIDAR Aircraft** - regional distribution of $O_3$ and PM, urban and power plant plume studies, regional and inter-regional transport, boundary layer evolution and variability.



**In Addition:** Contract aircraft, wind profiler network, Instrumented tall tower, ozonesonde network

**Deployment: August 1 - Sept 15, 2006**

# TexAQS II Planning Participants

- TCEQ
- Research Scientists
  - National Oceanic and Atmospheric Administration (NOAA)
  - Department of Energy (DOE)
  - National Science Foundation (NSF - NCAR)
  - Texas Universities (U of Houston, U of Texas , Texas A&M, Lamar, Rice, Texas A&M Kingsville, U of Texas Arlington, Baylor, Texas Tech)
  - Other National Experts
- EPA
- Non-Government Research Institutions: Texas Environmental Research Consortium (TERC), Houston Advanced Research Center (HARC), Texas Air Research Center (TARC), Houston Regional Monitoring (HRM) Network
- Local Governments
- Contractors
- Industry

Funding from the State of Texas - $ 21.5M
(TCEQ, TERC, & TARC)