The New England Air Quality Study (NEAQS) – 2002 Campaign

Science Questions:

- What are the key factors determining the distribution of O_3 and other pollutants in the New England sea coast and coastal marine region?
- What processes lead to the large spatial variability in O_3 mixing ratio and its diurnal variation at New England monitoring sites, *e.g.*, why is the mixing ratio of O_3 much greater on average at Appledore Island than at Thompson Farm?
- How can we quantify the different attributing processes to better understand important mechanisms controlling trace gas and aerosol diurnal cycles?
- What is the depth of the nocturnal inversion layer in the sea coast area and what is its influence on the chemistry?
- As the nocturnal inversion is destroyed during the morning hours, do the rapidly changing mixing ratios of trace gases and aerosols largely reflect mid-to-upper PBL characteristics?
- How important are biogenic sources for trace gases and aerosols in New England?
- How important is the low level nocturnal jet for transporting pollutants to the New Hampshire seacoast region?
- How does the land/sea breeze affect the likelihood of an O_3 event?

Atmospheric Chemistry Measurements:

A suite of measurements of important tropospheric chemical species are now being conducted at each of the three main AIRMAP monitoring sites. The instrumented sites are located along a 200 km north-south transect in eastern NH beginning near the Atlantic coast at Thompson Farm (Durham), up to 400m elevation at Castle Springs (Moultonborough), and 2000 m at summit of Mount Washington (North Conway). Many of these have been brought on-line over the last year. The array of parameters measured at each site is summarized in the table below. We are working to have the ones labeled “soon” be on-line by mid-July when the Ron Brown is in New England. Near-real time data for many of these parameters can be viewed on the Internet at http://athena.sr.unh.edu/airmap/. Fifteen minutes average values are also available there for key species.

Atmospheric Measurements Conducted at the AIRMAP Monitoring Sites

Species	*Thompson Farm*	*Castle in the Clouds*	*Mount Washington*
O_3	✓	✓	✓
CO	✓	✓	✓
NO	✓	✓	✓
PAN	soon	2003	2003
NO_y	✓	✓	soon
SO_2	✓	✓	✓
CO_2	✓	2003	2003
Hydro/Halocarbons	✓	soon	
Alkyl Nitrates	✓	soon	
JNO_2	✓	✓	✓
Bulk Aerosol Comp.	✓	✓	✓
CN	✓	✓	✓
Black Carbon Conc.	✓		
PM2.5 Mass Conc.	✓	2003	2003
PM2.5 Scattering	✓	✓	✓
PM2.5 Absorption	✓		
MC/IC Aerosol Comp.	soon		

Ancillary Chemical Measurements:

In addition to the three continuously operated AIRMAP sites, CO, O_3, NO, and NO_y are being measured during June – September on Appledore Island, Isles of Shoals. This site is located approximately 12 km off the New Hampshire coastline. We have also teamed with Physical Sciences, Inc. to operate an O_3 photometer on the Isles of Shoals ferry during summer 2002. These data will be made available through the AIRMAP database and web page.

We also built a new automated instrument to measure gas phase HNO_3 that will deployed on the NOAA research vessel the Ronald Brown. An AIRMAP technician and a graduate student will be onboard the ship to operate the instrument and reduced the data on a daily basis.

Meteorological Measurements:

AIRMAP has deployed numerous meteorological sensors and teamed with local groups operating their own systems throughout the seacoast region. The data from this network will facilitate our understanding of the spatial and temporal occurrence of the local land/sea breeze system.

Through our collaboration with The Mount Washington Observatory (MWO), the GroundWinds Doppler Lidar system will be operated nearly continuously from mid-July to mid-August to obtain vertical profiles of wind speed and direction and relative aerosol backscatter.

AIRMAP has moved its shadow band radiometer instrument to the GroundWinds site to conduct column measurements of aerosol optical depth. Comparisons will be made of optical depth estimated from both instruments.

MWO personnel will also launch four radiosondes per day during mid-July to mid-August. Profiles of physical meteorological parameters will be obtained at 0000, 0600, 1200, and 1800 UTC. The 0000 and 1200 times are coincident with the standard weather service launches in the New England region.

Modeling Studies:

The AIRMAP modeling component is focused on mechanistic studies to understand the three-dimensional distribution of trace gases and aerosols, quantification of the different processes contributioning to New England air pollution, and estimation of the importance of local biogenic sources. Over the past year the AIRMAP modeling capabilities have been increasing at a rapid pace. We now have operational the meso-scale meteorological model MM5 and the EPA emission model SMOKE. We are working on implementing the EPA photochemical model CMAQ in the near future.

We will utilize MM5 to simulate atmospheric dynamics during interesting intervals during mid-July to mid-August when the Ron Brown is in the New England region. The SMOKE emissions model will generate the areal, point, mobile, and biogenic sources for the domain and time of interest using 1996 emissions inventories and MM5 output. These model outputs will be used to drive the photochemical model CMAQ. Through these studies we will estimate the mixing ratios of key atmospheric species, such as O_3, CO, selected hydrocarbons, and NO_y in the AIRMAP study region, and moreover, understand causative dynamical and chemical mechanisms. Model evaluations will be conducted using the AIRMAP field measurements to provide confidence in model application and serve as a basis for model improvement.

Data Analysis:

Analysis of the spatial and temporal patterns in atmospheric species will be used to facilitate our work to develop answers to the scientific questions posed above. The NOAA HYSPLIT trajectory model will be used to identify transport characteristics of air parcels to New England. These analyses will be used to complement ongoing modeling studies of O_3 episodes in the AIRMAP study region. Graduate students will conduct and make significant contributions to the AIRMAP data analysis. We are also planning to hire a Postdoctoral Fellow to assist with this work.

Graduate Student Participation:

UNH graduate students form an integral component of the AIRMAP research team. Below is a list of participating students along with their principal research area.

Linsey DeBell – seasonal relationships in CO and O_3 and their dependence on air mass source region as determined by backward trajectories

Marcy Vozzella – measurements of HNO_3 on the Ron Brown and development of a mist chamber/denuder instrument for continuous high-time resolution measurements of ionic aerosol species.

Rachel Russo – use of hydrocarbons tracers to diagnose biogenic and anthropogenic emissions

Adam Wilson – human health issues related to air pollution events

Zak Irons – relationship between aerosol nitrate and sulfate and their use as tracers of long-range transport

Sam Miller – occurrence and geographic distribution of the land/sea breeze phenomenon along the east coast of New England

Kevan Carpenter – NO_x and NO_y as tracers of local versus long-range transport

Eric Scheuer – measurements of HNO_3 on the Ron Brown and development of atmospheric chemistry instrumentation