Study of Houston Atmospheric Radical Precursors (SHARP)

Barry Lefer & Bernhard Rappenglück (University of Houston)
Jack Dibb & Rob Griffin (Univ. of New Hampshire)
Jochen Stutz (UCLA)

Study of Houston Atmospheric Radical Precursors (SHARP)

Based on the TRAMP findings, the following additional issues in are proposed for further study:

1) The contribution of direct emissions of OH radical precursors HCHO and HONO from flares, smoke stacks, and other point sources as well as from mobile sources, is currently not well quantified.

2) Surface-induced formation of HONO has not yet been sufficiently investigated.

3) The question of daytime HONO levels as well as possible sources of HONO during the day are not well understood

These uncertainties limit our ability to model radicals and ozone formation.

Better understanding of HCHO and HONO has been explicitly recognized in the TERC-Strategic Research Plan (TERC-SRP).

Study of Houston Atmospheric Radical Precursors (SHARP)

I. TRAMP Data Analysis Papers

II. Support and Collaboration for the “Surface-induced Oxidation of Organics in the Troposphere (SOOT)” Field Campaign

III. HONO levels and their Impact on Radical Levels in Houston: HONO Intercomparison (HINT)

IV. Traffic Related Emissions of HONO and HCHO (TREC)

V. Study of HONO Surface Fluxes (SURF)

VI. Imaging Differential Optical Absorption Spectrometer (Eye-DOAS)

VII. Interactions of Nitric Acid, Nitrous Acid, and Particles (NAPA)

I. TRAMP Data Analysis Questions

a) What is the relative importance of ozone photolysis, HONO, HCHO, and HOOH as radical sources to the Houston Atmosphere?

b) How much of the HCHO and HONO measured at Moody Tower is from primary emissions?

c) Are the high HONO and aerosol surface area observed during TRAMP evidence for a major daytime source of HONO through processing on primary organic aerosol?

d) What are the important nighttime chemistry processes?

e) What is the impact of cloud and aerosol reductions of solar radiation on ozone production rates?

f) How representative was the TRAMP measurement period?

g) Why have the peak ozone levels observed in Houston decreased over the past several years?

h) What was the NOy and Hg speciation observed during TRAMP?

i) How did the nocturnal boundary layer evolve during TRAMP?

j) What are anthropogenic and biogenic the sources of the VOCs at MT?

k) What is the role of the residual layer in the following days ozone production?

I. TRAMP Data Analysis

Duration: April – August 2008

PI Groups: UH,UNH, UCLA, PSU, PSU, NOAA-ARL, Valpo

Purpose: To interpret the existing data set and modeling results of CMAQ 3-dimensional chemical transport model and various photochemical box models with goal of submitting journal papers to Atmospheric Environment in August 2008.

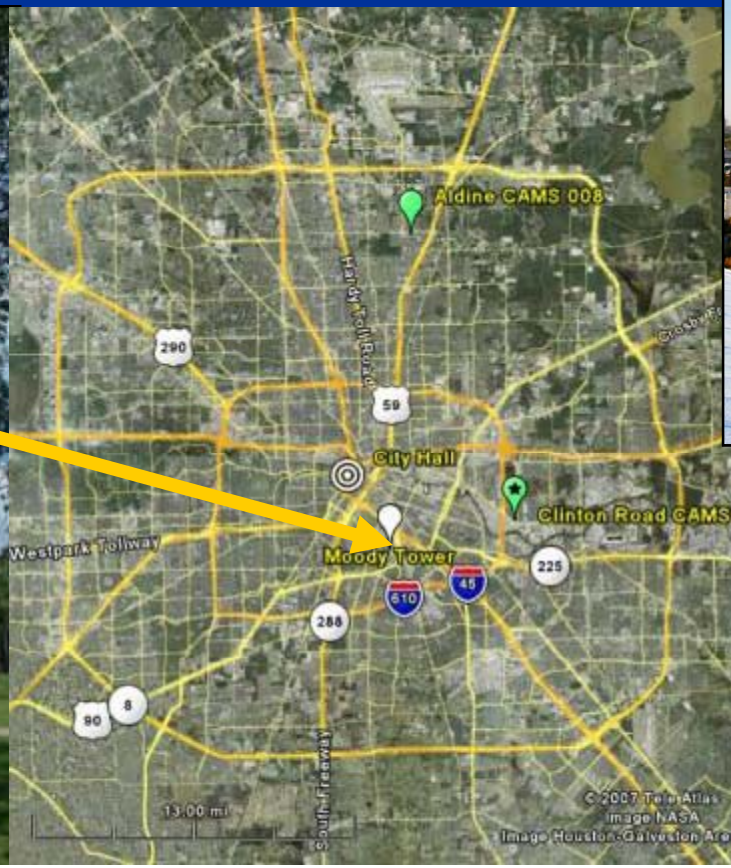
Major Components:

UH Graduate Student Salaries	$10,000
UNH Graduate Student Salaries	$11,500 (includes 15% IDC)
Workshop	$10,000

Total: $36,225

II. Surface-induced Oxidation of Organics in the Troposphere (SOOT) Collaboration

- 70 m a.g.l.
- 5 km SSE of downtown Houston



II. Surface-induced Oxidation of Organics in the Troposphere (SOOT) Collaboration

Duration:

Field campaign: April 01 – May 15, 2009

Data analysis: April – August 2009

PI Groups: UH & UNH

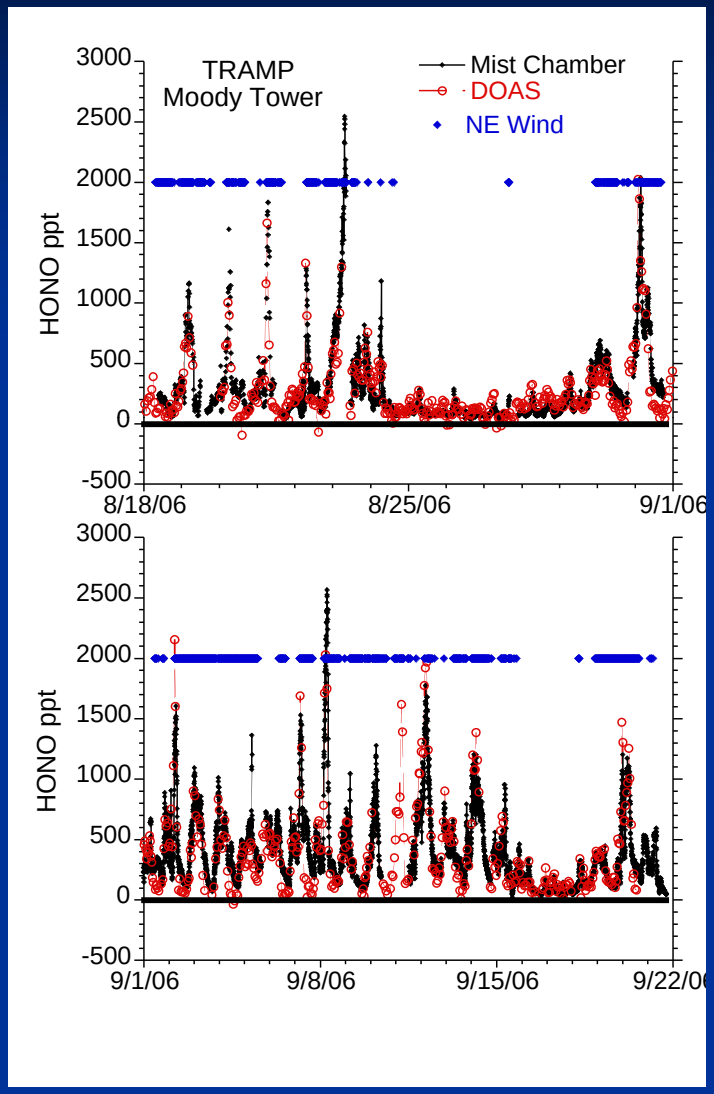
Purpose: To support 6-week field component of SOOT proposed by Texas A&M. UH will provide infrastructure and air quality instrumentation at the Moody Tower site. UH will accommodate TAMU instrumentation and provide suite of Moody Tower measurements: NO, NO_2, NOy, speciated PANs, O_3, CO, SO_2, HCHO, HOOH, speciated VOCs, photolysis frequencies, AOD, sky cam, and basic met. Measurements of HNO_3 and HONO by UNH.

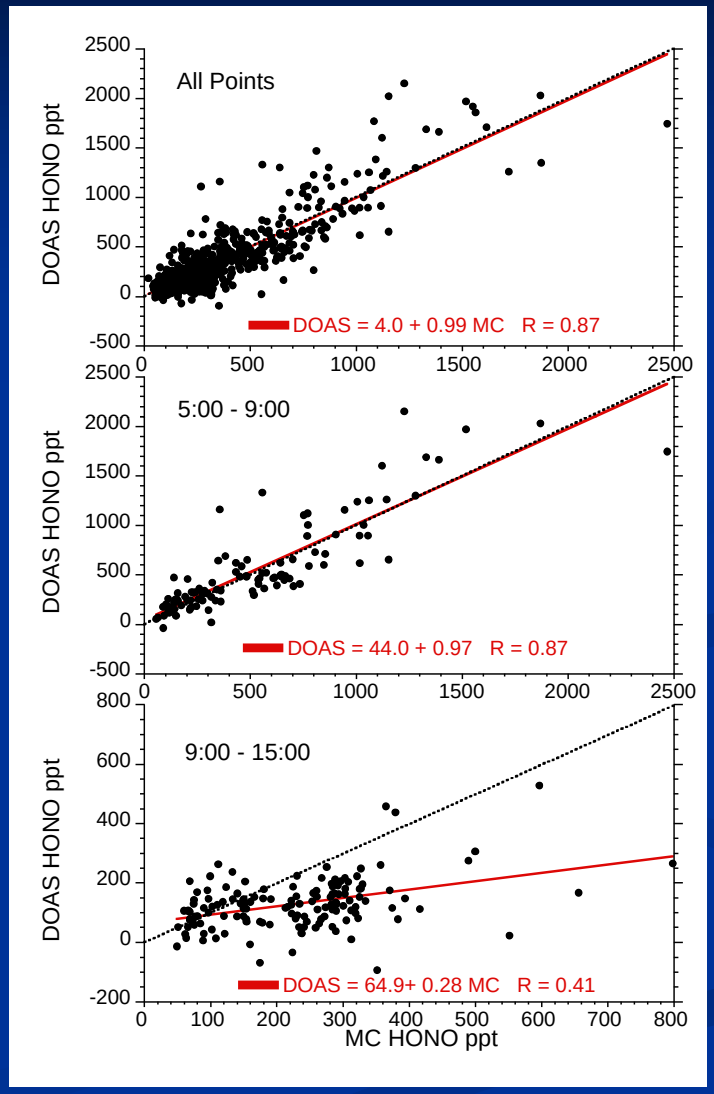
Major Components:

UH Salaries	$50,000
UH Materials, Supplies, Upgrades	$35,600
NOy Upgrade	$15,000
UNH Subcontract	$38,640 (incl. 15% IDC)
UNH Supplies, Shipping, Travel	$19,000

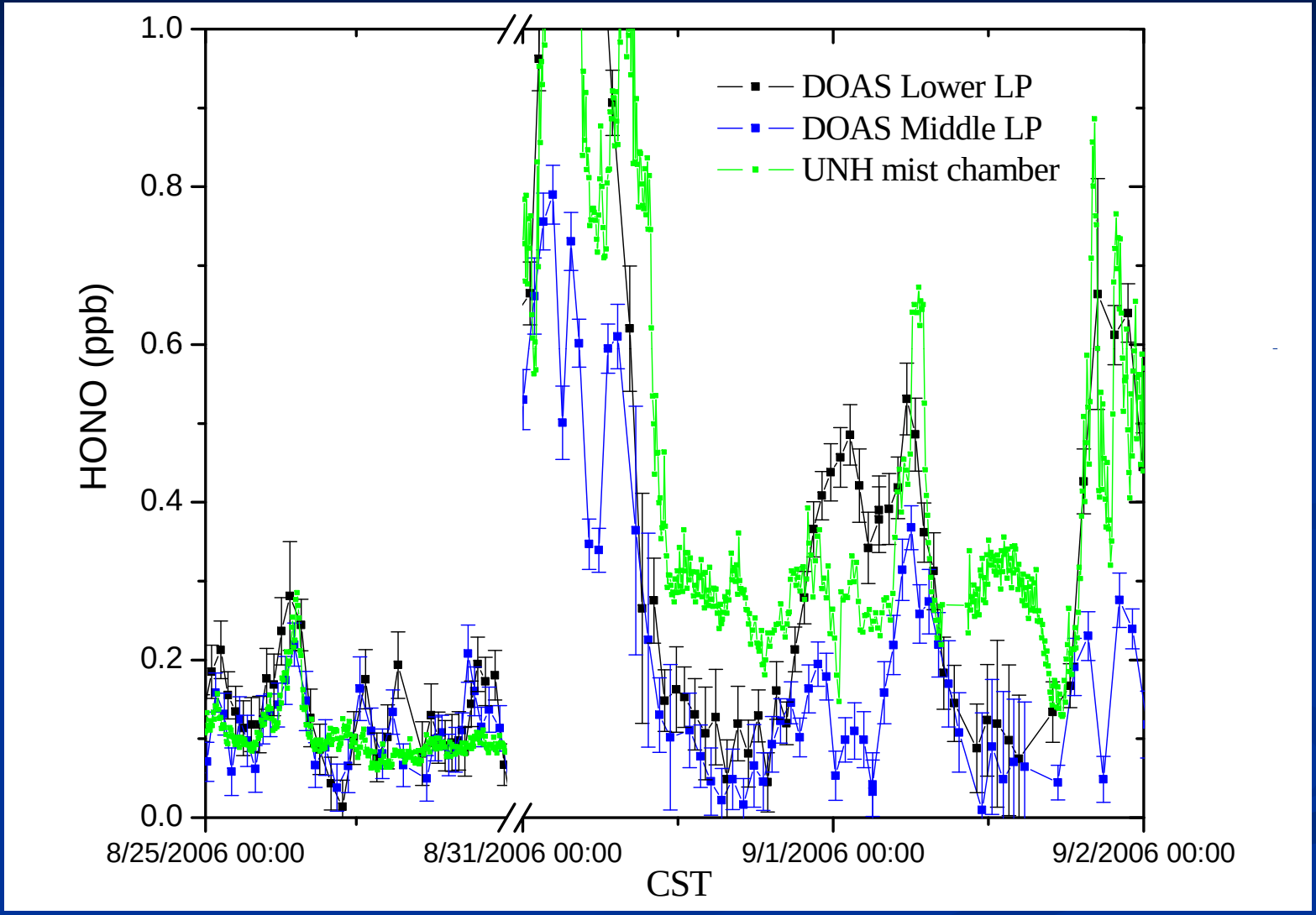
Total: $173,976 = $100,600 + $57,640 + IDC

III. HONO levels and their Impact on Radical Levels in Houston: HONO Intercomparison (HINT)





III. HONO levels and their Impact on Radical Levels in Houston: HONO Intercomparison (HINT)



III. HONO levels and their Impact on Radical Levels in Houston: HONO Intercomparison (HINT)

Duration:

Intercomparison in atmosphere simulation chamber: summer/fall 2008
Field campaign: April 01 – May 15, 2009 (Same as SOOT)
Data analysis: Fall 2008 – August 2009

PI Groups: UH, UNH, UCLA, and TAMU

Purpose: To help determine ambient HONO levels as accurate as possible by:
(i) participation of a LOPAP instrument in a chamber intercomparison (Jülich/Germany)
(ii) deployment of multiple HONO instruments on UH Moody Tower to challenge instruments with the complex "real world" ambient Houston air (UNH mist chamber, Texas A&M CI-MS, UH LOPAP, and UCLA's long-path DOAS)

Major Components:

LOPAP HONO	$75,000
HONO Calibration Source	$15,000
UH Travel/Shipping Jülich	$15,000
UCLA Subcontract, Supplies, Shipping,Travel	$51,500 (includes 15% OH)

Total: $166,475 (not including UH Campaign Base + UNH HONO/HNO_3)

IV. Traffic Related Emissions of HONO and HCHO (TREC)

IV. Traffic Related Emissions of HONO and HCHO (TREC)

Duration:

Field campaign: October 2008

Data analysis: October 2008 – August 2009

PI Groups: UH

Purpose: To determine primary emissions of HONO and HCHO from mobile sources.

(i) Measurements of HCHO, HONO, CO and met parameters at a roadside location in Houston for about 4 weeks.

(ii) Determination of HCHO/CO and HONO/CO ratios during nighttime and rush-hour.

(iii) Identify signatures of burning fossil fuel using CO_2 fluxes

(iv) Identify possible relationships between H_2O fluxes and HONO

(v) Results available as input and validation data for air quality modeling

Major Components:

Student Salaries	$16,000
CO_2 and H_2O Flux Instrument	$20,000
CO Instrument	$15,000
Supplies	$ 7,000
LOPAP HONO	$75,000

Total: $61,450 (not including LOPAP HONO Instrument)

V. Study of HONO Surface Fluxes (SURF)

V. Study of HONO Surface Fluxes (SURF)

Duration:

Field campaign: Selected time periods November 2008 – March 2009
Data analysis: November 2008 – August 2009

PI Groups: UH

Purpose: To evaluate whether common surfaces may serve as an important source for HONO in Houston. The specific goals of this task are:

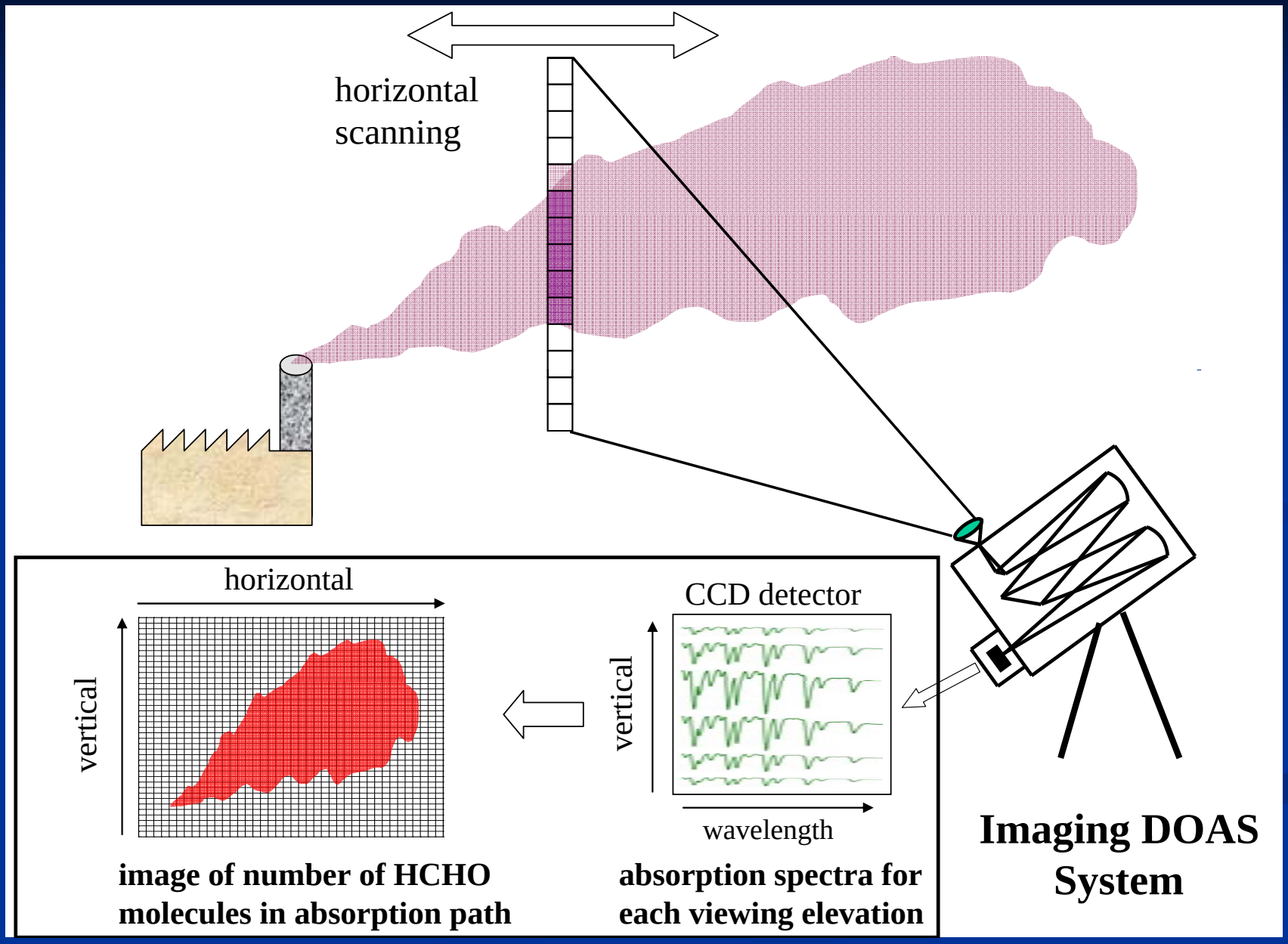
(i) Assembly of a mobile unit to determine microscale fluxes of HONO and NO_2 within a range of 0-3 m above over different urban surfaces, such as parking lots, buildings, and parking garages.
(ii) Identification of signatures of burning fossil fuel using CO_2 fluxes.
(iii) Identification of possible relationships between H_2O fluxes and HONO.
(iv) Results available to IMAQS modeling group to improve air quality modeling.

Major Components:

Student Salaries	$20,000
NO/NO_2 Instrument	$25,000
Enclosure and Supplies	$17,000
LOPAP HONO	$75,000
CO_2 and H_2O Flux Instrument	$20,000

Total: $66,500 (not including LOPAP and CO_2/H_2O flux instruments)

VI. Imaging Differential Optical Absorption Spectrometer (Eye-DOAS)



VI. Imaging Differential Optical Absorption Spectrometer (Eye-DOAS)

Duration:

Instrument Construction: May – November 2008
Field campaign: selected time periods during November 2008 – March 2009
Data analysis: November 2008 – August 2009

PI Groups: UH & UCLA

Purpose: To measure multiple trace gases at distances of 0 – 3km using an expansion of the Multi-Axis DOAS technique. Eye-DOAS delivers a one-dimensional array of trace gas column densities, and with the addition of an opto-mechanical scanner, an "image" of column densities of a several trace gases inside and outside the plume can be obtained. Features of this measurement include:

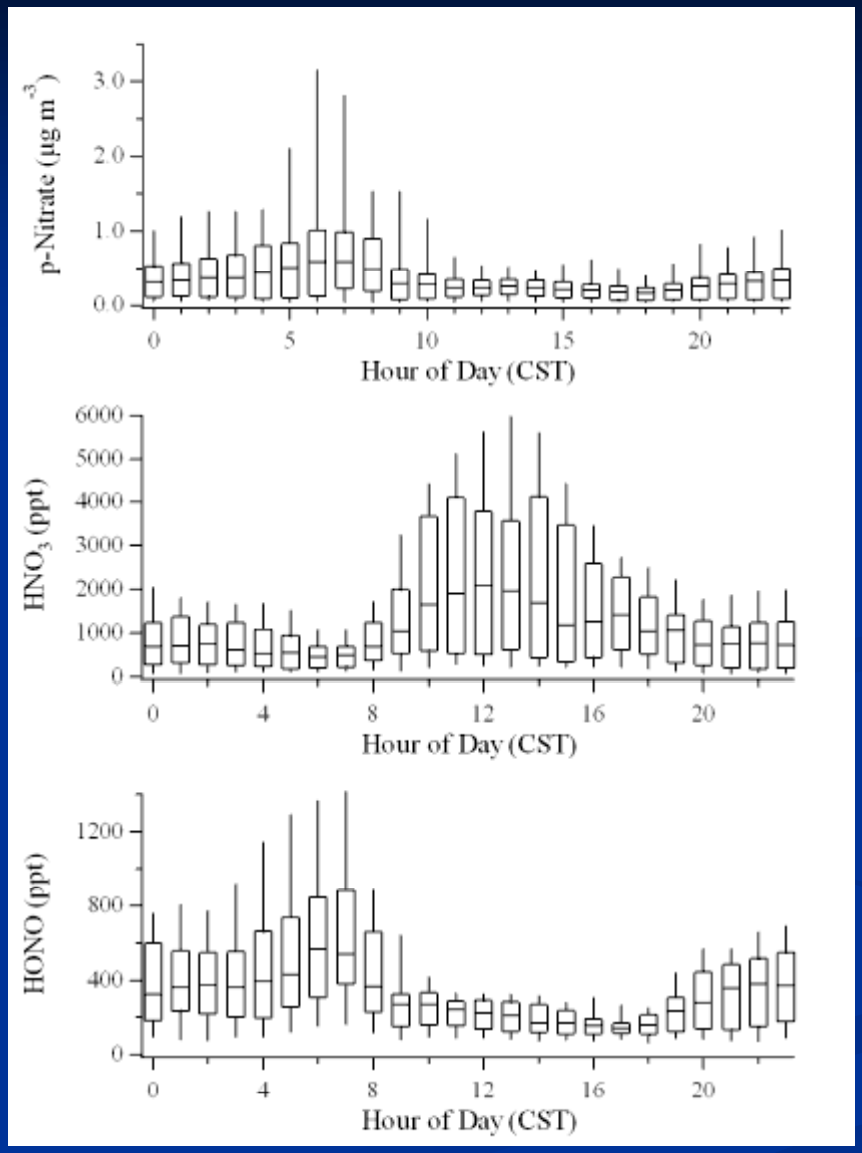
(i) trace gases such as HCHO, HONO, NO_2, and SO_2 are monitored simultaneously,
(ii) The integration of the column densities in the vertical dimension over the plume will thus result in the total number of molecules in a slice through the plume.

Major Components:

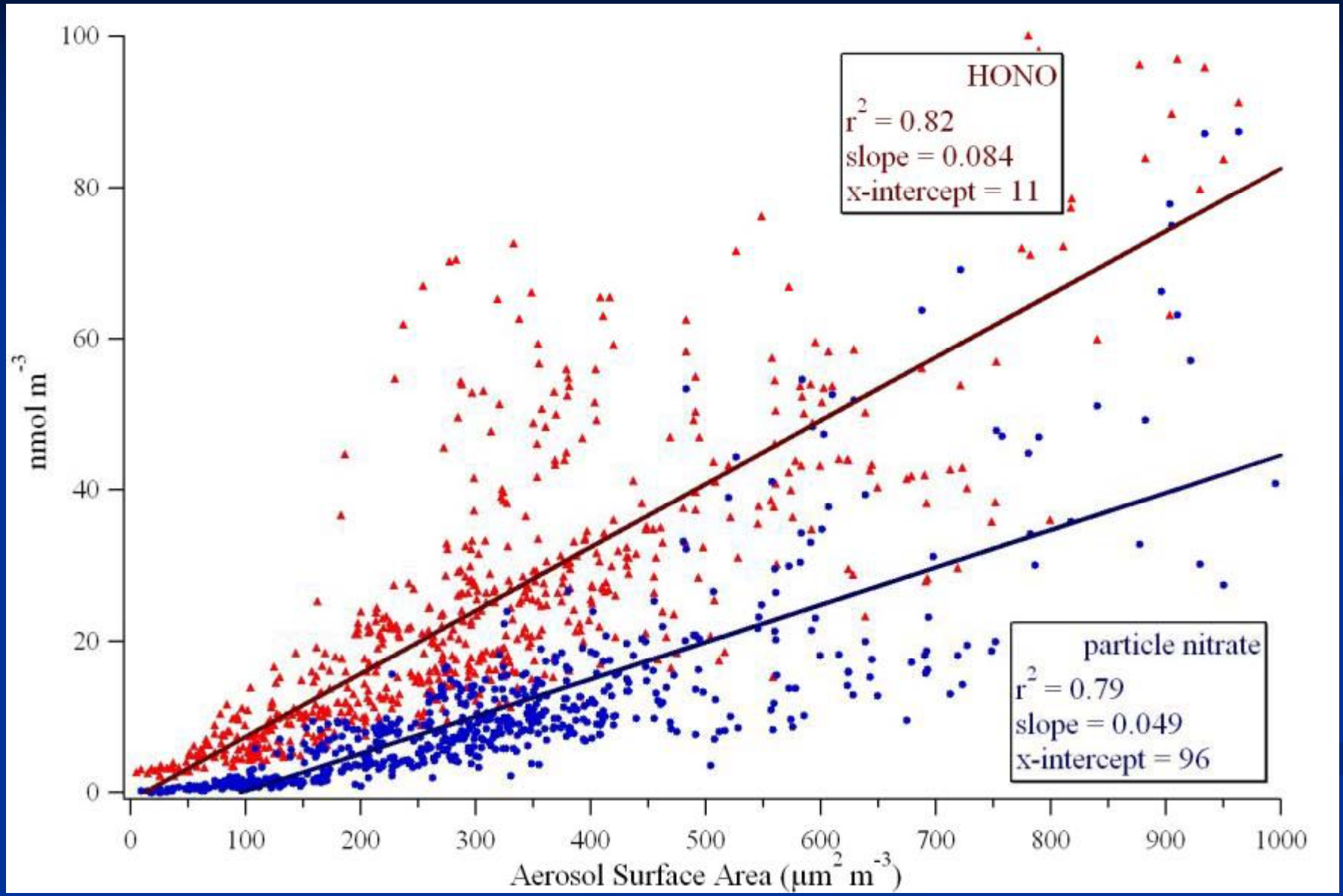
UH Student Salaries and Travel	$29,000
Eye-DOAS Instrument	$60,000
UCLA Salaries	$49,450 (includes 15% OH)
UCLA Supplies, Shipping, Travel	$ 5,000

Total: $153,668

VII. Interactions of Nitric Acid, Nitrous Acid, and Particles (NAPA)



VII. Interactions of Nitric Acid, Nitrous Acid, and Particles (NAPA)



VII. Interactions of Nitric Acid, Nitrous Acid, and Particles (NAPA)

Duration:

Field campaign: April 01 – May 15, 2009

Data analysis: April – August 2009

PI Groups: UNH and UH

Purpose: To provide high temporal resolution measurements of aerosol size distribution and composition at the Moody Tower in conjunction with the UNH MC/IC HONO and HNO_3. Specific aerosol measurements to be include:

(i) composition and aerodynamic size distributions from an aerosol mass spectrometer

(ii) continuous light absorption (proxy for elemental carbon (EC), by aethalometer or PSAP)

(iii) analysis of 12-hr filter samples (soluble ions by IC, organics by the Sunset Labs EC/OC and H+-NMR for functional group characterization)

(iv)analysis of a third filter exposed only during the rush hour period for organics as above to characterize more specifically the organic aerosol during this crucial time.

Major Components:

UNH Salaries	$54,200 (includes 15% OH)
UNH Travel	$10,000
UNH Supplies and Shipping	$28,500

Total: $95,104 (not including UH Campaign Base + UNH HONO/HNO_3)

Study of Houston Atmospheric Radical Precursors (SHARP)

I. TRAMP Data Analysis Papers

II. Support and Collaboration for the “Surface-induced Oxidation of Organics in the Troposphere (SOOT)” Field Campaign

III. HONO levels and their Impact on Radical Levels in Houston: HONO Intercomparison (HINT)

IV. Traffic Related Emissions of HONO and HCHO (TREC)

V. Study of HONO Surface Fluxes (SURF)

VI. Imaging Differential Optical Absorption Spectrometer (Eye-DOAS)

VII. Interactions of Nitric Acid, Nitrous Acid, and Particles (NAPA)