

## A52A-0105 1330h POSTER

## Infrasound Sensors on a Budget - A simplified design

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Previous work has shown that some inexpensive electret microphones have a response that may be extended below 1/2 Hz by using suitable backing volume extenders. Current models are based on a simple enclosure and backing volume that can produce a microphone with a known response. By using a large number of consumer grade electret elements, it is possible to produce an infrasound sensor suitable for acoustic infrasound with low self noise. For research use, such systems must be calibrated. Two methods of calibration have been demonstrated, one using a bursting membrane in a calibration chamber and one using a small impulse pump on the backing volume (displacement method).

Such a sensor can easily be produced with simple tools and materials and may be of interest to both researchers and educators.

## A52A-0106 1330h POSTER

## A Comparison of Sulfur Dioxide Column Content Between Aircraft and Satellite Over the U.S. Mid-Atlantic

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Sulfur Dioxide (SO<sub>2</sub>) is a major contributor to air pollution in the mid-Atlantic region of the United States. Sources of SO<sub>2</sub> include coal fired power plants as well as diesel engines. Fine particulate sulfate (with diameter less than 2.5 μm) formed from SO<sub>2</sub> can cause health problems as well as decreased visibility. Reliable measurements of SO<sub>2</sub> within the lower troposphere are needed to determine sources, test emission inventories and to evaluate federal air quality standards. Monthly averages of SO<sub>2</sub> lower-tropospheric column content for various points in the mid-Atlantic region of the United States have been calculated from episodic aircraft measurements during the summer months of 2000 and 2001 (<http://www.meto.umd.edu/umadair/rammp01.html>). A Thermo Environmental Instruments 43C SO<sub>2</sub> analyzer was used to obtain data during aircraft spiral profiles, usually made from the near-surface to an altitude in the range of 2.3 to 3.1 km. From June to August 2000, 44 columns of SO<sub>2</sub> were calculated from aircraft profiles over 11 different locations between North Carolina and Pennsylvania. Individual column concentrations of SO<sub>2</sub> ranged from 0.10 to 2.31 Dobson Units (DU). Monthly averaged column concentrations were made for each location and the average concentrations for 2000 ranged from 0.02 to 1.18 DU. In 2001, 149 columns of SO<sub>2</sub> were obtained from 36 different locations for the months of May through August. The individual column concentrations ranged from 0.01 to 3.40 DU and the monthly averaged columns ranged from 0.05 to 3.40 DU. UV-visible spectra collected by the Global Ozone Monitoring Experiment (GOME) have been analyzed for SO<sub>2</sub> by the research group at the University of Bremen in Germany (<http://www.iup.physik.uni-bremen.de/gome/>). The period of data collection by the University of Maryland team coincide with data collection by the University of Bremen. The monthly averages of SO<sub>2</sub> determined from aircraft measurements are compared with measurements from the satellite in order to characterize the transport and dynamics of SO<sub>2</sub> over the mid-Atlantic region.

## A52A-0107 1330h POSTER

## Spectrally Resolved Ocean Optics in the Vicinity of COVE Site

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Radiative transfer at the air-sea interface plays a significant role in the global climate system. Investigations of radiation to date have tended to focus on one of the two media (atmosphere or ocean) explicitly, regarding the other as a simple boundary condition or correction factor in remote sensing. Our analysis with the CERES Ocean Validation Experiment (COVE) treats both media explicitly using thorough measurements and coupled radiative transfer theory. Long-term observations at the rigid COVE sea platform are sponsored by the Clouds and the Earth's Radiant Energy System (CERES) program of NASA's Earth Observing System (EOS).

We show data from the Chesapeake Lighthouse and Aircraft Measurements for Satellites (CLAMS), which was a field campaign (June - August, 2001) at COVE, and from the summer of 2002. Analytical Spectral Devices spectroradiometers on board the NASA Langley OV-10 aircraft measured both downwelling and upwelling irradiances (350 - 2250 nm with an effective resolution of 8-12 nm interpolated to 1 nm); spectral albedo is readily obtained. In addition to calibration using data provided by the manufacturer, a second inter-instrument calibration was conducted using the same sources: outdoor solar radiation and an indoor 1000-W QTH lamp with 8" integrating sphere applied to both the uplooking and downlooking instruments.

The albedo of the ocean surface is a function of numerous variables; some are hard to measure. A Coupled Ocean-Atmosphere Radiation Transfer (COART) model based on Discrete Ordinate Radiation Transfer (DISORT) has been developed by Z. Jin. COART has been used to compute the spectral albedo of the ocean surface under various conditions. The measured data show reasonable agreement with the COART model results.

## A52B MCC: Hall D Friday 1330h

## Air Toxics: Regional Assessments Through Atmospheric Monitoring or Modeling Posters

Presiding: B Hutzell, U.S.

Environmental Protection Agency; R Bullock, U.S. Environmental Protection Agency

## A52B-0108 1330h POSTER

## Modeling Mercury Atmospheric Deposition in the United States

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A multiscale modeling system that consists of a global chemical transport model (CTM) and a nested continental CTM was applied to simulate the atmospheric fate and transport of mercury over North America. Model performance was evaluated with data from the Mercury Deposition Network (MDN). Performance statistics were satisfactory with  $r^2=0.81$ ,  $error=18\%$  and  $bias=4\%$ . A set of model simulations was done for individual source areas to develop a response-surface model that can be used to conduct a large number of emission scenarios with minimal computational cost. The results of the response-surface model are shown to agree well with those of the original CTM. The response-surface model is used to investigate the effect of various emission scenarios on mercury deposition at selected receptors. The global background is calculated to contribute on average about 70% to mercury deposition in the contiguous United States.

## A52B-0109 1330h POSTER

## Seasonal and Diurnal Cycles of Elemental Mercury in the Marine Boundary Layer: Evidence for Rapid In-Situ Photo-Oxidation

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Gas-phase elemental mercury (Hg<sub>0</sub>) measurements were made at Cheeka Peak, Washington in the marine boundary layer for the period March - December, 2001. Highest concentrations of Hg<sub>0</sub> were observed during the spring and lowest in late fall, with a seasonal amplitude of 21% of the mean value (1.56 ng/m<sup>3</sup>). Variability of Hg<sub>0</sub> over the entire data set gives a Junge lifetime of about 7 months, on the low end of the most recent published estimates. Hg<sub>0</sub> depletion was observed in all seasons during local pollution episodes that periodically influence Cheeka Peak. This depletion was strongest in the summer and when locally influenced air had enhanced CO concentrations. One particularly strong regional smog event in August produced an Hg<sub>0</sub> depletion of 37% below the monthly mean. Estimated removal rates based on average urban Hg<sub>0</sub> concentrations upwind of Cheeka Peak and average transport times, are on the order of days to weeks. Diurnal variability in air masses that had no contact with local sources was also large (as high as 29% peak-to-peak amplitude). O<sub>3</sub> exhibited a strong negative correlation with Hg<sub>0</sub> (as high as  $R = -0.92$ ) during certain periods in the summer, in both polluted and clean air masses. These observations suggest a gap in the understanding of Hg<sub>0</sub> oxidation processes that occur in marine boundary layer of the mid-latitudes, since the fastest known Hg<sub>0</sub> reactions rates give a lifetime on the order of several months, which is not fast enough to account for our data.

## A52B-0110 1330h POSTER

## Atmospheric Lead and Bromine Levels in Central Europe

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Abatement measures (fuel composition) in recent years have depleted Pb and Br values in the environment in central Europe.

We studied atmospheric lead, Pb, and bromine, Br, over a two-year period at an urban site (Leipzig, weekly PM<sub>10</sub> samples), and at several rural and urban sites in short-term campaigns (mostly daily TSP samples) in central Europe, 1998-2000. The samples were collected on quartz fibre filters and analyzed using x-ray fluorescence analysis (total element contents).

In the long-term study at the urban site, the levels were found to be 19.2 ng m<sup>-3</sup> (0.66 mg g<sup>-1</sup> PM<sub>10</sub>) and 3.2 ng m<sup>-3</sup> (0.11 mg/g PM<sub>10</sub>) for Pb and Br, respectively, as the annual mean. Winter concentrations exceeded summer concentrations by a factor of 3, similar to other anthropogenically highly enriched elements (crustal enrichment factors for Pb and Br were 550 and 490, respectively). At rural sites (total sampling time 7 weeks) the levels were 13.4 ng m<sup>-3</sup> (0.62 mg g<sup>-1</sup> TSP) and 5.1 ng m<sup>-3</sup> (0.24 mg g<sup>-1</sup> TSP) for Pb and Br, respectively. The two elements are correlated, however, less pronounced than previously. By average, it was Pb/Br = 6.2. This value is higher than observed in previous years in Germany which raises the question whether sources other than vehicular traffic are significant today. Time dependent correlation coefficients between particulate phase mass fractions and source loadings which were based on air mass back trajectory analyses suggest the existence of two Pb species, which are undergoing a selection process during aging and, hence, differ by their atmospheric residence time.

## A52B-0111 1330h POSTER

## Particulate Matter Size, Distribution and Concentrations in the Lower Urban Atmosphere

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Aerosols and atmospheric gases continually alter the amount of radiation reaching the Earth's surface. Aerosols cause a direct climate forcing by reflecting some of the solar radiation that would reach the Earth's surface. The uncertainty in the direct aerosol radiative forcing is due to the poorly known optical properties and the amount and distribution of aerosols in the atmosphere. In order to improve our knowledge of the role of aerosols in our environment, it is necessary to accurately estimate the aerosol radiative forcing and determine the size, distribution and concentration of aerosols in the atmosphere. A PC-2H Air Particle Analyzer QCM Cascade Impactor and a Multi-Filter Rotating Shadow-band Radiometer (MFRSR-7) are used to measure optical depth, particle size, distribution and horizontal spatial variability along with the impact of atmospheric conditions in lower urban atmosphere (less than 100 meters). Aerosol particles contribute significantly to the pollution of urban air. Monitoring particulate matter in urban air has important health implications, especially since asthma and other lung diseases in inner city communities are above the national average. Results on the size, distribution and concentration of particles at various low heights (less than 100 meters) and their relationship with aerosol optical depth and the impact of atmospheric conditions will be presented. This research is supported by grants from NASA MURSPIN, NASA Space Science and NSF LSAMP.

## A52B-0112 1330h POSTER

## Gas Phase Emission Ratios From In-Use Diesel and CNG Curbside Passenger Buses in New York City

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The Aerodyne Mobile Laboratory simultaneously measured gas phase and particulate emissions from in use vehicles during two campaigns in New York City. The campaigns took place during two weeks in October, 2000 and four weeks in July-August, 2001. Passenger curbside buses were the primary focus of the study, but school buses and several other heavy duty diesel vehicles were also characterized. This paper describes the methodologies used to measure individual in use vehicles and presents the results of the gas phase measurements.

Emission ratios for NO, NO<sub>2</sub>, SO<sub>2</sub>, N<sub>2</sub>O, CO, CH<sub>4</sub> and H<sub>2</sub>CO relative to CO<sub>2</sub> have been determined across several classes of buses. The gas phase concentrations were measured each second, using Tunable Infrared Laser Direct Absorption Spectroscopy (TILDAS). Some of the categories of buses into which the data has been sorted are: diesel (both 6V92 and Series 50) with and without the Continuous Regenerative Technology (CRT) retrofit, compressed natural gas powered (CNG) and hybrid diesel-electric buses. The New York Metropolitan Transit Authority (MTA) cooperated with this work, providing details about each of

their buses followed. In addition to MTA buses, other New York City passenger bus operators were also measured.

In September 2000, MTA began to switch to 30 ppm sulfur diesel fuel while it is believed the non MTA operators did not. The measured emission ratios show that low sulfur fuel greatly reduces the amount of SO<sub>2</sub> per CO<sub>2</sub>. Roughly one third of the MTA fleet of diesel buses have been equipped with the CRT retrofit. The gas phase results of interest in this category show increased direct emission of NO<sub>2</sub> and companion work (also submitted to the 12th CRC) show the impact the CRT retrofit has on particulate emissions. CNG buses show increased H<sub>2</sub>CO and CH<sub>4</sub> emission ratios relative to diesel powered motors.

## A52B-0113 1330h POSTER

## On the Aerosol Source Livestock Raising

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Agriculture is a prime stakeholder in the atmospheric and climate changes as on one hand side it will be strongly affected by a changing climate and yet is today by air pollution while on the other hand, through her emissions agriculture is also driving these changes. Particulate matter is important for air pollution / human health. Very little is known about the mass flux and composition of the particulate matter emitted from livestock farming.

We report on the design and results of a pilot study investigating the aerosol source livestock farming undertaken at the experimental farm Talgut Lindenhof of the University of Hohenheim, in a hilly region in Southern Germany.

Particulate matter was sampled for off-line chemical analyses and physically characterized in-situ close to the animal housings as well as through simultaneous measurements upwind and downwind of the farm. Off-line analyses comprised particulate matter mass, inorganic ion content, carbon fractions, total element content, single particle analyses, besides other. Estimates on the emission term are made.

## A52B-0114 1330h POSTER

## Tracing Ambient Air Geochemistry using a Modified X-Ray Fluorescence Filter Method

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Modifications of x-ray fluorescence counting procedures enable tracing of aerosol dispersals related to weather fronts and local weather phenomena. Improved X-ray fluorescence methods for bulk aerosols deposited under positive air pressure conditions onto Millipore filters at 80 liters/hour enable the tracing of geological samples in periods down to one hour. Vacuum-plating aliquots of USGS standards onto 0.2 micron polycarbonate and quartz Millipore filters create standards with a shelf life of several months. The analytical system permits detection of light oxides, such as silica to 10 ppm, and heavy elements, such as iron to 0.5 ppm. These collections allow discriminations to be drawn between dominantly geological, silica-enriched air mass and dominantly iron-enriched air of possible industrial origin. These ambient air collections at 120 feet elevation at City College are used to create possible distinctions in air masses related to points of origin. Splits of aerosol examined by neutron activation and coupled plasma emission spectroscopy agree with x-ray fluorescence methods to within analytical error.

Aerosol flux conditions are monitored for speciation using direct examination by scanning electron microscopy with energy dispersive analytical capability plus aerosol physical properties by sun photometry. The latter provides bulk optical transmission at six major wavelengths and estimates for bulk aerosol size properties. Preliminary data show positive photometry links with iron-aerosols with a correlation coefficient with southwesterly wind-driven conditions of seventy percent over a four hour monitoring period. Aerosol flux comparisons with heavy metal populations, Ba, Rb, Zr, La show uniform distributions with iron- and silica-enriched populations indicating a pervasive background condition in the ambient air mass over New York City.

## A52B-0115 1330h POSTER

## Persistent Organic Compounds - Long-range Transport and Multicompartmental Distribution

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Many chemicals, intentionally (such as pesticides) or unintentionally introduced into the environment are persistent or undergo long-range transport. The environmental fate is determined by chemical transformations in the compartments and inter-media and intra-media transports. Once, deposited from the atmosphere, semivolatile compounds, such as POPs and most pesticides, which are slowly degradable in the ground compartments will undergo one or more subsequent atmospheric cycles. This may imply effectively long atmospheric residence times.

We use a complex (3D, dynamic) multicompartment chemistry-transport model which is based on a general circulation model of the atmosphere, ECHAM4, for the study of the multimedia environmental fate of semivolatile organic compounds. The atmospheric cycling and the geographic and compartmental distributions of pesticides is studied as influenced by the mode of entry and the region of emission. Respective results will be presented and discussed.

## A52B-0116 1330h POSTER

## Variations of Persistent Organic Pollutants in Ambient Air of Jeju Island, Korea

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Atmospheric concentrations of persistent organic pollutants (POPs) were measured at Gosan, Jeju, two times, in November 2001 and in March and April 2002, each time for two weeks. Gosan is a representative background site in Korea and was a super site during ACE-Asia. Purposes of this work were to monitor the background concentrations of POPs in Korea and to assess the effect of long-range transport of these substances. Primary target pollutants were twelve chemicals such as organochlorine pesticides, PCBs, and PCDD/Fs listed in the Stockholm Convention adopted in May 2001. However, PAHs were also measured in order to understand the overall characteristics of the POPs distribution since PAHs are most abundant POPs in our environment. Fine particles are usually an ideal carrier for long-range transport of POPs; size distribution and chemical composition of fine particles were analyzed in order to estimate the transport of POPs.

Much higher concentrations of pollutants such as PAHs, PCDD/Fs, SO<sub>2</sub> and fine particles, which were

believed to be emitted from combustion sources, than other measurement data until that time, were observed in the latter part of the November 2001 measurement period. Change of nitrate distribution from coarse to fine particles at that time indicates that higher concentrations could be resulted from emissions in the nearby area. Variations of organochlorine pesticides did not correlate with those of other pollutants; their concentrations were not consistently low even compared with those from contaminated areas in the world. March and April are the period of Yellow Sand in Northeast Asia. In the latter part of the spring 2002 measurement period, PM10 concentration went up to 320  $\mu\text{g}/\text{m}^3$  because of heavy Yellow Sand. Characteristics of the variations of POPs in the two distinct measurement periods were compared and discussed.

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#### A52B-0117 1330h POSTER

##### A regional model for PCDD/Fs based on a photochemical model for air quality and particulate matter.

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How important is gas to particle partitioning in predicting air concentrations and deposition of PolyChlorinated Dibenzo-p-Dioxins and Furans (PCDD/Fs)? Studies indicate that the fate controlling processes drastically change. Dry deposition decreases if fine particulate matter up takes the compounds but it increases if coarse and larger particulates provide a large amount of particulate mass. Wet deposition increases, as sorption to particulate matter increase but increased wet deposition is episodic. Competing effects then make assessing impacts from partitioning difficult. This presentation attempts explores the impact with a regional model for air quality and particulate matter. The model uses a continental domain and a simulation period from one to two months. Both facilitate investigating compounds that undergo long-range transport such as PCDDs and PCDFs. To quantify the above impacts, deposition and transport changes are rated against congeners with differing volatility. Additional evaluation compares observed air concentrations to model results.

#### A52B-0118 1330h POSTER

##### Atmospheric Transport Simulation of the Chernobyl Accident by a GCM Eulerian Model

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The atmospheric transport of radionuclides from a source close to Chernobyl is simulated by the Global Climate Model LMDZ, developed at the Laboratoire de Mtorologie Dynamique in Paris. The source has been released at different altitudes and at different times between April 26 and April 28 1986. Simulations with 192x145 grid cells essentially distributed over Western Europe and 19 levels vertically, are carried out in a "nudged" mode, where horizontal velocities and temperature are relaxed towards wind analyses ECMWF, available every 6 hours. Transport is based on mass conservation of the tracer in the atmosphere, taking into account the parameterization of turbulent mixing and convection. Concentration maps for a transport episode of 15 days show that the grid resolution of a few tens of kilometers is necessary in this model. Numerical results show that South-East of France is affected by the radioactive plume on 1st and 2nd May with calculated concentrations close to the estimated ones. Finally, sensitivity tests are carried out for this accident by varying the vertical spatial resolution, by using different precipitation models, and by testing a new vertical parameterization of vertical transport in the boundary layer.

#### A52B-0119 1330h POSTER

##### Evaluation of a Regional Air Quality Model Using Ground-based Observations in North-eastern Canada and United States

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The 3-dimensional regional air quality model (MC2AQ) was used to simulate the high ozone episode recorded at numerous ground-based observations over North-eastern Canada and United States in July 1999. The model, driven by a non-hydrostatic mesoscale compressible community meteorological model (MC2), includes online oxidant chemistry of inorganic and organic species, as well as emissions and deposition. Two different standard emissions inventories for the year 1990 and year 1985 were used separately as the model input from anthropogenic and natural sources. The comparisons using various statistical methods between model predictions and the ground based observations show that the model can capture ozone (O3) diurnal variation, peak concentration, and geographical distribution very well. Over the entire MC2AQ domain, the values of 18.5% for normalized gross error (NGE) and -10.9% for normalized bias (NB) are found to be within acceptable ranges. About 80% of the monitoring sites have an index of agreement (between the predicted and the measured ozone) larger than 0.8. The predictions for other gaseous species, such as SO<sub>2</sub>, NO, NO<sub>2</sub> and NO<sub>x</sub>, were also compared to the measurements and show some discrepancies, but they are consistent with the results from other models evaluated by others in the literature. In addition, the predictions of wind speed and direction showed good agreement with the use of the MC2 meteorology driver. Further model development and evaluation will focus on particulate matter.

#### A52B-0120 1330h POSTER

##### Airborne Characterization of Haze Over the Mid-Atlantic and Northeastern U.S.

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The mid-Atlantic and Northeastern regions of the United States are notorious for air pollution, the most evident manifestation of which is the severe and semi-permanent haze that during the worst episodes greatly reduces visibility and may be inversely related to respiratory health. On an intensive field campaign lasting from May through September 2002 aboard a Piper Aztec light aircraft outfitted for atmospheric research, and spanning the region from Virginia to Maine, our group has studied the radiative properties, vertical structure, chemical composition, and size distribution of the particulate matter that leads to the haze phenomenon. These regions experienced consistently elevated haze levels throughout the summer with a few episodes that are particularly interesting. During a mid-August Northeastern haze episode, total particle count exceeded 10,000  $\text{cm}^{-3}$  aloft at 800 m MSL and the total scattering coefficient,  $b_{\text{scat}}$ , was  $>10^{-4} \text{ m}^{-1}$  at 450 nm, 550 nm, and 700 nm. On one 800 m constant altitude transect from Maine to Maryland during the afternoon of August 14, ozone mixing ratios aloft were well above 125 ppb for several hours and even topped 180 ppb for a short time. Correlations between ozone, Ozone/CO, and SO<sub>2</sub>/Ozone coupled with back trajectory analyses and a comparison of SO<sub>2</sub>/ $b_{\text{scat}}$  (550 nm) to RH suggest metropolitan areas as emission sources strongly influencing air quality aloft. Ozone and  $b_{\text{scat}}$  (550 nm) and Ozone and  $b_{\text{ap}}$  (565 nm) were also strongly correlated suggesting a similar pollution source and possibly increased ozone production due to scattering from the haze. Other flights using chemical tracer species and trajectory analyses to characterize the boundary layer and lower free troposphere over the mid-Atlantic and Northeast during pollution episodes are generally suggestive of an industrialized Midwest regional source.

URL: <http://www.meto.umd.edu/~umdair/ramp01.html>

#### A52B-0121 1330h POSTER

##### Pollution Gradients on a Fine Spatial Scale

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Gas phase tropospheric oxidants in photochemical smog are measured with a mobile unit to determine if localized concentration gradients exist. Species sampled include ozone, hydrocarbons, and nitrogen oxides. The study was conducted in the area immediately surrounding the California State University Los Angeles campus, with sampling sites between 200 to 1000 meters apart. Pollutant concentrations are correlated with variables such as local topography, land use, meteorological conditions, and traffic patterns. Meteorological sampling at each measurement site consists of temperature, humidity, dew point, barometric pressure, wind speed and direction.

Preliminary sampling suggest no strong correlations between concentration gradients and meteorological factors, rather they are weak determinants. Stronger correlation is shown with land use; sites in close proximity to busy freeways tend towards lower ozone concentration. The largest gradients are seen when pollutant concentrations are moderate to high. The possible causes for these trends and gradients will be discussed.

#### A52B-0122 1330h POSTER

##### Air Quality in the Mid-Atlantic/Northeast Region: An Aircraft Survey

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Parts of the U.S. Mid-Atlantic and Northeast are frequently in violation of the 125 ppbv 1-hr national ambient air quality standard for ozone (O3). The frequency of occurrence and spatial coverage of these violations are expected to increase when/if new standards for fine particulate matter (PM) and ozone averaged over 8-hr come into effect. Online aircraft measurements provide a powerful tool for determining the levels and origins of both primary and secondary pollutants of interest. During the summer of 2002 the University of Maryland at College Park used a twin engine Piper Aztec-F PA-27-250 aircraft to; investigate pollution transport (ozone, haze, and gaseous precursors) over region, state, and class 1 area boundaries; characterize planetary boundary layer (PBL) height, dynamics and development; investigate cross-corridor (transport corridors, metropolitan/ industrial areas) differences in air quality aloft leading to downwind enhancements in pollutants; investigate mesoscale and sub-regional transport influences (e.g. bay and sea breezes, low-level jets, urban island effects) upon near surface air quality and visibility; acquire in situ data for initialization, constraint, and evaluation of ongoing and planned measurement analyses efforts and modeling studies within the region. A total of 54 research flights (192.5 hours), consisting of fixed-position vertical survey spirals and constant altitude transects, were made upwind, near and downwind of selected major cities/industrial areas, transport corridors and class 1 areas in the Northeast, Mid-Atlantic regions. Preliminary results from upwind, near and downwind data show that major cities/industrial areas (Richmond, Washington, Baltimore, Philadelphia, New York and Boston) and transport corridors are net sources of primary and secondary pollutants (gaseous precursors, ozone, and haze). Class 1 areas (Shenandoah national park VA, Lye Brook NY, Mt. Washington in New Hampshire NH and Acadia in ME), on the other hand, are net recipients. Long-range transport is an important contributor to the regional pollutant load. Its significance was demonstrated in the data from research flight 13 conducted on 06/24/02 that captured elevated levels of pollutants aloft the Washington/Baltimore area, the source of which was traced to Canadian forest fires, which were raging at the time of the flight.