

identify the influence of measurement conditions and developed a model of the LII process that accounts for particle heating by laser absorption, oxidation, and annealing and cooling by sublimation, radiation, and conduction to the surrounding atmosphere. The model also accounts for mass loss by oxidation, sublimation, and nonthermal photodesorption of carbon clusters. The results of this study allow us to identify the largest uncertainties associated with the understanding of LII and predict the influence of measurement parameters on LII signal under varying conditions encountered in the atmosphere.

A11E-0033 0830h POSTER

Exploring the Potential of Satellite Data for Air Quality Applications

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We explore the relationship between column aerosol optical thickness (AOT) derived from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the Terra/Aqua satellites and hourly fine particulate mass (PM_{2.5}) measured at the surface at seven locations in Jefferson county, Alabama for 2002. Results indicate that there is a good correlation between the satellite-derived AOT and PM_{2.5} (linear correlation coefficient, R=0.7) indicating that most of the aerosols are in the well-mixed lower boundary layer during the satellite overpass times. There is excellent agreement between the monthly mean PM_{2.5} and MODIS AOT (R>0.9), with maximum values during the summer months due to enhanced photolysis. The PM_{2.5} has a distinct diurnal signature with maxima in the early morning (6:00-8:00AM) due to increased traffic flow and restricted mixing depths during these hours. Using simple empirical linear relationships derived between the MODIS AOT and 24hr mean PM_{2.5} we show that the MODIS AOT can be used quantitatively to estimate air quality categories (e.g., good, moderate, unhealthy for special groups, unhealthy and hazardous) as defined by the U.S. Environmental Protection Agency (EPA) with an accuracy of more than 90% in cloud-free conditions. We emphasize that several factors including aerosol vertical distribution and local meteorological conditions could affect the correlation between satellite-derived AOT and PM_{2.5} mass. Therefore, more research is needed before applying these methods and results over other areas. Similar analysis including plume transport model analysis over other PM_{2.5} locations will also be presented.

A11E-0034 0830h POSTER

Modeling Studies of the Contribution of Regional Transport to the Formation of Secondary Aerosol over the Western United States

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The formation of ammonium nitrate particles from nitrogen oxides, volatile organic compounds and ammonia produces a large fraction of secondary aerosol particles over the Western United States. The three largest source regions in California are Los Angeles, the San Francisco Bay Area and the San Diego Region. Simulations were made with a 3-d air quality model, the Comprehensive Air Quality Model with eXtensions (CAMx), to estimate the effect of emissions from these urban areas on secondary aerosol concentrations over the Western United States. The emissions were found to increase aerosol production over much of California but the effect was smaller for cities such as Las Vegas. Preliminary simulations showed that secondary aerosol concentrations reached peak values, up to 11.5 mg m⁻³, during the early morning hours in Las Vegas. The mass fractions of nitrate, ammonium, sulfate and organic aerosol in the secondary aerosol were calculated to be 71.6, 22.4, 5.0 and 1.1%, respectively. Eliminating the VOC and NOx emissions from Los Angeles resulted in a maximum reduction of total secondary aerosol near 25% in Las Vegas with an average reduction of 8.9%. Eliminating emissions from the San Francisco Bay Area resulted in a maximum reduction near 10% with an average reduction of 3.0% and eliminating

emissions from the San Diego Region resulted in a near 10% reduction with an average reduction of 3.3%. Improved simulations are in progress with improved emissions inventories and models, including the MM5-Chem model.

A11E-0035 0830h POSTER

Application of Size-resolved and Chemically-specified Particulate Matter Emission Measurement Data to Air Quality Modeling in the Lower Fraser Valley

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The size and composition information of aerosols in the atmosphere is critical in understanding its behavior and environmental impacts. Emission inventories usually report particulate matter (PM) as PM_{2.5} and PM₁₀ respectively. In order to realistically simulate aerosol size and chemical composition variations in the air, size-resolved and chemically-specified PM emissions are desirable. In this work, we collected measured size and chemical species distributions of PM emissions for various source categories existing in the Lower Fraser Valley (LFV) region, British Columbia. Corresponding source category codes (SCCs) were assigned to the collected data. A SCC based database was built accordingly. A software package was developed and used to process the data to generate size-segregated chemical speciation profiles for the SCCs of PM emissions in the LFV region. These profiles were used in the emission processing stream to produce size-resolved and chemically-specified PM emissions. The resulting PM emissions were utilized by Models3/CMAQ in an air quality modeling study in the LFV region. In Models3/CMAQ, aerosols are represented as a superposition of three lognormal size-distributions named Aitken mode, accumulation mode and coarse mode. A methodology was developed to allocate emissions of different PM species in various size bins to model species in the three modes, based on the modeled ambient particle size distributions. The model results with and without size-resolved, chemically-specified PM emissions showed significant differences with respect to spatial and temporal distributions of modeled aerosol loading in the LFV region. Depending on the modeled PM species, the time averaged concentrations in the LFV from the two results can differ by orders of magnitude. Using the size resolved, chemically specified PM emissions introduced relative changes in the domain averages of the modeled fine PM and coarse PM concentrations ranging from 120% to -40% and 700% to -10%, respectively. The size resolved and specified PM emissions also showed positive impacts on the model performance.

A11E-0036 0830h POSTER

Modeling the Big Bend Regional Aerosol and Visibility Observational (BRAVO) Study using CMAQ-MADRID

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A scientifically rigorous treatment of particulate matter within the framework of the Community Multiscale Air Quality (CMAQ) model is provided by CMAQ-MADRID (Model for Aerosol Dynamics, Reaction, Ionization, and Dissolution). CMAQ-MADRID is used to simulate the fate and transport of ambient gases and particulate matter (PM) during the Big Bend Regional Aerosol and Visibility Observational (BRAVO) study. The configuration of CMAQ-MADRID used for this study comprises the Regional Acid Deposition

Mechanism v.2 (RADM2) gas-phase chemistry mechanism, a sectional PM solver incorporating the ISOR-ROPIA inorganic thermodynamics module and the AER/EPRI/Caltech (AEC) secondary organic aerosol (SOA) module, and the Carnegie Mellon University (CMU) cloud chemistry module. Boundary conditions for gas- and particle-phase species are prescribed by an outer domain simulated using the Regional Modeling System for Aerosols and Deposition REMSAD (whose domain comprises most of North America). Sulfur dioxide (SO₂) and particulate sulfate boundary conditions for the REMSAD domain are provided by the Georgia Tech/Goddard Global Ozone Chemistry Aerosol Radiation Transport (GOCART) model. Concentrations of sulfur dioxide and particulate sulfate at the CMAQ boundary are scaled to observations from monitoring stations of the Clean Air Status and Trends Network (CASTNet) and Interagency Monitoring of Protected Visual Environments (IMPROVE) network. The performance of CMAQ-MADRID is evaluated by comparing predictions with field measurements of the principal components contributing to visibility degradation: salts of ammonium with sulfate and nitrate, organic mass, elemental carbon and "other" particulate matter constituents, e.g. dust, sea salt and metal oxides. Model performance with respect to sulfate predictions, including model performance for its gas-phase precursor, sulfur dioxide, is explored across the thirty-seven stations comprising the BRAVO Network. The performance of CMAQ-MADRID in simulating total fine particulate matter across the BRAVO Network is also investigated. Detailed diagnostic analyses of model performance, including comparison between observed/simulated trends, are performed for fine particulate matter and its main components (SO₄²⁻, NO₃⁻, NH₄⁺, OM, EC and "other") at Big Bend National Park. Potential causes for discrepancies between model predictions and observations during the BRAVO study are discussed.

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A11E-0037 0830h POSTER

Infrared Mineral Dust Property Retrievals Using AIRS on Aqua

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A physically-based infrared mineral dust property retrieval algorithm has been developed and tested with daytime AIRS radiances as inputs over ocean and land in the presence of dust to determine the surface temperature, effective dust temperature, dust effective radius and dust optical thickness at 550 nm. The aerosol optical thickness results from the physical retrieval algorithm are shown to agree with both MODIS and AERONET aerosol retrievals, and the surface temperature retrievals are shown to agree with the 11.1 μm AIRS surface brightness temperatures, which were not used in the retrievals.

A11F MCC: Level 1 Monday 0830h

Reactive Chemistry in the Troposphere Posters

Presiding: P I Palmer, Harvard University; P S Stevens, Indiana University

A11F-0038 0830h POSTER

Photolysis of PAN at High Latitude

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Tropospheric composition is in part determined by chemical reactions between anthropogenic and biogenic compounds. Acetyl peroxyoxynitrate (PAN) is formed from reactions of partially oxidized hydrocarbons and NO_x . Once formed, PAN can remain stable thereby transporting quantities of NO_x from regions of high hydrocarbon- NO_x pollution to remote areas of the globe. In Arctic regions, the thermal decomposition of PAN is slowed to a rate comparable to that of UV photolysis. The primary photoproducts from PAN are NO_2 and NO_3 . Photolysis producing NO_2 and acetyl peroxy radical is reversible, thus leading to irreversible PAN loss. We report measurements of the quantum yield of NO_3 from PAN photolysis. By detecting nitrate radical using cavity ring-down absorption spectroscopy, a highly precise value of $\phi_{\text{NO}_3} = 0.30 \pm 0.06$ is determined. Previous modeling studies of PAN photolysis results have assumed wavelength independence. The results presented indicate the possibility of a wavelength dependence of ϕ_{NO_3} . Atmospheric implications of PAN photolysis in the Arctic will be discussed.

A11F-0039 0830h POSTER

Distribution of Reactive Nitrogen in the Sierra Nevada Foothills

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Nitrogen oxides can exert regional influence over areas downwind by governing photochemical ozone production and by contributing to nitrogen deposition in ecosystems. The Sierra Nevada mountain counties routinely exceed national ozone standards and atmospheric nitrogen deposition has been identified as a potential cause of the declining water clarity of Lake Tahoe. Thermal dissociation laser-induced fluorescence (TD-LIF) was used to make continuous, high time resolution observations of NO_2 , total peroxy nitrates (ΣPNs), total alkyl nitrates (ΣANs), and HNO_3 at two sites in the Sierra Nevada foothills. This is the fourth year of measurements by TD-LIF at the Blodgett Forest Research station (38.90°N, 120.63°W, 1315 m asl). Measurements began at Big Hill, 30 miles to the east (38.85°N and 120.42°W, 1850 m asl), in spring of 2003 as part of the Lake Tahoe Atmospheric Deposition Study. The abundance and partitioning of the reactive nitrogen species, NO_2 , ΣPNs , ΣANs , and HNO_3 , over several months at the two sites are compared. The Blodgett Forest site is subjected to a regular daily pattern of mountain-valley flow, whereas the site at Big Hill is exposed to a wider range of synoptic weather patterns. The similarities and differences between the diurnal profiles and absolute amounts of reactive nitrogen species at the two sites allow us to begin to examine the complex interplay between transport and chemistry that governs the distribution of nitrogen species in the boundary layer.

A11F-0040 0830h POSTER

Nitrous Oxide Emissions From Interior Chaparral in the Southwestern United States

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Amidst the growing tide of interest in global trace gas budgets and process studies, scant attention has been paid to arid and semi-arid ecosystems (<500mm of annual precipitation). This paper reports on chamber and eddy covariance measurements of nitrous oxide fluxes made in the interior chaparral in the Central Arizona Highlands. The interior chaparral is a highly unusual ecosystem in the temperate latitudes because nitrogen fixing woody shrubs dominate the vegetation community. The bimodal nature of the annual precipitation regime leaves extended dry periods during which little denitrification can take place, thus allowing for the potential buildup of soil nitrate levels. Summer wet season precipitation could then lead to significant emissions of nitrous and nitric oxides. Measurements taken during the wet summer season of 2003 were used

to quantify fluxes of nitrous oxide at a site dominated by *Cercocarpus betuloides* and *Ceanothus greggii*, both actinorhizal N-fixing plants. These measurements confirmed the presence of significant nitrous oxide fluxes. The results are used to draw some preliminary conclusions about the overall contribution to nitrous oxide emissions from chaparral in the Southwestern United States.

A11F-0041 0830h POSTER

Comparing Techniques to Measure Low Mixing Ratios of Nitrous Acid in the Arctic

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Real time measurements of atmospheric nitrous acid (HONO) were made in the European high Arctic at Ny-Ålesund, Svalbard (79°N) during May 2003 using SA/NED derivatization and subsequent HPLC analysis. Our 3σ detection limit was on the order of 1 pmol mol^{-1} in a 10-min measurement. Preliminary measurement results show a diurnal variation of HONO above the snow surface, with a maximum of only 3 - 4 pmol mol^{-1} in the early afternoon. Simultaneous measurements were made using the C.N.R.-IIA filter/denuder technique. This technique yielded results that were systematically higher by a couple of pmol mol^{-1} . The systematic differences will be discussed in this work. These results support recent findings that HONO emissions in marine Arctic environments are reduced above alkaline snow surfaces because of the low mobility of the nitrate ion in the snow.

A11F-0042 0830h POSTER

Impact of Increased Nitrogen Oxide Emissions from Diesel Engines on Regional Atmospheric Chemistry

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Over the last 30 years, major efforts have been made to control emissions from light-duty passenger vehicles (in North America, these vehicles are almost all powered by spark-ignition gasoline engines). Progress in reducing these emissions has been more rapid for carbon monoxide and volatile organic compounds than for nitrogen oxides. Emission reductions have occurred despite increases in the number of vehicles on the road, the amount they are driven, and the amount of gasoline burned. Efforts to control heavy-duty compression-ignition (diesel) engine emissions began more recently, and to date have resulted in only minor reductions in the emission rate of nitrogen oxides. Furthermore, since use of diesel fuel has been growing at a rate that is about three times faster than gasoline, nitrogen oxide emissions from diesel engines have been increasing in both relative and absolute terms. The overall result is that mobile source (mainly gasoline engine) emissions of CO and VOC are declining, while total (gasoline+diesel) mobile source NO_x emissions are approximately unchanged. Weekly cycles are observed on regional to continental scales in the measured atmospheric concentrations of nitrogen oxides. In California, an observed effect of higher ozone on weekends has become much more widespread between 1980 and 2000. The spreading of this weekend ozone effect is consistent with the increasingly important role of diesel engines as a source nitrogen oxides, and the strong weekly cycle in diesel engine activity and emissions.

A11F-0043 0830h POSTER

Assessment of the Photochemistry of OH and NO₃ on Jeju Island during the Asian Dust-Storm Period in the Spring of 2001

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In this study, we examined the influence of long-range transport of dust particles and air pollutants on the photochemistry of OH and NO_3 on Jeju Island, Korea (33.17°N, 126.10°E) during the Asian Dust-Storm (ADS) period of April 2001. Three ADS events were observed during the periods of April 10-12, 13-14, and 25-26. Average concentration levels of daytime OH and nighttime NO_3 on Jeju Island during the ADS period were estimated to be about 1×10^6 molecules cm^{-3} and 2×10^8 molecules cm^{-3} , respectively. OH levels during the ADS period were lower than those during the non-Asian-Dust-Storm (NADS) period by a factor of 1.5. This was likely to result from higher CO levels and the significant loading of dust particles, reducing the photolysis rates of ozone. Decreases in NO_3 levels during the ADS period was likely to be determined mainly by the enhancement of the N_2O_5 heterogeneous reaction on dust aerosol surfaces. Averaged over 24 hours, the reaction between HO_2 and NO was the most important source of OH during the study period, followed by ozone photolysis, which contributed more than 95% of the total source. The reactions with CO, NO_2 , and non-methane hydrocarbons (NMHCs) during the study period were major sinks for OH. The reaction of N_2O_5 on aerosol surfaces was a more important sink for nighttime NO_3 during the ADS due to the significant loading of dust particles. The reaction of NO_3 with NMHCs and the gas-phase reaction of N_2O_5 with water vapor were both significant loss mechanisms during the study period, especially during the NADS. However, dry deposition of these oxidized nitrogen species and a heterogeneous reaction of NO_3 were of no importance. Key Words: OH, NO_3 , Asian dust storm, ACE-Asia, Jeju Island

A11F-0044 0830h POSTER

Measurement of total OH reactivity in the urban atmosphere by Chemical Perturbation using a Laser-Induced Fluorescence technique

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A measurement system of total OH reactivity in the atmosphere has been newly developed by chemical perturbation using a laser-induced fluorescence method. Ambient air was introduced into a flow tube placed just above an OH detector. In the flow tube, a pulsed 266-nm laser (a fourth harmonic of Nd:YAG laser) with a low repetition rate (0.5 - 10 Hz) was irradiated. OH is generated in the photolysis of ozone by the UV laser. The OH reacts with trace species in the reaction tube and the concentrations of OH are decreased with time after irradiating the laser pulse. The OH decay in the flow tube is measured by laser-induced fluorescence. The air in the reaction tube was introduced into a low-pressure (~300 Pa) fluorescence detection cell through an orifice (1-mm diameter), which was settled at the center of the radial cross section of the flow tube. The A-X(0,0) Q₁(2) line of OH ($\lambda \sim 308$ nm) was excited by use of a tunable frequency-doubled dye laser pumped by a second harmonic of the Nd:YVO₄ laser with a repetition rate of 10 kHz. The resonant fluorescence was detected using a photomultiplier tube. When concentrations of the species which react with OH radicals are much higher than the OH radicals, it is expected that the OH decay rate is pseudo-first order. The time profile of the measured LIF signal was fit to single-exponential curve and then the decay rate was determined by use of the fitting expression. The decay rates of zero air with known amount of CO were measured and the obtained second-order rate coefficient agreed excellently with the previous reported value. Field observations were conducted in Tokyo Metropolitan University in July and August 2003. Simultaneous measurements of O₃, CO, SO₂, NO, NO₂, VOCs, OVOCs, temperature and relative humidity were made during the observations. The measured OH reactivities were usually higher than the calculated values using simultaneously measured concentrations of various trace species and the rate coefficients of OH and the trace gases. This disagreement would be due to existence of unknown species reacting with OH and/or the uncertainty of the OH + NO₂ reaction rate coefficient. OH uptake on particles was not confirmed during this observation.

A11F-0045 0830h POSTER

Product Analysis of the OH Oxidation of Acetic Acid in Air in the Presence of NO

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The oxidation of acetic acid (CH₃COOH) by OH in air and in the presence of high NO was studied under "wall-less" conditions in Harvard's High Pressure Flow System. The experiments were conducted at 50 torr with a reaction time on the order of a second. In the present work, first stage products are formed at 10¹² molecules/cm³ levels and analyzed in-situ by FTIR spectroscopy. The use of Reaction Modulation Spectroscopy allows for determination of product concentrations and for accurate measurement of the very small (<1% and <3%, respectively) change in acid and NO reactants. Observed products from the reaction include nitrogen dioxide (NO₂) and near unit yield of carbon dioxide (CO₂), supporting the proposed mechanism of attack on the acidic hydrogen followed by dissociation. The expected co-product formaldehyde (CH₂O) is not observed, but the anticipated concentrations are below the detection limit in the current experiment. We observe no evidence of formation of carbon monoxide (CO), placing an upper limit on its yield at <1%, indicating that attack of the methyl hydrogens is either insignificant or does not form CO as has been previously proposed. The observed primary products and proposed mechanism have long been suggested, but this is the first direct observation of the near unit CO₂ yield of the reaction under high NO₂ conditions.

A11F-0046 0830h POSTER

Hydroxyl Radical Formation in Solutions of Fe(III) and Hydrogen Peroxide - Impact of Freezing and Thawing Process

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Hydroxyl radical formation was studied by detecting concentration of formate in solutions of hydrated formaldehyde, HOOH, and Fe(III) or Cu(II). Oxidation of hydrated formaldehyde by OH radical is known to form formate. Formate formation increased by about 4 times when the solution underwent freezing and thawing. Although the reaction mechanisms are not clearly understood, we believe that the concentration effect of freezing enhanced the catalytic reactions between HOOH and Fe(III) or Cu(II) and the reduction of transition metals, i.e., Fe(III) to Fe(II) and Cu(II) to Cu(I). The concentration effect also enhanced reactions between Fe(II) and HOOH or Cu(I) and HOOH, which generated OH radical (freeze-Fenton reaction). Study of the effects of pH showed that formate formation was the highest at pH = 4.0, indicating that the speciation of Fe(III) affected the formation of formate. Concentration-dependent experiments demonstrated that Fe is probably the limiting agent under typical atmospheric conditions. Our results suggested that the freezing process could be an important source of hydroxyl radical in high cloud, winter fog, rime ice and freezing acidic rain, and more importantly, a potentially additional oxidation mechanism in the atmosphere.

A11F-0047 0830h POSTER

The role of dew in controlling HONO surface-air exchange during the night and in the morning

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The presence of dew on surfaces may significantly influence temporal distributions of water-soluble species, such as HONO, in the atmospheric boundary layer. Our ambient HONO measurements at several rural sites suggest that wet ground surfaces act as a sink for ambient HONO during the late night and in the early morning, reversing the trend of nighttime HONO accumulation. When dew evaporates in the morning, part of the trapped nitrite is released into the overlying atmosphere, contributing to the high-than-expected HONO concentrations despite of its effective photolysis. Here we present several new evidences to support the hypothesis that dew on ground surfaces is a sink and a temporary reservoir for atmospheric HONO. First, vertical HONO gradient measurement over a forested site indicates that HONO exchange between canopy surface and the overlying air is closely coupled with air relative humidity. Secondly, a temperature-controlled flow reaction experiment mimicking dew formation and evaporation shows an efficient loss of gas-phase HONO when surface is moist and a fast release of HONO into the gas-phase when surface is dry. And thirdly, samples from washing tree leaves

contain significant amount of nitrite when moist during early morning and little nitrite when dry in either morning or other time of the day. Atmospheric implications of our observations will be discussed in details.

A11F-0048 0830h POSTER

Development of a laser-induced fluorescence based instrument for measuring HONO at atmospheric concentrations

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A laser-induced fluorescence technique for in situ measurement of atmospheric HONO is described. The technique is based on photofragmentation of HONO followed by probing the vibrationally excited OH at 282 nm and measuring the fluorescence around 309 nm. The instrument is calibrated using standard addition of HONO. The system will be deployed during the Antarctic Tropospheric Chemistry Investigation (ANTCI) by the end of this year. The limit of detection is estimated to be around 10ppt or better in five minutes, which is adequate to address many problems in photochemistry.

A11F-0049 0830h POSTER

In-situ Measurement of Atmospheric NO₃ Radical by Laser-Induced Fluorescence Technique

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Nitrate radical (NO₃) plays critical roles in the nighttime atmosphere. NO₃ is important as an intermediate in the NO_x loss process. In addition, NO₃ can oxidize various tracers like hydrocarbons and generate peroxy radicals at night. The abundance of NO₃ is very small, at the level of pptv, due to its high reactivity. Temporal and spatial variability of NO₃ is large. Thus, sensitive, fast, in-situ measurement of NO₃ is essential. However, there are few techniques which can satisfy all requirements. In this study, a new laser-induced fluorescence (LIF) instrument for measuring NO₃ has been developed and improved. As the excitation light, the laser beam from a dye laser pumped by an SHG of Nd:YVO₄ laser (7 W, 10 kHz) is utilized. Typical output of the laser was 600 mW at 623 nm where the absorption spectrum of NO₃ has a peak. The sample air was introduced into the excitation cell at the pressure of ~2 Torr. The red-shifted fluorescence emitted from the excited NO₃ was detected by a cooled photomultiplier. Optimization of the instrument was conducted for various settings and configurations. Specifications of the instrument were explored for two standard samples: (a) NO₃ formation from NO_x oxidation by O₃, (b) NO₃ formation from thermal decomposition of N₂O₅ and then conversion to NO₂ by NO addition. As a result, good agreement between these two methods of NO₃ formation was confirmed. Finally, the sensitivity and background were 0.24 cps ppbv⁻¹ mW⁻¹ and 0.20 cps mW⁻¹, respectively. The limit of detection was estimated as 4 pptv for S/N = 1 and 10-min averaging. Thus, the instrument has sufficient potential to detect nighttime NO₃ in the atmosphere. As a next step, field test of the instrument will be carried out. The LIF-NO₃ instrument is promising for research on nighttime chemistry in near future.

URL: <http://atmchem.apchem.metro-u.ac.jp/~mjun/agu03/>

A11F-0050 0830h POSTER

Reactive Halogen Studies by Long-term MAX-DOAS Observations at Alert, Nunavut

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During sudden ozone and mercury depletion events in the polar boundary layer (BL) after sunrise, bromine oxide radicals (BrO) play a key role in catalytic ozone destruction cycles. Concentrations of BrO and several other species (e.g. IO, NO₂) in the BL including vertical profile information can be obtained using ground-based Multi Axis Differential Optical Absorption Spectroscopy (MAX-DOAS). Previous studies were focussed on the chemical changes during and shortly after polar sunrise. In February 2003 a new fully automated Mini-MAX-DOAS system was set-up at Alert, Nunavut, Canada (82.5°N, 62.5°W) to perform the first long-term studies of reactive halogen chemistry (particularly BrO and IO) at this high Arctic location. Compared to satellite-based measurements which are available on a daily basis throughout the year, ground-based observations have a much higher temporal and spatial resolution at a specific location which is necessary for chemical process studies in the boundary layer. The high sensitivity of ground-based MAX-DOAS allows studying small events during springtime and possible reactive halogen abundances during other times of the year. Results of several BrO events observed during polar spring 2003 as well as first data obtained during summer are presented and discussed here.

A11F-0051 0830h POSTER

Test of practical utilization of PTR-MS and observation of the urban air in Tokyo during summer time

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Proton transfer reaction mass spectrometry (PTR-MS) is a technique that has been developed recently. It has several advantages for measurement of volatile organic compounds (VOCs) in the atmosphere. PTR-MS instrument can observe VOCs with high time resolution, and can also measure oxygenated volatile organic compounds (OVOCs). Furthermore, PTR-MS does not require carrier gases. Although PTR-MS is available as a commercial instrument from the company (IONICON), the instrument is not enough characterized for general users. In this study, PTR-MS was calibrated with a permeator, several kinds of standard gases and data from PTR-MS were compared with that of GC-FID. Substances used to try calibration with the permeator were as follows; acetonitrile (CH₃CN), methanol (CH₃OH), acetone (CH₃COCH₃), acetaldehyde (CH₃CHO). Results of these substances had good linearity. In the case of standard gases that contained aromatics, isoprene and dimethylsulfide (DMS), they also showed good linearities. Measurements in the urban air in Tokyo from June to August were carried out. Tokyo Metropolitan University (TMU) is located in the west of Tokyo. Although TMU is urban site, there are many trees near the observation site. Therefore, the results were affected by the emission from plants. Aromatics, isoprene, terpenes were also measured by GC-FID in the beginning in June, and the results of PTR-MS were compared with the result of GC-FID. There was good correlation for all substances, especially of benzene, toluene, and xylene. CH₃CHO and isoprene showed clear diurnal changes. These concentrations were higher in the daytime and lower at night. HCHO signal was much lower than actual concentration because protonated ion had a reverse reaction with water. But clear diurnal change was observed. If proper correction is applied, HCHO could be measured by PTR-MS. Acetone did not show such clear diurnal changes. This result suggested that acetone had been affected by solvent emission rather than photochemical production. Peaks of methylvinylketone (MVK) and methacrolein (MACR) were shifted to later time than isoprene because MVK and MACR were produced by the oxidation of isoprene.

A11F-0052 0830h POSTER

Atmospheric trace gas measurements by PTR-MS over western Pacific during late winter in 2003 (MR03K01 cruise)

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Atmospheric measurements were conducted on R/V Mirai from February 20 to March 30 in 2003 over western Pacific. The ship left from Sekinehama, northern Japan, and went to 51°N 165°E, and then cruised down to south on 155°E line to 17°N. Then the ship cruised up to 40°N on 155°E line and returned to Japan. Data on northern Pacific during winter time were obtained during this cruise. Also there was an opportunity to get information about latitudinal gradient of atmospheric species at west Pacific in winter time. Concentrations of CO, O₃, SO₂, NO, NO₂, and JNO₂ value were measured continuously. VOCs were measured by Proton Transfer Reaction Mass Spectrometry (PTR-MS). Air was also sampled into canisters for VOC measurements (total 42 samples). The sampled air was analyzed by GC-FID and GC-MS in the laboratory in Tokyo after the cruise. At the northern Pacific, the concentration of CO and O₃ were almost constant. And only slight concentration gradient was observed between in 45°N and in 17°N on the 155°E line in this season. This was quite different from the similar observation in May in 2002; at that time quite lower concentration was observed at lower latitude and the latitudinal gradient was very clear. About longitudinal variation, the concentrations were almost same at high latitude and did not depend on the distance from the continent. Even short life species in the atmosphere such as pentane showed similar concentration along with distance from the land. The concentration of DMS was relatively low in this season. But DMS tended to become higher concentration at lower latitude. Sporadic high peaks of DMS were observed at lower latitude. Concomitantly, acetone became lower concentration. This would be related to the upwelling of sea water. CH₃CN was higher in lower latitude. There was no clear evidence of transport of air plume influenced by biomass burning. But the higher concentration at low latitude is probably related to the enhanced biomass burning at low latitude because lifetime of CH₃CN is relatively long.

A11F-0053 0830h POSTER

Estimating the sources and sinks of methyl iodide in the springtime North Atlantic Ocean

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Methyl iodide is a naturally produced compound that can be used to identify transport of marine air masses. Since methyl iodide is primarily produced in the ocean and has a short lifetime (on the order of 3-5 days), high concentrations suggest the recent influence of the ocean on an air mass. However, interest in methyl iodide is not limited to its use as a tracer. Methyl iodide is a major supplier of iodine for chemical reactions in the marine boundary layer, and it could contribute to ozone removal in the troposphere and stratosphere. Rapid vertical advection, particularly in the tropics, could transport methyl iodide to the lower stratosphere, releasing iodine radicals that participate in ozone depletion. This transport is expected to be most important in the tropics, but methyl iodide could also be delivered to the stratosphere at mid-latitudes. The cycling of methyl iodide in the water and the atmosphere is not well understood, which makes it difficult to predict how its concentrations will respond to global climate change. To address this, we use data collected for 30 days in a warm-core eddy (at about 46°N, -21°E) during the GasEx 98 cruise in the North Atlantic Ocean to study the oceanic cycling of methyl iodide. During this cruise methyl iodide concentrations were measured in both air and seawater samples. Methyl iodide seawater concentrations ranged from roughly 5-25 pM (corresponding to saturation anomalies of about 1000-8000%), although changes were generally gradual, taking place over the course of several days. We use surface irradiance measurements to test the assumption that methyl iodide production in the surface ocean is primarily photochemical. Methyl iodide air concentrations were more variable, increasing from about 0.8 ppt

to about 3 ppt in a day or two on more than one occasion. The episodic increases in atmospheric values corresponded to increased wind speed events and also are strongly anticorrelated with two anthropogenic compounds (perchloroethylene and dichloromethane). We use flux calculations and air mass trajectories to identify the relative contributions from the local oceanic flux and from more distant transport of methyl iodide-rich air masses.

A11F-0054 0830h POSTER

Formation of Gaseous Bromine From the Photolysis of Nitrate and Hydrogen Peroxide in Sea-Salt Solutions

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The formation of reactive halogen gases in sea-salt particles can play a significant role in chemistry within the marine boundary layer (MBL). While there have been several proposed mechanisms for the formation of reactive halogens in sea-salt particles, we were interested in whether hydroxyl radical (·OH) generated within the particles themselves could lead to release of gaseous reactive bromine species (Br*(g)). To examine this question, we illuminated (313 nm) solutions of chloride and bromide that contained either nitrate or hydrogen peroxide as a photochemical source of ·OH. Experiments were performed either in concentrated seawater or in laboratory solutions with halide concentrations that in most experiments were typical for deliquesced, aged sea-salt particles (e.g., 3.5 M Cl⁻, 5.0 mM Br⁻, 100 mM NO₃⁻, and pH 4). During illumination we bubbled air through the solutions and collected the released gaseous reactive bromine in downstream bubblers or denuders. We found that gaseous bromide was nearly always released during the illumination of solutions containing either nitrate (100 mM) or hydrogen peroxide (1.0 mM). In order to gain insight into the mechanisms for these reactions, we studied the effects of several factors on the rate of release of gaseous bromine. For example, the release of Br*(g) was enhanced in solutions at lower pH, and this pH-dependent trend was similar in both the nitrate and hydrogen peroxide systems. In solutions containing bromide and nitrate at a fixed ionic strength, the addition of chloride showed little effect on the Br*(g) release, while increasing ionic strength significantly slowed down its release. In hydrogen peroxide solutions, however, the presence of chloride strongly enhanced Br*(g) release, while the ionic strength of the solution was shown to have no effect on the reaction. Furthermore, the Br*(g) formation rate increased rapidly with bromide concentration in nitrate solutions containing 0 - 2 mM Br⁻, but was constant in the concentration range more typical in sea-salt particles (2 - 6 mM Br⁻). Finally, we found that Br*(g) release was independent of temperature in the range of 5 to 35°C in concentrated seawater with added nitrate. The dependence of Br*(g) release on bromide concentration and temperature in hydrogen peroxide solutions are currently being investigated. These findings suggest that OH-initiated reactions in sea-salt particles may be a source of gaseous reactive bromine species in the MBL, especially in polluted areas. The implications of this study for chemistry in the MBL, and possible mechanisms for the formation of gaseous bromine, will be discussed.

A11F-0055 0830h POSTER

The Global Cycle of Atmospheric Methyl Bromide – What Next?

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Atmospheric methyl bromide (CH₃Br) has received considerable attention and produced some controversy over the past decade, owing to its significant role in ozone depletion and its complex cycling in nature. Unlike other gases regulated by the Montreal Protocol on Substances that Deplete Stratospheric Ozone, methyl bromide has substantial natural sources and sinks at Earth's surface, in addition to its losses in the atmosphere. Consequently, estimating the sources and sinks and calculating the lifetime of this gas have not been as straightforward as for gases, such as the CFC's, of entirely anthropogenic origin and with losses only in the atmosphere. For almost ten years our understanding of the budget of this gas was one where sinks vastly outweighed sources and the lifetime kept getting shorter with the discovery of new sinks. Complicating the picture has been the absence of an atmospheric

record in the early 1990s, just as industrial production of the gas was held to constant levels. Research necessarily focused on identifying and quantifying the sources and sinks of this gas in marine and terrestrial systems in an effort to understand the budget and to calculate the atmospheric lifetime of CH₃Br. Recently published records documenting the decline of CH₃Br in the atmosphere following reductions in production shed new light on this gas, allowing us to revise budgets and lifetimes with a new set of constraints. The latest data also open up additional questions regarding lifetime calculations and biogenic emissions and suggest new opportunities for research. Montzka, S. A., J. H. Butler, B. D. Hall, D. J. Mondeel, and J. W. Elkins, A decline in tropospheric organic bromine, *Geophys. Res. Lett.*, 30(15), 1826, doi:10.1029/2003GL017745, 2003. URL: <http://www.cmdl.noaa.gov>

A11F-0056 0830h POSTER

Methyl bromide in pre-industrial air: measurements from an Antarctic ice core

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This paper presents the first ice core measurements of methyl bromide (CH₃Br). Samples from a shallow Antarctic ice core (Siple Dome, West Antarctica), with estimated gas dates ranging from 1671 to 1942, were analyzed using GC/MS. The ice core samples gave a mean CH₃Br mixing ratio of 5.8 ppt, considerably lower than the modern southern hemispheric mean CH₃Br level of 7.9 ppt. These results extend the existing historical record derived from air and Antarctic firn air to about 350 years. Model simulations illustrate that the ice core results are consistent with current estimates of the impact of anthropogenic activity (fumigation, combustion, and biomass burning) on the atmospheric CH₃Br burden. A preindustrial scenario assuming no fumigation, no combustion, and a 75 per cent reduction in biomass burning sources, yields agreement with the ice core results. However, there is a significant imbalance between the known CH₃Br sources and sinks in the modern atmospheric CH₃Br budget, and the ice core data do not resolve the question of whether this imbalance is due to anthropogenic or natural sources.

A11F-0057 0830h POSTER

Novel halogen chemistry in the marine boundary layer

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This paper will report the first observations of I₂ in the marine boundary layer, made by Differential Optical Absorption (DOAS) spectroscopy during a field campaign at Mace Head (Ireland) in the summer of 2002. Very large I₂ concentrations correlating with low tide indicate that the source is emission from macroalgae. Simple scaling suggests that this coastal emission could approach 2 Tg per year, making it a major contribution to the global iodine budget. During the same campaign, DOAS observations were also made of the halogen oxides IO, OIO and BrO. The pulses of IO and BrO that were measured at sunrise are strong evidence for heterogeneous processing on sea-salt aerosol producing high levels of IBr during the night. Simple modelling shows that the observed concentrations of the halogen radicals will play important roles in ozone depletion, the oxidation of dimethyl sulfide, and the formation of new particles in the marine boundary layer.

A11F-0058 0830h POSTER

Genetic Control of Methyl Halide Production in *Arabidopsis*

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Methyl chloride and methyl bromide are the primary carriers of natural chlorine and bromine to the stratosphere where they catalyze the destruction of ozone, whereas methyl iodide influences aerosol formation and ozone loss in the troposphere. Methyl bromide is also an agricultural fumigant whose use is scheduled to be phased out by international agreement. Despite the economic and environmental importance of these methyl halides, their natural sources and biological production mechanisms are poorly understood. Currently identified sources include oceans, biomass burning, industrial and agricultural use, fuel combustion, salt marshes, wetlands, rice paddies, certain terrestrial plants and fungi, and abiotic processes. We demonstrate that the model plant *Arabidopsis thaliana* produces and emits methyl halides and that the enzyme primarily responsible for the production is encoded by the *HARMLESS TO OZONE LAYER (HOL)* gene located on chromosome II. In mutant plants that have a disruption of the *HOL* gene, methyl halide production is largely eliminated. A phylogenetic analysis using the *HOL* gene suggests that the ability to produce methyl halides is widespread among vascular plants. This approach provides a genetic basis for understanding and predicting patterns of methyl halide production by plants.

A11F-0059 0830h POSTER

Evaluation of CO Simulations and the Analysis of the CO Budget for Europe

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Carbon Monoxide (CO) is a well-suited indicator for the transport of pollutants in the troposphere on a regional and global scale. For the study presented here, simulations of CO concentrations from a global chemistry-transport model (MOZART-2) have been used to diagnose the contributions of different processes and sources on the CO load over Europe. The CO molecules in the model were tagged according to the emission type and the source region. A set of optimized surface emissions has been incorporated in the model runs derived by inversion of modeled CO concentrations with CO data from the Measurements of Pollution in the Troposphere (MOPITT) remote-sensing instrument. The evaluation of the model simulations is based on an extensive comparison with remote-sensing, aircraft, and ground-based CO measurements. The results indicate that the model values represent the background conditions as well as the large scale transport over Europe relatively well, and, therefore, are suited for studying the CO budget over Europe. The analysis of the tagged model simulations shows the predominant impact of European emissions on CO concentrations over Europe near the surface, and a strong influence of sources from North America and Asia on the CO load in the free troposphere. Focus has been set mainly on CO emitted from technological sources, biofuel use, and biomass burning, which together contribute to the total CO concentrations over Europe by about 40-70% near the surface, and by about 30-60% at 500hPa. The contributions from other sources (e.g. biogenics, photochemistry,...) on the CO burden over Europe are outlined too.

A11F-0060 0830h POSTER

Changes in Tropospheric Carbon Monoxide During the Past Century

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Future changes in the abundance atmospheric carbon monoxide (CO) have the potential to exert significant effects on the earths radiative balance. Although CO is not strong absorber of infrared radiation, and thus not considered a greenhouse gas, the photochemically-driven cycle of CO provides it with an indirect greenhouse effect similar in magnitude to that of nitrous oxide (~10% that of CO₂). This paper will examine CO trends over the past 100 years derived from ice core data, from total column measurements, and from recent global surface measurements. Determination of long-term CO trends is complicated by several factors, including the precision of available measurement techniques, their long term stability, and significant year to year variability in CO. The available data suggest a strong anthropogenic influence on tropospheric CO, particularly in the Northern Hemisphere (fewer data are available for the Southern Hemisphere). Recent measurements show a high degree of interannual variability which dramatically impacts short term growth rates. Long term changes are more difficult to quantify. Although the magnitudes of the individual sources comprising the global budget of CO contain large uncertainties, we find that human activity impacts the three major CO sources (combustion of fossil fuel and biomass, and methane oxidation). Natural events, such as volcanic eruptions, also may affect CO. The major sink of CO, reaction with the hydroxyl radical (OH), is found to efficiently scavenge short-lived pulses of CO to the atmosphere. Long term trends in CO are small (relative to the increase in emissions) suggesting tropospheric CO is strongly buffered by OH.

A11F-0061 0830h POSTER

Widespread Persistent Near-Surface Ozone Depletion at Northern High Latitudes in Spring

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Springtime near-surface ozone depletion has been observed at northern high latitudes. The O₃ loss is thought to be catalyzed by BrO_x (Br + BrO). Due to limited observations, the spatial and temporal extent of low O₃ concentrations near the surface is still unknown. A regional 3-D chemistry and transport model is applied to simulate surface O₃ depletion catalyzed by bromine radicals at northern high latitudes in March and April 2000. Satellite observations of BrO column by the ESA Global Ozone Monitoring Experiment (GOME) were processed to specify the BrO concentrations in the lower troposphere. The model captures reasonably well the O₃ depletion events observed at two surface sites, Alert, Canada (82.5N, 62.3W) and Barrow, Alaska (71.3N, 156.6W), and by airborne in situ and DIAL instrument during the TOPSE experiments at northern high latitudes. Model results indicate that low O₃ concentrations (<20 ppbv) near the surface cover ~60% of the northern high latitudes and that the depleted O₃ concentrations (<10ppbv) cover ~20% of the region in April. The high BrO events tend to be large-scale and persistent (1-2 weeks). We find that they are correlated with low temperature, a condition conducive for heterogeneous reactions on frozen snow or aerosol surfaces.

A11F-0062 0830h POSTER

Surface Spectroscopy Studies of the Reactive Uptake of Ozone on Alkali Halides

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Heterogeneous reactions in the atmosphere have attracted a lot of attention. In particular, reactions involving sea-salt in the form of aerosol droplets, particles, and/or sea-ice have been implicated to significantly affect the chemistry and composition of the marine boundary layer. For example, highly reactive chlorine and bromine atoms resulting from the oxidation of sea-salt halides (Cl^- and Br^-) have been implicated in tropospheric ozone depletion in the arctic and in lower latitude marine regions, as well as the deposition of mercury. While the heterogeneous processing of sea-salt has been studied extensively in laboratory, field and model studies, the mechanistic details behind the release of gas-phase halogens remains unclear and has sparked some interests. Recently there has been attention focused on the interaction of important atmospheric oxidants (e.g., OH and O_3) with halides that reside at the air-particle interface of sea-salt. Such chemical interactions at the surface of particles may lead to unique chemical transformations that can alter current views of known chemical processing of sea-salt particles. There are several laboratory investigations which have investigated the surface reactivity of salts by measuring the reactive loss and/or formation of gas-phase species, indicating that reactions at the interface likely play an important role in aerosol chemistry. The efficacy of such surface-phase chemistry has yet to be elucidated with surface spectroscopy studies. X-ray photoelectron spectroscopy (XPS) is a surface spectroscopy technique with submonolayer resolution. Using XPS, we have investigated changes in the surface chemistry of various alkali halide salts upon exposure to ozone in an ultra-high vacuum (UHV) instrument. Salt samples were either freshly cleaved single crystals which were prepared from a melt, or purified salt crystals/powders pressed into pellets. Upon exposure to ozone, oxygen on the salt surfaces was monitored by measuring the O(1s) photoelectron peak. Initial XPS spectra of salts in the vacuum chamber prior to ozone exposure indicated that the salts were either devoid of oxygen, or contained a small amount of oxygen from strongly adsorbed water under ultra-high vacuum. In all cases, in-vacuo exposure of the salts to ozone lead to an increase in O(1s) photoelectron signal. For NaCl this was surprising since previous studies have been interpreted to indicate that ozone is essentially unreactive towards solid NaCl. The initial uptake of oxygen on the surface gave a broad O(1s) peak, indicating that there are several types of oxygen species on the surface. Reference spectra were obtained for NaClO_2 , NaClO_3 , and NaClO_4 salts. The O(1s) binding energies in these reference spectra increased in series with $\text{NaClO}_2 < \text{NaClO}_3 < \text{NaClO}_4$. Based on these results, it is suggested that the reaction of ozone with pure NaCl initially leads to the formation of NaClO_2 and NaClO_3 , with the formation of NaClO_4 at higher ozone doses. The oxygen uptake upon ozone exposure to alkali bromide and iodide salts were also investigated and compared to reference salts. Future work will incorporate the influence of adsorbed water and subsequent ozone exposures on the surface chemistry of salts.

A11F-0063 0830h POSTER

A Preliminary Field Campaign in the Kathmandu Valley, Nepal: an Urban Photochemistry Study

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The Kathmandu Valley in Nepal experiences severe winter temperature inversions due to its location as a high altitude plateau situated in a semi-enclosed basin. This combined with a rapid increase in population and vehicle ownership has made air pollution of great concern in the valley within the last decade. Only a few sporadic studies have been done characterizing either the meteorology or the chemistry of the valley. This paper presents preliminary surface measurements of O_3 and NO_x ($\text{NO} + \text{NO}_2$) from a field campaign in the Kathmandu Valley during January and February of 2003 and examines the photochemical processes affecting these trace gases. Peak ozone mole fractions ranged from 40 to 100 ppb, while peak NO_x mole fractions were between 20 and 80 ppb. Diurnal variations of ozone, which are substantial, are compared to simultaneous NO_x and micrometeorological measurements to infer factors influencing the production and loss rates

of surface ozone and NO_x . A box model parameterizing the major processes thought to affect valley photochemistry and meteorology is used to further distinguish the relative effect of each precursor emission and model parameter on ozone mole fractions. The magnitude of the simulated maximum or minimum ozone mole fractions appears to be largely dependent on the deposition velocity and ozone levels aloft. The time at which simulated maximum or minimum ozone occurs seems to depend more on ultraviolet dissociation rates and the thickness of the surface and mixed layers.

A11G MCC: 3018 Monday 1020h

A Quarter Century of Satellite Measurements by TOMS II (joint with OS, SA, V)

Presiding: R S Stolarski, NASA
Goddard Space Flight Center; J A
Kaye, NASA Headquarters

A11G-01 1020h INVITED

TOMS and the Identification and Environmental Characterization of Global Dust Sources.

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Although the Total Ozone Mapping Spectrometer (TOMS) was designed for ozone measurements, it has proven to be extremely useful for measuring aerosols. TOMS is especially sensitive to the presence of UV absorbing aerosols such as smoke and mineral dust. An advantage of TOMS as an aerosol sensor is that it can detect aerosols over land as well as ocean surfaces. As a result TOMS has provided us with an unprecedented picture of the global distribution of smoke and dust and their transport paths through the atmosphere. The TOMS absorbing aerosol product has been particularly useful in the study of mineral dust sources which are of great interest because of the important role that dust plays in atmospheric radiation and cloud processes. There were, however, major uncertainties in the sources of dust and the factors affecting dust mobilization and transport. The TOMS product has led to dramatic improvements in our knowledge of the global distribution of dust sources. This, in turn, has enabled us to identify the environmental characteristics of these dusty terrains. TOMS-based studies show that dust sources, regardless of size or strength, can usually be associated with topographical lows located in arid regions with annual rainfall under 200-250 mm. Although the source regions themselves are arid or hyperarid, the action of water is evident from the presence of ephemeral streams, rivers, lakes, and playas. Most major sources have been intermittently flooded through the Quaternary as evidenced by deep alluvial deposits. In this presentation we will review some of these studies and present examples of some of the dust source types that are believed to be characteristic of major sources.

A11G-02 1045h

A long term record of aerosol absorption from TOMS observations

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The discovery of the TOMS capability to detect the presence of absorbing aerosols made possible, for the first time in the history of aerosol sensing from space, the observation of the spatial and temporal variability of carbonaceous and mineral aerosols, over the oceans and the continents. In spite of its qualitative nature, the TOMS aerosol index has been found to be a very useful tool in a variety of applications. In addition to the Aerosol Index product, an inversion procedure was developed to transform the information content of the aerosol index into physically meaningful aerosol parameters: aerosol optical depth and single scattering albedo. Thus, the long term record (1979-1993, 1996-present) of TOMS near UV observations has been used to produce the only global data set on aerosol absorption. The TOMS global climatological record of aerosol absorption optical will be presented and discussed. The results presented here constitute the first long-term nearly global climatological record of aerosol absorption optical depth over both land and water surfaces over regions and times (1979 to present) where ground-based observations are not available.

A11G-03 1100h

TOMS aerosol data and GOCART dust model: Results of a collaborative research

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Satellite data provides the most useful data sets to study aerosol distribution at the global scale over several years. Among the related instruments, the Total Ozone Mapping Spectrometer (TOMS) has the particularity to measure backscattering radiances in the near UV. The advantage of the near UV technique is that aerosol properties can be retrieved over both land and ocean. A difficulty of the technique is the sensitivity of the backscattering radiances to the vertical distribution of absorbing aerosols which is measured continuously at only a few places. Such information has been provided by simulating dust distribution with the Global Ozone Chemistry Aerosol Radiation Transport (GOCART) model. The collaboration GOCART-TOMS went well beyond the delivery of vertical profiles. Some of the key scientific results are: 1) the establishment of the first global inventory of dust source, 2) the characterization of dust emission from the major sources, 3) the study of dust long range transport and dust variability, in particular it was found that dust emission and distribution over Africa is correlated in winter with the North Atlantic Oscillation. Recently, TOMS data has been combined with higher resolution satellite instruments to map exactly all dust sources associated with ephemeral lakes. These results will be presented as well as the methodology developed to obtain them, in particular the use of an equivalent aerosol index which allows direct quantitative comparison with TOMS AI.

A11G-04 1115h

An Expanded UV Irradiance Database from TOMS Including the Effects of Ozone, Clouds, and Aerosol Attenuation

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The TOMS UV irradiance database (1978 to 2003) has been expanded to include 5 new products (noon irradiance at 305, 310, 324, and 380 nm, and noon erythemal-weighted irradiance), in addition to the existing erythemal daily exposure, that permit direct comparisons with ground-based measurements from spectrometers and broadband instruments. The new data are available on <http://toms.gsfc.nasa.gov>. Comparisons of the TOMS estimated irradiances with ground-based instruments are given along with a review of the sources of known errors, especially the recent improvements in accounting for aerosol attenuation. Trend estimations from the new TOMS irradiances permit the clear separation of changes caused by