

A41C-06 0945h

Using MOPITT Data to Improve Temporal Profiles of Boreal Forest Fire Emissions

Edward J Hyer¹ (3014057282; ehyer@umd.edu)Eric S Kasischke¹ (301-405-2179; ekasisch@geog.umd.edu)Dale J Allen² (301-405-7629; allen@atmos.umd.edu)¹University of Maryland, Department of Geography, University of Maryland, College Park, College Park, MD 20742, United States²University of Maryland, Department of Meteorology, University of Maryland, College Park, College Park, MD 20742, United States

Broad-scale modeling of how terrestrial sources affect the atmospheric trace gas composition has largely been limited to coarse-resolution analyses of background air. In the case of boreal forest fires, emissions are extremely localized in space and time, and aggregating to coarse spatial resolutions and monthly time scales results in a great loss of information for atmospheric studies. Emissions estimates in the literature have largely relied on three different methods for estimating temporal profiles of fire activity: reported data from fire management agencies, satellite detections of thermal hot spots, and satellite measurements of aerosol optical depth. We used MOPITT data together with a highly resolved emissions model and the Goddard/UM CTM to compare these methods. We found that while the biases of using reported data are more or less as expected due to delays in reporting, the inaccuracies of the other methods are more complex, and more difficult to account for. We found that while hot spot based methods generally perform better than aerosol-based methods at fine temporal scales, these methods are can be complementary in certain cases.

A42A CC: 520 D Thursday 1030h Tropospheric Chemistry and Dynamics Using Data From Measurement of Pollution in the Troposphere (MOPITT) Experiment II

Presiding: J R Drummond, University of Toronto; J C Gille, National Center for Atmospheric Research

A42A-01 1030h INVITED

Simulating CO Concentrations over Europe: Evaluation and Budget Study

Gabriele Pfister^{1,2} (303 497 2915; pfinder@ucar.edu); Gabrielle Petron^{1,3} (petron@ucar.edu); Louisa K Emmons¹ (emmons@ucar.edu); John C Gille¹ (gille@ucar.edu); David P Edwards¹ (edwards@ucar.edu); J.-F. Lamarque¹ (lamar@ucar.edu); Jean-Luc Attie⁴ (attj1@aero.obs-mip.fr); Claire Granier^{3,6,7} (clg@aero.jussieu.fr); James R Drummond⁵ (james.drummond@utoronto.ca)

¹National Center for Atmospheric Research, P.O. Box 3000, Boulder, CO 80307, United States²Institute for Geophysics, Astrophysics, and Meteorology University of Graz, Universitaetsplatz 5/II, Graz 8010, Austria³Service d'Aeronomie Universite Paris 6, 4, Place Jussieu, Paris 75252, France⁴Laboratoire d'Aerologie Observatoire Midi-Pyrenees, 14 Avenue Edouard Belin, Toulouse 31400, France⁵University of Toronto, 60 St. George Street, Toronto, Canada⁶CIRES/NOAA Aeronomy Laboratory, 325 Broadway, Boulder, CO 80305, United States⁷Max Planck Institut fuer Meteorologie, Bundesstrasse 55, Hamburg 20146, Germany

CO is an indicator for the transport of pollutants in the troposphere on a global and regional scale. The first global and vertically resolved measurements of atmospheric CO have been provided by the Measurements Of Pollution In The Troposphere (MOPITT) remote-sensing instrument on board the Terra satellite. MOPITT CO data from the first year of operation (March 2000 to March 2001) have been employed in an inversion scheme to optimize the CO surface emissions in

the global chemistry transport model MOZART-2. For evaluating the simulations we compare the modeled CO fields with MOPITT data, and also with independent aircraft and ground-based in-situ measurements of CO. The comparison indicates that (1) the agreement typically improves by using the optimized emissions, and (2) the model concentrations represent the background conditions and large scale transport over Europe relatively well, and, therefore, are suited for the budget studies we conducted. To diagnose the contributions of different processes and source regions on the CO load over Europe we tagged the CO molecules in the model according to the emission type and the source region. The results of this analysis indicate to which extent expected source changes might impact the European CO field.

A42A-02 1045h

Seasonal and Geographic Trends in Performance of MOPITT CO Profile Retrievals

Merritt N. Deeter¹ (mnd@eos.ucar.edu)Louisa K. Emmons¹ (emmons@ucar.edu)David P. Edwards¹ (edwards@ucar.edu)John C. Gille¹ (gille@ucar.edu)James R. Drummond² (james.drummond@utoronto.ca)¹National Center for Atmospheric Research, P. O. Box 3000, Boulder, CO 80307, United States²University of Toronto, 60 St. George St., Toronto, ON M5S 1A7, Canada

Retrievals of carbon monoxide (CO) tropospheric profiles by the MOPITT (Measurements of Pollution in the Troposphere) satellite instrument rely primarily on measurements of thermal infrared radiation in a band near 4.7 microns. With respect to information content (and vertical resolution), the performance of the MOPITT CO retrieval algorithm depends on the surface temperature and atmospheric temperature profile. Seasonal and geographical variability of these geophysical parameters imposes corresponding variability on the performance of the MOPITT retrieval algorithm. For example, weak thermal contrast in polar regions (associated with low surface temperatures and weak thermal gradients in the troposphere) produces retrievals which are typically weighted by a priori information more heavily than in tropical regions. In this study, retrieval information content is quantified by Degrees of Freedom for Signal (DFS), which is calculable from the retrieval averaging kernel matrix. Both seasonal and geographic trends in DFS will be presented.

A42A-03 1100h

Measurements of CO Tropospheric Burden From the Ground and From a Satellite: Error Analysis

Leonid N. Yurganov¹ (81-45-778-5729;leonid@jamstec.go.jp); Anatoly V. Dzhola²(dzhola@ifaran.ru); Evgeny I. Grechko²(grechko@ifaran.ru); David P. Edwards³(edwards@ucar.edu); John C. Gille³(gille@ucar.edu); James R. Drummond⁴

(james.drummond@utoronto.ca)

¹Frontier Research Center for Global Change, 3173-25 Showa-machi, Kanazawa-ku, Yokohama 236-0001, Japan²Obukhov Institute of Atmospheric Physics, Pyzhevsky 3, Moscow 109017, Russian Federation³National Center for Atmospheric Research, Box 3000, Boulder, CO 80307-3000, United States⁴University of Toronto, 60 St. George St., Toronto, ON M5S 1A7, Canada

Spectroscopic measurements in 2002 and 2003 at Zvenigorod (located in 60 km from Moscow, Russia) reveal abnormally high CO total column amounts comparing to other years. Especially high, even record, CO column amounts were observed in September 2002. A comparison to other sites in the northern hemisphere allows one to treat this event as a regional pollution connected with strong peat fires around Moscow. CO surface layer concentrations measured in Moscow city were also unusually high. Increased CO column amounts at the same region were detected by the MOPITT/Terra instrument as well; however, the absolute values were much less, then those measured by the ground-based spectrometer. CO anomalies (i.e., the deviations from the "normal" monthly means, determined as averages over 2000- 2001) were also different for the MOPITT and for the spectrometer. An underestimation of the CO boundary layer contribution in the total

column that is inherent to the MOPITT methodology may explain this difference. The ground-based network of the spectroscopic stations is free of this error, but it is very sparse and almost lacking in the source regions. The report focuses on estimating an error in the hemispheric CO burden (total CO mass in the troposphere) measured using the existing ground-based and satellite-based instruments.

A42A-04 1115h

Assimilation of MOPITT observations using GEM-AQ

Richard Menard^{1,2} (1-514-421-4613; Richard.Menard@ec.gc.ca)Alain Robichaud¹ (1-514-421-4799; Alain.Robichaud@ec.gc.ca)Jacek Kaminski³ (1-416-822-6940; jacek@yorku.ca)¹Meteorological Service of Canada, 2121 Transcanada Highway, Dorval, Qc H9P 1J3, Canada²Department of Atmospheric and Oceanic Sciences McGill University, 805 Sherbrooke Stree West, Montreal, Qc H3A 2K6, Canada³Department of Earth and Atmospheric Science York University, 4700 Keele Street 113 Petrie Science Building, Toronto, Ont M3J 1P3, Canada

The Meteorological Service of Canada is developing a Chemical Weather Prediction and Monitoring system based on the operational meteorological model GEM coupled online with a tropospheric chemical model used for air quality prediction; GEM-AQ. The assimilation is conducting using a 3D Var scheme with the addition a bias correction scheme to estimate systematic errors due to misspecifications of the chemical sources. The bias correction scheme is at variance with the proposed scheme by Dee and daSilva (1998) as it contains explicit cross-covariance error statistics. Issues about observability of chemical sources and the use of innovation error covariance statistics to adjust covariance parameters will be discussed in detail.

A42A-05 1130h

Implications of Spatial and Temporal Sampling on CO and Aerosol Fields Retrieved From Satellite-Borne Sensors

Thomas U Kampe^{1,2} (3039395455; tkampe@ball.com)Irina N Sokolik³ (404-894-6180; irina.sokolik@eas.gatech.edu)¹Program of Atmospheric and Oceanic Sciences, University of Colorado, Boulder, UCB 311, Boulder, CO 80309-0311, United States²Ball Aerospace and Technologies Corp., M/S RA-2 1600 Commerce St., Boulder, CO 80301, United States³School of Earth and Atmospheric Sciences, Georgia Institute of Technology, 311 Ferst Drive, Atlanta, GA 30332-0340, United States

Carbon monoxide, mineral dust and carbonaceous aerosols are central to many problems in the atmospheric sciences, ranging from atmospheric chemistry and air pollution to climate change. It is critical to understand the sources and transport of CO and aerosols if their diverse impacts are to be reliably predicted. Satellite remote sensing offers a unique tool to address these issues, by providing information on the spatial and temporal distribution of CO and aerosols on regional and global scales. This study presents the results of our ongoing work towards finding and exploiting synergy between CO and aerosols retrieved from multi-satellite, multi-sensor data. The goals have been to 1) investigate whether the collocated CO and aerosol optical depth fields retrieved from satellites can provide additional constraints on sources, lifetime and transport routes of these species, and 2) to determine how the correlation between retrieved CO and aerosol fields are influenced by the spatial and temporal sampling, and the inherent spatial averaging that occurs, as provided by satellite remote sensing instruments. Collocated fields of CO derived from MOPITT measurements and aerosol optical depth (from MODIS and TOMS), were analyzed for several recent biomass burning events and Asian and Saharan dust outbreaks. The results of correlation analysis will be presented and implications for data assimilation by chemical transport model will be addressed.

A42A-06 1145h

Integrating MOPITT and aircraft observations in inverse modeling of Asian CO emissions

Colette L. Heald¹ (heald@fas.harvard.edu); Daniel J. Jacob¹ (djj@io.harvard.edu); Dylan B.A. Jones¹ (dbj@io.harvard.edu); Paul I. Palmer¹ (pip@io.harvard.edu); Jennifer A. Logan¹ (jal@io.harvard.edu); David G. Streets² (dstreets@anl.gov); Glen W. Sachse³ (g.w.sachse@larc.nasa.gov); John C. Gille⁴ (gille@ucar.edu)

¹Department of Earth and Planetary Sciences, Harvard University, 29 Oxford Street, Cambridge, MA 02138, United States

²Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, IL 60439, United States

³NASA Langley Research Center, NASA Langley, Hampton, VA 23681

⁴National Center of Atmospheric Research, 1850 Table Mesa Drive, Boulder, CO 80303, United States

Satellite and aircraft observations of trace species provide independent top-down constraints on emissions. We examine the consistency of these very different observations. Daily MOPITT satellite observations and CO data from the TRACE-P aircraft mission over the NW Pacific are applied here to the regional estimation of CO emissions from different Eurasian regions for the spring of 2001. We use the GEOS-CHEM global 3-D model of atmospheric chemistry as the forward model. A priori estimates of Asian emissions are based on gridded inventories for the observation period. We account for the model transport error using an approach based on paired forecasts of CO as well as differences between observations and simulated concentrations. This method accounts for the daily spatial correlations of the errors. We examine the sensitivity of the a posteriori source estimates to the structure of the error covariance as well as the range of Asian emission source strengths defined by the combination of the satellite and aircraft observations. MOPITT observations indicate that emission estimates are underestimated in regions dominated by anthropogenic sources, whereas biomass burning emissions are overestimated. The range of a posteriori solutions provides a better estimate of the uncertainty of the solution than the a posteriori errors and can in some cases exceed the a priori uncertainty on the source. We find that the aircraft and satellite observations are broadly consistent in terms of their constraints on regional CO sources, but that the satellite observations allow for additional source disaggregation.

A43A CC: 220 C-E Thursday 1330h

Aerosol, Ice, and Cloud Properties and Microphysics I Posters (joint with H)

Presiding: S Cho, York University; N T O'Neill, NASA Goddard Space Flight Center

A43A-01 1330h POSTER

Removal of Ultra-Fine Aerosol Particles from the Atmospheric Boundary Layer During Precipitation

Constantin Andronache (1-617-552-6215; andronac@bc.edu)

Boston College Gasson Hall 012, 140 Commonwealth Ave., Chestnut Hill, MA 02467, United States

New aerosol particles are formed in atmospheric environment as a result of the secondary particle production, or homogeneous nucleation of gaseous species. Direct emissions of small particles into atmosphere are related to road traffic, power plants and additional mechanisms involving ion-assisted nucleation. These processes contribute to ultra-fine particle (UFP) presence in atmosphere (defined as particles with diameter less than 100 nm), which can have health effects and can impact cloud properties. UFP formed in the boundary layer (BL) need to grow up to a diameter $d_p \sim 100$ nm to become activated as cloud droplets (CD). The time required to reach $d_p=100$ nm is about 2-3 days for a typical growth rate of 5 nm hr^{-1} , while significant variability was reported from experimental data. If precipitation occurs, most UFP are too small to become CD and some particles are removed by scavenging processes. A model to estimate the UFP wet removal from the BL by rainfall and coagulation is presented.

The scavenging coefficient that describes the decay of aerosol mass in various size bins is a function of aerosol size (d_p), rainfall rate (R), and BL background aerosol. The model is applied to determine the UFP characteristic removal time during precipitation, due to below-cloud scavenging by falling raindrops, coagulation with background aerosol, mixing-in-cloud followed by coagulation with cloud hydrometeors. Results show that during rain events, the 0.5-folding time is $t_{0.5} \sim 1$ hr for $R \sim 1 \text{ mm hr}^{-1}$ for newly created particles ($d_p < 10 \text{ nm}$) and $t_{0.5} \sim 1$ day for larger UFP ($d_p \sim 10\text{-}100 \text{ nm}$). The likelihood of UFP removal at locations with specific precipitation regimes is also illustrated.

A43A-02 1330h POSTER

Zooming in on cirrus with the Canadian Regional Climate Model

Cristina Stefanof¹ (514 3651613; cristina@sca.uqam.ca); Alexandru Stefanof¹ (5149873000; stefanof@sca.uqam.ca); Alain Beaulne³ (5144217246; alain.beaulne@ec.gc.ca); Rodrigo Munoz Alpizar¹ (987 3000; rodrigo@sca.uqam.ca); Wanda Szyrmer² (5143983764; wanda@sca.uqam.ca); Jean-Pierre Blanchet¹ (5149873000 3316; blanchet.jean-pierre@uqam.ca)

¹University of Quebec at Montreal, Department of Earth and Atmospheric Sciences, 201 Av. President Kennedy west, Montreal, QC H3C 3P8, Canada

²University McGill, Department of Atmospheric and Oceanic Sciences, 805 Sherbrooke Street West, Montreal, QC H3A 2K6, Canada

³Canadian Meteorological Centre, 2121 TransCanadae, Dorval, QC H9P 1J3, Canada

The Canadian Regional Climate Model plus a microphysical scheme: two-moments microphysics with three hydrometeor categories (cloud liquid water, pristine ice crystals and larger precipitation crystals) is used to test the simulation in forecast mode using ECMWF data at 0.4×0.4 degree.

We are zooming in on cirrus at higher resolutions (9, 1.8, 0.36 km). We are currently using the data set measured in APEX-E3, measurements of radar, lidar, passive instruments and interpreted microphysics for some flights (G-II, C404, B200). The radar and lidar data are available for high level cirrus. The south west of Japan is the flight region. The dates are March 20, March 27 and April 2, 2003. We first focus on the March 27 frontal system.

We did a rigorous synoptical analysis for the cases. The cirrus at 360 m resolution are simulated. The cloud structure and some similarities between model simulation and observations will be presented.

A43A-03 1330h POSTER

MODIS Terra and Aqua Products and Data Tools Available from the NASA GES DISC

Dimitar Ouzounov¹ (ouzounov@eosdataat.gsfc.nasa.gov); Andrey Savtchenko¹ (asavtche@g0mos16.gsfcmo.ecs.nasa.gov); Dongliang Yuan¹ (dyuan@g0mos16.gsfcmo.ecs.nasa.gov); Gregory Leptoukh¹ (leptoukh@eosdata.gsfc.nasa.gov); Jim Acker¹ (acker@daac.gsfc.nasa.gov); Jim McManus¹ (mcmanus@daac.gsfc.nasa.gov); Darryl Nickless¹ (dnickles@g0mos16.gsfcmo.ecs.nasa.gov); Dana Ostrenga¹ (dostreng@g0mos16.gsfcmo.ecs.nasa.gov); Arun Gopalan¹ (gopalan@eosdata.gsfc.nasa.gov); Suhung Shen¹ (sshenn@daac.gsfc.nasa.gov); Zhong Liu¹ (zliu@daac.gsfc.nasa.gov); Hualan Rui¹ (rui@daac.gsfc.nasa.gov); Bill Teng¹ (teng@eosdata.gsfc.nasa.gov)

¹Goddard Earth Sciences Data and Information Services Center, NASA GSFC, MS 902, Greenbelt, MD 20771, United States

The NASA Goddard Earth Sciences Data and Information Services Center (GES DISC), which includes the GES Distributed Active Archive Center (DAAC), distributes three major groups of MODIS products: Level 1 Radiometric and Geolocation data, and Level 2 and higher levels of Atmosphere and Ocean products. The GES DISC provides a broad spectrum of MODIS support for the Earth Observing System (EOS) Project, covering data access, visualization tools, tools for data search and order, documentation, data content, and science and software support. To optimize data access and usage, the MODIS Support Team (MDST) at the GES DISC has developed a variety of tools. The MODIS Multiple Data Ordering Page (MDOP) provides a convenient way to order several MODIS data sets simultaneously, including Level 1, Level 2, and

Level 3 products. The MODIS Ocean On-demand Spatial Subsetting tool enables the parameter and spatial subsetting of all MODIS Ocean mapped data products from the GES DAAC Search and Order System. The MODIS L3 Atmospheric products Online Visualization and Analysis System (MOVAS) addresses the "HDF-data-order-free" desire of science users for the on-line study of aerosols, water vapor, and clouds on a large regional to global basis, without downloading huge amounts of data. To increase the distribution capacity of the EOS Core System (ECS), the so-called Data Pool has been added, providing a very large (50 TB) anonymous FTP area for users to directly download data of interest, without having to submit orders to the main tape archive. New information about MODIS data products, tools, and services can be found on the Web gateway for MODIS information at <http://daac.gsfc.nasa.gov/MODIS/>

A43A-04 1330h POSTER

Using ATSR Fire Counts to Create Biomass Burning Aerosol Source Inventories: Integration Into the AODSEM Aerosol Optical Depth Analysis Package

Martin Aubé^{1,2} (1-819-564-6350-165; aubema@collegesherbrooke.qc.ca)

Normand T O'Neill² (1-819-821-8000; Norm.Onneil@Usherbrooke.ca)

Stéphanie Dumaine Allard¹ (allard_steph@hotmail.com)

David Lavoué³ (David.Lavoue@ec.gc.ca)

Alain Royer² (1-819-821-8000; alain.royer@usherbrooke.ca)

¹GRAPHYCS, Collège de Sherbrooke, 475, rue du Parc, Sherbrooke, QC J1E 4K1, Canada

²CARTEL, Université de Sherbrooke, 2500, boul. de l'Université, Sherbrooke, QC J1K 2R1, Canada

³Meteorological service of Canada, 4905 Dufferin Street, Downsview, ON M3H 5T4, Canada

Tracking of the Aerosol Optical Depth (AOD) is of particular importance in monitoring aerosol contributions to global radiative forcing. Aerosol emissions from forest fires contribute significantly to the atmospheric AOD. The modelling of the AOD spatio-temporal evolution using an aerosol transport model requires accurate and dynamic emission inventories. Current inventories are largely based on monthly or seasonal climatological averages. Since forest fire occurrence is highly variable in time and space, emission inventories of a climatological nature are clearly inadequate as inputs to aerosol transport models. This is especially true near the time and position of large-magnitude forest fires events. In this communication we present a method for improving current inventories of biomass burning aerosol emission. The basic idea is to exploit the dynamic temporal information contained in the ATSR open fire counts database to correct or update monthly databases. Daily temporal variations in emissions rates are obtained by multiplying the climatological inventories with the ratio of ATSR daily fire counts over the monthly daily average of ATSR fire counts. This simple operation results in a daily aerosol emission inventory which maximizes the use made of the knowledge resources imbedded in climatological databases. While the information concerning emission flux and injection height are taken from the climatological inventories the high frequency temporal variations are given by the ATSR dataset. We applied this method to the large Canadian forest fire events of August 1998. The resulting aerosol biomass burning emissions were used as an input to the Aerosol Optical Depth Spatio-temporal Evolution Model (AODSEM V2.0). Results of AODSEM model runs were compared with AOD measurements acquired from the AERONET sunphotometer network and with a control run using original climatological emission inventory data as input. Our results shows the improvements of our new method compared to the more classical one.

URL: <http://www.graphyics.qc.ca/NOMAD/index.html>

A43A-05 1330h POSTER

Analysis of the Transport of Volcanic Ash from the July, 2003 Eruption of the Soufriere Hills Volcano on Montserrat to Puerto Rico

Jason D. White¹ (202-806-9219; jdwhite@howard.edu)

Lizette Roldan¹ (202-806-9219; lroldan@howard.edu)

Vernon Morris¹ (202-806-9088; vmorris@howard.edu)

¹Howard University, 525 College St, NW Room B-21, Washington, DC 20059, United States