

# Preliminary Results and Findings from the 2005 Southeast Texas Transport Study

**Carl M. Berkowitz and Rahul A. Zaveri**

**Battelle Northwest Laboratories, Richland, Washington**

**Paul Voss**

**University of Massachusetts/Smith College, Amherst, Massachusetts**

**Ralph J. Valente**

**Tennessee Valley Authority, Muscle Shoals, Alabama**

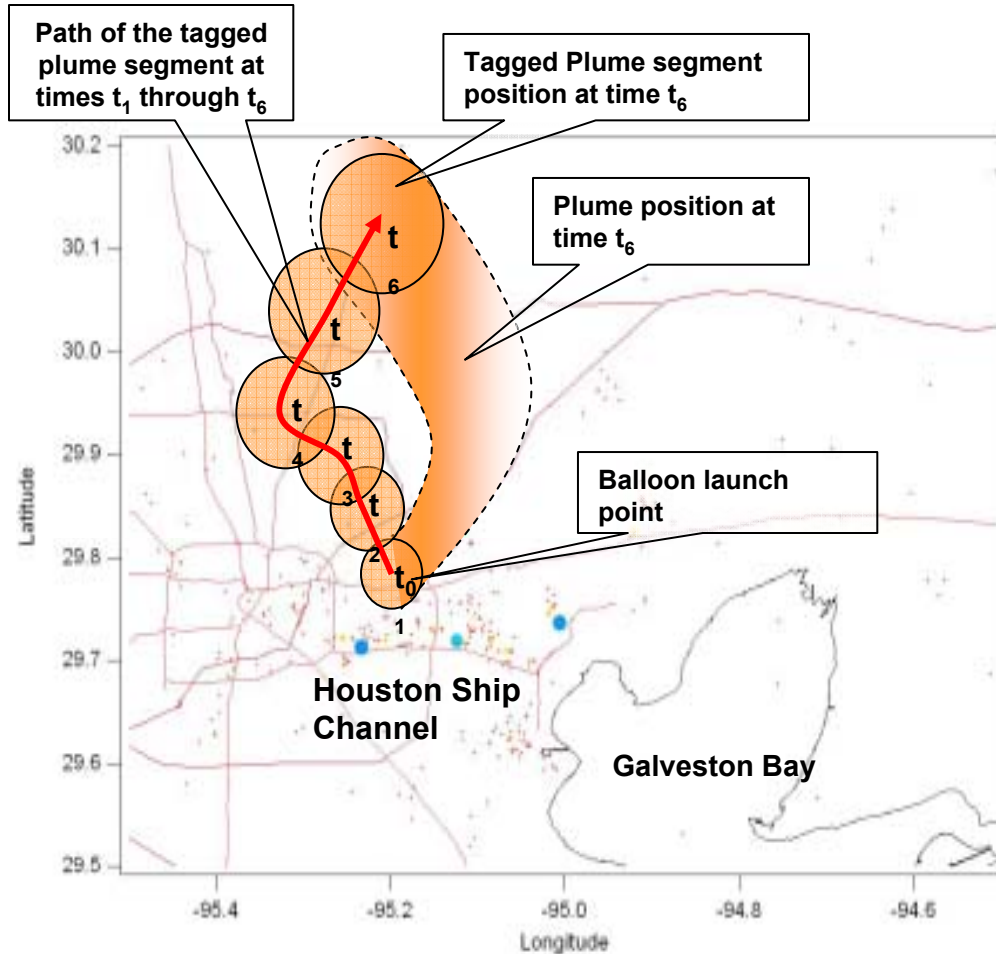
**Ed Fortner and Renyi Zhang**

**Texas A&M University**

***TERC Science Advisory Committee***

***November 14-15, 2005, The Woodlands, Texas***

# Transport & evolution of polluted air mass

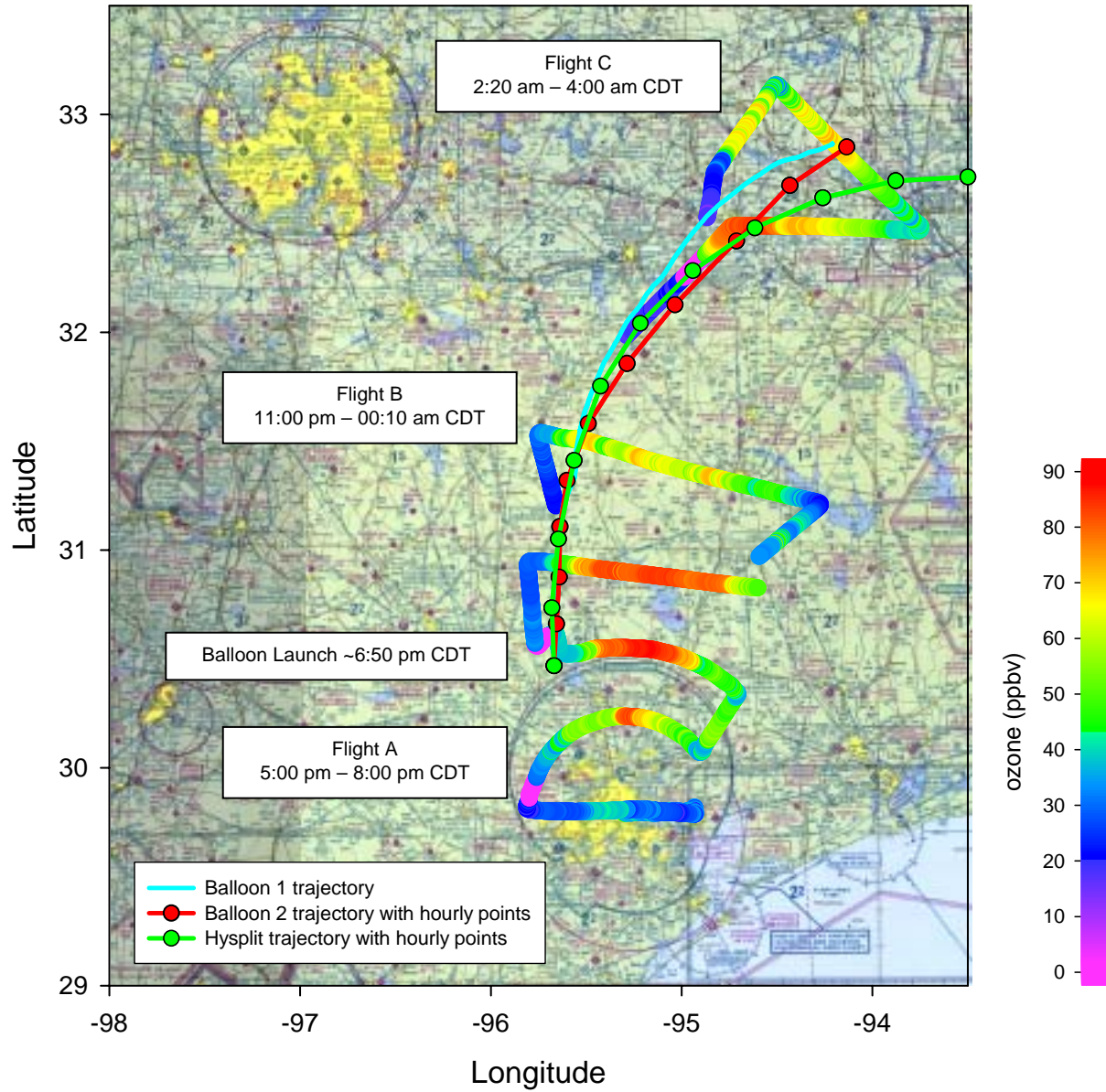


- use altitude-controlled balloons that transmit their position + local state variables (temperature, pressure, moisture) to tag a single plume segment containing Houston emissions.
- Then make repeated chemical measurements from an instrumented aircraft that knows the position of the balloons.
- Special software allows tracking aircraft + balloons + emissions.

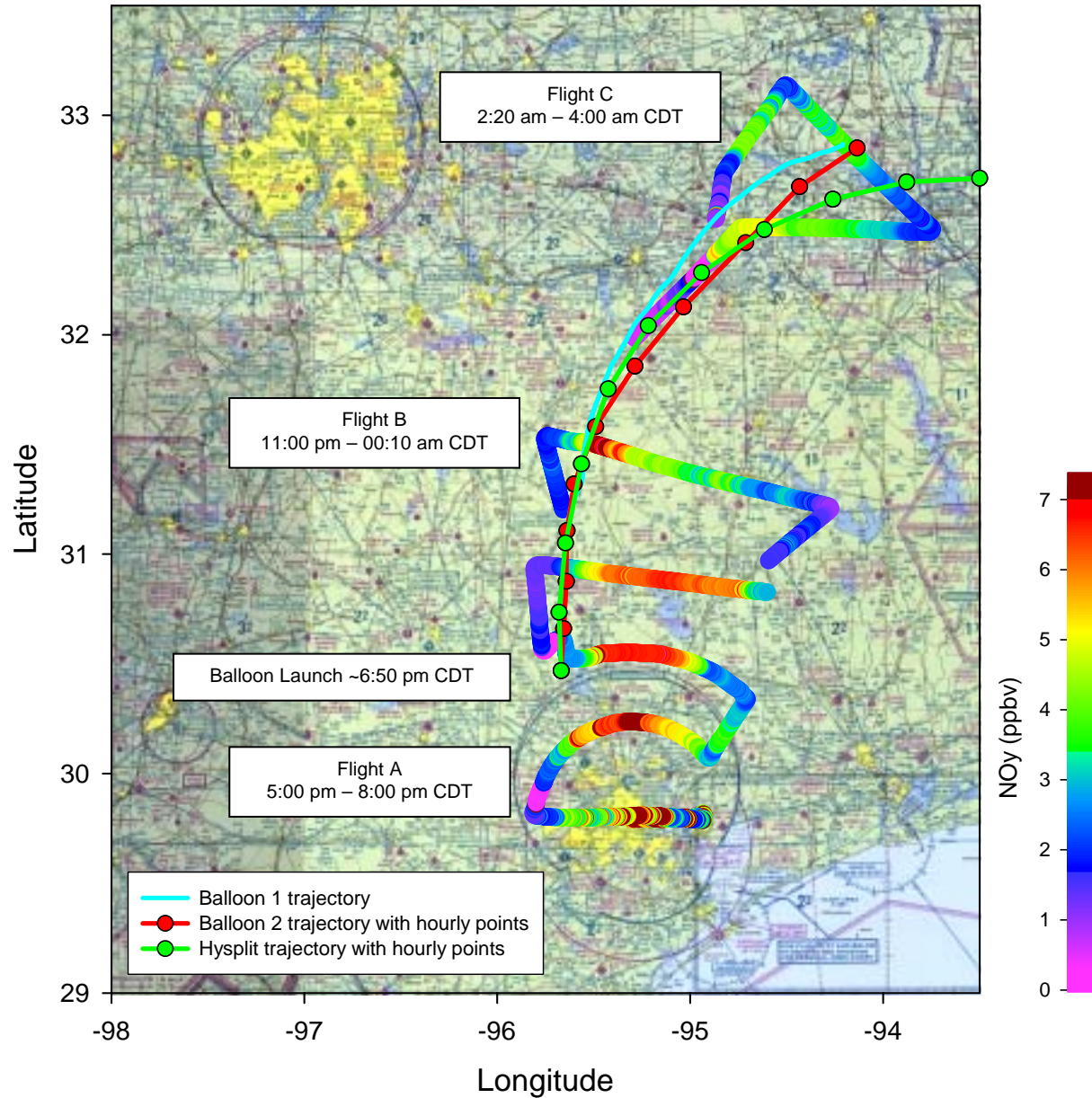
# Logistical Summary

- **All releases were done at night (>7PM LST) from Lake Conroe**
  - Daily thunderstorms and precipitation.
  - damage to the balloon,
  - systems were expected to so thoroughly mix the lower troposphere that no detectable chemical signal would be found in the plumes emanating from Houston.
- **Launch dates, travel time, 'kill zone' and Great Circle travel distance:**
  - **July 21 ( $\Delta t = 15.4$ hrs, to s'west of Longview, distance ~ 200km)**
  - **July 23 ( $\Delta t = 8.7$ hrs, to east of Sulphur Springs, distance ~ 290km)**
  - **July 26 ( $\Delta t = 10.4$  hrs, to n'west of Shreveport, LA, distance ~ 300km)**
- **Data: login anonymously to <ftp.tceq.state.tx.us> and navigate to /pub/OEPAA/TAD/DA/Aircraft/ TVA2005**
- **Logistical Details are given in:**  
**<http://files.harc.edu/Projects/AirQuality/Projects/H039.2005/H39FinalReport.pdf>**

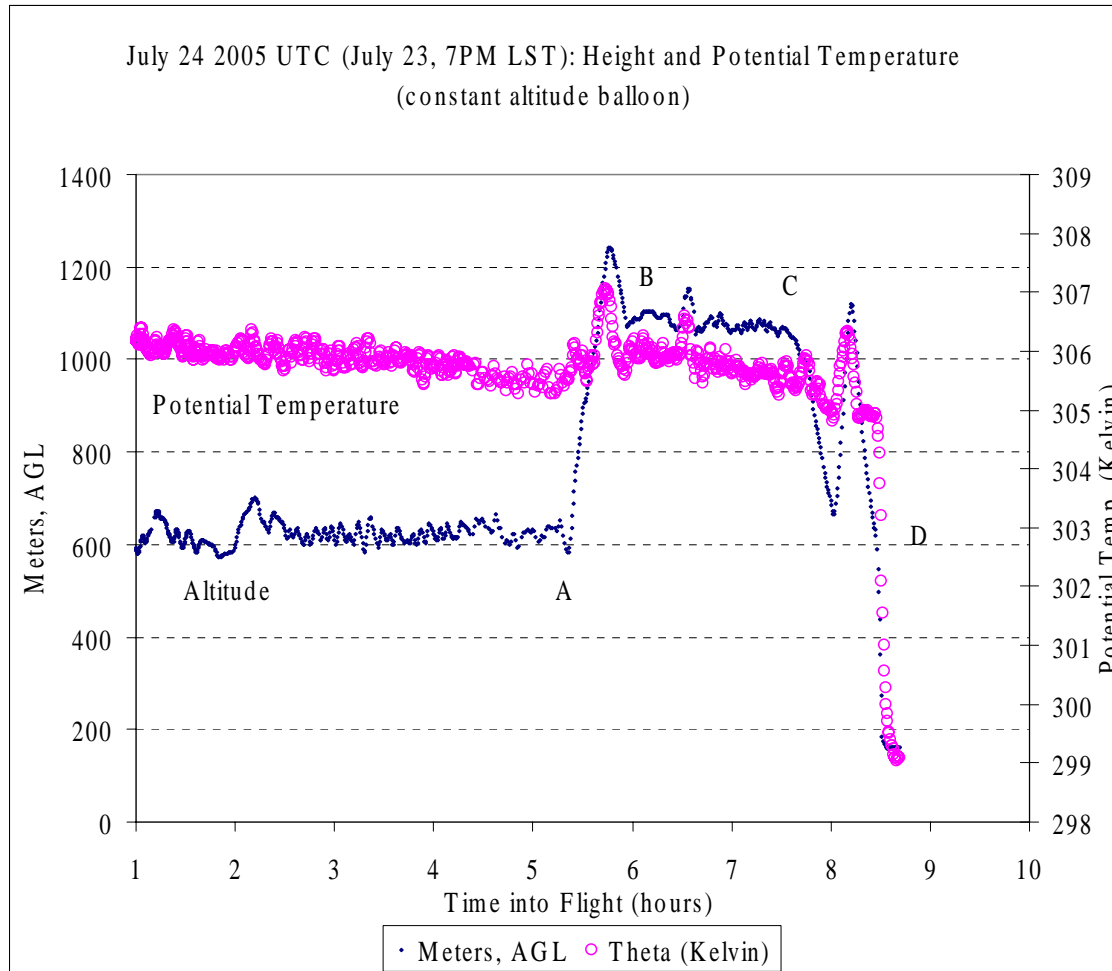
# Ozone: July 26-27, 2005



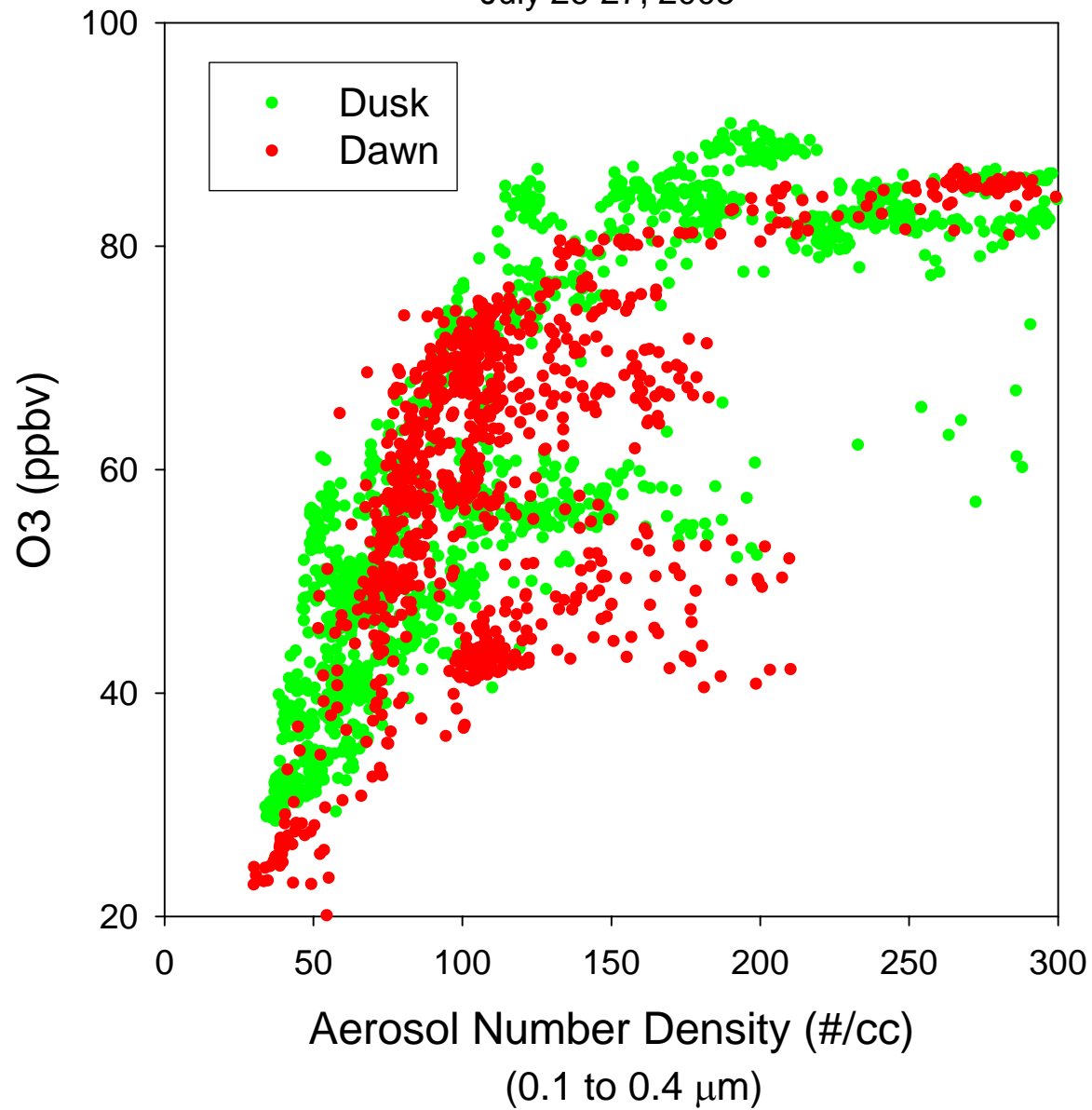
# NOy: July 26-27, 2005



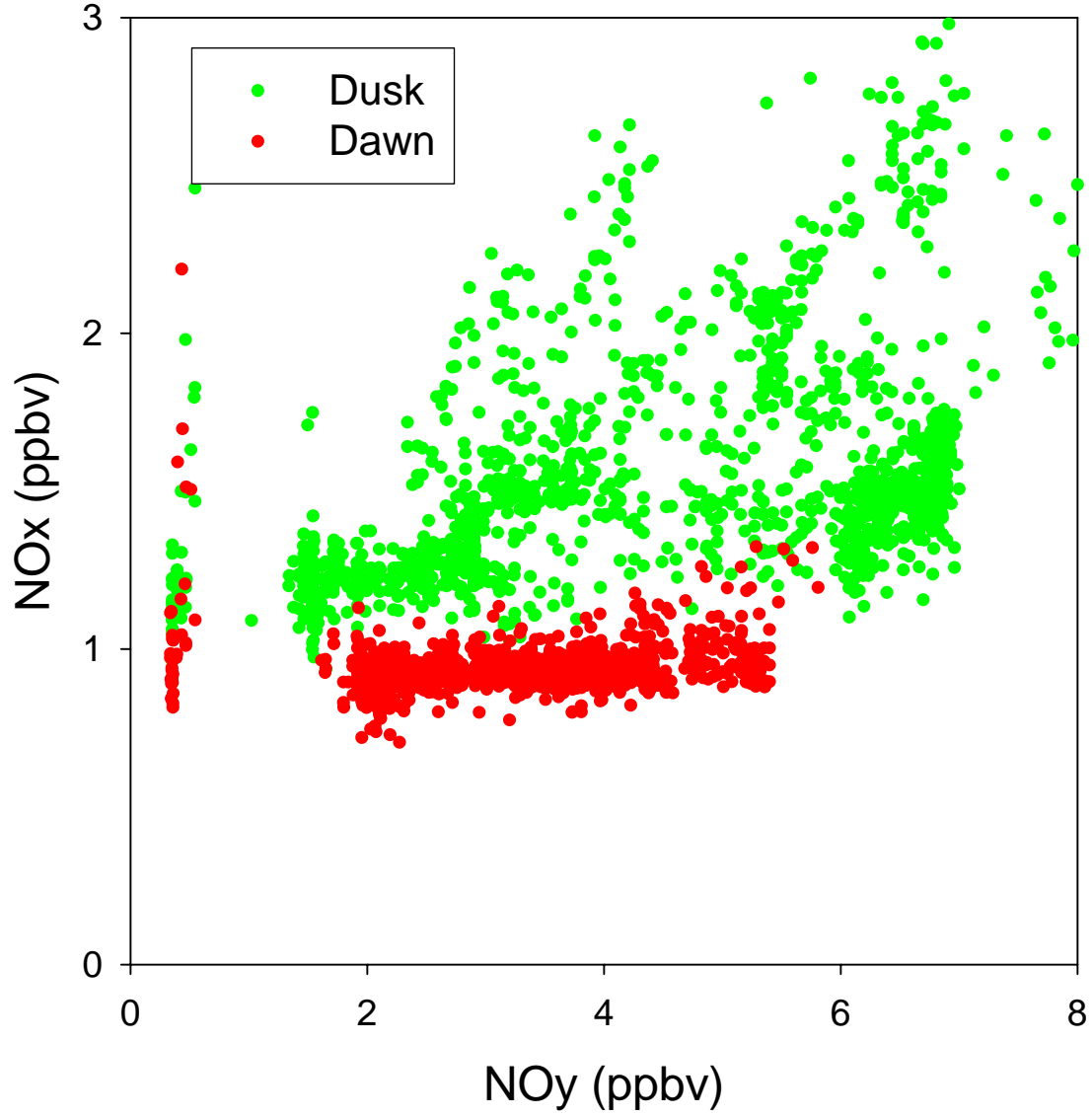
# Constant Air Mass?



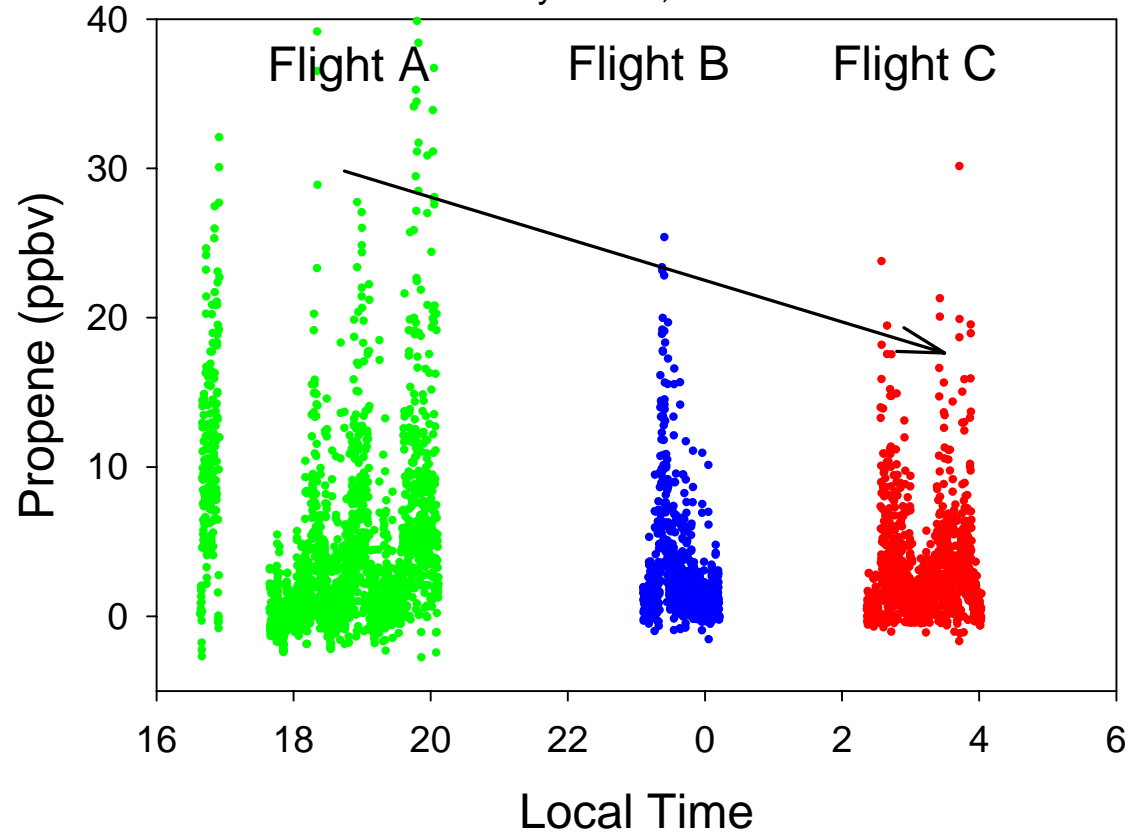
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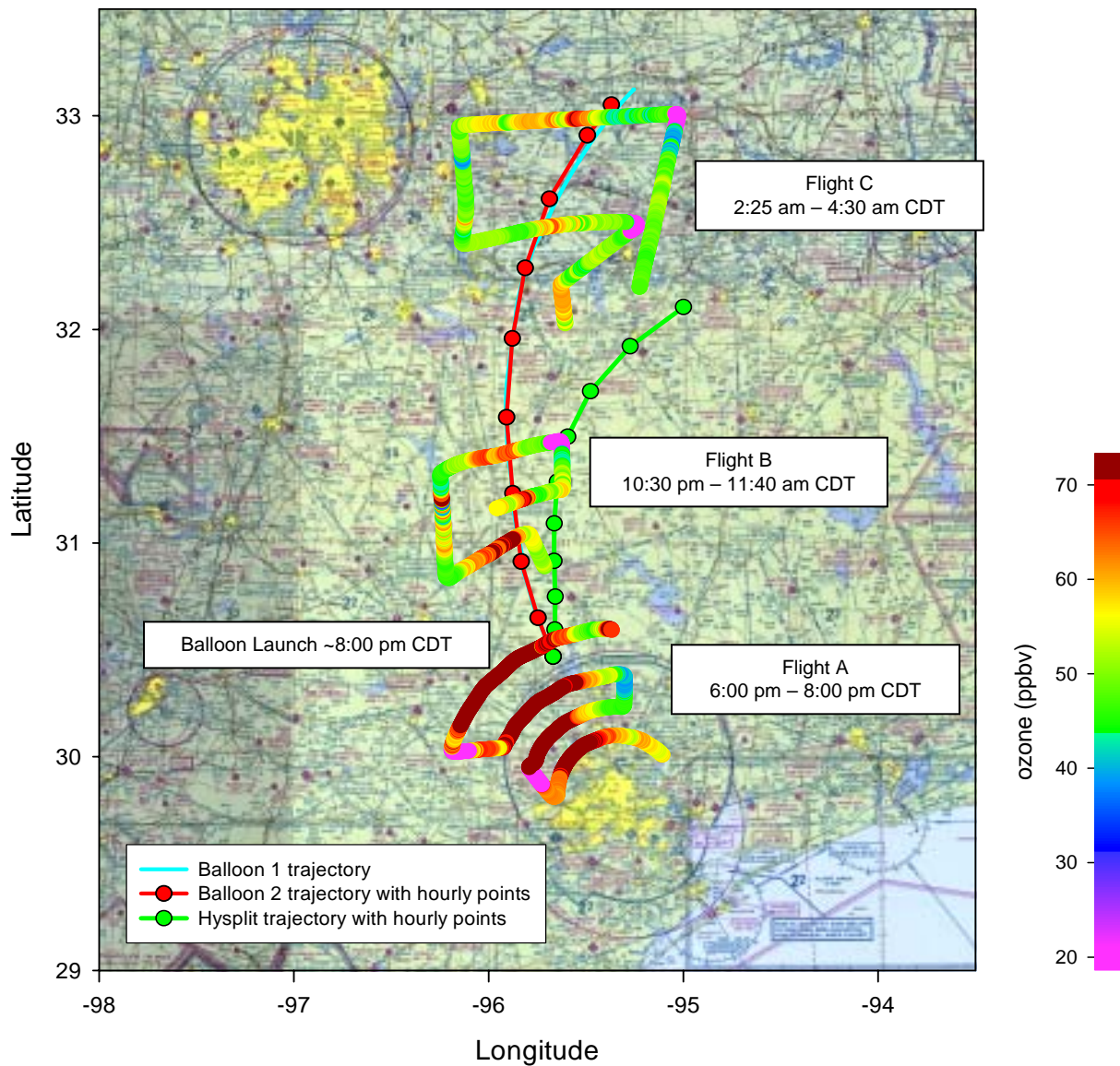
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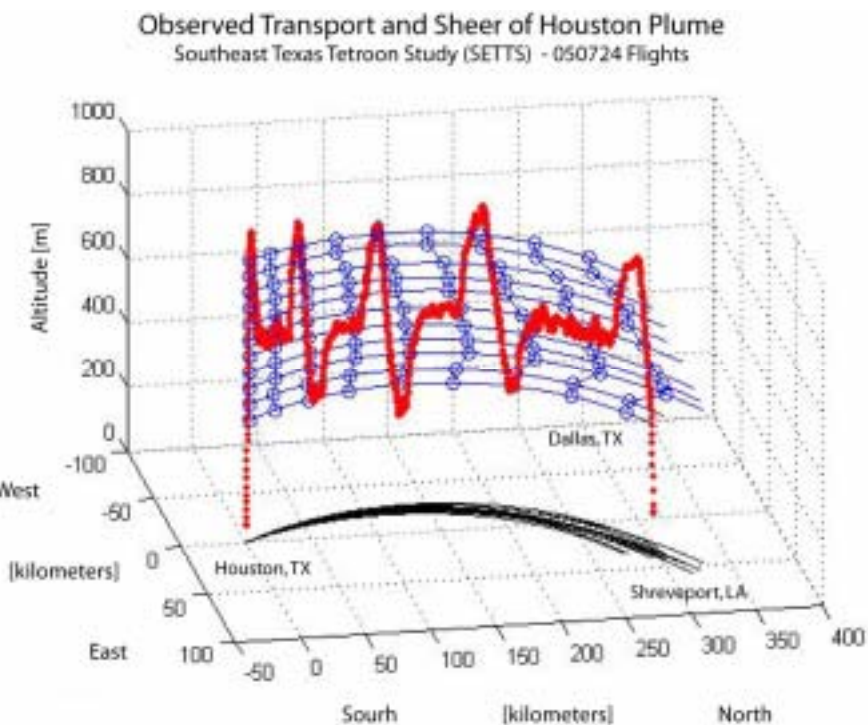
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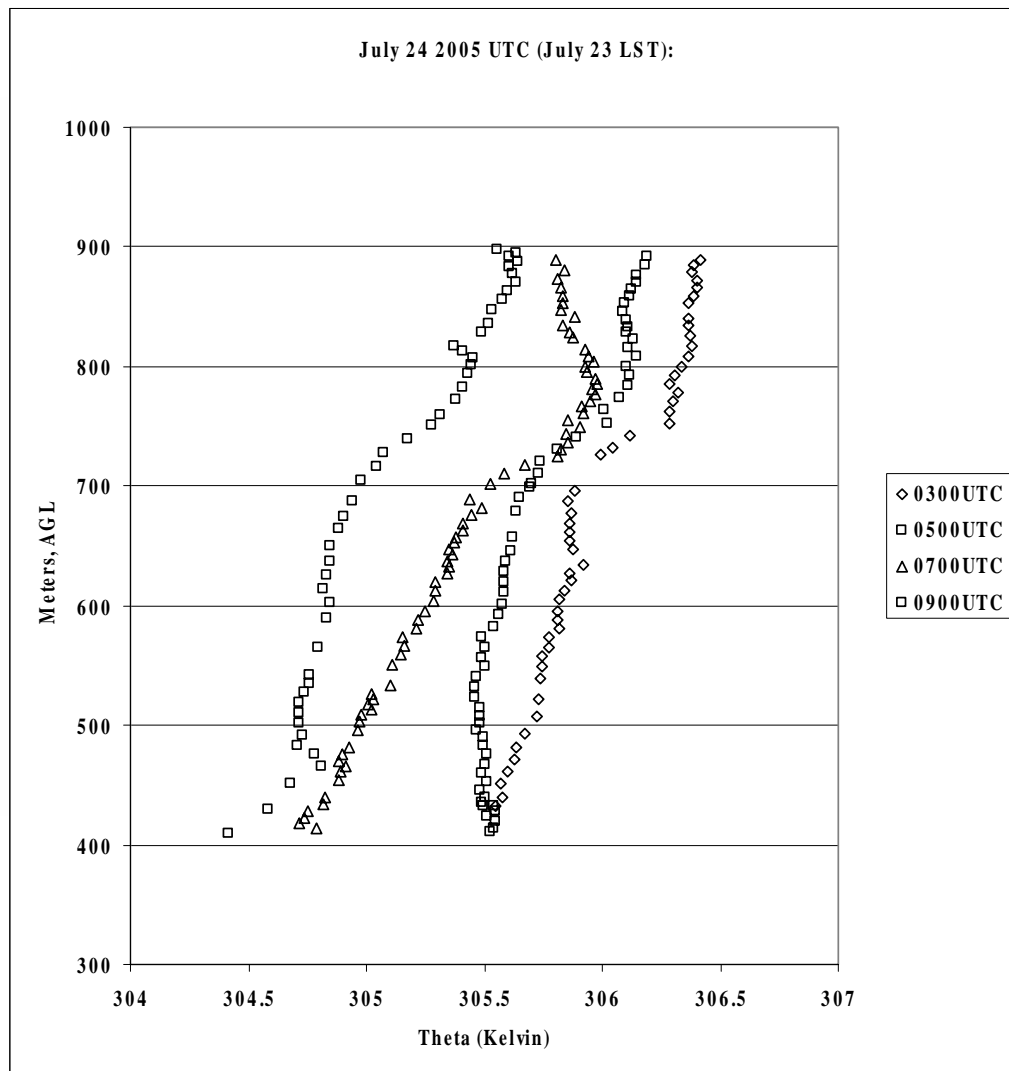
# Ozone: July 23-24, 2005



# Smart balloons can change altitude on command: profiles of winds and temperature

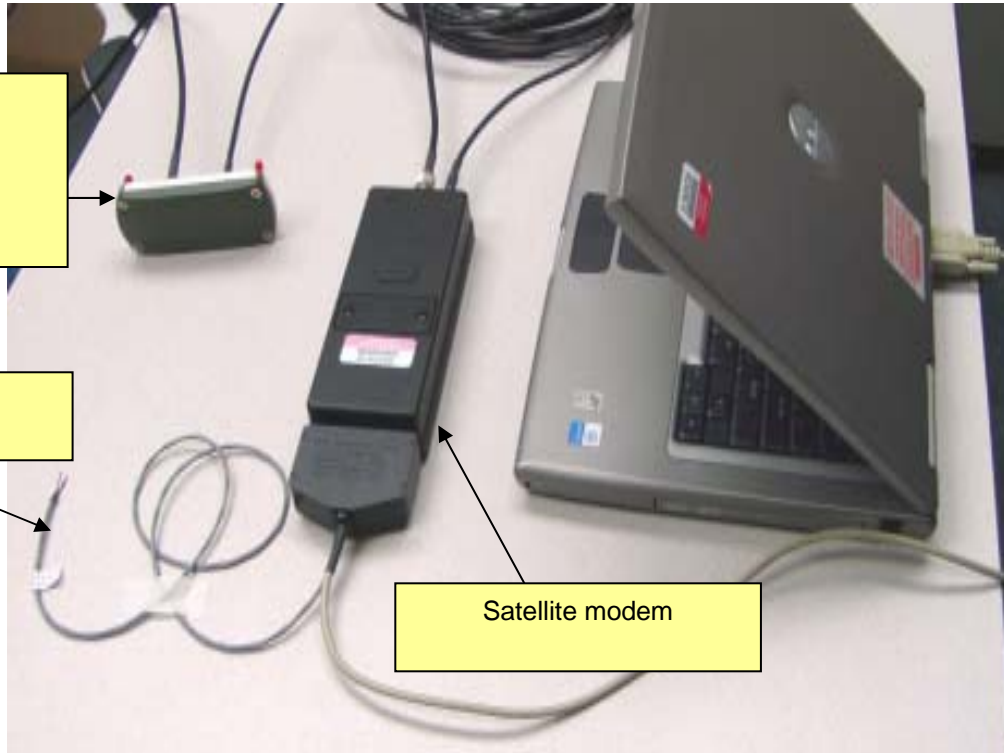


*Wind profiles and visualization of wind shear at increasing downwind distances from release, throughout the night.*



*Theta profiles at increasing downwind distances from release, throughout the night.*

# Minimal Additional Equipment Needed onboard Aircraft



## Instrumentation

- O<sub>3</sub>, NO<sub>y</sub>, NO<sub>2</sub>, NO, SO<sub>2</sub>, CO
- PTRMS, canisters,
- P, T, RH
- aerosol backscatter (3-λ )
- PCASP (.1 to 3μm)
- vector winds,
- latitude, longitude, altitude.

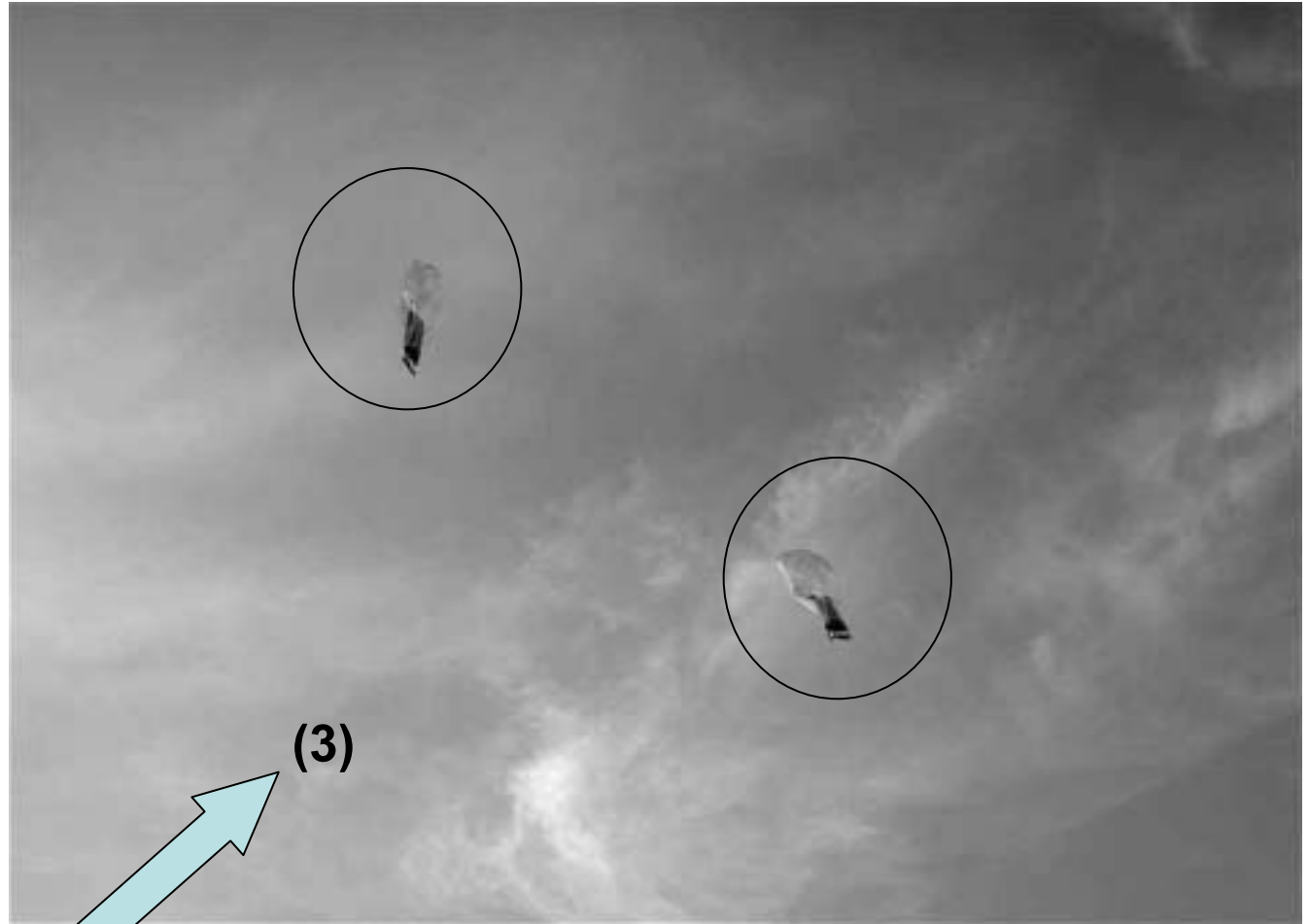
# Ease of Deployment



(1) ↓



(2)



(3)

# Some 'Working Hypotheses'

- Emissions from Houston are high enough and the transport at night fast enough that it is reasonable to consider that these emissions and their product species have the potential to affect air quality  $\geq 200$  miles downwind of Houston. Dilution may play less of a role than previously thought.
- While none of the balloons went directly into the Dallas-Ft. Worth area or crossed into Louisiana, cases that came very close to these areas of interest were found (the balloons launched for the July 26 case were deliberately brought down at sunrise, per an earlier agreement with the FAA).
- It also seems reasonable to conclude that if high levels of pollutants from Houston can be transported at night to the Dallas - Ft. Worth area then similar exchange processes are possible throughout the state under appropriate meteorological conditions.

# 2005 Observations: Where Next?

- Complete q.a. on aircraft observations
- Evaluate our 'working hypotheses.'
- Use observations to evaluate how 'standard' models
  - reproduce transport and jets?
  - reproduce chemistry within sampled air parcels?
- Analysis to quantify fumigation of observed chemical mix on surface air quality.
  - Surface observations vs. simulated downward mixing of observed concentrations
- Examine observations for *in situ* evidence of nighttime chemistry (e.g., N<sub>2</sub>O<sub>5</sub> hydrolysis to nitric acid?)

# 2006 Science Goals

## Lagrangian experiments to study...

1. **Source Apportionment:** chemical characterization of nighttime plumes from Gulf Coast, Central and East Texas that are forecast to impact Dallas/Ft. Worth and Northeast Texas.
2. **Chemical processing** within tagged volumes of air from different source areas using instrumented aircraft
3. Evaluate role of **low level nocturnal jets** and the capabilities of models to describe these streams of fast moving air.

# Desired Airborne Measurements

1. Balloon base of operations co-located with aircraft & forecasting team
2. Coordinated Flights
  1. G-1: late afternoon/early evening flights
  2. P-3: evening/pre-dawn flights.
3. Real-time plume location.
4. O<sub>3</sub>, SO<sub>2</sub>, NO<sub>x</sub> (NO & NO<sub>2</sub>) and NO<sub>y</sub>, [*NO<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>?*]
5. Real-time VOCs (PTRMS) & canisters (ethylene)
6. Moisture, temperature and winds
7. Total aerosol number (CCN) and size spectrum (Ultrafine CPC (?) + PCASP)
8. [*size dependent aerosol composition (ToF-AMS)?*]

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**TERC**