

drawn and then updated. The analyst now has the ability to view GOES, POES, and MODIS data in a single loop. This allows the fire analyst the ability to easily confirm a fire in three different data sets. The upgraded HMS has faster satellite looping and gives the analyst the ability to design a false color image for a particular region. The GOES satellites provide a relatively coarse 4 km infrared resolution at satellite subpoint for thermal fire detection but provide the advantage of a rapid update cycle. GOES imagery is updated every 15 minutes utilizing both GOES-10 and GOES-12. POES imagery from NOAA-15, NOAA-16 and NOAA-17 and MODIS from Terra and Aqua are employed with each satellite providing twice per day coverage (more frequent over Alaska). While the frequency of imagery is much less than with GOES the higher resolution of these satellites (1 km along the suborbital track) allows for detection of smaller and/or cooler burning fires. Each of the algorithms utilizes a number of temporal, thermal and contextual filters in an attempt to screen out false detects. However, false detects do get processed by the algorithms to varying degrees. Therefore, the automated fire detects from each algorithm are quality controlled by an analyst who scans the imagery and may either accept or delete fire points. The analyst also has the ability to manually add additional fire points based on the imagery. Smoke is outlined by the analyst using visible imagery, primarily GOES which provides 1 km resolution. Occasionally a smoke plume seen in visible imagery is the only indicator of a fire and would be manually added to the fire detect file. The Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPPLIT) is a forecast model that projects the trajectory and dispersion of a smoke plume over a period of time. The HYSPPLIT is run for fires that are selected by the analyst that are seen to be producing a significant smoke plume. The analyst defines a smoke producing area commensurate with the size of the fire and amount of smoke detected. The output is hosted on an Air Resources Lab (ARL) web site which can be accessed from the web site listed below. All of the information is posted to the web page noted below. Besides the interactive GIS presentation users can view the product in graphical jpg format. The analyst edited points as well as the unedited automated fire detects are available for users to view directly on the web page or to download. All of the data is also archived and accessed via ftp.

URL: <http://www.ssd.noaa.gov/PS/FIRE>

## A22C MCC: Level 2 Tuesday 1330h

### Effects of Biomass Burning Plumes on the Troposphere and Stratosphere IV Posters (joint with B, AE)

#### Presiding: A Stohl, Cooperative

Institute for Research in Environmental Sciences (CIRES); N Jones, University of Wollongong

#### A22C-1074 1330h POSTER

### EXPERIMENTAL STUDIES OF THE MICROPHYSICS OF CLOUD CONDENSATION NUCLEI AS A FUNCTION OF ORGANIC SOLUTE

Evans Dure<sup>1</sup> (202.806.5450; [edure@howard.edu](mailto:edure@howard.edu))

Vernon R. Morris<sup>1</sup> (202.806.5450; [vmorris@howard.edu](mailto:vmorris@howard.edu))

Natasha Greene<sup>1</sup> (202.806.5450; [tashism@angelfire.com](mailto:tashism@angelfire.com))

<sup>1</sup>NOAA CENTER FOR ATMOSPHERIC SCIENCES, HOWARD UNIVERSITY 525 COLLEGE ST. NW, WASHINGTON, DC 20059, United States

Biomass burning has played, and continues to play a significant part in the lives of indigenous people across the world. Biomass burning results from brushfires, land clearing, and cloud-to-ground lightning strikes, this is particularly true in the tropics. A unique feature about the biomass burning aerosols is that its sources are overwhelmingly confined to the tropics despite evidence that their effects may be global in extent. Recently, Rosenfeld has argued that the inclusion of biomass aerosols into warm clouds can also inhibit precipitation. However, several reported case studies in the literature report precipitation enhancements due to aerosol entrainment as well. Quantitative relationships between the indirect forcing from clouds and anthropogenic aerosol inclusions have not been developed to a point where the resultant prediction of cloud optical properties is reliable. The problem is the lack of understanding of the basic microphysical processes governing cloud droplet nucleation and evolution. This level of understanding requires that the physical chemistry of the systems be well understood. Because such

a large fraction of anthropogenic aerosol and specifically biomass aerosol are organic in nature, we have performed laboratory simulations of the nucleation of aerosols with organic inclusions. In our study, homogeneous and heterogeneous nucleation effects were studied for several organic solutions; n-Hexane, benzene, chlorobenzene, nitrobenzene, with and without crushed graphite. We will report results of the analyses of the size distribution characteristics, electrical mobility, and number density characteristics.

#### A22C-1075 1330h POSTER

### Inverse modeling of biomass smoke emissions using the TOMS AI

Sophia Y Zhang<sup>1</sup> ([yangz@umich.edu](mailto:yangz@umich.edu))

Joyce E Penner<sup>1</sup>

Omar Torres<sup>2</sup>

<sup>1</sup>Department of Atmospheric, Oceanic and Space Sciences, University of Michigan, 2455 Haywood, Ann Arbor, MI 48109, United States

<sup>2</sup>JCET, University of Maryland Baltimore County, Baltimore, MD 20771, United States

Results of inverse modeling of biomass smoke emissions using the TOMS AI and a three-dimensional transport model are presented. The IMPACT model with DAO meteorology data in 1997 are utilized to obtain aerosol spatial and temporal distributions. Two absorbing aerosol types are considered, including biomass smoke and mineral dust. First, a radiative transfer model is applied to generate the modeled AI. Then a Bayesian inverse technique is applied to optimize the difference between the modeled AI and the EP TOMS AI in the same period by regulating monthly a priori biomass smoke emissions, while the dust emissions are fixed. The modeled AI with a posteriori emissions generally is in better agreement with the EP TOMS AI. The annual global a posteriori source increases by about 13% for the year 1997 (6.31 Tg/yr BC) in the base scenario, with a larger adjustment of monthly regional emissions. Five sensitivity scenarios are carried out, including sensitivity to the a priori uncertainties, the height of the smoke layer, the cloud screening criteria of the daily EP TOMS AI, the adjustment of emissions in a lumped region outside of the major biomass burning regions, and the covariances between observations. Results suggest that a posteriori annual global emissions in the sensitivity scenarios are within 15% of that of the base scenario. However, the difference of annual a posteriori emissions between the sensitivity scenarios and the base scenario can be as large as 50% on regional scale. We are also applying the inverse model technique to the year 2000 to compare with biomass emissions deduced from an analysis based on burned areas.

#### A22C-1076 1330h POSTER

### Space-Based Observations of the Seasonal Variations in Biomass Burning Emissions of NO<sub>x</sub> and VOCs over Africa during 2000

Lyatt Jaegle<sup>1</sup> (206-685-2679; [jaegle@atmos.washington.edu](mailto:jaegle@atmos.washington.edu)); Linda Steinberger<sup>1</sup> ([llou@atmos.washington.edu](mailto:llou@atmos.washington.edu)); Randall V Martin<sup>2</sup> ([Randall.Martin@Dal.Ca](mailto:Randall.Martin@Dal.Ca)); Kelly V Chance<sup>3</sup> ([kchance@cfa.harvard.edu](mailto:kchance@cfa.harvard.edu)); Thomas P Kurosu<sup>3</sup> ([tkurosu@cfa.harvard.edu](mailto:tkurosu@cfa.harvard.edu)); Paul I Palmer<sup>4</sup> ([pip@sol.harvard.edu](mailto:pip@sol.harvard.edu)); Mian Chin<sup>5</sup> ([chin@rondo.gsfc.nasa.gov](mailto:chin@rondo.gsfc.nasa.gov))

<sup>1</sup>Department of Atmospheric Sciences, University of Washington, BOX 351640, Seattle, WA 98195, United States

<sup>2</sup>Department of Physics and Atmospheric Science, Dalhousie University, Halifax, NS B3H 3J5, Canada

<sup>3</sup>Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, United States

<sup>4</sup>Division of Engineering and Applied Sciences, Harvard University, Pierce Hall, 29 Oxford Street, Cambridge, MA 02138, United States

<sup>5</sup>NASA Goddard Space Flight Center, Code 916, Greenbelt, MD 20771, United States

We use tropospheric NO<sub>2</sub> and HCHO columns from the Global Ozone Monitoring Experiment (GOME) satellite instrument to map the spatial and seasonal variations of NO<sub>x</sub> and volatile organic compounds (VOC) emissions over Africa during 2000. Our tropospheric column retrievals include the local effects of aerosols, clouds, as well as shape factors for NO<sub>2</sub> and HCHO from the GEOS-CHEM global 3-D chemical transport model. The GOME NO<sub>2</sub> columns display a very strong biomass burning signal with the well-known seasonality: fire season in Northern (Southern) Africa between November and March (May and

October) with a north to south (northwest to southeast) progression. In addition, a strong signal from biogenic NO<sub>x</sub> emissions is present throughout the wet season, with particularly high NO<sub>2</sub> columns in June over North Africa. Elevated GOME HCHO columns are observed over biomass burning areas, as well as over the tropical forests of central Africa (indicating strong biogenic isoprene emissions). We derive a top-down NO<sub>x</sub> emission inventory from the GOME column NO<sub>2</sub> observations through an inversion with the GEOS-CHEM model. Our estimate of annual surface NO<sub>x</sub> emissions is 8 Tg N yr<sup>-1</sup> over Africa for 2000 (4.1 and 3.9 Tg N yr<sup>-1</sup> for North and South Africa, respectively), which is 50% larger than our bottom-up GEOS-CHEM emission inventory. Most of the difference is attributed to stronger than expected biogenic NO<sub>x</sub> emissions from soils, as well as to too low NO<sub>x</sub> emission factors used in the GEOS-CHEM model for North African Savannas. We will use space based observations of active fires (ATSR, VIRS) and burned areas (GBA2000) to separate biomass burning from biogenic emissions of NO<sub>x</sub> and VOCs, and examine their respective spatial and temporal variability during 2000. In addition, we will compare the GOME observations and GEOS-CHEM model results to studies from the SAFARI 2000 field mission over Southern Africa.

#### A22C-1077 1330h POSTER

### Cloud-Radiation Field Changes due to the Direct Effect of Smoke Aerosols in Southeast Mexico

Martin J Montero-Martinez<sup>1</sup> (52-777-3293600; [mmontero@tlaoc.imta.mx](mailto:mmontero@tlaoc.imta.mx))

Noe Gonzalez-Flores ([neo\\_glez@hotmail.com](mailto:neo_glez@hotmail.com))

<sup>1</sup>Mexican Institute of Water Technology, Paseo Cuauhnahuac 8532 Col. Progreso, Jiutepec, Mor 62550, Mexico

In general, aerosols affect climate mainly by directly absorbing and scattering input solar radiation and indirectly through their role as cloud condensation nuclei. Smoke aerosols from biomass burning are considered to be the second most important source of anthropogenic particles (sulfate aerosols being the first) that are influencing the climate. Numerical simulations are carried on MM5 (using the CCM2 radiative scheme) by introducing the smoke aerosol spectral optical properties in the southeastern Mexican region. The neighborhood of this region is the most important source of biomass burning aerosols in Central America during the dry season (February-June). The particles are considered to be homogeneous in composition and the optical properties are calculated using Mie theory and the Remer et al. (1998) smoke model. Simulations are performed for March 17-20 and April 18-20, 2003. These two periods resulted to be a relative maximum in the number of fires detected in the studied region according to different algorithms based on satellite imagery. GDAS data are used to initialize the MM5 model. The goal is to study the changes in the cloud-radiation field due to the aerosol direct effect varying the smoke aerosol optical properties, especially the optical depth. Preliminary results support the argument that not only the aerosol effect is important but also the cloud changes due to the radiative differences caused by the aerosol direct effect itself. These cloud effects followed very different ways sometimes depending on atmospheric conditions of course, but also on other characteristics such as orography or land surface features. The simulations indicate a wide range on the surface radiative forcing varying from -40 W/m<sup>2</sup> for smoke particles with an optical depth of 0.2 (at 670 nm), to -140 W/m<sup>2</sup> for particles with an optical depth of 0.8.

#### A22C-1078 1330h POSTER

### The Use of Aerosol Optical Depth in Estimating Trace Gas Emissions from Biomass Burning Plumes

Nicholas Jones<sup>1</sup> (+61-2-42214296; [njones@uow.edu.au](mailto:njones@uow.edu.au)); Clare Paton-Walsh<sup>1</sup> (+61-2-42214296; [clarem@uow.edu.au](mailto:clarem@uow.edu.au)); Stephen Wilson<sup>1</sup> (+61-2-42214296; [swilson@uow.edu.au](mailto:swilson@uow.edu.au)); Arndt Meier<sup>3</sup> (+61-2-93856188; [arndt@apollolifesciences.com](mailto:arndt@apollolifesciences.com)); Nicholas Deutscher<sup>1</sup> (+61-2-42214296; [nmd03@uow.edu.au](mailto:nmd03@uow.edu.au)); David Griffith<sup>1</sup> (+61-2-42213515; [griffith@uow.edu.au](mailto:griffith@uow.edu.au)); Fred Murcray<sup>2</sup> (303-9783557)

<sup>1</sup>Department of Chemistry, University of Wollongong, Wollongong, NSW 2522, Australia

<sup>2</sup>Department of Physics, University of Denver, Denver, CO 80208, United States

<sup>3</sup>Appollo Life Sciences Pty Ltd, PO Box 371 Kingsford, Sydney, NSW 2032, Australia

We have observed significant correlations between aerosol optical depth (AOD) at 500 nm and column amounts of a number of biomass burning indicators

(carbon monoxide, hydrogen cyanide, formaldehyde and ammonia) in bushfire smoke plumes over SE Australia during the 2001/2002 and 2002/2003 fire seasons from remote sensing measurements. The Department of Chemistry, University of Wollongong, operates a high resolution Fourier Transform Spectrometer (FTS), in the city of Wollongong, approximately 80 km south of Sydney. During the recent bushfires we collected over 1500 solar FTIR spectra directly through the smoke over Wollongong. The total column amounts of the biomass burning indicators were calculated using the profile retrieval software package SFIT2. Using the same solar beam, a small grating spectrometer equipped with a 2048 pixel CCD detector array, was used to calculate simultaneous aerosol optical depths. This dataset is therefore unique in its temporal sampling, location to active fires, and range of simultaneously measured constituents. There are several important applications of the AOD to gas column correlation. The estimation of global emissions from biomass burning currently has very large associated uncertainties. The use of visible radiances measured by satellites, and hence AOD, could significantly reduce these uncertainties by giving a direct estimate of global emissions of gases from biomass burning through application of the AOD to gas correlation. On a more local level, satellite-derived aerosol optical depth maps could be inverted to infer approximate concentration levels of smoke-related pollutants at the ground and in the lower troposphere, and thus can be used to determine the nature of any significant health impacts.

#### A22C-1079 1330h POSTER

##### Siberian Biomass Burning Plumes Across the Pacific: Aircraft Observations in the Pacific Northwest

Isaac Bertschi<sup>1</sup> (425-352-3479;  
isaacpb@u.washington.edu)

Dan Jaffe<sup>1</sup> (425-352-5357; djaffe@u.washington.edu)  
<sup>1</sup>University of Washington Bothell, Interdisciplinary Arts and Sciences, Bothell, WA 98011, United States

During the summer of 2003, we employed a small research aircraft to collect vertical profiles of O<sub>3</sub>, CO, and total aerosol scattering in the 0 to 6 km column along the northwestern coastline of Washington State. Surface observations were also made and are discussed in the presentation by Jaffe et al. We conducted nine research flights between May 27 and August 5 and frequently observed airmasses with highly correlated enhancements of O<sub>3</sub>, CO, and aerosol scattering, especially the flights on June 2nd and August 5th. The most polluted airmass was observed on June 2, when absolute levels of O<sub>3</sub>, CO, and the aerosol scattering coefficient (green) exceeded 100 ppbv, 200 ppbv, and 130 Mm<sup>-1</sup>, respectively. The Del(O<sub>3</sub>)/Del(CO) and Del(scattering)/Del(CO) values (0.40 ppbv/ppbv and 1.25 Mm<sup>-1</sup>/ppbv, respectively) observed during this episode are similar to our previous observations of Asian boreal fire emissions transported to the North-east Pacific during May 2002. Subsequent analyses of back-trajectories (NOAA Hysplit4), aerosol forecasting models (NAAPS/NOGAPS), and satellite images (NASA's TERRA MODIS/AQUA, TOMS) indicate that the June 2nd and August 5th events were primarily due to the long-range transport of Siberian boreal fire emissions. The summer of 2003 appears to be exceptional in terms of the amount of Siberian biomass burning. Our observations of the variability of background O<sub>3</sub> in the 0-6 km column during the summer of 2003 are similar to O<sub>3</sub>-sonde data collected in Northern California from 1995 through 2002. These results suggest that transport of Siberian biomass burning emissions is an important component of the background O<sub>3</sub> variability during summer along the west coast of the U.S.

#### A22C-1080 1330h POSTER

##### Correlating MOPITT CO Data With ATSR Fire Count Data

Jane Liu<sup>1</sup> (jliu@atmosph.physics.utoronto.ca)

James Drummond<sup>1</sup>  
(jim@atmosph.physics.utoronto.ca)

Florain Nchituu<sup>1</sup>  
(nchituu@atmosph.physics.utoronto.ca)

Jason Zou<sup>1</sup> (jzou@atmosph.physics.utoronto.ca)

<sup>1</sup>Department of Physics University of Toronto, 60 St. George Street, Toronto, ON M5S 1A7, Canada

Biomass burning has long been recognized as a major source of atmospheric carbon monoxide (CO). The MOPITT instrument (Measurements Of Pollution In The Troposphere) on board the Terra satellite is making global observations of CO and therefore provides a valuable dataset to assess CO emission from biomass burning at the global scale. In this study, we correlate MOPITT CO data with fire count data from the Along-Track Scanning Radiometer (ATSR) on board

the ERS-2 satellite. ATSR offers a surrogate for fire data and is one of a few global fire datasets available. As ATSR detects fires at night, nighttime CO is extracted and analyzed. For the first year operation of MOPITT from March 2000 to February 2001, CO emission from the biomass burning could be easily detected in many places around the world. Seasonal variations of CO emission from biomass burning for the different regions will be presented and the limitations of this analysis will be discussed.

#### A22C-1081 1330h POSTER

##### Comparison of Biomass Burning Smoke Plume Models

Lisa J Carlson<sup>1</sup> (716-673-2120;

carl9042@fredonia.edu); Sherri A Mason<sup>1</sup>

(716-673-3292; mason@fredonia.edu); Joerg

Trentmann<sup>2</sup> (jtrent@atmos.washington.edu); Tanja

Winterrath<sup>3</sup> (twinter@mpch-mainz.mpg.de); Ted J

Christian<sup>4</sup> (theo@selway.umd.edu); Robert J

Yokelson<sup>4</sup> (byok@selway.umd.edu); Meinrat O

Andreae<sup>3</sup> (biogeo@mpch-mainz.mpg.de); Peter V

Hobbs<sup>2</sup> (phobbs@atmos.washington.edu)

<sup>1</sup>SUNY-Fredonia, Department of Chemistry, Fredonia, NY 14063, United States

<sup>2</sup>University of Washington, Department of Atmospheric Sciences, Seattle, WA 98195, United States

<sup>3</sup>Max Planck Institute for Chemistry, Biogeochemistry Department, Mainz 55020, Germany

<sup>4</sup>University of Montana, Department of Chemistry, Missoula, MT 59812, United States

Biomass burning is known to inject considerable quantities of trace gases into the atmosphere. Recent laboratory, field, and modeling studies have shown that significant atmospheric transformations occur within the vicinity of fire events before these emissions are released into the regional atmosphere. Understanding the local-scale transformations is an important parameter for inclusion into larger, global tropospheric models. An inter-model comparison was carried out between two independently developed zero-dimensional, gas-phase tropospheric models used to describe the photochemical evolution of young biomass burning smoke plumes. One of these models was developed and operated at the Max Planck Institute in Mainz, Germany; the second was constructed at the University of Montana-Missoula and is currently run at SUNY Fredonia. Identical initial parameters used in both models were taken from field measurements of biomass burning events under very different fire conditions (African savanna and Alaskan forest/shrub/bog mixture). The Fredonia model predicts slightly different chemistry than the Mainz model, which results in higher radical concentrations and lower PAN production when the same initial conditions are applied. Differences in the simulated results may be attributed to subtle differences in the calculation of photolytic rate constants and the modeled tropospheric chemistry. We survey the differences in model construction and the outcomes.

#### A22C-1082 1330h POSTER

##### Physical, Chemical, and Optical Properties of Smoke-Impacted Aerosols in Yosemite National Park

Christian Carrico<sup>1</sup> (carrico@lamar.colostate.edu);

Sonia Kreidenweis<sup>1</sup>  
(sonia@chem.atmos.colostate.edu); Jeffrey

Collett<sup>1</sup> (collett@lamar.colostate.edu); Gavin

McMeeking<sup>1</sup> (grm@lamar.colostate.edu);

Taehyoung Lee<sup>1</sup> (thlee@lamar.colostate.edu);

Jacqueline Carrillo<sup>1</sup> (heath@lamar.colostate.edu);

Pierre Herckes<sup>1</sup> (herckes@lamar.colostate.edu);

Guenter Engling<sup>1</sup> (gengling@lamar.colostate.edu)

<sup>1</sup>Colorado State University, Department of Atmospheric Science, Ft. Collins, CO 80523, United States

Elucidation of the role of prescribed and wild fires in North and Central America in influencing visibility in the western U.S. is an important component of regional haze issues. A field study was undertaken in Yosemite National Park in summer 2002 to characterize the physical, chemical and optical properties of ambient aerosols, including days that were heavily impacted by smoke. Observations indicate that the most likely sources of this smoke were the large fires in Oregon and Sequoia National Park that were burning during the study period, contributing to regional haze in some areas of the western U.S. Smoke-impacted periods, as indicated by multiple chemical tracers, featured shifts to larger mean particle diameters, increased fine aerosol mass fractions of organic carbon, and lower aerosol hygroscopicity, relative to non-smoke-impacted days. PM<sub>2.5</sub> dry light scattering coefficients (530 nm) were

quite high during smoke impacted periods, often exceeding 100 Mm<sup>-1</sup>. We compare the optical characteristics of the smoke-impacted aerosols (mean size, refractive index, and hygroscopicity) with prior measurements of biomass-burning aerosols in Africa and South America.

#### A22C-1083 1330h POSTER

##### The Impact of North American Fires on Aerosol in the U.S.

Sonia Kreidenweis (970-491-8350;  
sonia@chem.atmos.colostate.edu)

Colorado State University, Department of Atmospheric Science, Ft. Collins, CO 80523, United States

Biomass burning, including forest fires, is a major global source for CO, aerosols and other pollutants. Much focus has been given to biomass burning in the tropics, but recent events have drawn attention to the role of wildfires in North and Central America in influencing aerosol concentrations in the U.S. In this study, we examined IMPROVE aerosol data from national parks in the southeastern U.S. to look for impacts from long-range transport of smoke. Our analyses show that smoke from fires in Canada and Central America, in addition to smoke from U.S. fires, can be detected in about 10% of the aerosol samples from spring and summer over the last decade, with higher contributions in some years. The methodology is being extended to parks in the western U.S., and preliminary results from these analyses will also be presented.

A

#### A22C-1084 1330h POSTER

##### Characterization of biomass burning particles: chemical composition and processing

Paula K Hudson<sup>1,2</sup> (303-497-4328;

phudson@al.noaa.gov); Daniel M. Murphy<sup>1</sup>;

Daniel J. Cziczo<sup>1,2</sup>; David S. Thomson<sup>1,2</sup>; Joost deGouw<sup>1,2</sup>; Carsten Warneke<sup>1,2</sup>

<sup>1</sup>NOAA-Aeronomy Lab, 325 Broadway R/AL 6, Boulder, CO 80305, United States

<sup>2</sup>CIRES, University of Colorado, Boulder, CO 80309, United States

During the Intercontinental Transport and Chemical Transformation (ITCT) mission in April and May of 2002, a forest fire plume was intercepted over Utah on May 19. Gas phase species acetonitrile (CH<sub>3</sub>CN) (a biomass burning tracer) and carbon monoxide (CO) measured greater than five fold enhancements over background concentrations during this plume crossing. In the 100 sec plume crossing, the Particle Analysis by Laser Mass Spectrometry (PALMS) instrument acquired 202 positive mass spectra of biomass burning particles. Many of these particles contained potassium in addition to organics, carbon, and NO<sup>+</sup> (which is a signature for any nitrogen containing compound such as ammonium or nitrate). From characterization of the particle mass spectra obtained during the plume crossing, a qualitative signature has been determined for identifying biomass burning particles. By applying this analysis to the entire ITCT mission, several transport events of smoke plumes have been identified and were confirmed by gas phase measurements. Additional species, such as sulfate, found in the mass spectra of the transported particles indicated processing or aging of the biomass burning particles that had taken place. The analysis has been extended to other field missions (Crystal-Face, ACCENT, and WAM) to identify biomass burning particles without the added benefit of gas phase measurements.

#### A22C-1085 1330h POSTER

##### Use of MODIS-derived Fire Radiative Energy to Estimate Smoke Aerosol Emissions over Different Ecosystems

Charles M Ichoku<sup>1</sup> (1-301-614-6212;  
ichoku@climate.gsfc.nasa.gov)

Yoram J Kaufman<sup>2</sup> (1-301-614-6189;  
kaufman@climate.gsfc.nasa.gov)

<sup>1</sup>NASA/GSFC, Code 913 (SSAI), NASA/GSFC, Code 913, Greenbelt, MD 20771, United States

<sup>2</sup>NASA/GSFC, Code 913, NASA/GSFC, Code 913, Greenbelt, MD 20771, United States

Biomass burning is the main source of smoke aerosols and certain trace gases in the atmosphere. However, estimates of the rates of biomass consumption and emission of aerosols and trace gases from fires have not attained adequate reliability thus far. Traditional methods for deriving emission rates employ the use of emission factors Ex (in g of species x per kg of biomass burned), which are difficult to measure from satellites. The era of continuous environmental monitoring from space was ushered in a few decades ago. Nevertheless,

fire characterization was not a major consideration in the design of the early satellite-borne remote sensing instruments, such as AVHRR. Therefore, although they are able to provide fire location information, they are not adequately sensitive to variations in fire strength or size, because their thermal bands used for fire detection saturate at the lower end of fire radiative temperature range. As such, hitherto, satellite-based emission estimates employ proxy techniques using satellite derived fire pixel counts (which do not express the fire strength or rate of biomass consumption) or burned areas (which can only be obtained after the fire is over). The MODIS sensors, recently launched into orbit aboard EOS Terra (1999) and Aqua (2002) satellites, have a much higher saturation level and, not only detect the fire locations 4 times daily, but also use their 4 micron channel temperatures to measure the at-satellite fire radiative energy (which is a measure of the fire strength). Also, MODIS measures the optical thickness of smoke and other aerosols. Preliminary analysis shows appreciable correlation between the MODIS-derived rates of emission of fire radiative energy and smoke over different regions across the globe. These relationships hold great promise for deriving emission coefficients, which can be used for estimating smoke aerosol emissions from MODIS active fire products. This procedure has the potential to provide more accurate emission estimates in near real-time, thereby broadening opportunities for various active fire disaster management applications such as alerts, evacuation and, smoke dispersion forecasting.

#### A22C-1086 1330h POSTER

##### The impact of the 1998 boreal forest fires on oxidant chemistry in the global troposphere

Fok-Yan Thomas Leung<sup>1</sup> (617-496-5492; fyl@io.harvard.edu)

Jennifer A Logan<sup>1</sup> (jal@io.harvard.edu)

David G Streets<sup>2</sup> (dstreets@anl.gov)

Eric S Kasaschke<sup>3</sup> (ekasisch@geog.umd.edu)

Edward Hyer<sup>3</sup> (ehyer@geog.umd.edu)

<sup>1</sup>Harvard University, 29 Oxford St, Cambridge, MA 02138, United States

<sup>2</sup>Argonne National Laboratory, Decision and Information Sciences division, Argonne, IL 60439, United States

<sup>3</sup>University of Maryland, Department of Geography, College Park, MD 20742, United States

The highest surface measurements of northern mid and high latitude CO in the past 15 years were recorded in the summer and fall of 1998. These high values have been linked with anomalously large boreal forest fires associated with El Nino conditions. To study the impact of these forest fires on oxidant chemistry in the global troposphere, we use the GEOS-CHEM global 3-D model driven by biomass burning emissions of trace gases derived from AVHRR firecount data. We compare model results for CO using two independently derived fire products with column data and with concentration measurements at CMDL monitoring sites. To probe the effects of the increased fire activity on OH and ozone, we study the differences between model runs using emissions specific to 1998 and using annual mean biomass burning emissions.

#### A22C-1087 1330h POSTER

##### In-situ aircraft and remotely sensed observations of pyrogenic plumes over southern Africa biomass burning regions during SAFARI 2000

Deborah C Stein<sup>1</sup> (434-924-6846; dcs5v@virginia.edu)

Robert J Swap<sup>1</sup> (rjs8g@virginia.edu)

David L Richardson<sup>1,2</sup> (dlr2n@virginia.edu)

Stuart J Piketh<sup>2</sup> (stuart@crp.bpb.wits.ac.za)

Stephen A Macko<sup>1</sup> (sam8f@virginia.edu)

<sup>1</sup>University of Virginia Department of Environmental Sciences, Clark Hall, PO Box 400123, Charlottesville, VA 22904-4123, United States

<sup>2</sup>School of Geography, Archaeology and Environmental Studies University of the Witwatersrand, PO Wits 2050, Johannesburg 2050, South Africa

As a part of the SAFARI 2000 validation effort, a series of research flights were coordinated with Terra and TOMS satellite overpasses. Many flights were conducted in regions profoundly affected by biomass burning plumes. This paper explores the relationship between remotely sensed aerosol products from Terra and in-situ aircraft observations made within these pyrogenically impacted areas. In-situ aircraft point data

were scaled up to the size of MODIS data pixels. Several correlations were found between aircraft measurements of trace gases and aerosols and the MODIS derived aerosol measurements. Results of comparisons with MISR and TOMS data are also presented. Column averages obtained during aircraft vertical profiles as well as averages stratified by altitude are presented and illustrate the importance of understanding the vertical structure of the atmosphere for proper data interpretation. As a result, the in-situ aircraft measurements and the remotely-sensed data are linked to meteorological parameters including the location of absolutely stable layers and synoptic conditions in an effort to better understand atmospheric controls on these plumes. Overall these comparisons provide a more robust understanding of column aerosol measurements and the factors that control the vertical distribution of pyrogenic products.

#### A22C-1088 1330h POSTER

##### Trace gas emissions from boreal forest fires - 1995 to 2002

Eric S Kasaschke<sup>1</sup> (301 405 2179;

ekasisch@geog.umd.edu); Edward J Hyer<sup>1</sup>

(ehyer@glue.umd.edu); Nancy HF French<sup>2</sup>

(nancy.french@altatum.org); Anatoly I Sukhinin<sup>3</sup>

(boss@ksc.krasn.ru); Jennifer H. Hewson<sup>1</sup>

(jhewsons@glue.umd.edu); Brian J Stocks<sup>4</sup>

(bstocks@nrcan.gc.ca)

<sup>1</sup>University of Maryland, Department of Geography 2181 LeFrak Hall, College Park, MD 20742, United States

<sup>2</sup>Altatum, PO Box 134001, Ann Arbor, MI 48104, United States

<sup>3</sup>Sukachev Forest Institute, Russian Academy of Sciences, Krasnoyarsk Krasnoyarsk, Russian Federation

<sup>4</sup>Canadian Forest Service, 1219 Queen Street East, Sault Ste. Marie, ON P6A 2E5, Canada

A new data set on area burned in eastern Russia developed from satellite observations has allowed us to develop estimates of trace gas emissions from boreal forest fires for the period of 1995 to 2002. This data set contains information on emissions on a 1 by 1 degree grid at weekly time steps and therefore can be used as a source term for specific fire events in the boreal forest region. During the study period, an average of 9.8 million ha (Mha)/year burned, ranging between 3.0 Mha and 15.6 Mha. In this paper, we will present the results of an approach developed to estimate emissions by merging area burned information with data sets depicting the spatial distribution of fuels and using models of combustion efficiency based on expected fire type (crown, surface, ground) that varied during the growing season. We estimate that an average of 209 Tg of carbon/year (range of 51 to 371 Tg) were released by boreal fires, including 68 Tg/year of CO (range of 50 to 122 Tg). Most of the emissions (80%) are from fires in Russia. There are also clear seasonal patterns to the emissions signature. During low fire years, there is a bi-modal seasonal distribution, with 25% of seasonal emissions occurring in both May and July. During large fire years, while the early season peak still occurs, the majority of seasonal emissions (40%) occur during large fires in August.

#### A22C-1089 1330h POSTER

##### Unexpectedly High Aerosol Load in the Free Troposphere Observed With Raman Lidar in Central Europe in Spring/Summer 2003

Detlef Müller<sup>1</sup> (+49 341 235 2154; detlef@tropos.de)

Albert Ansmann<sup>1</sup> (+49 341 235 2149; albert@tropos.de)

Ulla Wandinger<sup>1</sup> (+49 341 235 2154; ulla@tropos.de)

Ina Mattis<sup>1</sup> (+49 341 235 2941; ina@tropos.de)

Dietrich Althausen<sup>1</sup> (+49 341 235 2460; dietrich@tropos.de)

<sup>1</sup>Institute for Tropospheric Research, Permoserstr. 15, Leipzig 04318, Germany

We present spectrally resolved backscatter and extinction coefficients, particle optical depths, Ångström exponents, extinction-to-backscatter ratios, and depolarization ratios of strongly enhanced particle loading in the free troposphere. The observations were made with Raman lidar at 355 and 532 nm wavelength at Leipzig (51.3° N, 12.4° E), Germany. Particle extinction coefficients were 5–30 Mm<sup>-1</sup> in the free troposphere from May to July, 2003. These numbers result in particle optical depths of 0.03–0.12 at the ultraviolet and visible wavelengths. In May and early June distinct aerosol layers could be observed above the boundary

layer, which typically was between 3 and 7-km height. By the end of June and in July the aerosol distribution became vertically more homogeneous and reached up to the tropopause. On the basis of satellite imagery and backward trajectory analysis it is most likely that severe forest fires in Siberia in early spring 2003 caused this enhanced free tropospheric background. Additional significant sources of the observed aerosols may have been strong forest fires in western Canada in the summer 2003.

#### A22D MCC: 3016 Tuesday 1340h

##### Biogenic Reactive Trace Compounds and Their Role in Atmospheric Chemistry and Climate III (joint with B, OS)

Presiding: J Rudolph, Centre for Atmospheric Chemistry, York University; L T Iraci, NASA Ames Research Center

#### A22D-01 1340h INVITED

##### Quantifying biogenic VOC emissions over North America using formaldehyde column observations from space

Paul I Palmer<sup>1</sup> (pip@io.harvard.edu); Dorian S Abbot<sup>1</sup> (abbot@fas.harvard.edu); Tzung-May Fu<sup>1</sup> (tmf@io.harvard.edu); Daniel J Jacob<sup>1</sup> (djj@io.harvard.edu); Randall V Martin<sup>2</sup> (randall.martin@dal.ca); Kelly Chance<sup>3</sup> (kchance@cfa.harvard.edu); Alex Guenther<sup>4</sup> (guenther@ucar.edu)

<sup>1</sup>Harvard University, Division of Engineering and Applied Sciences, Cambridge, MA 02138, United States

<sup>2</sup>Dalhousie University, Department of Physics and Atmospheric Science, Halifax, NS B3H 3J5, Canada

<sup>3</sup>Harvard-Smithsonian Center for Astrophysics, Atomic and Molecular Physics Division, Cambridge, MA 02138, United States

<sup>4</sup>National Center for Atmospheric Research, Atmospheric Chemistry Division, Boulder, CO 80307, United States

Formaldehyde (HCHO) columns measured from space using solar UV backscatter allow mapping of reactive hydrocarbon emissions. Our study focuses on North America, where isoprene provides the dominant contribution to HCHO during summer months. Using seven years (1995-2001) of HCHO column data from the GOME satellite instrument we show that the seasonal and interannual variability of HCHO over North America is consistent with known factors that drive regional-scale isoprene emissions. Our previous work has highlighted discrepancies between isoprene emissions derived from GOME and current inventories. These discrepancies are addressed by performing a detailed simulation of oxidant chemistry using the GEOS-CHEM global 3-D model, driven by a new-generation biogenic emission inventory. The contributions from other VOCs, in particular the terpenes, to the GOME HCHO data is also examined. An emission inventory of isoprene calculated from GOME HCHO data is presented with its estimated uncertainties. We evaluate these emissions using in situ measurements of isoprene flux and HCHO concentrations.

#### A22D-02 1355h

##### Climate Induced Changes in Biogenic Emissions - Global Chemical and Radiative Effects

Cynthia S. Atherton<sup>1</sup> (1-925-422-1825; atherton2@llnl.gov)

Daniel J. Bergmann<sup>1</sup> (1-925-423-6765; bergmann1@llnl.gov)

Jane E. Dignon<sup>1</sup> (1-925-423-2570; dignon1@llnl.gov)

Keith E. Grant<sup>1</sup> (1-925-423-6740; grant3@llnl.gov)

John R Tannahill<sup>1</sup> (1-925-423-3514; tannahill1@llnl.gov)

<sup>1</sup>Lawrence Livermore National Laboratory, P.O. Box 808, L-103, Livermore, CA 94550, United States

A number of key biogenic emissions are temperature-sensitive. Thus, future climate and temperature changes may lead to changes in the emissions