The NAOPEX 2002 Field Campaign and its link to climate and trace-gas/aerosol interactions

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Nighttime Aerosol/Oxidant Plume Experiment

- NAOPEX is designed to study chemical interactions between aerosols and trace gases and the associated aging of the aerosols
- Results from past campaigns suggest a detectable link, but the evidence is still circumstantial
- An important component: tetroon deployment to allow Lagrangian-style sampling
- Climate link: aerosol processing in urban plume and statistical contrast with continental, day-time observations

General Scientific Questions - 1

- How are concentrations and optical properties of aerosols over land modified as the airmass moves across a large urban area and out over the Atlantic?
- It is believed that chemical processing (aging) converts hydrophobic aerosols into hydrophilic ones. The resulting hygroscopic aerosols have greater optical depths, shorter lifetimes, and are better cloud condensation nuclei. How much ‘chemical aging’ occurs at night and how does it change the hygroscopicity of these aerosols?
- With NEAQS: What is the aerosol optical depth of the urban plume over land and off the east coast and how does it affect the distribution of solar energy on the surface and the lower troposphere?

General Scientific Questions - 2

- How much aerosol growth is associated with the deposition of semi-volatile secondary organic vapors to pre-existing aerosols? This process would increase the size of small aerosols, and hence increase the efficiency with which they can scatter incoming solar radiation thereby enhancing their contribution to direct radiative forcing on climate.

- What is the relationship between chemical aging of aerosols and the concentrations of radiatively important trace gases such as ozone? While laboratory and modeling studies suggest that chemically active aerosol surfaces destroy ozone, this has not been definitively confirmed by field observations.

- Compare satellite-based estimates of aerosol optical properties with in situ measurements made over land and ocean.

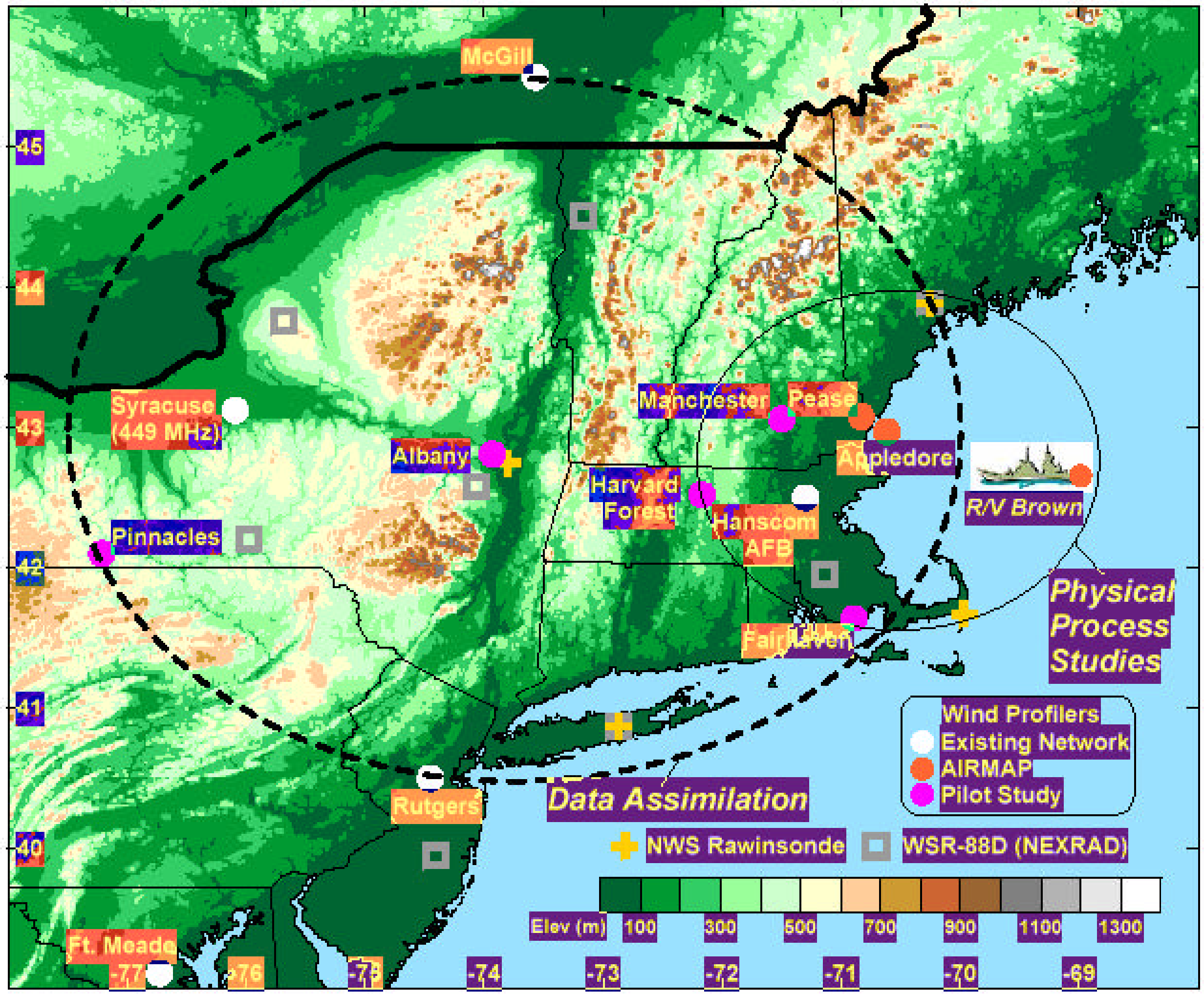
Key Aircraft Observations

- Trace-gas: O3, VOCs, NOx/NOy
- Aerosol:
  - Composition
  - Size
  - Black carbon content (Particle Soot Absorption Photometer)
  - Scattering coefficient (integrating nephelometers)
- Meteorology:
  - plume location (tetroons, wind profilers/sodars),
  - mixing (CO)
  - thermodynamic structure (radiosondes)

Key Non-Aircraft Observations

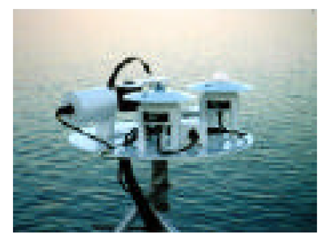
- Surface Site for DOAS and related in situ measurements
- Tetroons with gps, O3, Temp, RH and pressure) to tag plume (new technology = risky but potentially high long-term payoff)
- Land-based Radiosondes to characterize continental CBL
- Wind Profilers…
  - On land
  - shipboard

Proposed locations for the eight NOAA profilers



NOAA Research Vessel 'Ron Brown'

- Ship to sample marine boundary layer off coast of Massachusetts July 12 to August 10
- On-board observations to include Portable Radiation Package (PRP):
  - Shadow-band radiometer (aerosol optical depth) ?
  - Portable Radiation Package (PRP)
  - Downwelling shortwave (PSP)
  - Downwelling longwave (PIR)
  - FRSR (Fast Rotating Shadow Band Radiometer) measures
    - Shortwave global, diffuse, and direct-beam at 415, 500, 615, 680, 870, and 940 nm.
    - Pitch, roll, compass.
- Lidar profiler (time/height ozone and aerosols) ?



Ship Tracks for Boston/NY Urban Plume Study

Logistical Questions for New Hampshire Meeting Next Week…

- Location of ACP/NAOPEX surface chemistry site (DOAS deployment)
- How to coordinate G-1 fly-overs with Ron Brown
- Need help in identifying launch sites for radiosondes and tetroons: Class B airspace is a concern!
  - Radiosondes to characterize continental boundary layer over Boston
  - Tetroon site downwind of urban plume (may or may not be co-located with ‘sonde launch site).
- FAA/tetroon approval…can we get it?
- Should we coordinate FAA G-1 approval with Peter’s experiment?

Additional Suggestions…

- Can we get some of their students to help us out with Radiosonde launches?
- Also, we may need some help for tetroon launches too.

Proposed Air Quality Instruments for Deployment on Ron Brown

Parameter	Method	Performing Laboratory
Ozone	UV Absorbance	AL
Ozone	NO Chemiluminescence	AL
Carbon Monoxide	Nondispersive IR	AL
Carbon Dioxide	Nondispersive IR	AL
Sulfur Dioxide	Pulsed Fluorescence	AL
Nitric Oxide	Chemiluminescence	AL
Nitrogen Dioxide	Photolysis Cell	AL
Total Nitrogen Oxides	Au Tube Reduction	AL
PANs	GC/ECD	AL
Alkyl Nitrates	GC/FID	AL
Photolysis Rates	Spectral Radiometer	AL
Ionic Aerosol Composition	PILS	PMEL/GIT
Size-resolved aerosol composition and gravimetric mass	Impactor (IC, XRF, and thermal-optical OC/EC).	PMEL
Aerosol Size and Composition	Aerosol Mass Spectrometer	AL/Aerodyne
Aerosol scattering (450, 550, 700 nm)	TSI Model 3563 Nephelometer	PMEL
Aerosol absorption (550 nm)	Radiance Research PSAP	PMEL
Aerosol number	CNC	PMEL
Aerosol size distribution	twin DMAs and an APS	PMEL
Continuous Specation of VOCs	PTR-MS/CIMS	AL

- Climate: aerosol radiative/optical properties (scattering, absorptivity)
  - Aerosol absorption coefficient = f(black carbon content, size)
    - Particle Soot Absorption Photometer (PSAP)
  - Scattering coefficient = f(composition, size & hygroscopicity)
    - Integrating nephelometers
  - Extinction coefficient = absorption coeff. + scattering coeff.
  - Aerosol optical depth = vertically integrated extinction coefficient
    - Aircraft profiles