Deriving Information on Surface conditions from COlumn and Vertically resolved observations Relevant to Air Quality
NASA-sponsored research study in Baltimore, the California Central Valley, Houston, Los Angeles, and Colorado, from 2011 to 2014.

Houston, Texas: September 2013

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Investigation Rationale

Near-surface pollution is one of the most challenging problems for Earth observations from space…

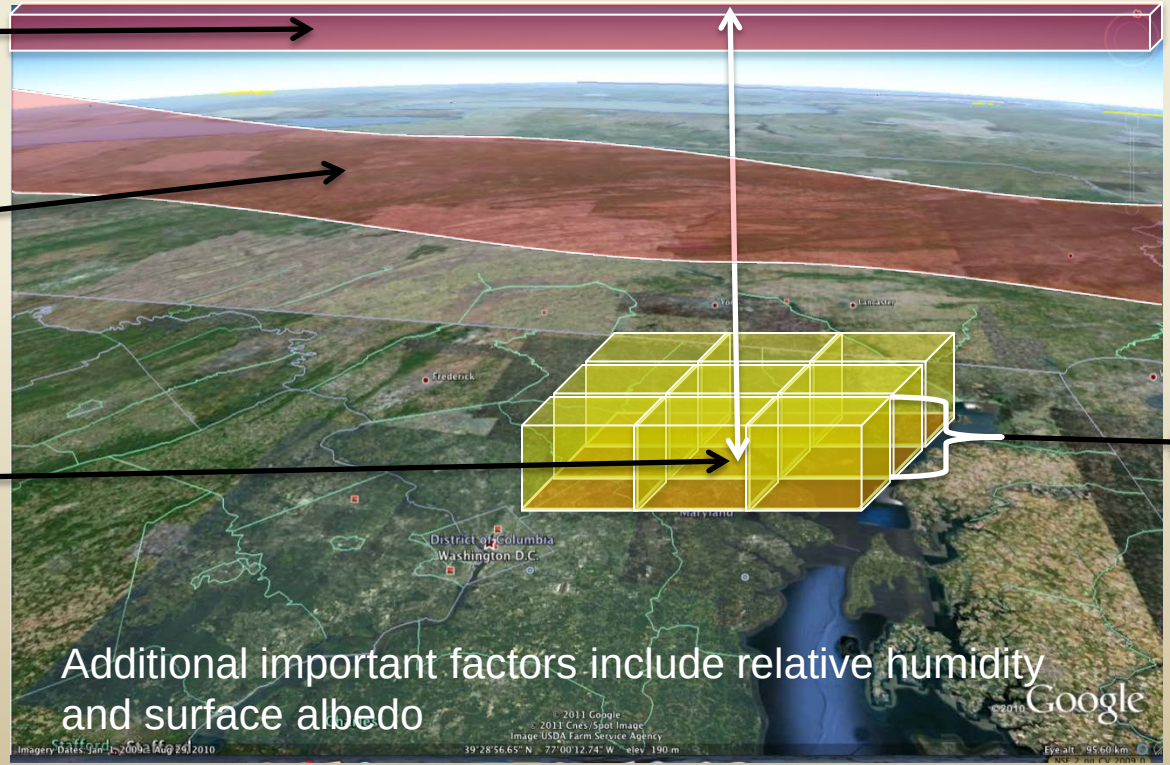
Near-surface information must be inferred from column-integrated quantities obtained by passive remote sensing from downward-looking satellite instruments.

Some constituents have large relative concentrations in the stratosphere and/or free troposphere (e.g., O_3 and NO_2) making it difficult to distinguish the near-surface contribution to the total column.

Stratospheric Burden

Long-range transport of pollution aloft

From space, the size of the measurement pixel matters (as does grid size for models)



Additional important factors include relative humidity and surface albedo

Boundary layer depth influences the volume over which surface pollution is mixed

It also matters how well the pollution is mixed

Investigation Overview

Deriving Information on Surface Conditions from Column and VERtically Resolved Observations Relevant to Air Quality

A NASA Earth Venture campaign intended to improve the interpretation of current and future satellite observations to diagnose near-surface conditions relating to air quality

Objectives:

1. Relate column observations to surface conditions for aerosols and key trace gases O_3, NO_2, and CH_2O

2. Characterize differences in diurnal variation of surface and column observations for key trace gases and aerosols

3. Examine horizontal scales of variability affecting satellites and model calculations

Deployments and key collaborators

Maryland, July 2011 (EPA, MDE, UMd, UMBC, Howard U.)
California, January 2013 (EPA, CARB, UC-Davis&Irvine)
Texas, September 2013 (EPA, TCEQ, U. of Houston)
TBD, Summer 2014

Deployment Strategy

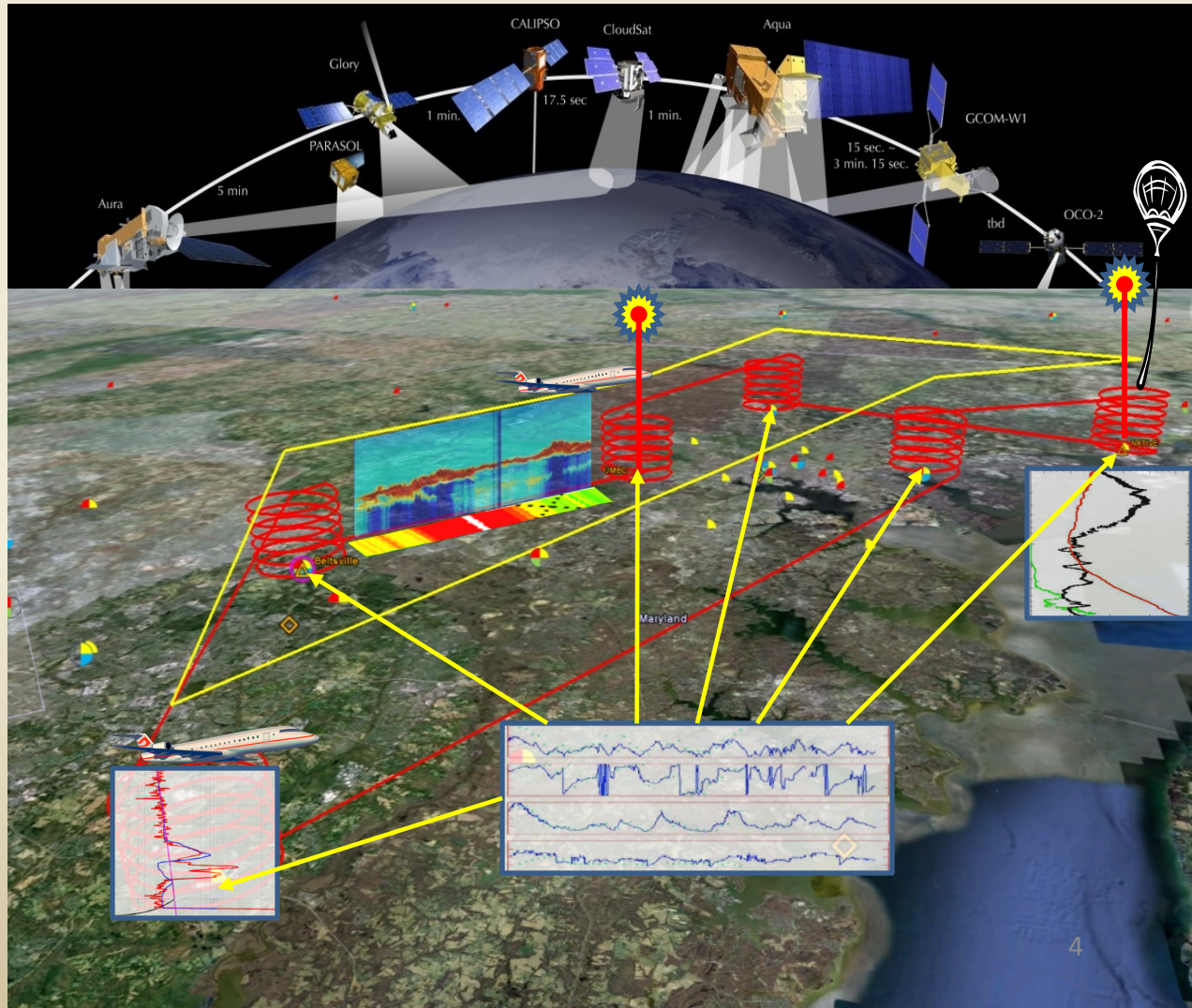
Systematic and concurrent observation of column-integrated, surface, and vertically-resolved distributions of aerosols and trace gases relevant to air quality as they evolve throughout the day.

Three major observational components:

<u>NASA King Air (Remote sensing)</u>
Continuous mapping of aerosols with HSRL and trace gas columns with ACAM

<u>NASA P-3B (in situ meas.)</u>
In situ profiling of aerosols and trace gases over surface measurement sites

<u>Ground sites</u>
In situ trace gases and aerosols
Remote sensing of trace gas and aerosol columns
Ozonesondes
Aerosol lidar observations



- P3 measurements (in situ): aerosols, ozone, NO, NO2, NOY, HNO3, alkyl nitrates, PAN analogues, formaldehyde, CO, CO2, CH4, non-methane hydrocarbons, water vapor, met. Possible ethylene or SO2 measurements.

- King Air measurements (remote sensing): aerosol profiles, column measurements of ozone, NO2, formaldehyde.

- Surface measurements: column measurements of ozone, NO2, formaldehyde; aerosol profiles (lidar); solar measurements; ozone, CO, NO, NOY.

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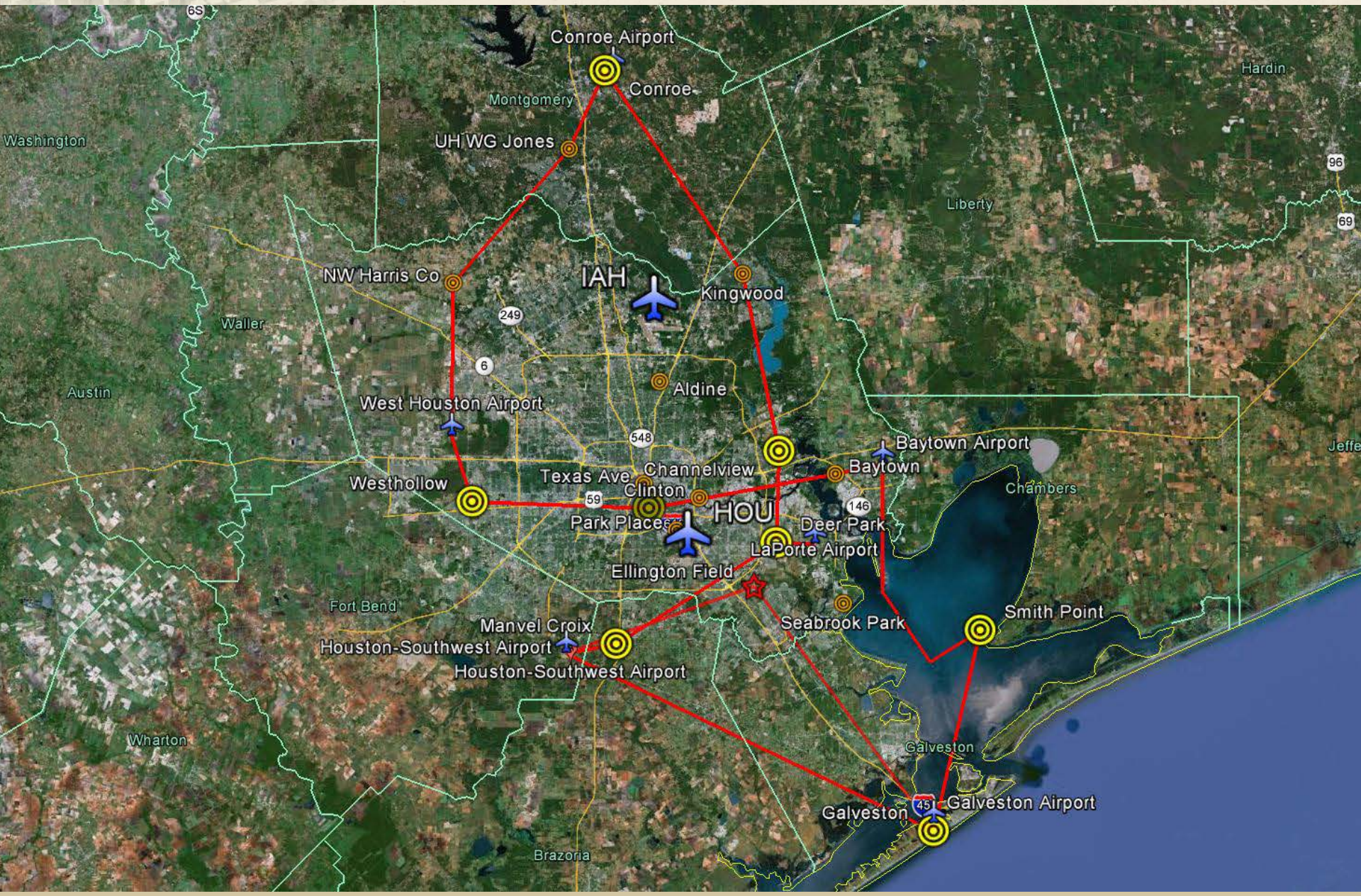
Conroe Airport
Conroe
Montgomery
UH WG Jones
Washington
Hardin
Liberty
NW Harris Co
IAH
Kingwood
Waller
Austin
West Houston Airport
Aldine
Baytown Airport
Baytown
Jeffe
Chambers
Westhollow
Texas Ave
Channelview
Clinton
HOU
Park Place
Deer Park
LaPorte Airport
Ellington Field
Fort Bend
Seabrook Park
Smith Point
Manvel Croix
Houston-Southwest Airport
Houston-Southwest Airport
Wharton
Galveston
Galveston
Galveston Airport
Brazoria

Proposed NASA P3 Houston flight path

- Spiral points at Conroe, Channelview, La Porte, Manvel Croix, Galveston, Smith Point, Moody Tower, Westhollow.
- Fly-overs at Kingwood, Baytown, Clinton, NW Harris, Jones Forest.
- Missed approaches possible at several small airports: Conroe, La Porte, Houston-Southwest, Galveston, Baytown, West Houston,

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Site Name	Authority	Spiral	Aeronet	Pandora	Other	Visit	Pollutants Measured	Horizon
Lynchburg Ferry	TCEQ					DNS	Met, O3, Nitrogen Oxides, VOC canisters, Auto GC	Good
Smith Point	TCEQ	X	X	X	NATIVE	DNS	Met	Good
Seabrook Park	TCEQ					M 1	Met, O3, Nitrogen Oxides, PM2.5, SO2	Probably good, some trees in distance
Clinton	City of Houston					M 10	Met, O3, CO, Nitrogen Oxides, PM2.5, SO2, Auto GC, Carbonyl	Trees to NE
Texas Ave	City of Houston					M 11	O3, CO, Nitrogen Oxides	Skyscrapers to NW
Park Place	City of Houston					M 12	Met, O3, CO, Nitrogen Oxides, PM2.5, SO2	Probably good, some trees in distance
Moody Tower	Univ. Houston	X	X	X		M 13	Met, O3, CO	Good
Galveston	TCEQ	X	X	X		M 14	Met, O3, Nitrogen Oxides, PM2.5, VOC canisters	Good
La Porte Airport	TCEQ					M 2		
Deer Park	TCEQ	X	X	X		M 3	Met, O3, CO, Nitrogen Oxides, PM2.5, PM10, SO2,VOC canisters, Auto GC, TSP, PAH/SVOC	Trees to North
Baytown	TCEQ					M 4	Met, PM2.5, VOC canisters	Water Tower! Some trees
Baytown East	TCEQ					M 5		
Wallisville Road	HRM	X	X			M 6	Met, O3, Nitrogen Oxides	Good
HRM 07	HRM					M 7		
Channelview	TCEQ	?	?	X		M 8	Met, O3, Nitrogen Oxides, PM2.5	Trees to South
HRM 04	HRM					M 9		
Manvel Croix	TCEQ	X	X	X		T1	Met, O3, Nitrogen Oxides	Good
Bayland Park	TCEQ					T2	Met, O3, Nitrogen Oxides, VOC canisters	Good
Westhollow	City of Houston	X	X	X		T3	Met, O3	Trees to North and South
Aldine	TCEQ					T4	Met, O3, CO, Nitrogen Oxides, NOy, PM2.5	Lone tree to south
Conroe	TCEQ			X		T5	Met, O3, Nitrogen Oxides, PM2.5, VOC canisters	Good
UH WG Jones	Univ. Houston					T6	Met, O3, CO	Ringed by trees
NW Harris Co	TCEQ					T7	Met, O3, Nitrogen Oxides	Good
~~Houston East~~	~~TCEQ~~	-	-	-	-	-	~~Met, O3, Nitrogen Oxides, PM2.5~~	~~Trees near and far in several directions~~
~~Kingwood~~	~~City of Houston~~	-	-	-	-	-	~~Met, PM2.5~~	~~Trees in distance, probably ok~~
~~Lake Jackson~~	~~TCEQ~~	-	-	-	-	-	~~Met, O3, Nitrogen Oxides~~	~~Good~~
~~Lang~~	~~City of Houston~~	-	-	-	-	-	~~O3, CO, Nitrogen Oxides~~	~~Trees in several directions~~

Additional ground measurements

- Chalmers mobile remote sensing and UH mobile monitoring van (J. Mellqvist, AQRP; B. Lefer, UH)
- UT and Rice University aerosol monitoring (R. Griffin, AQRP)
- Ozonesondes from Valparaiso and UH (G. Morris, AQRP)
- Baylor aerosol measurements: aerosol formation (R. Sheesley, AQRP)
- UT aerosol measurements: interactions of organic aerosols and ozone (L. Hildebrandt-Ruiz, AQRP)
- NOAA O3, NO, NO2, NOy, SO2 measurements (X. Ren, AQRP), mobile ozone lidar (C. Senff, NOAA-ESRL)
- TCEQ, City of Houston, HRM, EISM, and HNET monitoring networks
- TCEQ/AQRP supplemental measurements with photolytic NO2 monitors, background CO monitors
- Aerodyne mobile monitoring van (funded by NASA)
- Penn State monitoring trailer (ozone, NOy, SO2, CO, solar, met, ozonesondes); potential tethersonde deployment
- EPA measurements of NO2 with photolytic monitors

Data available publicly within 4 months of campaign

- http://discover-aq.larc.nasa.gov/planning-reports_CA2013.php