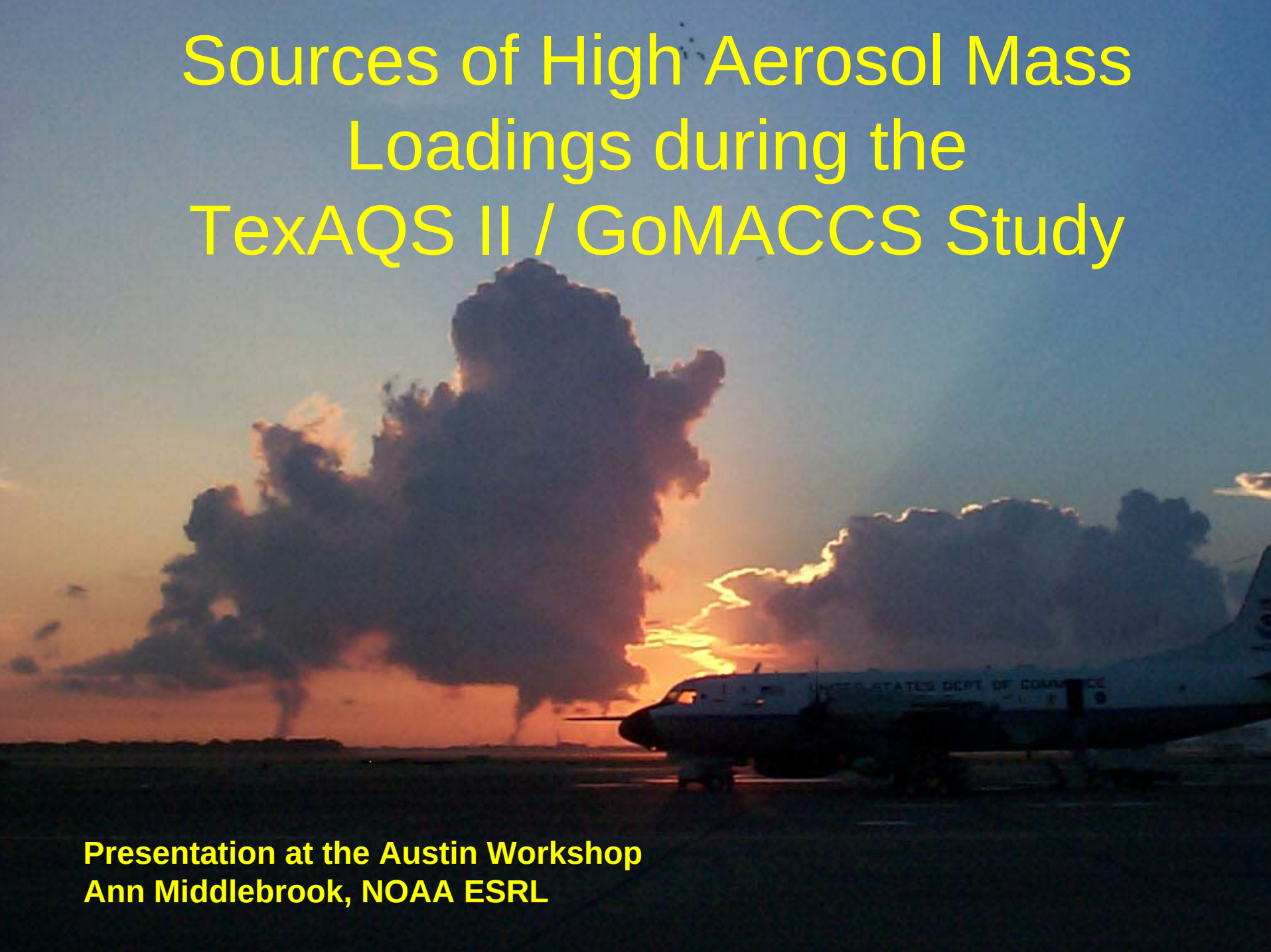
Sources of High Aerosol Mass Loadings during the TexAQS II / GoMACCS Study



Presentation at the Austin Workshop
Ann Middlebrook, NOAA ESRL

Houston Aerosol Processes

Background:

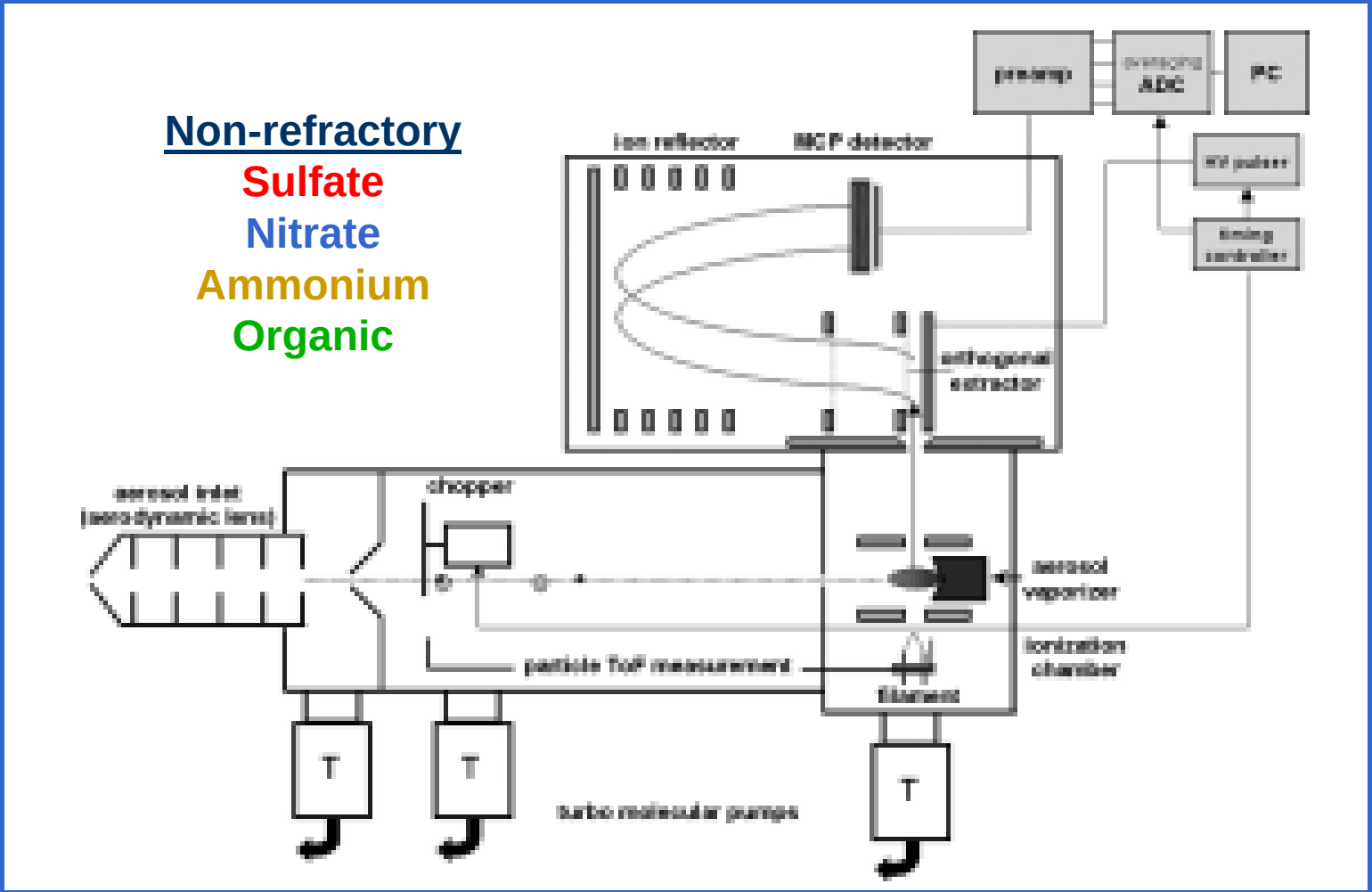
- **Some local sites (e.g., Clinton Dr) are close to "non-attainment" status for the NAAQS 24-hr (35 $\mu g/m^3$) and annual (15 $\mu g/m^3$) PM2.5 standards.**
- **The 2000 study did not include aerosol composition.**
- **The ship channel, Parish power plant, and urban area contribute to high aerosol volume.**
- ***Using only size distributions and SO_2*, Brock et al. (2003) showed that aerosol growth rates downwind of the ship channel were larger than those downwind of the Parish power plant or predicted from sulfur oxidation rates.**

Houston Aerosol Processes

2006 Principle Findings:

- **Plumes from the ship channel aerosol contains both sulfate and organic material, the Parish power plant produces mainly sulfate aerosol, and the urban aerosol is typically organic with a little sulfate.**
- **Sulfate formation rates are similar in ship channel and Parish power plant plumes.**
- **Slightly more secondary organic aerosol (SOA) relative to CO is formed downwind of the ship channel compared to the urban area.**
- **Processed air has Δ(Organic Mass)/ΔCO ~0.1 μg/m^3/ppbv.**
- **No evidence of significant acid-catalyzed SOA.**

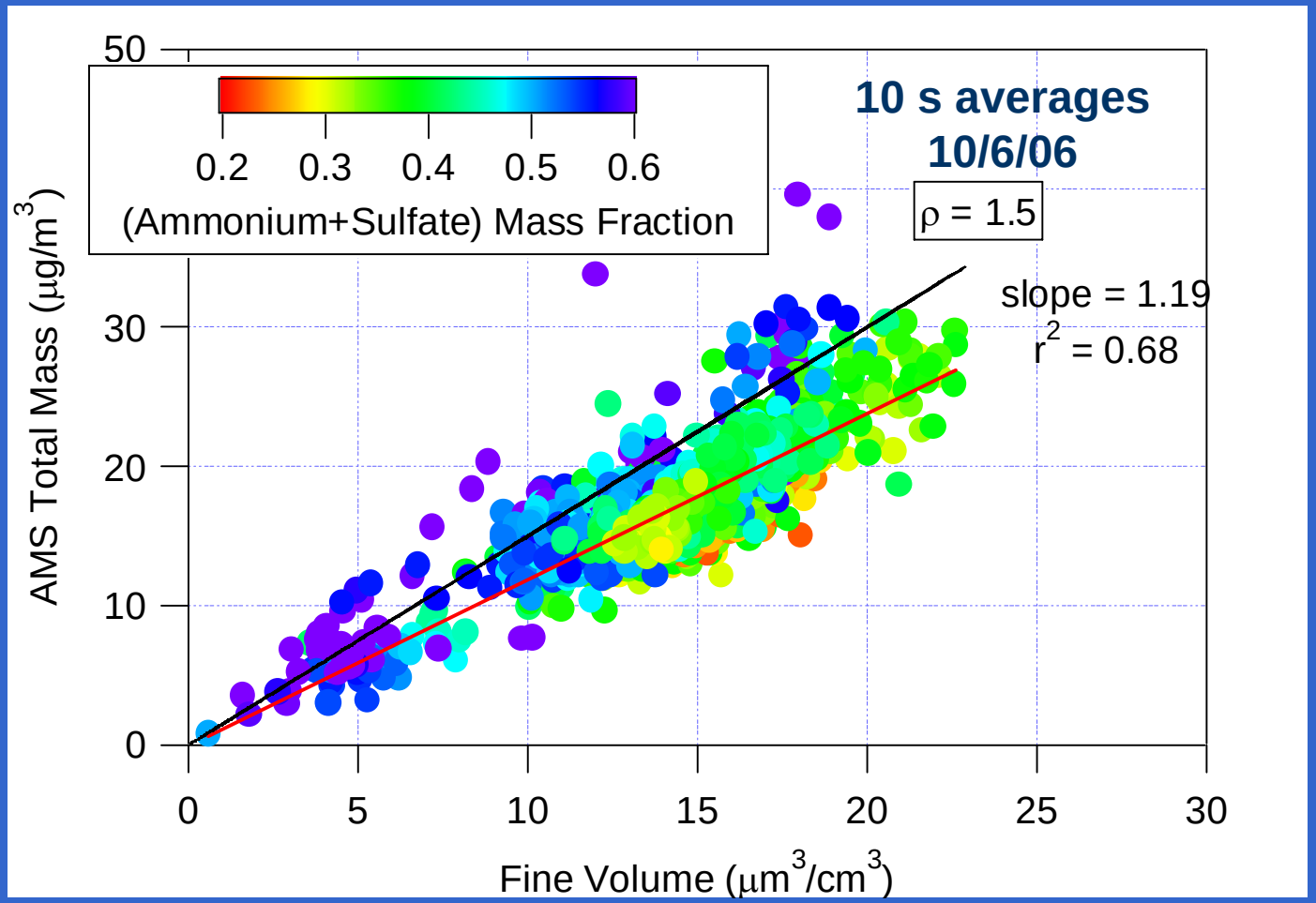
Compact Time-of-Flight Aerosol Mass Spectrometer (C-ToF AMS)



Drewnick et al., *Aerosol Sci. Technol. 39*, 637-658, 2005.

amm2

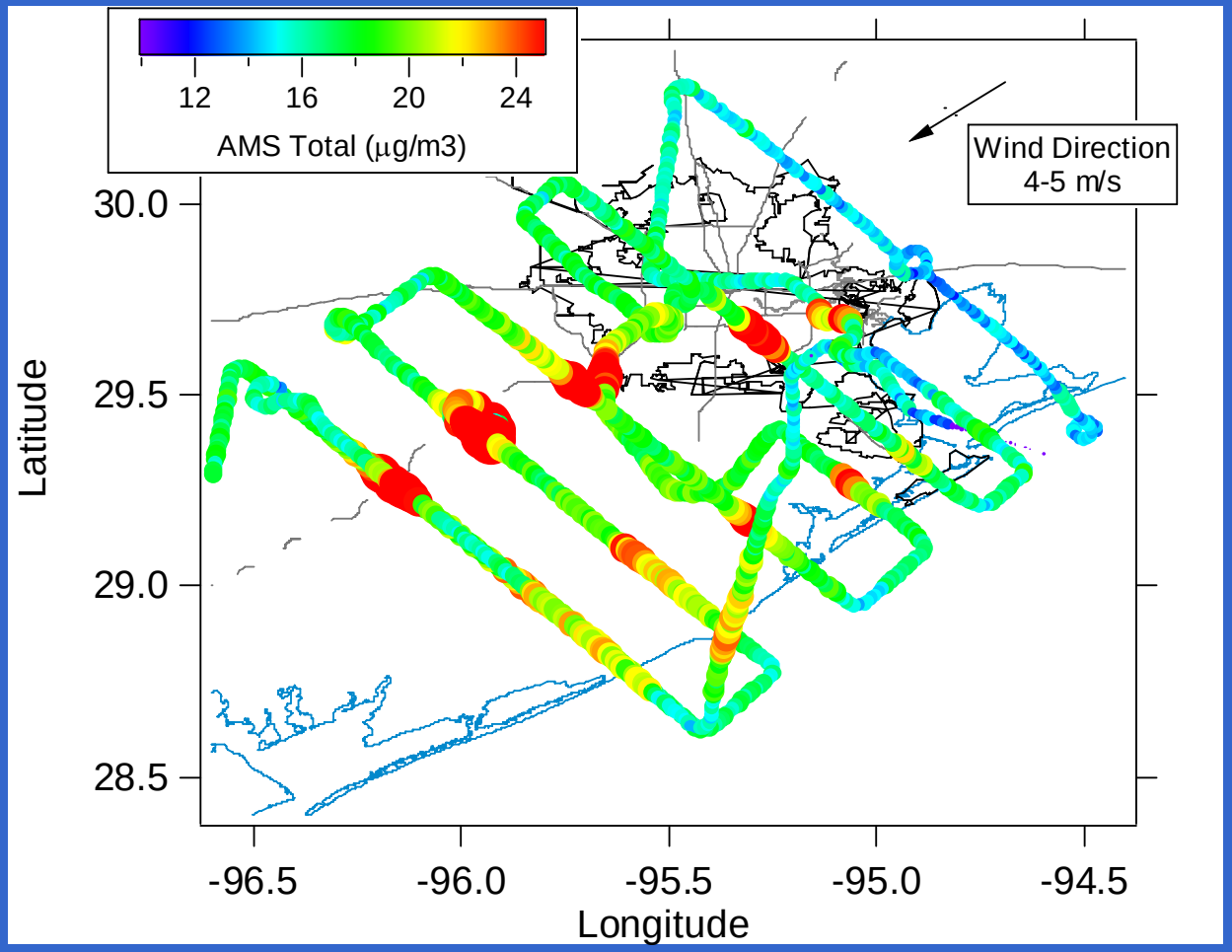
C-ToF AMS Total Mass Compared to Fine Particle Volume



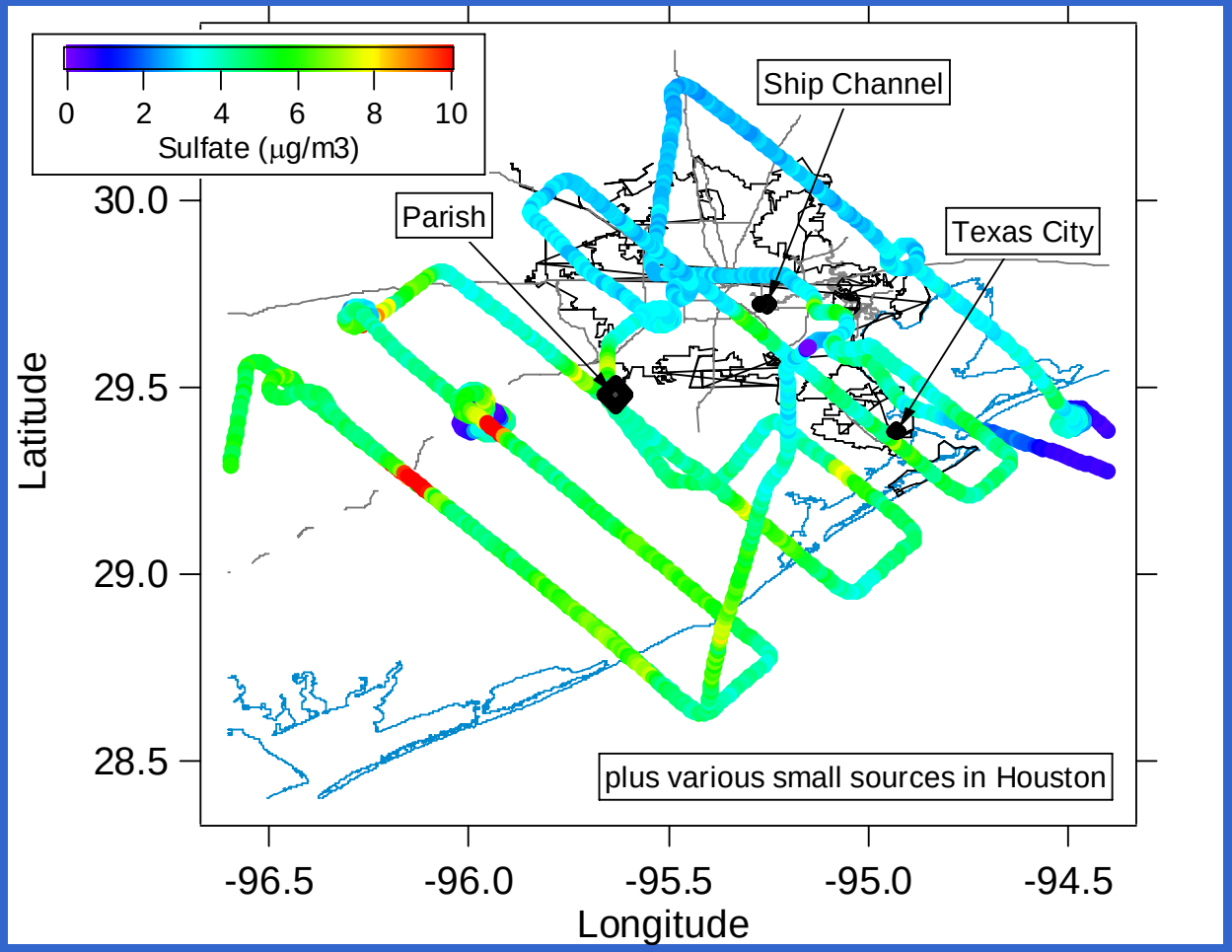
Mostly within +/-20%, sometimes within +/-50%.

amm2 perhaps add good comparison with PILS?
add volume size range
Ann Middlebrook, 5/24/2007

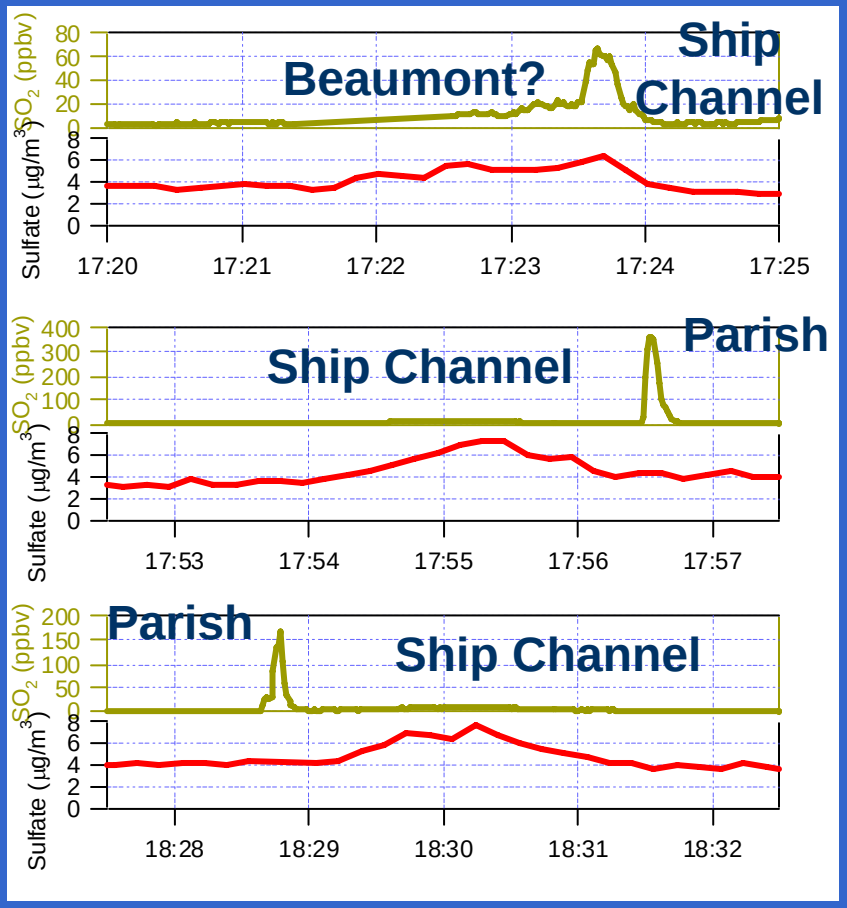
Flight Track on Oct. 6: Increased Aerosol Mass Downwind

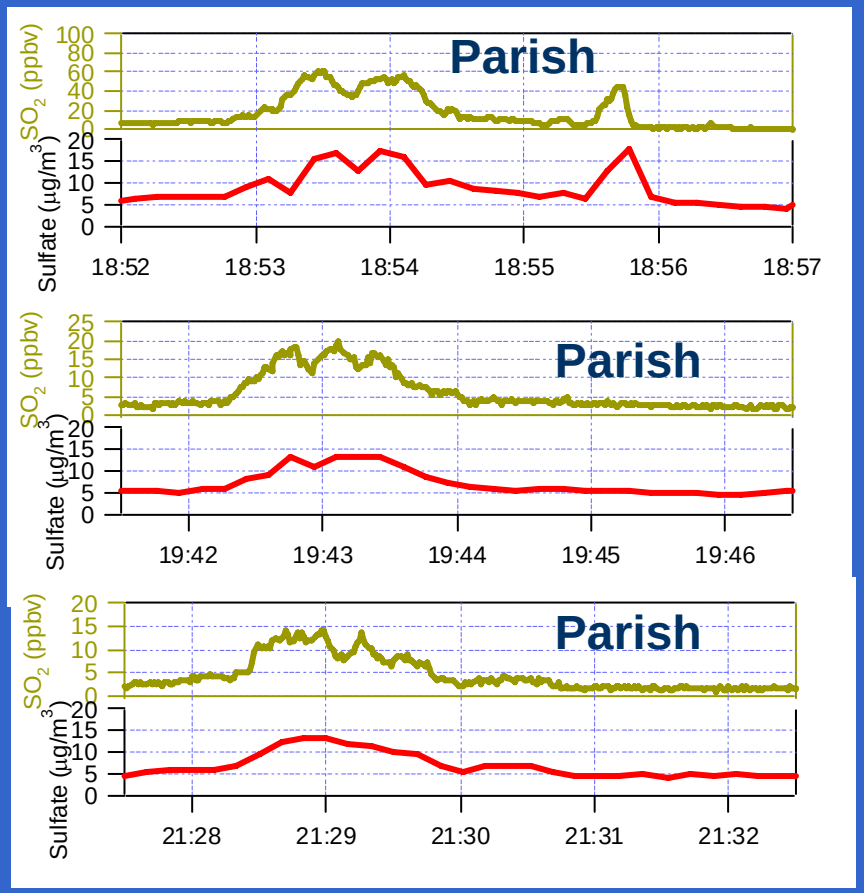


Sulfate Map: Increases Downwind of SO_2 Sources



Sulfate Formation from SO_2

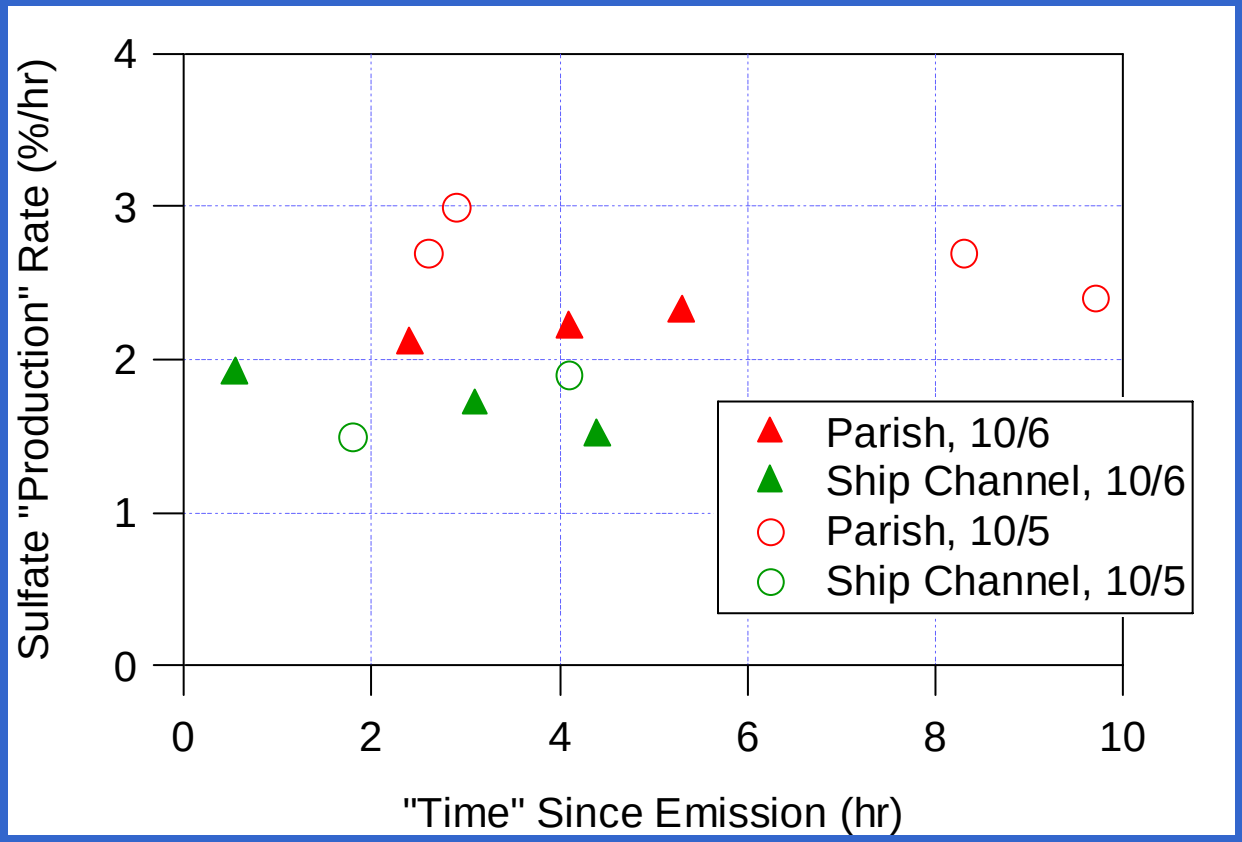




Large local SO_2 sources are the ship channel and Parish.

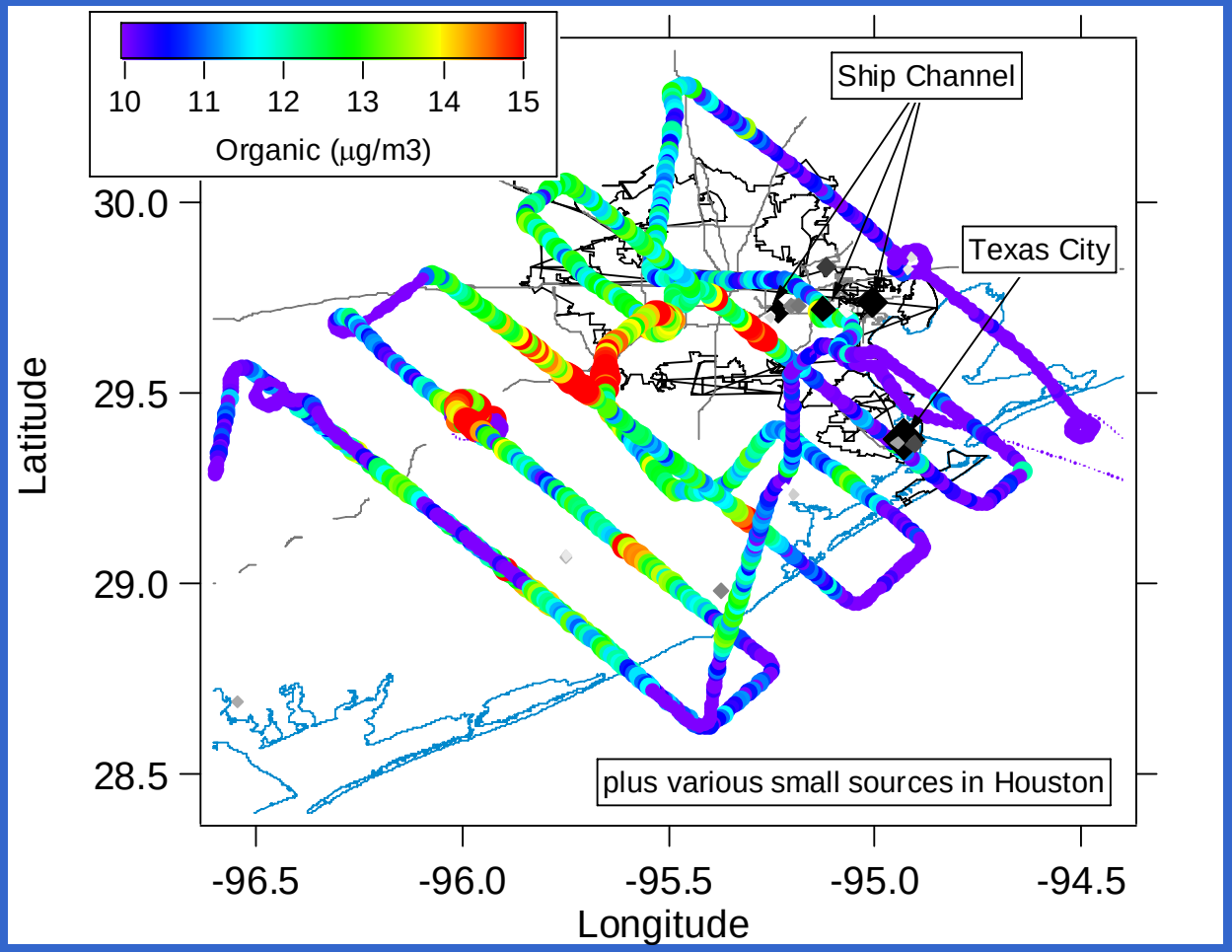
Sulfate “Production” Rates

or increase in aerosol sulfate/total sulfur /“time” since emission

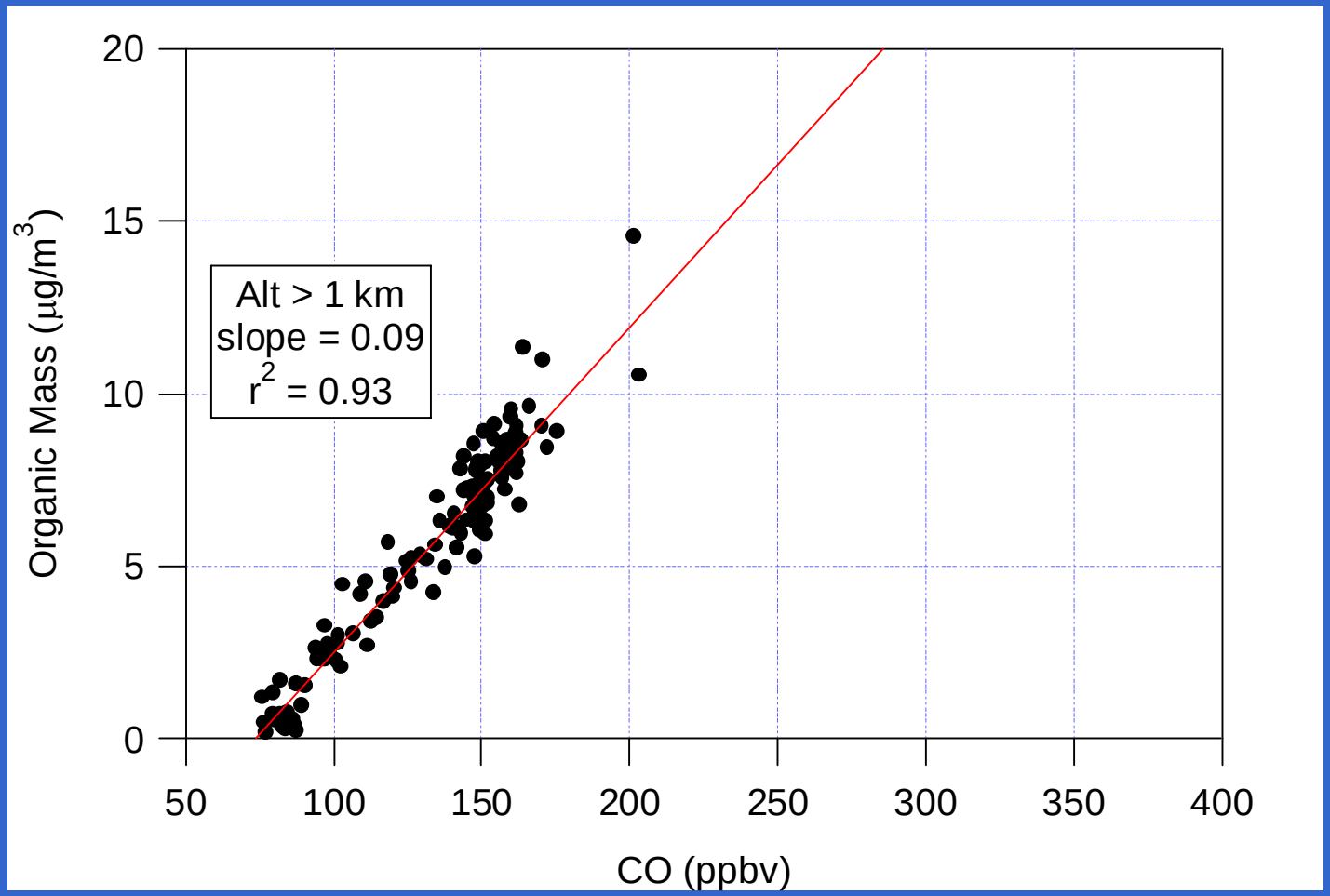


Within uncertainties (not shown), the rates downwind of Parish and the ship channel are probably similar.

Organics Map: Increases Downwind of VOC Sources

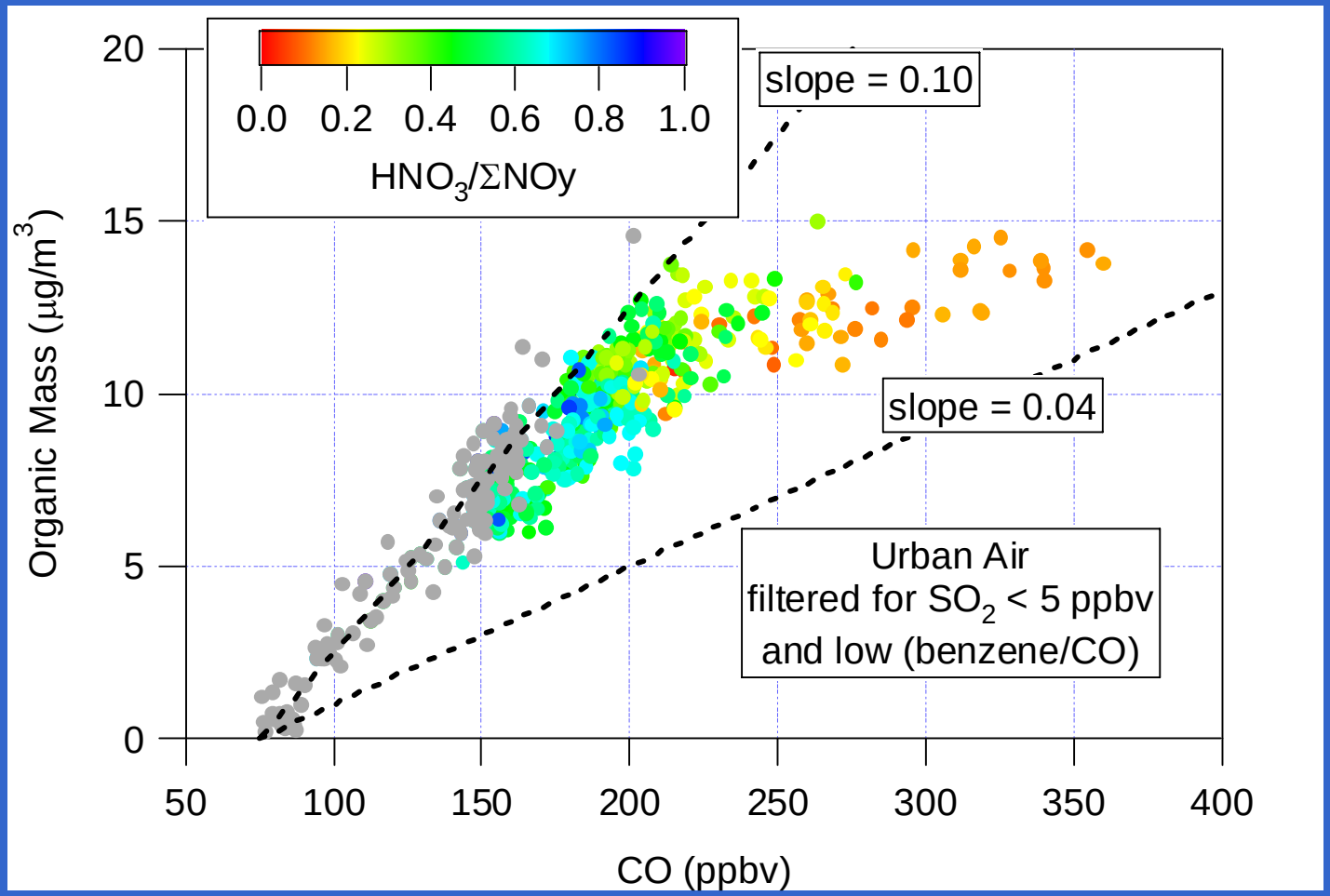


Organic Aerosol at High Altitudes is Correlated with CO



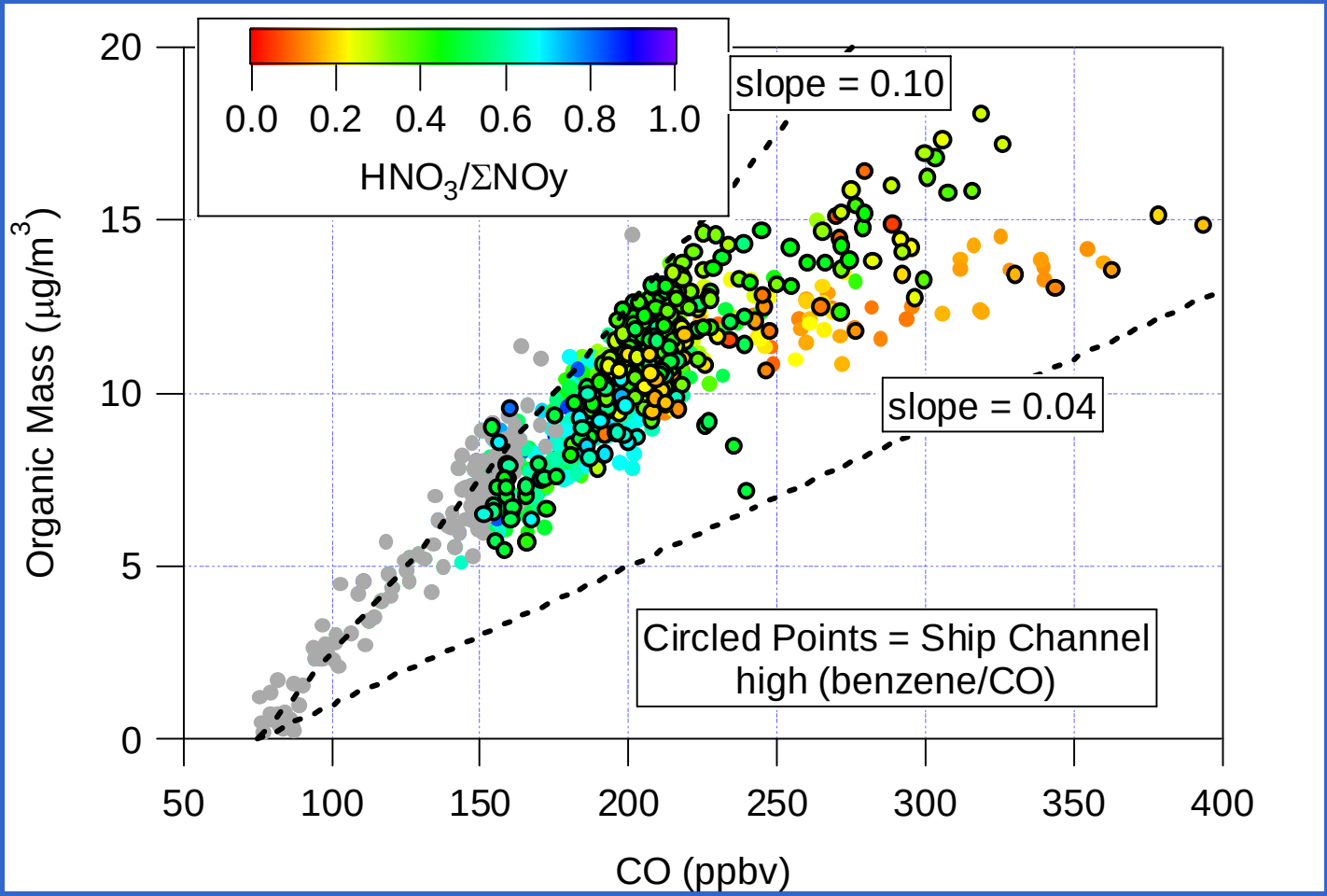
Similar to 0.07 from NEAQS2002 (de Gouw et al., 2003).

Urban Air Mass: ΔOM/ΔCO Increases with Age



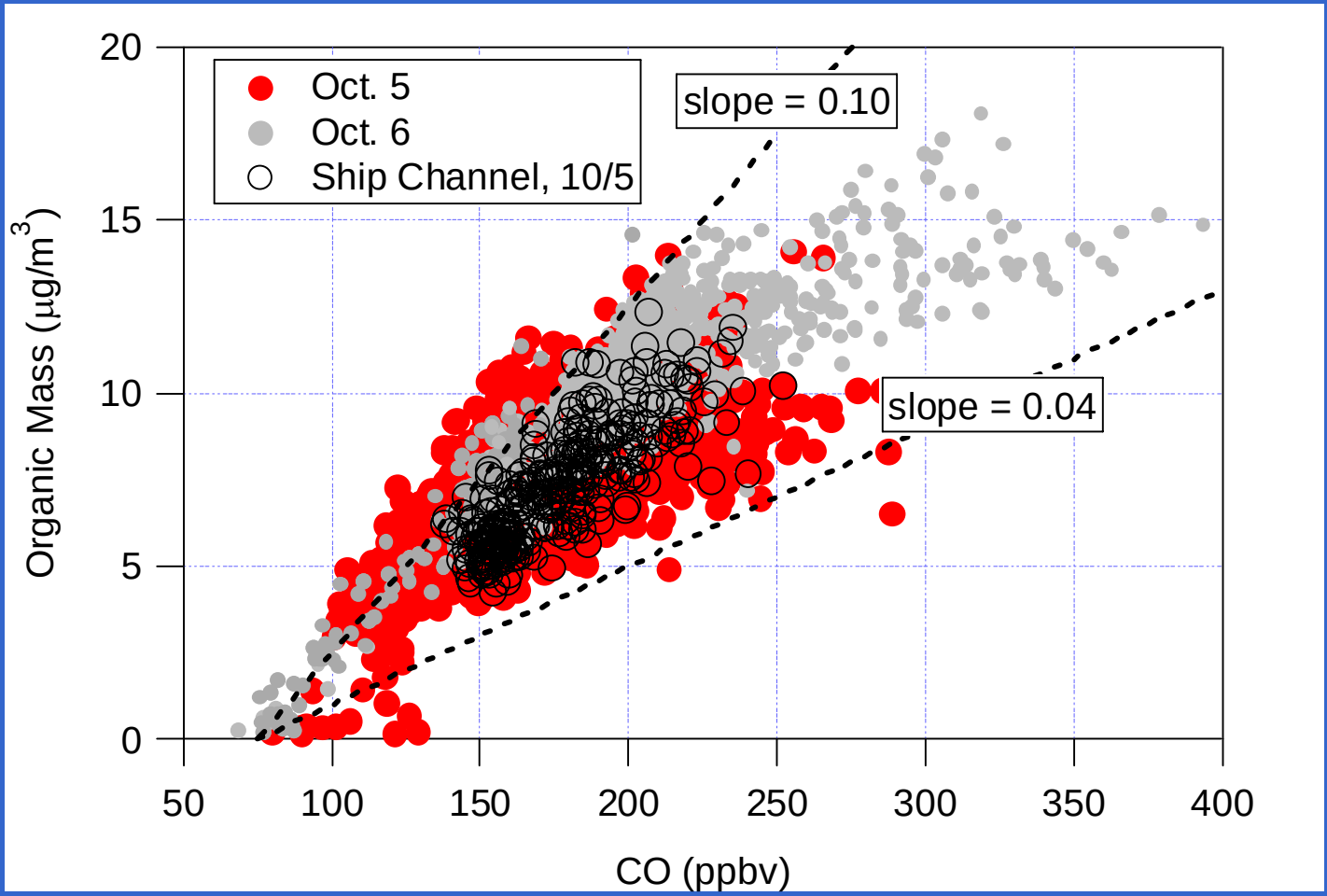
Aged urban air approaches ΔOM/ΔCO = 0.10.
Lower bound ~0.04 – see Bahreini's poster (R5P52).

Organic Mass in Ship Channel Plumes



Slightly higher from ship channel.
Also approaches ΔOM/ΔCO = 0.10.

Organic Mass on Oct. 5



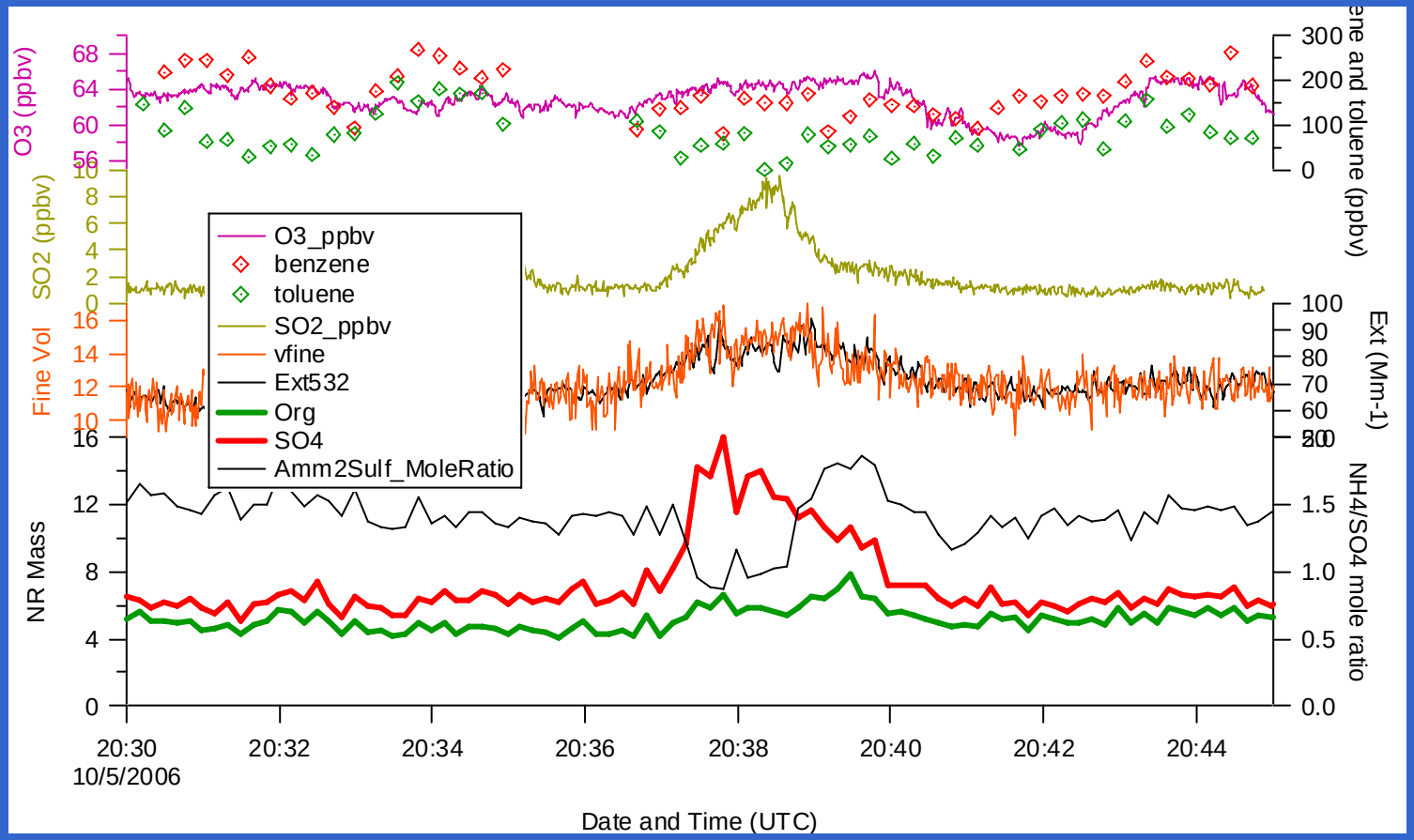
Lower CO and less VOC precursors, likely due to meteorology but can't preclude lower emissions.

$1,000,000 Question:
Is there acidic SOA production?

Look at “last” transect,

downwind of Parish.

Small Acidic Sulfate Particles: Not Much SOA (Processed?)



Also not significant in other plumes and flights.

Houston Aerosol Processes

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Acknowledgements

C-ToF AMS:

Bahreini, Jimenez, DeCarlo, Kimmel, Dunlea, Aiken, Sueper, Furher, Onasch, Jayne, and Worsnop

Other Aerosol Measurements:

Brock, Wollny, Gallar, Baynard, Hecobian, Peltier, Weber, Schwartz, Spackman, Gao, and Fahey

Gas Phase Measurements:

deGouw, Warneke, Holloway, Neuman, Nowak, Huey, and Ryerson

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