

model dependent, and range from a 9% decrease to a 19% increase in global annual emissions for the different model scenarios. Apart from these discrepancies, which are the result of cancellation of positive and negative changes in dust emissions in different parts of the world, we find common features in the different model scenarios. The reliability of such future estimates depends to a large degree on the performance of the climate models that are used to produce the meteorological fields that drive dust emissions.

#### A24B-02 1545h INVITED

##### Uncertainties and constraints on estimates of the natural and anthropogenic atmospheric budget of mineral aerosols

Natalie M Mahowald<sup>1,2,3</sup> (303-497-1719; mahowald@ucar.edu)

Masaru Yoshioka<sup>1,2,3</sup> (yoshioka@ucar.edu)

Chao Luo<sup>2,3</sup> (chaoluo@bren.ucsb.edu)

Jean-Louis Dufresne<sup>3,4</sup> (jean-louis.dufresne@lmd.jussieu.fr)

<sup>1</sup>NCAR, PO Box 3000, Boulder, CO 80307, United States

<sup>2</sup>Bren School, UCSB, Santa Barbara, CA 93106, United States

<sup>3</sup>ICISS, UCSB, Santa Barbara, CA 93106, United States

<sup>4</sup>LMD/IPSL, CNRS/UPMC-Boite 99, Paris 75252, France

Estimating the global source of mineral aerosols is difficult due to the highly episodic nature of mineral aerosols and their relatively short lifetime. Comparisons with available observations suggest that models can capture the observed climatology reasonably well using several different source mechanisms and reanalysis datasets, and yet these results differ in the mass budgets. Previous studies have shown that the differences in concentration between different meteorological datasets and source parameterization are of the same magnitude as differences between including a 50 percent land use source or a 0 percent land use source, suggesting that determining the portion of land use will be difficult from concentration datasets. Simulations of the absorbing aerosol index which can be quantitatively compared with the TOMS AAI allow us to consider the source strengths close to the source regions. These results suggest that a 0-25 percent land use source is most likely in North Africa, but that uncertainties due to meteorology and source parameterization are larger than the differences in the inclusion vs. exclusion of land use sources, again frustrating our efforts to constrain anthropogenic impacts on mineral aerosols. Differences in mineral aerosol source parameterizations may also have important ramifications for feedbacks on climate. Thus efforts should be made to provide not only best estimates of mineral aerosol sources but also the uncertainties in these best estimates.

#### A24B-03 1600h

##### Constraining Dust Sources in Central and East Asia With Satellite and Ground-based Observations

Kremena Darmenova<sup>1</sup> (404-385-6031; kdarmenova@eas.gatech.edu)

Irina N Sokolik<sup>1</sup> (404-894-6180; isokolik@eas.gatech.edu)

<sup>1</sup>School of Earth and Atmospheric Sciences, Georgia Institute of Technology, 311 Ferst Drive, Atlanta, GA 30332

The aerosol transport models become the most comprehensive tool available for predicting the diverse impacts of dust on the climate system. Despite the recent advances in model developments, reliable prediction of the dust emission and spatio-temporal distribution of the dust burden has been proven difficult. One of the key issues is how to quantify dust emission rates from both natural and anthropogenic sources with the pertinent temporal and special resolution. Our study addresses this issue by examining the extent to which an integrated analysis of routine surface meteorological observations (including visibility) and satellite imagery helps to constrain the strength of dust sources and dust transport. We will report the results of an integrated analysis of satellite observations (MODIS, TOMS and SeaWiFS) and surface meteorological data conducted over Central and East Asia. In addition, the meteorological fields predicted by the PSU/NCAR mesoscale model (MM5) driven by NCAR NCEP reanalysis data were incorporated into several dust production schemes of different complexity. The dust emission was simulated at a range of model-grid spatial resolution (from 10 km to 200 km) to estimate the uncertainties in dust fluxes predicted by different schemes. The effects of

spatial averaging for individual dust sources with different topography, vegetation cover, and surface soil properties were investigated. By relating dust modeling to observations, we attempt to identify the appropriate temporal and spatial resolution for adequate intercomparison between model results and observational data.

#### A24B-04 1615h

##### A Simulated Climatology of Asian Dust Aerosol and its Trans-Pacific Transport - Interannual Variability and Climate Connections

Sunling Gong<sup>1,2</sup> ((416)739-5749;

Sunling.Gong@ec.gc.ca); Xiaoye Zhang<sup>2</sup>

(xiaoye@loess.llqg.ac.cn); T.L. Zhao<sup>1</sup>

(Tianliang.Zhao@ec.gc.ca); X.B. Zhang<sup>1</sup>

(xuebin.zhang@ec.gc.ca); Ian G. McKendry<sup>3</sup>

(ian@geog.ubc.ca); C.S. Zhao<sup>4</sup> (zcs@pku.edu.cn)

<sup>1</sup>Meteorological Service of Canada, 4905 Dufferin Street, Toronto, Ont M3H 5T4, Canada

<sup>2</sup>Institute of Earth Environment, Chinese Academy of Sciences, P. O. Box 17, Xian 710075, China

<sup>3</sup>Atmospheric Science Programme/Geography The University of British Columbia, 251-1984 West Mall, Vancouver, BC, Canada

<sup>4</sup>Department of Atmospheric Science School of Physics, Peking University, Beijing, China

A 44-year climatology of spring Asian dust aerosol emission, column loading, deposition, trans-Pacific transport routes and budgets during 1960 - 2003 was simulated with NARCM (Northern Aerosol Regional Climate Model). Interannual variability in Asian dust aerosol and transport properties simulated by the model is compared with major climate indices and variations in ground observations. For dust production from most of the source regions, the strongest correlations were with the surface wind speed in the source region, the area (AIAPV) and intensity (IIAPV) indices of the Asian polar vortex, and dust emissions were negatively correlated with precipitation and surface temperatures in spring. The strength of the East Asian Monsoon was not found to be directly related with dust production but rather with the transport of dust from the Asian subcontinent. The interannual variability of dust loading and deposition showed similar relationships with various climate indices. The correlation of Asian dust loading and deposition with the atmospheric teleconnection Western Pacific (WP) pattern and Atmospheric Circulation Index (ACI) exhibits contrasting meridional and zonal distributions. AIAPV and IIAPV were strongly correlated with the mid-latitude zonal distribution of dust loading and deposition over the Asian subcontinent and North Pacific. The Pacific/North American pattern (PNA) and Southern Oscillation Index (SOI) displayed an opposite correlation pattern of dust loading and deposition in the Eastern Pacific, while SOI correlated significantly with dust loading over Eastern China and Northeast Asia. The Pacific Decadal Oscillation (PDO) was linked to the variations of dust aerosol and deposition not only in the area of Eastern North Pacific and North America but also in the Asian dust source regions. The anomalies of transport flux and its divergence as well as dust column loading were also identified for eight typical El Niño and eight La Niña years. A shift of the trans-Pacific transport path to the North was found for El Niño years, which resulted in less dust storm and dust loading in China. El Niño- and La Niña-event had opposite effects on dust divergence in the troposphere over East Asian. On the basis of the variability of Asian dust aerosol budgets, the ratio of inflow to North America to the outflow from Asia was found to be correlated negatively with the PNA-index and positively with the WP- index.

#### A24B-05 1630h

##### Modeling Wet Removal of Mineral Dust as Hydrophobic and Hydrophilic Aerosols in the Atmosphere

Song-Miao Fan<sup>1</sup> (6094526569; snf@gfdl.noaa.gov)

Hiram Levy<sup>1</sup> (6094526581; hl@gfdl.noaa.gov)

Walter Moxim<sup>1</sup> (6094526522; wm@gfdl.noaa.gov)

<sup>1</sup>Geophysical Fluid Dynamics Laboratory/NOAA, P.O. Box 308, Princeton, NJ 08542, United States

Wet removal of mineral dust particles may result from drop nucleation in clouds, depending on whether a particle is hydrophilic or hydrophobic. Hydrophilic dust particles are fully wettable, while hydrophobic particles may be partially wettable. We calculate drop nucleation and growth using a numerical model of an ascending air parcel, considering the size, chemical composition, and number density of particles. Dust nucleated on silt-sized (radius > 1 μm) particles can

grow readily to the size for efficient collision and accretion. However, silt particles originating from desert regions, which dominate the mass of dust in the troposphere, may be hydrophobic and may not be removed by drop nucleation. Clay minerals, mainly silicates, are hydrophilic, although drop nucleation may be suppressed for variable portions of clay-sized (radius < 1 μm) particles due to their small size and low content of readily soluble materials. Clay particles with radii between 0.4-1 μm may be removed preferentially by cloud nucleation during rain events. Seasonal variations of dust observed over the tropical North Atlantic are best simulated in a global transport model when Saharan dust aerosols are assumed to be hydrophobic and may be transformed to hydrophilic by chemical absorption and reactions during transport.

#### A24B-06 1645h

##### Global Simulation of Mixing of Mineral Dust and Carbonaceous Aerosols With Sulfate and Effects on Their Mass Concentrations

Xiaohong Liu<sup>1</sup> (xhliu@engin.umich.edu)

Joyce E Penner<sup>1</sup> (penner@umich.edu)

Michael Herzog<sup>1</sup> (herzogm@umich.edu)

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

An aerosol dynamics module is coupled with a global chemistry and transport model (IMPACT) which is driven by the NASA Data Assimilation Office meteorological data. The aerosol module considers the major aerosol components: sulfate aerosol and non-sulfate aerosols (organic matter (OM), black carbon (BC), mineral dust, and sea salt), and includes the sulfate aerosol nucleation, condensation of H<sub>2</sub>SO<sub>4</sub> gas on the pure sulfate aerosol and non-sulfate aerosols, and coagulation within sulfate aerosol, between sulfate and non-sulfate. Mode approach is used for sulfate aerosol (two modes: nuclei and accumulation mode; and two moments: mass and number). We compare our model calculated aerosol mass and number with surface observations and calculated aerosol optical thickness with satellite measurements. In this study we are especially interested in the interactions between sulfate and non-sulfate aerosols. Specifically the mixing status of carbonaceous aerosols and mineral dust with sulfate in the atmosphere, and how these interactions affect mineral dust and carbonaceous aerosol mass concentrations are studied. Our results show that carbonaceous aerosols are generally internally-mixed with sulfate aerosol in the atmosphere, while mineral dust is externally mixed with sulfate except for the submicron dust particles. Global model calculated mass burdens are changed by 10-20 % (increase) for mineral dust and by 20-30 % (reduction) for BC between the two runs using the realistic wet scavenging efficiencies based on the surface coating of non-sulfate aerosols by sulfate in the atmosphere and using the assumed wet scavenging efficiencies (1 for dust and 0.4 for carbonaceous aerosols). Dust and BC mass concentrations and distributions are also compared between the two runs. Dust mass concentrations are found to agree generally much better with surface observations using the realistic scavenging efficiency in sites away from the dust source regions.

#### A31A CC: 220 C-E Wednesday 0830h

##### Bioaerosols: Measurement, Laboratory, and Modeling Studies II Posters (joint with B, OS, GC)

**Presiding:** P A Ariya, McGill

University; G Mainelis, Rutgers University

#### A31A-01 0830h POSTER

##### Microbial Transformation of Dicarboxylic Acids by Airborne Bacteria

Valerie Cote<sup>1</sup> (514-398-6920; valerie.cote2@mcgill.ca)

Parisa Ariya<sup>1</sup> (514-398-6931; parisa.ariya@mcgill.ca)

<sup>1</sup>McGill University, 801 Sherbrooke St. W., Montreal, QC H3A 2K6, Canada

Organic aerosols are assumed to be key players in driving climatic changes and can cause health problems for human. Dicarboxylic acids (DCA) include a large fraction of identified important class of organic

aerosols. In addition to direct sources, DCA are partly formed as the result of ozonolysis of terpenes and cyclic alkenes. Previous works in our laboratory show that airborne fungi collected from urban and suburban air play an important role in the transformation of several organic aerosols such as DCA. Our present study focuses on understanding the potential chemical transformation induced by airborne bacteria and on identification of the transformation products. Airborne bacteria have been collected using a biosampler and cultivated on a solid media. Each bacterial colony is being tested by HPLC for their ability to transform DCA in liquid cultures. Also, GC-MS, SPME and NMR are being used to identify the metabolites generated from the transformation. We will present our preliminary results and we will discuss the application of bacterial activities on the chemical transformation of organics in atmosphere.

### A31A-02 0830h POSTER

#### Identification of Volatile Organic Compounds (VOCs) From Photochemical Activity in Snow Samples

Gregor Kos<sup>1</sup> (+1-514-398-6920; gregor.kos@mcgill.ca)

Parisa A. Ariya<sup>1</sup> (+1-514-398-6931; parisa.ariya@mcgill.ca)

<sup>1</sup>McGill University, Department of Atmospheric and Oceanic Sciences, 805 Sherbrooke Street West, Montreal, QC H3A 2K6, Canada

The occurrence of VOCs in snow has been observed and can be related to anthropogenic emissions and biological activity. Photochemistry and microorganisms play a major role in the transformation of compounds in different compartments of the global ecosystem. Studies so far focused on the determination of single analytes or a class of compounds - mainly of anthropogenic origin (e.g. halogenated aromatic hydrocarbons) - that were considered important with regard to health and environmental concerns. Broader studies that describe a range of different compounds with different functionalities are relatively rare, especially for those of biological origin. The presented study investigated the formation of VOCs in snow samples and their connection with microbiological activity. The main aim was to pre-concentrate, identify and quantify volatile organic compounds. Snow samples were collected in an urban environment (Montreal, Canada) with sterilized containers. Samples were transferred into a heated reaction flask, where the sample was melted. A two-trap system was employed for pre-concentration: The first trap was used for water removal. The second trap was used for the collection of expected analytes by removing volatiles from the circulating air. Circulation was maintained with a pump at atmospheric pressure. Adsorption to glass walls of the reaction flask was prevented with halocarbon wax coating. Different sterilization methods were employed to suppress microbiological activity in order to collect background data and identify compounds of biological origin. VOC concentration and compound identification was performed with gas chromatography and mass spectrometric detection (GC-MS) by taking a sample with a gas-tight syringe through a septum-port. The sample was directly injected into the GC system. Compounds were identified by their respective mass spectra and included aldehydes and alcohols.

### A31A-03 0830h POSTER

#### Conversion of Atmospheric Aerosol by Bacteria and Their Influence on Ice-Nucleation Activity

Gregor Kos<sup>1</sup> (+1-514-398-6920; gregor.kos@mcgill.ca)

May Shawi<sup>1</sup> (+1-514-398-6920; may@sus.mcgill.ca)

Parisa A. Ariya<sup>1</sup> (+1-514-398-6931; parisa.ariya@mcgill.ca)

<sup>1</sup>McGill University, Department of Atmospheric and Oceanic Sciences, 805 Sherbrooke Street West, Montreal, QC H3A 2K6, Canada

The presence of microorganisms such as bacteria and fungi in the boundary layer of the atmosphere has been established for some time. These species can also convert organic aerosol species (e.g. dicarboxylic acids), a transformation that was so far assumed to occur only via physico-chemical pathways. As a result, the ice nucleation activity of certain aerosol species can be altered by biochemical transformations including metabolite production and bacterial growth and these new species as well as the microorganisms themselves can act as ice nuclei. In this study we have used dicarboxylic acids (DCA) as model nutrients, which are commonly observed in the aerosol population of the boundary layer. *Pseudomonas syringae* and *Erwinia herbicola* are two types of bacteria that have been found to possess ice nucleation ability, caused by lipoglycoprotein, which consists of a sequence of amino

acids that favor the formation of ice. The main objective was to look into the conversion of DCA by bacterial species, their ice nucleating ability and the identification of metabolites from bacterial activity. Furthermore, the influence of different parameters on the ice nucleation of bacteria was investigated. A Freezing Nuclei apparatus was used in order to assess the freezing temperature of a population of small drops to study both homogenous and heterogeneous nucleation of different concentrations of malonic acid containing bacterial species. An acid concentration in the lower g/l-range was chosen, matching earlier observations in an urban environment. Other varied parameters include the pH and bacterial membrane shearing. All labware was sterilized prior to use and airtight containers minimized external contamination. Malonic acid concentration was determined by gas chromatography with mass spectrometric detection (GC-MS) after esterification with a mixture of borontrifluoride and 1-propanol, modified from Kawamura, 1991. Malonic acid and its metabolites were identified by characteristic mass spectra.

### A31A-04 0830h POSTER

#### Interaction of selected Organic Compounds with Airborne Fungi: Impact in Ice Nucleation

Josiane Penelope Lafleur<sup>1</sup> (514-398-6920; josiane.lafleur@mail.mcgill.ca)

Parisa A. Ariya<sup>1</sup> (514-398-6931; parisa.ariya@mcgill.ca)

<sup>1</sup>McGill University, 801 Sherbrooke street west, Montreal, Qc H3A 2K6, Canada

Due to their radiative properties, clouds have a large potential impact on climate change. Ice nucleation is a significant atmospheric process, which leads to the formation of clouds. The aim of this study was to determine whether airborne fungi play a role in altering the chemical composition of organic compounds, and consequently alter the ice nuclei of airborne taxa and organic aerosols. We have performed experiments in which malonic acid solutions at concentrations similar to atmospheric organic droplets, were infected with four different types of fungi. Organic molecules were probed using a gas chromatograph with mass selective detections, a solid state nuclear magnetic spectrometer, an ultraviolet-visible spectrometer, and a freezing plate. We observed distinct changes in the freezing points of organic solutions immediately after the introduction of fungi. The solutions were allowed to stand for twenty-one days at room temperature and analysis on a regular basis showed that the trend was towards a further decrease in freezing temperature with time. We will present our results, present potential mechanisms, and discuss their implications in the formation of clouds.

### A31A-05 0830h POSTER

#### Study of Ice Nucleation by Organic Compounds via Heterogeneous Mechanism

Shashi Kant Pathak<sup>1</sup> ((514) 398-6920; shashi.pathak@mcgill.ca)

Parisa A Ariya<sup>1</sup> ((514) 398-6931; parisa.ariya@mcgill.ca)

<sup>1</sup>McGill University, Department of Atmospheric and Oceanic Sciences, 805 Sherbrooke Street West, Montreal, QC H3A 2K6, Canada

In an attempt to explore the formation of ice in clouds and to identify clouds role in the climate, real-time experiments of ice nucleation on aerosol surfaces have been performed with the help of Ice Nucleation Chamber Facility (INCF). The present studies indicate the nucleation of ice by organic compounds followed by ice crystal growth under supercooled conditions pertaining to the tropospheric environment. It suggests that phase transformation from water vapor into ice may not be solely attributed to the deposition mechanism, however it seems to be inclusive of condensation followed by deposition under high humidities. The activated ice nuclei grow in the supersaturated environment by water vapor uptake, thus eventually limit the maximum supersaturation. However, results obtained so far seem to reflect an interesting understanding that ice formation occurs via heterogeneous mechanism by organic compounds and thus the probability of ice formation in the upper troposphere by these compounds can not be ruled out than that expected by inorganic compounds.

### A31A-06 0830h POSTER

#### A Novel Experimental Technique for Ice Crystal Generation Under High Humid Environments

Shashi Kant Pathak<sup>1</sup> ((514) 398-6920; shashi.pathak@mcgill.ca)

Parisa A Ariya<sup>1</sup> ((514) 398-6931; parisa.ariya@mcgill.ca)

<sup>1</sup>McGill University, Department of Atmospheric and Oceanic Sciences, 805 Sherbrooke Street West, Montreal, QC H3A 2K6, Canada

Ice formation by aerosol particles in the atmosphere and its implications on global climate is a topic of current environmental interest. The presence of organic aerosols in the atmosphere has been well documented by several researchers and their quantification has been reported in the literature. We present here a novel experimental technique of ice nucleation by atmospheric aerosols under supersaturated environments using Ice Nucleation Chamber Facility (INCF). INCF has been designed and built indigenously in our laboratory to investigate heterogeneous nucleation of ice on aerosol surfaces. The ice-nucleating surface has been created inside a Bigg-Warner chamber by generating aerosol particles using an atomizer aerosol generator TSI-9302 along with a vacuum pump & compressor KNF-UN05. Present work provides a qualitative evidence of ice crystal generation via heterogeneous mechanism under high humid environments. These results elucidate ice nucleation on heterogeneous surfaces and suggest that the presence of organic aerosols in cloud droplets basically enhance the freezing capability of solution droplets at a higher temperature than that required for homogenous freezing thresholds.

### A31A-07 0830h INVITED POSTER

#### Impact of Organic molecules on Ice Nucleation and Cloud Condensation

Jiming Sun<sup>1</sup> (514-8454434; sunjm@zephyr.meteo.mcgill.ca)

Parisa Ariya<sup>1</sup> (514-3986931; Parisa.Ariya@mcgill.ca)

<sup>1</sup>Atmospheric and Oceanic Sciences McGill University, 805 Sherbrooke Street West, Montreal, Qc H3A 2k6, Canada

Atmospheric organic aerosols are suggested to be important players in cloud formation, since they serve as ice nuclei (IN) and cloud condensation nuclei (CCN). In this present study, we have attempted to determine the role of bioorganic matter (e.g., bacteria, fungi, and cellulose) in the cloud formation processes using a column version of the model NARCM-LCM. The local model of the climate (LCM) is a one-dimensional version (column) of NARCM (Northern Aerosol Regional Climate Model). It focuses on one-dimensional (1-D) evolution of aerosol distributions within North America and it simulates deposition, and size distributions of aerosol particles in the region of interest. Bioaerosols are now being incorporated in the column version of NARCM. We mainly consider the dry and humid deposition of bioaerosols, the formation of ice crystals and precipitation. We will present our progress on the development of the new version. Moreover, we will simulate the interactions between the bioaerosols and the clouds and discuss our preliminary results of the impact of bioaerosols on cloud formation.

### A31A-08 0830h POSTER

#### Biogenic Sulphate in PM2.5: Results from a Field Campaign on Canada's West Coast

Ann-Lise Norman<sup>1</sup> (403-220-5405;

annlisen@phas.ucalgary.ca); Kurt Anlauf<sup>2</sup> (Kurt.Anlauf@ec.gc.ca); Jeff Brooks<sup>2</sup>; Katherine Hayden<sup>2</sup> (Katherine.Hayden@ec.gc.ca); Bruce Thomson<sup>2</sup> (Bruce.Thomson@ec.gc.ca); Shao-Meng Li<sup>2</sup> (Shao-Meng.Li@ec.gc.ca)

<sup>1</sup>The University of Calgary, 2500 University Dr. N.W., Calgary, AB T2N 1N4, Canada

<sup>2</sup>Meteorological Service of Canada, 4905 Dufferin Street, Toronto, ON M3H 5T4, Canada

Stable S and O isotopes were used to constrain the amount of biogenic sulphate present in aerosol sulphate less than 2.5 micrometers in diameter and to provide a relative measure of primary versus secondary sulphate. Biogenic sulphate in coastal regions is largely derived from the oxidation of dimethyl sulphide. If this sulphate is isotopically distinct from other sulphur sources on a regional basis, a simple apportionment model can be used to account for the proportion of biogenic sulphur in well mixed air. Aerosols collected during the Pacific 2001 field study in the Fraser Valley were found to make up, on average, thirty percent of the sulphate

in PM 2.5 in air masses transported from the ocean during the day. Sulphate from ocean biogenic sources contributed between 0.07 and 0.5 mg/m<sup>3</sup> (average 0.3 mg/m<sup>3</sup>) to atmospheric sulphate concentrations in the Fraser Valley during the Pacific 2001 field campaign from August 16 - 30. Significantly, nitrate at an inland site, Langley, was related to the amount of biogenic sulphate present. Higher nitrate concentrations corresponded to air masses that were more oxidized and contained a larger proportion of biogenic sulphate, while lower concentrations were associated with well-mixed but more polluted airmasses over the Strait of Georgia.

#### A31A-09 0830h POSTER

##### Bioaerosols at snow-air interface

Parisa A. Ariya<sup>1</sup> (parisa.ariya@mcgill.ca)

Valerie Cote<sup>1</sup> (valerie.cote@mail.mcgill.ca)

Hojatollah Vali<sup>2</sup> (vali@eps.mcgill.ca)

<sup>1</sup>Parisa Ariya, Departments of Atmospheric and Oceanic Sciences, and Chemistry, McGill University, 801 Sherbrooke St. W., Montreal, PQ H3A 2K6, Canada

<sup>2</sup>Departments of Earth and Planetary sciences, and Anatomy, McGill University, Canada

Bioaerosols, airborne living or products of biological activities, can impact the chemical composition of snow at the atmosphere-snow interface. In this talk, we will present three-year observation data on selected chemical species and biological entities of snow in an urban, two sub-urban, and an Arctic site. We will also present a conceptual model of snow-air chemical interactions in presence of micro-organisms.

#### A31B CC: 220 C-E Wednesday 0830h

##### Constraining the Global Mass Distribution of Mineral Dust Aerosol III Posters (joint with B, GC)

**Presiding:** R L Miller, NASA Goddard Institute for Space Studies; C S Zender, University of California, Irvine

#### A31B-01 0830h POSTER

##### Natural and Anthropogenic Mineral Dust: Systematic Terminology and Current Mass Budget Estimates

Charles S Zender<sup>1</sup> ((949) 824-2987; zender@uci.edu)

Ron Miller<sup>2</sup> ((212) 678-5577; rlm15@columbia.edu)

<sup>1</sup>Department of Earth System Science, University of California at Irvine, Irvine, CA 92697-3100, United States

<sup>2</sup>Goddard Institute for Space Studies, 2880 Broadway, New York, NY 10027, United States

The Second International Workshop on Mineral Dust convened in Paris September 10-12, 2003. During discussion of how best to improve estimates of dust loading and radiative forcing, we recognized that the binary division of dust into "natural" and "anthropogenic" emissions is inadequate for many purposes. While natural dust sources like deserts are easily visualized, anthropogenic dust sources come in many forms. A consensus terminology is necessary to objectively define, attribute, and intercompare dust mass budgets and forcings. Policymakers request an objective definition and distinction of "natural" and "anthropogenic" dust. Models may simulate various types or species of anthropogenic dust that are impossible to discriminate in observations. Our dust taxonomy is based on these requests and limitations. Dust is classified as either Natural Dust (DN), Direct Anthropogenic Dust (DA1), Passive Anthropogenic Dust (DA2), or Indirect Anthropogenic Dust (DA3). We illustrate this taxonomy by applying it to most extent mineral dust mass budget estimates. We find that the range in Natural Dust estimates is about a factor of four. Few studies provide any Anthropogenic Dust (DA) estimates. Of those, none fully distinguish between anthropogenically mobilized dust (DA1), Naturally mobilized dust from anthropogenic sources (DA2), and changes in emissions from natural source regions due to anthropogenically induced climate change (DA3). The causes and potential for remediation of each DA subclass are significantly different. Apportioning modeled and observed estimates into these dust classes would therefore be valuable to policymakers while simultaneously facilitating model inter-comparisons.

#### A31B-02 0830h POSTER

##### Testing MODIS Dust Detection Capabilities Over the Ocean Using Visible and IR Channels

Anton Darmenov<sup>1</sup> (404-385-6031; adarmenov@eas.gatech.edu)

Irina N Sokolik<sup>1</sup> (isokolik@eas.gatech.edu)

<sup>1</sup>School of Earth and Atmospheric Sciences, Georgia Institute of Technology, 311 Ferst Drive, Atlanta, GA 30332

Remote sensing from space offers the best opportunity to detect and track the mineral dust, especially over the oceans where data are extremely limited. Global transport models rely on satellite retrievals of dust to constrain the spatial distribution of aerosol optical depth as well as radiative forcing predicted by models. Several recent studies have attempted to assimilate satellite aerosol products into the transport models seeking a better model performance. Given the importance of the subject in climate change studies, there is a great need for reliable and accurate dust data from satellites. In this study we examine how well the Moderate Resolution Imaging Spectroradiometer (MODIS) can detect dust, especially in the presence of clouds. Since clouds frequently occur in the regions affected by dust transport, reliable discrimination of dust from clouds would be a required first step in any aerosol retrievals. For our analysis we use the MODIS Level 1B data containing calibrated and geolocated reflectances and radiances from seven spectral channels for the period of February 24th 2000 - January 31st 2004 over various geographical regions. The granules with dust, cloud and clear sky pixels over the oceans were identified using the true color images. Thirty granules were selected for a detailed analysis. For each case, we tested MODIS cloud mask as well as aerosol and cloud products. We found that MODIS cloud mask fail to differentiate between dusty and cloudy pixels. Dust was mistakenly identified as clouds in many circumstances. To address this issue, we investigated whether a combination of visible reflectances, local standard deviations, visible to infrared reflectance ratio and brightness temperature differences can be used to uniquely detect mineral dust plumes over the oceans. The results will be presented and implications for model validation and dust-cloud interaction studies will be discussed.

#### A31B-03 0830h POSTER

##### A Japan-Sino joint project, ADEC - Aeolian Dust Experiment on Climate Impact

Masao MIKAMI (81-29-853-8623; mmikami@mri-jma.go.jp)

Meteorological Research Institute, 1-1, Nagamine, Tsukuba, Ibaraki 305-0052, Japan

In recent years, aeolian dust has been thought to be an important factor of the climate system on the earth by the radiative forcing effect in the atmosphere and by the influence on the carbon dioxide cycle because deposited dust supplies nutrient salts for the phytoplankton on the ocean surface. Among them, radiative forcing direct and/or indirect effects are important factors of the global warming. Nevertheless, the reliability of the evaluation regarding the radiative forcing impact of aeolian dust is very low. [IPCC, 2001]. This is because the understanding and the model representations of dust entrainment, spatial and temporal distribution of dust, and optical properties of dust particles are not so accurate. Based on this background, Aeolian Dust Experiment on Climate Impact (ADEC) was started in April 2003 as a Japan-Sino Joint Project. The goal of this project is to evaluate the global dust supply to the atmosphere and its radiative forcing direct effect. For this purpose, we have made: 1) in situ observations at desert areas in China for wind erosion processes, 2) network observations from China to Japan, ranging from 80 to 140 East, for understanding spatial-size distribution, chemical, and optical properties of dust particles, and 3) numerical simulation by GCM dust model for evaluation of dust impact on the global climate over the past 50 years. This was planned as a five-year project and two intensive observations, IOP-1, April 12-25 2002, and IOP-2, March 15-26 2003, were put into practice. Intensive observations were made at 6 sites in China (Qira, Aksu, Dunhuang, Shapotou, Beijing, and Qingdao) and 4 sites in Japan (Naha, Fukuoka, Nagoya, and Tsukuba). Preliminary results show that 1) saltation flux at a gobi desert monitored by a newly developed sand particle counter was around 10 times larger than that of a sand dune, which will be caused by the difference of the parent soil size distribution of each ground condition, 2) the background of KOSA events were found in the atmosphere over Japan, 3) based on the Asian dust mineral components, evaluated radiative forcing of the Asian dust is weaker than OPAC3.1 dust model, 4) GCM dust model represented the global distribution of dust which shows reasonable agreement with the observational results. In the presentation, a brief summary of the two IOPs and preliminary results of 2004 spring field campaign will be shown.

URL: <http://www.aeoliandust.com/>

#### A31B-04 0830h POSTER

##### Modeling Arabian Dust Mobilization During the Asian Summer Monsoon: the effect of Prescribed Versus Calculated Sea Surface Temperatures.

Ron L Miller<sup>1,2</sup> ((212) 678-5577; rlm15@columbia.edu)

Jan Perlwitz<sup>1,2</sup> ((212) 678-5607; jperlwitz@giss.nasa.gov)

Ina Tegen<sup>3</sup> ((49) 3641 643747; itegen@bgc-jena.mpg.de)

<sup>1</sup>Dept of Applied Physics Columbia University, 2880 Broadway, New York, NY 10025, United States

<sup>2</sup>NASA Goddard Institute for Space Studies, 2880 Broadway, New York, NY 10025, United States

<sup>3</sup>Max Planck Institute for Biogeochemistry, P. O. Box 10 01 64, Jena 07701, Germany

Mobilization of dust over the Arabian Peninsula during the Northern Hemisphere summer monsoon is strongly sensitive to radiative scattering by dust particles. In an experiment with prescribed SST, emission increases with the particle absorptivity and is up to 40% larger compared to an experiment that omits dust radiative forcing. Radiative heating within the dust layer acts as an elevated heat source, driving low-level convergence and reinforcing the monsoon circulation. In contrast, dust radiative forcing reduces Arabian emission by 20% if SST is calculated. This discrepancy results from the absence of a surface energy constraint in the prescribed SST experiments. With calculated SST, the reduction of sunlight incident upon the surface is balanced by a reduction in the turbulent fluxes of latent and sensible heat into the atmosphere. This represents a cooling of the atmosphere which almost precisely cancels radiative heating within the dust layer. The contrasting effect of dust radiative forcing in the two experiments shows the importance of the surface energy budget to the climate response to dust, which is absent in prescribed SST experiments.

#### A31B-05 0830h POSTER

##### Radiative-Induced Climate Feedbacks of the Present Mineral Dust Cycle - Results From a Global Modeling Study

Martin Werner<sup>1</sup> (+49 3641 576266; martin.werner@bgc-jena.mpg.de)

Ina Tegen<sup>1</sup> (+49 3641 576270; ina.tegen@bgc-jena.mpg.de)

Philip Stier<sup>2</sup> (+49 40 41173388; stier@dkrz.de)

<sup>1</sup>Max-Planck-Institute for Biogeochemistry, P.O. Box 100164, Jena D-07701, Germany

<sup>2</sup>Max-Planck-Institute for Meteorology, Bundesstr. 53, Hamburg D-20146, Germany

Mineral dust may modify the interplay of the various components of the Earth system, atmosphere, land and ocean, in different ways. One of its key effects is altering the radiative balance of the atmosphere by an increased aerosol loading. The strength of this radiative effect and of possible feedback mechanisms on both the Earth's climate and the mineral dust cycle itself, are poorly understood on a global scale, yet. Here, we present first results of a new model approach to enhance our knowledge of the mineral dust cycle, changes of the radiative forcing and potential feedback mechanisms within the Earth system. A recently developed dust emission model (including a prognostic vegetation-phenology scheme) was incorporated into a new aerosol scheme (HAM) of the latest version of the Hamburg General Circulation Model ECHAM5. Coupled to a slab ocean model, this set-up allows simultaneously studying of vegetation-dust feedbacks, changes in surface temperatures both over land and ocean, and large-scale variations of the atmospheric circulation, all induced by radiative effects attributable to mineral dust aerosol loading. Performing several ECHAM5 simulations prescribing appropriate present-day boundary conditions enables us to focus on the following aspects: (1) How strong is the disturbance of the atmosphere's radiative balance by mineral aerosol loading? (2) How does this radiative disturbance translate into surface temperature changes? (3) What are the main dust-induced changes of the atmospheric circulation? (4) Do radiative effects of mineral aerosol increase or decrease the strength of the dust cycle itself? (5) Are the simulation results substantially altered by small variations of the computed size-distribution, and the prescribed refractive indices of the dust particles?