Monday, October 5, 2009
Session: IPCC-AR5…emissions and experiments

9:20-9:40 AM

OMA01

Title: IPCC-AR5 emission choices

Authors: Brian Magi (1), Vaishali Naik (2)

(1) Princeton University/NOAA GFDL, Princeton, NJ
(2) High Performance Technologies, Inc. (HPTi) /NOAA GFDL, Princeton, NJ, USA

Abstract: We will present the historical (1850-2000) emissions estimates suggested for use in IPCC AR5 era climate models, and offer an outsider's perspective of the methods used to compile the so-called IPCC AR5 biomass burning and anthropogenic emissions inventories. In addition to global and regional comparisons with other emissions estimates, we will also discuss the differences in the time evolution between IPCC AR5 and AeroCom emissions inventories. Finally, we will discuss uncertainties and point out what is *not* included in the emissions inventories (e.g. volcano emissions).

9:45-10:05 AM

OMA02

Title: Comparison of two emission scenarios of BC, OC, and SO2, for the period 1980-2008

Authors: Thomas Diehl(1)

(1) UMBC/NASA GSFC, greenbelt, MD

Abstract: A number of research groups have recently focused their attention on the time frame 1980-2008 for various hindcast experiments. A crucial prerequisite for these experiments is a comprehensive emission inventory for the species included in the hindcast. Emission inventories for the major aerosol species black carbon and organic carbon as well as the aerosol precursor SO2 have been compiled by several groups. We will compare the inventory compiled by Diehl et al., available through AeroCom, and the IPCC AR5 inventory.

10:10-10:30 AM

OMA03

Title: Estimation of Aerosol emission intensities through variational assimilation of aerosol optical depth

Authors: Nicolas Huneeus (1), Frederic Chevalier (1), Olivier Boucher (2)

(1) LSCE, Gif-sur-Yvette, France
(2) UK Met Office, Exeter, UK

Abstract: The representation of aerosol processes in the general circulation model LMDz was successfully simplified by grouping its 24 aerosol species into 4 lumped species, namely gaseous precursors, fine mode aerosols, coarse mode desert dust and coarse mode sea salt. Additional modifications were introduced in the computation of aerosol optical depth, in the process of sedimentation, dry and wet deposition and sulphur chemistry to ensure consistency with the new set of species and their computations. This simplified aerosol model reproduces the main features of the aerosol distribution in LMDz. Simulated aerosol optical depths of the simplified model are within the variability of AERONET observations for all aerosol types and all sites throughout most of the year. The tangent linear and adjoint models of the simplified aerosol model were derived and implemented together with the direct model in a global variational data assimilation scheme. The intensity of the aerosol emission is then estimated through the assimilation of daily values of the total and fine mode aerosol optical depths at 550 nm. Results for the month of July 2002 will be shown.

11:00-11:20 AM

OMA04

Title: Trend of aerosol radiative forcing during last several decades estimated with different emission inventories

Authors: Toshihiko Takemura (1)

(1) Kyushu University, Fukuoka, Japan

Abstract: Time evolution of the radiative forcing due to various climate forcing agents after the Industrial Revolution using a general circulation model, MIROC, coupled with a global aerosol transport-climate model, SPRINTARS, was shown in Takemura et al. (2006) and Figure 2.23 of IPCC AR4 (2007). In this presentation, trends of the radiative forcing of the aerosol direct and indirect effects during last several decades estimated by MIROC/SPRINTARS with different emission inventories, IPCC AR4 standard, AeroCom Phase II, and new IPCC inventory, are compared.

11:25-11:45 AM

OMA05

Title: Aerosol modeling in the new Norwegian earth system model, NorESM, and comparisons with results from CAM-Oslo used for AeroCom.

Authors: Alf Kirkevåg, Øyvind Seland, Corinna Hoose, Trond Iversen, Jon Egill Kristjansson, Mats Bentsen, and Jens Debernard

(1) Norwegian Metetorological Institute, Oslo, Norway

Abstract: NorESM is a Norwegian Earth System Model based on development versions of the NCAR CCSM4. The ocean model is replaced by a modified version of the Miami Isopycnic Coordinate Ocean Model (MICOM), and aerosol and aerosol-cloud interaction parameterizations are from or based on CAM-Oslo. The Rasch-Kristjánsson stratiform microphysics scheme is used instead of the Morrison and Gettelman scheme. This enables using the already developed scheme for prognostic cloud droplet number concentrations in CAM-Oslo. One important update is a revised treatment of natural background aerosols. Impacts of this and other model updates on aerosol life cycling, physical properties and radiative forcing will be discussed. The effect of switching from AeroCom to IPCC emissions will also be addressed in the talk.

Monday, October 5, 2009
Session: IPCC-AR5…emissions and experiments

11:50AM-12:10PM

OMA06

Title: Evolution of aerosol effects on climate during the 20th century in the GISS model.

Authors: Dorothy Koch (1)

(1) Columbia University, New-York, NY, USA

Abstract: We will present results from our coupled climate simulations using on-line aerosols and aerosol effects in the GISS model. Climate sensitivity experiments are performed that allow isolation of the indirect effect and BC effect of snow albedo during the century. We find that the BC-albedo effect on the Arctic peaks during the 1930-40s and has declined in recent decades therefore even contributing to Arctic cooling since the 1980s. The simulation that included the indirect effect produced a better pattern of warming for most of the 20th century than the simulation without indirect effect. However the indirect effect contributes a stronger cloud forcing in these deep-ocean simulations than it did in Qflux simulations (of Koch et al., 2009), and in order to accurately simulate 20th century temperature trends we had to “weaken” the indirect effect. Decline in the indirect effect near the end of the century contributes to warming especially in the Arctic.
We will show comparison of model aerosol trends to aerosols observed in ice core and lake trends; we will also compare model with observed surface radiation (global dimming/brightening) trends. While the climate results are from pre-AR5 model work, we will also show our initial AR5 aerosol simulation results. By comparing the AR5 aerosols to aerosol fields used in the climate simulations, we will discuss anticipated aerosol impacts for AR5.

3:00-3:20 PM

OMP01

Title: AEROCOM indirect effect intercomparison

Authors: Johannes Quaas (1)

(1) Max Planck Institute, Hamburg, Germany

Abstract: First results of the indirect effect intercomparison are under revision for ACP. We compare the ten models contributing to the analysis against satellite retrievals using statistical relationships of AOD to cloud and radiation properties. Main results are an overestimation of the indirect effect over land compared to the satellite retrievals, and a relatively good representation over oceans. Second aerosol indirect effects are likely to be deficient in the models, since the relationship between AOD and liquid water path is far too large in the models compared to the data. A revised, smaller, forcing estimate is given.

3:20-3:40 PM

OMP02

Title: AeroCom aerosol absorption assessment

Authors: Dorothy Koch (1), Michael Schulz (2), Johannes Quaas (3)

(1) Columbia University, New-York, NY, USA
(2) Laboratoire des Sciences du Climat et de l'Environnement, France
(3) Max Planck Institute, Hamburg, Germany

Abstract: We will present brief final summary results from the AeroCom BC model – observation experiment (now in ACPD). We will discuss availability of the data used in this study for ongoing model evaluation.

Preliminary results from the "Impact of BC reductions on the indirect effect" model experiments will also be presented. AeroCom models with aerosol microphysics (internal mixing of BC and other aerosol species) have been invited to submit results for four experiments: a) reduction of 50% of fossil fuel BC, b) 50% reduction of BC and OC from biofuels, c) removal of all BC and OC from diesel and d) removal of all BC and OC from woodstoves. We are interested to learn how the indirect effect changes with these BC reductions. We anticipate that the models cloud condensation nucleii population could decrease as secondary aerosols condense upon other available particles, however it could also increase if the secondary species nucleate extra new particles. These two possible responses could each dominate in different regions. Finally, if BC reduction causes a positive indirect effect forcing, is it greater or less than the direct effect negative forcing; i.e. does BC reduction result in a net negative radiative forcing?

3:40-3:50 PM

OMP03

Title: First results from the “AeroCom prescribed” model/satellite intercomparison study

Authors: Philip Stier (1), Stefan Kinne (2), Nicolas Bellouin (3), Gunnar Myhre (4), Michael Schulz (5), John Seinfeld (6)

(1) Oxford University, Oxford, UK
(2) Max Planck Institute for Meteorology, Hamburg, Germany
(3) UK MetOffice, UK
(4) University of Oslo, Norway
(5) Laboratoire Science Climat et de l'Enivonnement, France
(6) California Institute of Technology, USA

Abstract: Aerosol radiative forcing estimates of global aerosol models and satellite retrievals show considerable diversity that can partly be attributed to differences in the aerosol radiative properties but partly also to processes and assumptions in the host models (e.g. surface albedos, clouds). The contribution of these host model processes to the total forcing uncertainty is entirely unclear.

The AeroCom model/satellite intercomparison study with prescribed aerosol radiative properties (AeroCom Prescribed) will facilitate their quantification. The simulated forcing variability among models with identical prescribed radiative properties is a direct measure of the forcing calculation contribution to the uncertainty in the assessment of the aerosol radiative effects.

This talk will introduce the input data for the AeroCom Prescribed experiment and describe the provided scripts to set up the input data for individual model configurations while maintaining consistency among the implementations. First results of AeroCom Prescribed test runs in the ECHAM5 and the HadGEM models will be presented.

Monday, October 5, 2009
Session: Working group activities

3:50-4:00 PM

OMP04

Title: The AeroCom A2-Trop/Arctic Experiment

Authors: Cynthia Randles (1), Stefan Kinne(2), Michael Schulz (3)

(1) University of Maryland Baltimore County/NASA GSFC, Greenbelt, MD, USA
(2) Max Planck Institute of Meteorology, Hamburg, Germany
(3) Laboratoire des Sciences du Climat et de l'Environnement, Gif-sur_Yvette, France

Abstract: There is considerable diversity in aerosol radiative forcing estimates from both global aerosol models and satellite retrievals. The proposed AeroCom Prescribed Forcing experiment seeks to facilitate the quantification of processes and assumptions in host models which may contribute to some of the variability in model direct aerosol radiative forcing estimates. Here we propose and additional, simple model inter-comparison study with prescribed standard atmospheres and surface albedo to test global model solar radiative transfer routines without aerosols or clouds. This experiment will reveal how each model treats Rayleigh scattering, ozone absorption, and water-vapor absorption and will facilitate analysis of the AeroCom Prescribed Forcing experiment results.

4:00-4:10 PM

OMP05

Title: Direct radiative forcing analysis

Authors: Gunnar Myrhe (1)

(1) Center for International Climate and Environmental Research – Oslo (CICERO) Oslo, Norway

Abstract: The preliminary results from Phase II direct aerosol effect radiative forcing will be discussed. These preliminary results from various models will be compared as well compared to previous published results. A main goal with this presentation is to get more modeling groups involved in the direct aerosol effect experiment.

4:40-5:10 PM

OMP06

Title: Evaluation of recent model submissions with AeroCom tools

Authors: Michael Schulz (1)

(1) Laboratoire des Sciences du Climat et de l'Environnement, Gif-sur-Yvette, France

Abstract: The evaluation of recent model results from the AeroCom phase II has been performed with the AeroCom idl tools at the LSCE and results are exposed via the aerocom web interface. The simultaneous incorporation of different observational datasets to obtain a quick-look on model quality for different aspects of the aerosol model simulation is presented. The results of the AeroCom phase II are then compared against model results from the first AeroCom phase and other simulations stored in the AeroCom database from HTAP, ECMWF and EUCAARI.

5:15-5:35 PM

OMP07

Title: Evaluating aerosol microphysics models: observational datasets and plans for the AEROCOM microphysics working group.

Authors: Graham Mann (1)

(1) University of Leeds, Leeds, UK

Abstract: Aerosol schemes in the IPCC AR5 generation of climate models will be more complex than at AR4 with many resolving new particle formation and growth. Such global aerosol microphysics schemes require detailed evaluation and have motivated AEROCOM's move to widen its diagnostic assessment between models to include size-resolved particle number concentrations in this 2nd phase. Comparing the models with rich observational datasets from EUSAAR (and other) supersites and recent field campaigns (e.g. EUCAARI) will help reduce model diversity and improve the robustness of IPCC simulated aerosol-climate forcings. This talk will present plans and preliminary results of the AEROCOM new aerosol microphysics working group experiments. New statistical approaches to objectively determine sources of aerosol model diversity will also be described.

5:40-6:00 PM

OMP08

Title: An AEROCOM Intercomparison Exercise in Organic Aerosol Modeling

Authors: K. Tsigaridis (1), M. Kanakidou (2)
(1) NASA Goddard Institute for Space Studies, New York, USA;
(2) Environmental Chemical Processes Laboratory, Department of Chemistry, University of Crete, Heraklion, Greece.

Abstract: Comparisons of individual models with organic aerosol (OA) measurements have shown a large underestimate of the OA component by the models. These discrepancies are very high in the free troposphere. Trying to bridge the gap between models and observations, several recent model developments account for secondary OA (SOA), intermediate volatility organics, multiphase chemistry and semi-volatile primary OA (POA).
OA simulations have many degrees of freedom due to the missing knowledge on the behavior and fate of both POA and SOA in the troposphere. Thus, several assumptions need to be made and are translated to model tuning parameters that vary greatly from one model to the other. The organic aerosol intercomparison AEROCOM exercise aims to evaluate the actual status of global modeling of the OA occurrence in the global troposphere and analyze discrepancies between models as well as between models and observations. It will quantify the uncertainties and attribute them to major contributors. It will also try to identify and analyze potential model systematic biases. The ensemble of the simulations will be used to build an integrated and robust view of organic aerosol sources and sinks in the troposphere.
The year 2006 was selected as the base year for the study. The first results of the intercomparison will be presented together with a compilation of field data that will be used for the validation of the models results.

Tuesday, October 6, 2009
Session: Absorption

8:30-8:50 AM

OTA01

Title: Light absorption by pollution, dust, and biomass burning aerosols: A global model analysis and comparisons with AERONET data

Authors: Mian Chin (1), Thomas Diehl (1,2) Oleg Dubovik (3), Tom Eck (1,2), Brent Holben (1), Aliaksandr Sinyuk (1,4), David Streets (5).

(1) NASA Goddard Space Flight Center, MD, USA

(2) GEST/University of Maryland Baltimore County, MD, USA

(3) University of Lille, France

(4) SSAI, MD, USA

(5) DOE Argonne National Laboratory, IL, USA

Abstract: Atmospheric aerosol distributions from 2000 to 2007 are simulated with the GOCART model to attribute light absorption by aerosol to its composition and sources from pollution, dust, and biomass burning. The 8-year, global averaged total aerosol optical depth (τ), absorption optical depth (τ_a), and single scattering albedo (ω) at 550 nm are estimated at 0.14, 0.0086, and 0.95, respectively, with sulfate and dust making the largest fractions of τ and BC and dust the largest fractions of τ_a. Natural aerosols account for more than 50% τ and τ_a. Comparing with data from AERONET, the model tends to reproduce much better the AERONET direct measured τ and the Ångström exponent (α) than its retrieved ω and τ_a. The model has small systematic bias of τ for pollution and dust but underestimates τ for biomass burning aerosols. The modeled α is too low (particle too large) for pollution and dust aerosols but too high (particle too small) for biomass burning aerosols, indicating errors in particle size distributions in the model. The model estimated ω is lower in dust regions than AERONET. These comparisons necessitate model improvements on aerosol size distributions, the refractive indices of dust and BC, and biomass burning emissions.

8:55-9:15 AM

OTA02

Title: Black carbon aerosol mass and size distribution measurements in spring western Arctic troposphere

Authors: Shao-Meng Li (1)

(1) Air Quality Research Division, Atmospheric Science and Technology Directorate, Science and Technology Branch, Environment Canada

Abstract: In March to April 2009, we made black carbon aerosol (BCA) measurements in the spring Western Arctic troposhere from the German Polar Institute Polar-5 aircraft, covering the European, Canadian, and Alaskan Arctic. The BCA was measured using the Single Particle Soot Photometer (SP2) to detect individual particle black carbon core. Concentrations and size distribution between 50 nm to 400 nm diameters were obtained covering large geographic regions in the western Arctic, in an altitude range from surface to approximately 3.5 km. BCA concentrations were typically about 0.1 ug m-3 in background air, where largest BCA mass typically resides at 150-200 nm in size. Plumes of high BCA, as high as 0.5 ug m-3, can be seen at altitudes of 3 km, typically having diameters of 70-100 nm.

9:20-9:40 AM

OTA03

Title: Black Carbon and Climate Warming: An uncertainty estimate study taking into account microphysical processes

Authors: Susanne Bauer (1)(2)

(1) Columbia University, New York, NY, USA
(2) NASA GISS, New York, NY, USA

Abstract: Recently, attention has been drawn towards black carbon aerosols as a likely short-term climate warming mitigation candidate. However the global and regional impacts of the direct and especially the indirect aerosol forcing effects are highly uncertain, due to the complex nature of aerosol evolution and its climate interactions. Black carbon is directly released as particle into the atmosphere, but then interacts with other gases and particles through condensation and coagulation processes leading to further aerosol growth, aging and internal mixing. Those aerosol characteristics determine their role in direct and indirect aerosol forcing, as their chemical composition and size distribution determine their optical properties and cloud activation potential. A new detailed aerosol microphysical scheme, MATRIX, embedded within the global GISS modelE climate model includes the above processes that determine the lifecycle and climate impact of aerosols. The scheme also provides the capability to probe a large range of possible aerosol climatologies, and then explore how these variations affect climate. This study presents a quantitative assessment and an uncertainty estimate of the impact of microphysical processes involving black carbon, such as condensation, coagulation, emission size distributions etc. on aerosol cloud activation and radiative forcing.

Tuesday, October 6, 2009
Session: Spatial distribution

10:00-10:20 AM

OTA04

Title: Decadal Trends in Aerosol Chemical Composition at Barrow, AK: 1976 – 2008

Authors: P.K. Quinn (1), T.S. Bates (1), K. Schulz (1), and G.E. Shaw (2)

(1) NOAA PMEL, 7600 Sand Point Way NE, Seattle, WA 98115, USA
(2) University of Alaska, 903 Koyukuk Dr., Fairbanks, AK, 99775, USA

Abstract: As part of NOAA's northern hemisphere regional station program, long-term measurements of aerosol composition (inorganic ions and total mass concentration) have been made at several sites for varying lengths of time since 1992. Data available from these stations and how to access them will be described. Recent analysis of data collected at Barrow, AK will be presented in more detail. During the past 30 years, aerosol measurements at Barrow, AK have identified the long range transport of pollution associated with Arctic Haze as well as ocean-derived aerosols of more local origin. Here, we focus on measurements of aerosol chemical composition to assess 1) trends in Arctic Haze aerosol and implications for source regions, 2) the interaction between pollution-derived and ocean-derived aerosols and the resulting impacts on the chemistry of the Arctic boundary layer, and 3) the response of aerosols to a changing climate. Aerosol chemical composition measured at Barrow, AK during the Arctic haze season is compared for the years 1976-1977 and 1997-2008. Based on these two data sets, concentrations of non-sea salt (nss) sulfate ($SO4^{=}$) and non-crustal (nc) vanadium (V) have decreased by about 60% over this 30 year period. Consistency in the ratios of nss $SO4^{=}$/ncV and nc manganese (Mn)/ncV between the two data sets indicates that, although emissions have decreased in the source regions, the source regions have remained the same over this time period. The measurements from 1997-2008 indicate that, during the haze season, the nss $SO4^{=}$ aerosol at Barrow is becoming less neutralized by ammonium ($NH4^{+}$) yielding an increasing sea salt aerosol chloride (Cl^{-}) deficit. The expected consequence is an increase in the release of Cl atoms to the atmosphere and a change in the lifetime of volatile organic compounds (VOCs) including methane. In addition, summertime concentrations of biogenically-derived methanesulfonate (MSA^{-}) and nss $SO4^{=}$ are increasing at a rate of 12 and 8% per year, respectively. Further research is required to assess the environmental factors behind the increasing concentrations of biogenic aerosol.

10:25-10:45 AM

OTA05

Title: long-term records of dust transport over oceans

Authors: Joseph M. Prospero (1)

(1) University of Miami, Miami, FL, USA

Abstract: The North Atlantic is by far the ocean region that is most heavily and consistently impacted by dust.

Forty years after the “discovery” of the African dust phenomenon, we still know very little about the factors controlling its long range transport and deposition to the Atlantic.

Some recent (and some old) research provides some insights on these processes.

10:50-11:10 AM

OTA06

Title: Satellite Aerosol Air Mass Type Mapping, and Its Role in the Global Picture

Authors: R Kahn and the MISR Team (1)

(1) NASA Goddard Space Flight Center, Greenbelt, MD, USA

Abstract: Although the quality of aerosol microphysical properties retrieved by the Multi-angle Imaging SpectroRadiometer (MISR) varies with scene conditions, the aggregate of particle size, shape, and single-scattering albedo (SSA) constraints provides sufficient information to produce a fairly robust classification. The process of extracting the aerosol type classes, based on MISR sensitivity to particle properties under average viewing conditions, is currently underway. This presentation will describe the status and prospects for the MISR aerosol air mass type mapping effort, as well as MISR aerosol optical depth accuracies, the wildfire plume height database project, and other MISR aerosol products under development.

Tuesday, October 6, 2009
Session: Spatial distribution

11:10-11:30 AM

OTA07

Title: Determining Aerosol Composition from the Spectral Dependence of Aerosol Absorption in the UV and Blue Wavelengths

Authors: Pawan K Bhartia (1), Omar Torres (2), Nickolay Krotkov (3), Changwoo Ahn (4)

(1) NASA Goddard Space Flight Center, Greenbelt, MD, USA
(2) Hampton University, Hampton, VA, USA
(3) U. of MD Baltimore County, Baltimore, MD, USA
(4) System Sciences & Application Inc., Lanham, MD, USA

Abstract: A growing body of evidence collected over the past decade suggests that the aerosol absorption optical thickness (AAOT), $\square(1-\square_0)$, of most aerosol types including mineral dust, carbonaceous aerosols, and volcanic ash increases substantially as one goes from the visible to the ultraviolet wavelengths. It has been suggested that the wavelength dependence of AAOT follows a power law ($\square^{-k}$)) very similar to the Angstrom power law of aerosol extinction optical depth ($\square$), but the value of k in this case depends on the composition of aerosols rather than their size distribution. The value of k varies from 3 for mineral dust to 1 for elemental carbon. For secondary organic carbons (SOC) it has been estimated to be between 2 and 3, which suggests that it may be possible to estimate the fraction of SOC in carbonaceous aerosols if we can measure k accurately. We will present recent results from our ongoing studies aimed at estimating k from ground-based and satellite remote sensing data.

11:40 AM-12:00 PM

OTA09

Title: Maritime Aerosol Network as a component of AERONET - current status

Authors: Alexander Smirnov (1)

(1) NASA Goddard Space Flight Center, Greenbelt, MD, USA

Abstract: The World Ocean covers approximately 70% of Earth's surface. Maritime aerosol optical studies help decrease uncertainties in aerosol forcing as a component in climate change and facilitate quantification of the role of aerosols in cloud formation and changes in precipitation. Not all areas of the World Ocean can be studied from islands therefore ship-based measurements is the only source of data for such regions. The Maritime Aerosol Network (MAN) started collecting aerosol optical data in various regions of the World Ocean in November 2006 and has completed over 50 cruises, with many cruises ongoing and planned. A public domain web-based database dedicated to the MAN activity can be found at http://aeronet.gsfc.nasa.gov/new_web/maritime_aerosol_network.html. Available data will help better understand the distribution of marine aerosols in time and space. The program exemplifies the mutually beneficial international, multi-agency effort in atmospheric aerosol optical studies.

12:00 -12:20 PM

OTA10

Title: New generation aerosol records from ice cores for GCM evaluation

Authors: Joseph R. McConnell (1)

(1) Desert research Institute, Reno, NV, USA

Abstract: Aerosols from sea spray, biomass burning, continental dust, and volcanic and industrial emissions are important components of climate forcing, yet few measurements are available prior to the mid- to late-20th century when modern measurements began. If appropriately analyzed, arrays of ice cores can provide high-time-resolution, long-term records of aerosol concentrations, sources, and transport pathways needed for climate model evaluation. We describe a unique, high-depth-resolution analytical system that produces a new generation of broad-spectrum measurements of aerosols and aerosol tracers from ice cores and present recently developed records from polar and alpine ice cores.

Tuesday, October 6, 2009
Session: Spatial distribution

12:20 -12:40 PM

OTA11

Title: The MODIS aerosol products: Evaluation, Aggregation, Trends and the Future

Authors: R. C. Levy (1)(2), L.A. Remer (2), S. Mattoo (1)(2), R. Kleidman (1)(2), G. Leptoukh (2), R. Kahn (2), and C. Salustro (1)(2)

(1) Science Systems and Applications, Inc (SSAI), Lanham, MD USA
(2) NASA-Goddard Space Flight Center, Greenbelt, MD USA 20771
(3) LOA, Lille, France

Abstract: Twin NASA's MODerate-resolution Imaging Spectroradiometers (MODIS) have been observing the Earth from polar orbit, from Terra since early 2000 and from Aqua since mid 2002. Consistent "dark-target" retrieval algorithms and processing procedures were applied, deriving the Collection 5 (C005) products of aerosol optical depth (AOD or τ) and size parameters. We have compared more than 100,000 cases of along-orbit (Level 2 or L2) retrieved products by collocating them with measurements from 328 globally distributed, co-located AERONET sites. We have "validated" the AOD products, by showing that at least 66% of the matched pairs fall within expected uncertainty (EU) of $\pm(0.04+0.05\tau)$ over ocean and $\pm(0.05+0.15\tau)$ over dark land. Although globally validated, we see systematic biases under certain conditions, and at specific locations. We have defined EU for size parameters (e.g., Ångstrom exponent and fine aerosol AOD), but quantitative skill is only demonstrated over ocean. Assuming validated AOD products, we warn that the way that the L2 data are operationally aggregated and averaged to derive daily and monthly mean products (Level 3 or L3) may be complicated by sampling issues. We characterize global and regional trends observed in the MODIS data, and discuss how artifacts, such as calibration, may be influencing the results. Finally, we discuss improvements, including developing a joint dark target / Deep Blue product, that may be applied in deriving future data collections.

3:00-3:20 PM

OTP01

Title: Status of CALIPSO aerosol data products and results of initial model intercomparisons

Authors: David Winker (1)

(1) NASA Langley Research Center, Hampton, VA, USA

Abstract: The CALIPSO satellite, launched in April 2006, carries a two-wavelength polarization lidar providing the global aerosol profiles during both day and night. Aerosol extinction, backscatter, and aerosol type are the primary aerosol data parameters produced. CALIPSO aerosol profiles are a new observational dataset for evaluating global aerosol models and preliminary intercomparisons with the GMAO/GOCART and RAQMS models have been performed. CALIPSO Version 2 data products including aerosol extinction have been available since 2008 and an improved Version 3 data product is in development and scheduled for release in the near future. This talk will discuss CALIPSO Version 3 aerosol data products and results from preliminary model intercomparisons.

3:20-3:40 PM

OTP02

Title: Global view of aerosol vertical distributions from CALIPSO lidar measurements and GOCART simulations: Regional and seasonal variations

Authors: Hongbin Yu (1)(2), Mian Chin (2), David M. Winker (3), Ali H. Omar, Zhaoyan Liu, Chieko Kittaka, and Thomas Diehl

(1) University of Maryland Baltimore County, Baltimore, MD, USA
(2) NASA Goddard Space Flight Center, Greenbelt, MD, USA
(3) NASA Langley Research Center, Hampton, VA, USA

Abstract: This study examines seasonal variations of the vertical distribution of aerosols through a statistical analysis of the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) lidar observations from June 2006 to November 2007. A data-screening scheme is developed to attain good quality data in cloud-free conditions and the polarization measurement is used to separate dust from non-dust aerosol. The CALIPSO aerosol observations are compared with aerosol simulations from the Goddard Chemistry Aerosol Radiation Transport (GOCART) model and aerosol optical depth measurements from the MODerate resolution Imaging Spectroradiometer (MODIS). The CALIPSO observations of geographical patterns and seasonal variations of aerosol optical depth (AOD) are generally consistent with GOCART simulations and MODIS retrievals especially near source regions, while the magnitude of AOD shows large discrepancies in most regions. Both the CALIPSO observation and GOCART model show that the aerosol extinction scale heights in major dust and smoke source regions are generally higher than that in industrial pollution source regions. The CALIPSO aerosol lidar ratio also generally agrees with GOCART model within 30% on regional scales. Major differences between satellite observations and GOCART model are identified, including (1) an underestimate of aerosol extinction by GOCART over the Indian sub-continent, (2) much larger aerosol extinction calculated by GOCART than observed by CALIPSO in dust source regions, (3) much weaker in magnitude and more concentrated in the lower atmosphere in CALIPSO observation than GOCART model and MODIS observation over transported areas in mid-latitudes, and (4) consistently lower aerosol scale height by CALIPSO observation than GOCART model. Possible factors contributing to these differences are discussed.

3:40-4:00 PM

OTP03

Title: Airborne High Spectral Resolution Lidar Aerosol Measurements and Comparisons with GEOS-5 Model

Authors: Richard Ferrare (1), Chris Hostetler (1), John Hair (1), Anthony Cook (1), David Harper (1), Sharon Burton (2), Mike Obland (1), Ray Rogers (1), Peter Colarco (3), Amy Jo Swanson (2)

(1) NASA Langley Research Center, Hampton, VA, USA
(2) Science Systems and Applications, Inc., USA
(3) NASA Goddard Space Flight Center, Greenblet, MD, USA

Abstract: The NASA Langley Research Center (LaRC) airborne High Spectral Resolution Lidar (HSRL) measured aerosol distributions and optical properties throughout North America during twelve field experiments over the last several years. The HSRL collected nearly 800 hours of aerosol measurements during these experiments. The LaRC airborne HSRL uses the spectral distribution of the lidar return signal to measure aerosol extinction and backscatter profiles independently at 532 nm and uses standard backscatter lidar techniques to derive aerosol backscatter and extinction profiles at 1064 nm. Aerosol depolarization profiles are measured at both wavelengths. A cluster analysis of the aerosol intensive parameters (lidar ratio, aerosol depolarization, ratio of depolarization (532 nm/1064 nm), backscatter color ratio (532 nm/1064 nm)) derived from airborne HSRL data has been used to identify specific aerosol types (e.g., marine (sea salt), dust, urban pollution, etc.) and mixtures of those types. The HSRL measurements of aerosol intensive parameters, and the aerosol types inferred from these measurements, are used to analyze the vertical variability in the aerosol properties. The HSRL measurements are also used to evaluate the aerosol analyses from the NASA Goddard Earth Observing System version 5 (GEOS-5) model during the Arctic Research of the Composition of the Troposphere from Aircraft and Satellites (ARCTAS) campaign conducted during spring/summer 2008.

4:30-4:50 PM

OTP04

Title: Seasonal Climatology of Vertical Profiles of Aerosol Optical Properties at Two Rural Locations in the U.S.

Authors: J.A. Ogren (1), E. Andrews (1)(2), P.J. Sheridan (1), A.R. Esteve (3)

(1) Earth Systems Research Laboratory, National Oceanic and Atmospheric Administration, Boulder, Colorado
(2) Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, Colorado
(3) Department of Earth Physics and Thermodynamics, University of Valencia, Valencia, Spain

Abstract: Instrumented small airplanes measured more than 1100 vertical profiles of aerosol optical properties over rural sites in Oklahoma and Illinois between March 2000 and September 2009. Statistically, these in-situ profiling measurements suggest there are significant differences in aerosol profile properties as a function of season. Over Oklahoma, the highest amounts of aerosol throughout the column are observed during the summer, while the aerosol is most absorbing (i.e., lowest single scattering albedo) in the winter (Oklahoma) or fall/winter (Illinois). Spring and fall profiles of aerosol scattering and absorption tend to be quite similar to the annual aerosol profiles. The seasonal variability observed for aerosol absorption and scattering is consistent with other reported aerosol measurements in the region (e.g., surface in-situ optical, mass concentrations and aerosol optical depth). This talk will compare the seasonal profiles of aerosol optical properties at the two sites, compare the profiles with aerosol optical properties observed at the associated surface sites, and examine the systematic dependence of aerosol single-scattering albedo with aerosol amount. Results from the in-situ measurements on the aircraft will be compared with values retrieved from co-located AERONET observations.

4:50-5:10 PM

OTP05

Title: Approaching 10 years of Systematic Aerosol Measurements in the FT and UT/LMS by the CARIBIC Passenger Aircraft

Authors: Markus Hermann (1), Bengt Martinson (2), Andreas Weigelt (3), Carl Brenninkmeijer (4)*, Andreas Zahn (4), F.Slemr (3)

*Presenter

(1) Leibniz Institute for Tropospheric Research, 04318 Leipzig, Germany
(2) Nuclear Physics Department, Lund University, S-22100 Lund, Sweden
(3) Atmospheric Chemistry Division, MPI for Chemistry, 55020 Mainz, Germany
(4) Institute for Meteorology and Climate Research, KIT, 76021 Karlsruhe, Germany

Abstract: CARIBIC, www.caribic-atmospheric.com, operates since 1997, with a ~2.5 year break 2002-2004. An airfreight container with instruments (1.5 ton) is used on a monthly basis for 4 long distance flights aboard a Lufthansa Airbus A340-600 in regular operation. For the CARIBIC task, the aircraft was retrofitted with an inlet system with probes for aerosols, trace gases, water vapor and ice, which is connected to the container prior to each set of 4 research flights. The inlet system also has a video camera (for spotting clouds), and a DOAS remote sensing system. The aerosol equipment comprises three particle counters (CPCs) and one particle sampler by which a large data set on particle concentrations and elemental composition for major regions of the northern hemispheric has been obtained. The CARIBIC aerosol package has been working with a high degree of reliability. The aerosol samples are analyzed for their elemental composition, including H, N, C, O by PESA and the heavier elements, importantly sulfur by PIXE. We present highlights for the almost ten years of measurements. These include partly unpublished data, particle probability distributions along different flight routes, estimated particle lifetimes, concentration maps for the northern hemispheric UT/LS, the contribution of organic material to the aerosol mass, etc. With major developments in the extremely complex aerosol modeling taking place, we would like to make this unique data set better known to foster future collaboration.

5:10-5:30 PM

OTP06

Title: ARCTAS Data for Use in Model Analysis and Assessment

Authors: Gao Chen (1)

(1) NASA Langley Research Center, Hampton, VA, USA

Abstract: NASA's Arctic Research of the Composition of the Troposphere from Aircraft and Satellites (ARCTAS) field campaign conducted in 2008 was the largest component of the International Polar Year field study program POLARCAT (Polar Study using Aircraft, Remote Sensing, Surface Measurements and Models, of Climate, Chemistry, Aerosols, and Transport). One of the major objectives was to characterize Arctic Haze. To achieve this objective, the NASA DC-8 aircraft was equipped with a comprehensive particle measurement package for measurements of microphysical, optical, and chemical properties. To be presented are several ARCTAS observed features that are potentially suitable for model assessments. At the same time, the model simulations will improve the understanding of these observations. Also reported are recent uncertainty assessments by the Tropospheric Airborne Measurement Evaluation Panel for measurements of particle optical, chemical, and size distribution. Finally, several prototype data products are presented, including merged data along flight tracks, grid box averages, as well as vertical profiles of particle optical and chemical measurements. Feedback is sought to better develop and/or improve the airborne data products for model assessment and evaluations.

6:00-6:15 PM

OTP07

Title: Aerosol-Cloud-Ecosystem Mission

Authors: Steven Ghan (1) and Ralph Kahn (2)

(1) Pacific Northwest National Laboratory, Richland, WA, USA
(2) NASA Goddard Space Flight Center, Greenbelt, MD, USA

Abstract: The NASA Aerosol, Clouds and Ecosystem (ACE) Mission, anticipated for launch in about 2020, is designed to characterize the role of aerosols in climate forcing, including their direct radiative effect, their impact on precipitation and cloud formation, and their role in air quality. In all three areas, the emphasis is on improving predictive capabilities, which points to a natural role for modeling in the mission itself. ACE also addresses ocean biosphere measurements (chlorophyll and dissolved organic materials) that could be greatly improved by coincident measurements of the overlying aerosols. The nominal ACE payload will call for lidar and polarimetric measurements of aerosols, radar measurements of clouds and precipitation, and a multi-band spectrometer for the measurement of ocean ecosystems (“ocean color”). An enhanced ACE payload under discussion includes microwave radiometer measurements of cloud ice and water outside the nadir path of the radar/lidar beams.

8:30-8:50 AM

OWA01

Title: Chemistry and Microphysics of CCN Formation

Authors: Peter J. Adams (1)

(1) Carnegie-Mellon University, Pittsburgh, PA, USA

Abstract: Recent results from global aerosol microphysics models suggest that growth of ultrafine particles to CCN sizes is an important, perhaps dominant, source of tropospheric CCN. It is imperative that global CCN models include rigorous descriptions of microphysical growth processes. Additionally, the fate of ultrafine particles is a strong function of their initial size. Smaller ultrafines are especially likely to be removed via coagulational scavenging before growing to CCN sizes. These results imply that global CCN levels are fairly robust with respect to uncertainties in nucleation rate and mechanism. However, it is important to develop size-resolved emissions inventories of ultrafine combustion particles and to find data sets to evaluate and constrain growth processes in global models.

8:50-9:10 AM

OWA02

Title: Insights into global sources of CCN

Authors: Joonas Merikanto (1)

(1) University of Leeds, Leeds, UK

Abstract: We describe the global scale processes that control CCN in different environments. We show that approximately half of global cloud-level CCN come from nucleation of new particles in the boundary layer and free troposphere. In some parts of the atmosphere this fraction is >90%. We also show that nucleation of new sulphate particles in the free troposphere means that the impact of SO2 emissions on CCN can vary widely from region to region. But CCN also come from primary carbonaceous emissions. By comparing the model against global CCN measurements for the first time, we show that carbonaceous particles make up a small fraction of the aerosol mass but a very large fraction of global CCN.

9:10-9:30 AM

OWA03

Title: Ice nucleation by mineral dust, soot, bacteria and pollen: GCM studies with new freezing parameterizations

Authors: Corinna Hoose (1), Jón Egill Kristjánsson (1), Anupam Hazra (2), Jen-Ping Chen (2)

(1) Department of Geosciences, University of Oslo, Norway
(2) Department of Atmospheric Sciences, National Taiwan University, Taiwan

Abstract: In numerous laboratory experiments, ice nucleation by different types of natural and anthropogenic aerosol particles has been investigated. Recently, Chen et al. (2008) applied the classical nucleation theory to various ice nucleation measurements and derived contact angles and activation energies for bioaerosol, soot and mineral dust. This study has now been extended to include more observations of deposition and immersion nucleation. Contact nucleation can be theoretically derived from the deposition nucleation parameters, following Cooper's (1974) hypothesis. The freezing point depression by the solute effect is also taken into account. These new parameterizations are based on more comprehensive datasets than previous formulations used in GCMs, have a solid theoretical foundation, and are flexible to include findings from new experiments. Using the CAM-Oslo GCM (Storelvmo et al., 2008; Hoose et al., 2009), we will present first results on the global importance of different ice nuclei, compared to field observations, and the implications for the anthropogenic aerosol indirect effect.

10:00-10:20 AM

OWA04

Title: Updates in the aerosol-climate model ECHAM5-HAM and their effects

Authors: Kai Zhang (1), Johann Feichter (1)
(1) Max Planck Institute for Meteorology, Hamburg, 20146, Germany

Abstract: Faithful simulations of the aerosol effects on climate require a realistic representation of aerosol mass and number concentrations as well as the size distribution of aerosol particles. In this work we attempt to quantify changes in the simulated aerosol distribution caused by various updates in the parameterization schemes of the global aerosol-climate model ECHAM5-HAM. Since its first version developed by Stier et al. (2005), ECHAM5-HAM has gone through further developments. The modifications include (1) a new time integration scheme for the condensation of the sulfuric acid gas on existing particles (Kazil et al. 2009), (2) a new aerosol nucleation scheme which takes into account the charged nucleation caused by cosmic rays (Kazil et al. 2009) , (3) an updated water uptake scheme for calculating the hygroscopic growth of aerosol particles (O'Donnell, 2009), and (4) a parameterization scheme explicitly describing the conversion of aerosol particles to cloud nuclei. Our analysis reveals that all these new treatments have resulted in significant changes in the model results. The simulated aerosol number concentrations and size distributions have improved in many aspects. The corresponding changes in the simulated climate forcing and some results from AeroCom simulations will also be discussed.

10:20-10:40 AM

OWA05

Title: Simulation of atmospheric sulfate phase transitions in GEOS-chem model

Authors: Jun Wang (1)

(1) Department of Geosciences, Univ. of Nebraska, Lincoln, NB, USA

Abstract: Sulfate particles are the largest anthropogenic contributor to the atmospheric fine-mode aerosol burden. Depending on their composition and relative humidity history, sulfate particles can be either in solid or aqueous phase. The transitions between solid and aqueous phases have important radiative impacts, as they affect the size, refractive index, and cloud nucleation capability of sulfate particles. In this presentation, the hysteresis of sulfate phase transition □ a major hurdle in the past modeling of sulfate phases, will be introduced. Its explicit simulation in a global chemistry transport model (GEOS-chem) will then be presented. Surprises in observing highly neutralized (and more likely solid) sulfate particles in the upper troposphere, which some models failed to capture, will be explained. The sensitivity of sulfate optical thickness and direct climate forcing to the various model treatments of sulfate phases in the past will be explored. The talk will end with a recommendation of reporting the ratio of the sulfate aerosol optical thickness calculated with versus without consideration of particle hygroscopicity for the model intercomparisons. :

10:40-11:00 AM

OWA06

Title: Indirect effect of aerosols produced by shipping: sensitivity to background concentrations

Authors: Yves Balkanski (1), M.R. Vuolo (1), N. Yan (1), M. Schulz (1)

(1) Laboratoire des Sciences du Climat et de l'Environnement, Gif-sur-Yvette, France

Abstract: In the new coupled model from IPSL, aerosols can be computed interactively or read in from previous simulations. We compared the direct and indirect radiative forcing from aerosols in both cases and find significant differences in absolute fluxes at the top-of-atmosphere, whereas net fluxes are similar. We diagnose the semi-direct effect in the model and separate the contribution of BC and dust. In a serie of sensitivity simulations on the indirect effect, we compute separately the effects of sulfate alone, of the sum of sulfate+BC+OC and of seasalt +sulfate+BC+OC. We analyse of these 3 cases and discuss the importance of the aerosol number concentrations for each of them.

2:00-2:20 PM

OWP01

Title: Indirect effect in NCAR CAM: Sensitivity to aerosol-cloud prameterizations

Authors: X. Liu (1), S. J. Ghan (1), R. E. Easter (1), R. Zaveri (1), A. Gettleman (2), H. Morrison (2), J.-F. Lamarque (2), C. Chuang (3), N. Meskhidze (4), J. Xu (4)

(1) Pacific Northwest National Laboratory, Richland, WA, USA;
(2) National Center for Atmospheric Research, Boulder, CO, USA;
(3) Lawrence Livermore National Laboratory, Livermore, CA, USA;
(4) North Carolina State University, Raleigh, NC, USA

Abstract: There are still large uncertainties in the estimate of aerosol indirect effects in global models which result not only from different treatments of aerosol (e.g., composition, size distribution and mixing states), but also from different treatments of aerosol-cloud interactions (aerosol activation and droplet autoconversion). In this presentation a modal aerosol treatment which predicts both aerosol mass and number, and internal mixing between aerosol components in the NCAR Community Atmospheric Model (CAM4) will be used to estimate aerosol indirect effects. The sensitivities to different activation parameterizations (Abdul-Razzak and Ghan, 2002; Nenes and Seinfeld, 2003) and to different autoconversion parameterizations (Khairoutdinov-Kogan, 2000; Manton-Cotton, 1977; Liu-Daum, 2004; Beheng, 1994) will be investigated and discussed.

2:25-2:45 PM

OWP02

Title: Cloud-aerosol interactions in ECHAM5-HAM: sensitivity studies

Authors: Ulrike Lohmann (1), Corinna Hoose (2), Sylvaine Ferrachat (1)

(1) ETH Zurich, Zurich, Switzerland
(2) Department of Geosciences, University of Oslo, Norway

Abstract: In this study, the role of the different aerosol effects on mixed-phase clouds is investigated: the glaciation effect due to increased anthropogenic aerosols on the one hand, and the de-activation due to sulfate coating on the other hand. The earlier refers to more frequent ice nuclei at present day relative to pre-industrial times, yielding increased heterogeneous freezing, and therefore increased precipitation and decreased cloud lifetime and cloud albedo. Reversely, the de-activation effect is the mechanism that decreases the efficiency of glaciation by contact freezing, due to a sulfate coating that converts externally mixed particles to internally mixed ones. Sensitivity studies evaluating the relative importance of these two phenomena is conducted here by means of the GCM ECHAM5-HAM, where a better physical treatment of the Bergeron-Findeisen process relative to the standard version has been implemented. It is shown that this improved and more stringent Bergeron-Findeisen modeling yields higher altitudes of freezing (via contact freezing of super cooled droplets), which drives a lowering of the total anthropogenic effect of 0.27 W.m-2 relative to the standard model. Decreasing the efficiency of the conversion of externally to internally mixed particles yields more contact freezing via externally mixed particles, which occurs at higher temperature than immersion freezing (via internally-mixed particles). This results in a lowering of the total anthropogenic effect of only 0.15 W.m-2 relative to the standard model.

2:50-3:10 PM

OWP03

Title: Constraining Indirect Effects on Process Level

Authors: Yi Ming (1)

(1) NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ, USA

Abstract: This talk will overview the treatment of aerosol direct and indirect effects in the new GFDL General Circulation Model (GCM) to be used for the IPCC AR5. Some key scientific questions covered include how mixing state and cloud distributions affect direct effect, and how one can formulate a framework in which the uncertainty in indirect effect would be attributed to individual physical processes, and thus reduced in a systematic fashion. Comparison of model simulations with in-situ and satellite measurements is a recurring theme throughout the talk.

3:40-4:00 PM

OWP04

Title: Strategies for testing model parameterizations of aerosol-cloud interactions for global models

Authors: Eric Wilcox (1)

(1) NASA Goddard Space Flight Center, Greenbelt, MD, USA

Abstract: The talk will review a few strategies for evaluating simulations including aerosol-cloud interactions using coarse-resolution atmospheric models using satellite and in-situ measurements. These will be strategies employed by our group working with the NASA GEOS-4 general circulation model, as well as others appearing in the literature. We will address the question of how to determine if the simulated microphysics of clouds is more or less sensitive to variations in aerosol amount than is apparent in the observations. It is hoped that the talk may stimulate some discussion among the group as to which strategies are most successful in this regard as well as most feasible given present observing systems.

4:05-4:25 PM

OWP05

Title: Aerosol and cloud interactions from combined satellite observations, back trajectory, and reanalysis data

Authors: Wenying Su (1)(2)

(1) System Sciences & Application Inc., Lanham, MD, USA
(2) NASA Langley Research Center, Hampton, VA, USA

Abstract: Satellite analyses have revealed a persistent correlation between cloud fraction and aerosol optical depth (AOD) in regions influenced by air pollution, and this correlation could be partially caused by satellite retrieval artifacts. These artifacts are avoided or minimized in our analyses of aerosol and cloud interaction. We combined satellite retrievals with ERA Interim reanalysis data and back trajectories to study aerosol and cloud interaction. Aerosols over the South Atlantic Ocean are classified as ‘continental’ or ‘oceanic’, based on back trajectory analysis. Dynamically and thermodynamically stratified differences in AOD, cloud properties and TOA albedo between these two aerosol groups are presented under constant liquid water path and for constrained cloud fraction. We found that the reduction in cloud droplet effective radius associated with continental aerosols relative to that associated with oceanic aerosols is about 0.8 micron if we constrain cloud fraction, compared to 2.1 micron if we do not constrain cloud fraction. This method can be applied to the AeroCom models to facilitate the assessment of the cloud albedo effect simulated by the models.

4:30-4:50 PM

OWP06

Title: Indirect effects of Aerosols inferred from GEOS4/5 GCM Simulations

Authors: Y. C. Sud (1), E. Wilcox (1), K. M. Lau (1), L. Oraiopoulos (1), G. K. Walker (1), and P. Bhattacharjee (1)
(1) NASA Goddard Space Flight Center, Greenbelt, MD, USA\

Abstract: Indirect effects of atmospheric aerosols are difficult to parameterize partly due to variations in the nucleating properties of water/ice clouds and partly due to differences in nucleating properties of aerosol species and their internal mixtures both of which are not well understood. Based on our present-day understanding of modeling cloud-aerosol-radiation interactions, we included four sub-models, namely: i) Fountoukis and Nenes aerosol activation for liquid-clouds, ii) Liu and Penner model of heterogeneous and homogeneous ice-cloud nucleation, iii) Sud and Lee precipitation microphysics developed for a coarse-resolution GCM, and iv) Khvorostyanov and Curry relations for cloud particle effective and volume radii, into the GCM. Subsequently, we made several simulations to develop a base-line understanding of doubling or halving the atmospheric aerosols on the direct and indirect effects of aerosols in some selected regions (India and Africa, and parts of Eastern North America and Central South America)*. Our results show that the summer season circulation and rainfall are significantly affected by the both the direct and indirect effects of aerosols in these regions. The two effects often work in concert exacerbating each other. Use of much higher single scattering albedo of the dust aerosols in these simulations suppressed significantly the "Elevated Heat Pump" effect on the monsoons, nevertheless, the simulated changes in the circulation and rainfall showed that both aerosol effects have a significant impact on the local climate that shows large region-to-region variability as well as some global consequences.

References:

Sud, Y.C., Eric Wilcox, William K.-M. Lau,G. K. Walker, X.-H. Liu, A. Nenes, Dongmin Lee, K.-M. Kim, Yaping Zhou, and P. S. Bhattacharjee: Sensitivity of Boreal-Summer Circulation and Precipitation to Atmospheric Aerosols in Selected Regions: Part I Africa and India , Accepted Angeo, 2009.

Wilcox, E. M, Sud, Y. C., Walker, G. K.: Sensitivity of Boreal-Summer Circulation and Precipitation to Atmospheric Aerosols in Selected Regions: Part II Americas, Angeo, In Review, Angeo, 2009.

10:30 AM-5:30 PM

PM01

Title: Evaluation of GOCART fine model aerosol simulation and investigation of multi-scale carbon monoxide and fine mode aerosol correlations

Authors: Huisheng Bian (1) (2), Mian Chin (2), Randy Kawa (2), Hongbin Yu (1)(2), Thomas Diehl (1)(2), Tom Kucsera (1)(2)

(1) Goddard Earth Sciences and Technology Center, University of Maryland, Baltimore County, Baltimore, Maryland, USA
(2) Laboratory for Atmospheres, NASA Goddard Space Flight Center, Greenbelt, Maryland, USA

Abstract: There are two objectives for this study. First, we evaluate fine mode aerosol optical depth (AODf) calculated from the Goddard Chemistry Aerosol Radiation and Transport (GOCART) model through 2000-2006 using AERONET measurement and MODIS satellite retrievals. Globally, the correlation of monthly AODfs between GOCART simulation and AERONET measurement over all AERONET stations is 0.63 and the model mean is about 0.9 of the AERONET mean. The AODf comparisons over individual stations indicate that the model simulation generally captures the measured AODf level and seasonal cycle over different aerosol characteristic regimes (i.e. industrial, biomass burning, dust). Second, we examine regional and global column CO and AODf correlations in daily and seasonal scales using the 7-year satellite observations from MOPITT and MODIS and simulations from GOCART. Our analyses indicate that column CO and AODf have similar spatial distributions, although CO is more spatially dispersed because of its longer lifetime. However, temporal CO-AODf correlations differ substantially over different time scales and regions. Particularly, the seasonal cycles of CO and AODf are out-of-phase in the northern hemisphere while in-phase in the southern hemisphere. Such correlations are explained by examining the emission, chemistry, and dynamic processes for CO and aerosols.

10:30 AM-5:30 PM

PM02

Title: Comparisons of aerosol types and associated lidar ratios between CALIPSO and GOCART model

Authors: Mian Chin (1), Hongbin Yu (1,2), Ali Omar (3), Richard Ferrare (3), Thomas Diehl (1,2), Qian Tan (1,2)

(1) NASA Goddard Space Flight Center, MD, USA
(2) GEST/University of Maryland Baltimore County, MD, USA
(3) NASA Langley Research Center, VA, USA

Abstract: We present our study comparing aerosol vertical profiles and types, as well as associated lidar ratios, from the CALIOP instrument on CALIPSO satellite with those estimated with the GOCART model. Tagging the atmospheric aerosols with their sources from pollution, smoke, dust, marine, and other natural sources, the model classifies the aerosols into 8 categories including polluted continent, smoke, polluted dust, dust, clean continent, clean marine, biogenic/volcanic, and other according to the relative abundance of aerosols from a particular sources. These categories are compared to the similar classification of “subtypes” identified by the CALIOP, based on the cluster analysis, at different geographical locations globally. The lidar ratios (extinction to backscatter) associated with each category from the GOCART model usually show significant variations, in contrast with the CALIOP which chooses one specific value for a particular subtype. The implications of using a fixed lidar ratio on the uncertainties of retrieved aerosol extinction profiles will be discussed.

Monday, October 5, 2009
Poster Session: Modeling

10:30 AM-5:30 PM

PM03

Title: Multi-scale integration in EUCAARI: A global model study comparing a sectional bin versus a modal aerosol scheme.

Authors: M.G. Frontoso (1), C. Reddington (1), K. S. Carslaw (1) , G. W. Mann (1) and D.V. Spracklen (1)

(1) Institute for Climate and Atmospheric Science, School of Earth and Environmental, University of Leeds, Leeds, United Kingdom

Abstract: Atmospheric aerosols play an important role in the global climate system. They can reflect or absorb a part of the incoming solar radiation back to the space (direct effect, Mc Cormic and Ludwig, 1967) and modify cloud droplet size distribution and cloud life cycle (indirect effect, Twomey 1974). Although there has been a large amount of progress in the development of the study of aerosol effects on the global climate, uncertainty in the estimation of the aerosol forcing remains high (Kinne et al., 2005).

Though in situ observations represent the most detailed insight into the aerosol system, they have limited spatial and temporal scales. Remote sensing data from ground-based instruments provide important information but they have sampling limitations as well. Then, satellite data only provide integral aerosol properties and retrievals rely on a priori information about the aerosol system and internal aerosol models. Global aerosol models can help to increase the understanding of the complex aerosol system for past, present and future conditions.

Global climate models generally only simulate aerosol mass and assume size distributions for the aerosol depending upon the composition. Sectional schemes resolving the size distribution of aerosol are often computationally expensive and therefore not suitable for inclusion within global circulation model (GCM). Aerosol size distribution can be also represented by log-normal scheme with a reduced computational time but with a priori assumption on the size distribution.

PM03 cont'd

Understanding and quantifying how a less expensive computational scheme is good to represent the aerosol size distribution is one of the main objective of this work.

Model simulations were performed using the GLObal Model of Aerosol PROcess (GLOMAP, Spracklen et al., 2005) since it has the unique advantage of having two aerosol schemes: a sectional bin scheme (GLOMAP-bin, 20 bins ranging from 1 nm to 25 um, carrying both number and mass) and a log-normal modal scheme (GLOMAP-mode, 7 lognormal modes defined in terms of number and masses of each chemical component), developed for use in the UK Met Office Unified Model (UM).

Model simulations have been benchmarked with observations made during the EUCAARI (European Integrated project on Aerosol Cloud Climate and Air Quality Interactions) campaigns (aircraft and in-situ measurements, May 2008).

Extensive evaluation of GLOMAP mass and size distributions have been made against measurements from several previous campaigns. However, the advantage of the intensive field campaign during EUCAARI project is that a lot of simultaneous measurements (mass concentration, size distribution, optical properties, hygroscopicity, mixing state, etc…) are available and this helps to avoid compensation errors.

Results are very encouraging since they show a very good agreement between GLOMAP-bin and GLOMAP-mode at the surface for species mass concentration (sulphate, organic carbon, black carbon). Inter-model differences (slope ranging from 0.98 to 1.04, correlation factor ranging from 0.96 to 0.99) are found to be lower than model-observation differences (slope ranging from 0.8 to 1.2, correlation factor from 0.76 to 0.79). At higher altitudes (3 - 5km) since aerosols are driven by processes rather than by emissions, the agreement between the two models and the observations is less good (slope ranging from 0.9 to 1.1, correlation factor ranging from 0.91 to 0.96).

Similar results are found for the size distributions, with the systematic presence of more larger particles (dry radius larger then 500nm) predicted by the modal scheme which leads to a small difference also in the aod.

This work is supported by the NERC APPRAISE programme (ADIENT project) and the EUCAARI EU Integrated Project. The authors would like to thank PIs in EUCAARI to provide data.

10:30 AM-5:30 PM

PM04

Title: Description and evaluation of aerosol modeling with GFDL AM3

Authors: P. Ginoux (1), L. Horowitz (1), Y. Ming (1), L. Donner (1), J.-C. Golaz (1), R. Hemler (1), V. Ramaswamy (1), B. Wyman (1), M. Zhao (1)

(1) NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ, USA

Abstract: The GFDL climate model has recently incorporated major developments in its new AM3 version, including the biospheric, dynamics, cloud physics, cloud microphysics, radiation, and tracers' modules. We will present a brief description of the aerosol module, which includes two configurations: a full and simplified sulfate chemistry. The other simulated aerosol components are organic and black carbon, dust and sea-salt. The aerosol emissions are essentially from IPCC AR-5. The optical properties of aerosol take into account hygroscopic growth of sulfate, organics and sea-salt, as well as internal mixing of sulfate and black carbon. The aerosol distribution and optical properties are compared with ground-based and remote sensing data for different configuration of sulfate chemistry. Major differences with the previous GFDL AM2 version include better representation of aerosol optical depth in biomass burning and polluted regions (factor 2 improvement), sea-salt distribution (factor 5 improvement), vertical distribution of extinction coefficient (2 orders of magnitude improvement in high troposphere), hygroscopicity (reduced excessive AOD in summer and more realistic size distribution), and dust absorption (reduced absorption).

10:30 AM-5:30 PM

PM05

Title: The Global Dust Aerosol Modeling System of the National Center for Environmental Protection

Authors: Dongchul Kim (1)*, Ho-Chun Huang (1), You-Hua Tang (1), Sarah Lu (1), Pius Lee (1),(7), Marina Tsidulko (1), Jeff McQueen (2), Mian Chin (3), and Thomas Diehl (3), Arlindo da Silva (3), Paula Davison (4), Ivanka Stajner (5), and William R. Stockwell (6)

(1) Scientific Applications International Corporation, Camp Springs, MD
(2) NOAA National Centers for Environmental Prediction, Camp Springs, MD
(3) NASA Goddard Space Flight Center, Greenbelt, MD
(4) Office of Science&Technology, National Weather Service,Silver Spring, MD
(5) Noblis, Inc. Falls Church, VA
(6) Howard University, Washington D.C
(7) Now at NOAA Air Resource Laboratory, Silver Spring, MD

Abstract: Dust and smoke are two major natural aerosols affecting environment and climate. When severe dust storms or wild fire events occur, it downgrades air quality causing human health issue. However there are difficulties in predicting realistic distribution of these aerosols due to the theoretical and technical problems. Recently, NASA GOCART aerosol model was coupled in an off-line manner with the NOAA/NCEP Global Forecasting Model System (GFS-GOCART) to produce preliminary forecasts of dust aerosols. The model has roughly 1 degree (T126) horizontal resolution. Column dust AOD is output every hour and 3-dimensional dust aerosol concentrations are available every three hours. The current model forecasts dust aerosol to 48 hours. Recent updates include dust source function at higher resolution (1.25x1 degree) with model parameters adjusted for GFS. Simulations were made for the summer 2006 and Saharan dust transport to US domain was analyzed. MODIS AOD has been used to evaluate dust forecasts for several episodes. Saharan dust events are captured well, even though there are some discrepancies near source regions and remote areas. Model results over the land compared with the MODIS Deep Blue, OMI, and MISR satellites indicate source area distributions are captured reasonably well while the intensity is still lower. Vertical distribution of dust aerosols are compared with aerosol extinctions from CALIPSO. Preliminary results of offline GFS-GOCART simulations that include biomass burning also will be discussed.

10:30 AM-5:30 PM

PM06

Title: Measurements and Modeling of Organic Carbon Absorption over Biomass Burning Regions

Authors: Brian Magi (1)(2), Paul Ginoux (2)

(1) Princeton University, Princeton, NJ, USA
(2) NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ, USA

Abstract: Biomass burning is a major source of carbonaceous particles in the atmosphere, but there are major discrepancies between simulations of the aerosol properties over biomass burning regions compared to those reported by in situ measurements and satellites, particularly with respect to aerosol absorption. In order to understand these discrepancies, we have to work across the interface between the measurement community and modeling groups. We used measurements to derive wavelength dependent mass absorption cross sections (MAC, m2/g) for organic and black carbon (OC and BC) over southern Africa and show that OC consistently accounts for about 20-30% of the aerosol absorption in the shortwave. Part of this is due to the overwhelming contribution of OC to total aerosol mass in the region, but also because MAC is much larger than what is generally assumed when modeling aerosol optical properties. This missing source of atmospheric absorption in the shortwave could be responsible for much of the discrepancy in simulated and measured aerosol absorption. Using the newest GFDL Atmospheric Model (AM3), we test this hypothesis and explore the sensitivity of global fields to more absorbing OC.

10:30 AM-5:30 PM

PM07

Title: AN INITIAL assessment of THE CLIMATE IMPACT OF SECONDARY ORGANIC AEROSOLS

Authors: Declan O'Donnell (1)

(1) Max Planck Institute, Hamburg, Germany

Abstract: Atmospheric aerosols influence the Earth's climate by absorbing and scattering solar radiation (the direct effect) and by altering the properties of clouds (indirect effects). Measurements have shown that a substantial fraction of the tropospheric aerosol burden consists of organic compounds. Hundreds of different organic species have been identified. While progress has been made in the understanding of the role of certain aerosol types in the climate system, that of organic aerosols remains poorly understood and the climate influences resulting from their presence poorly constrained.

Organic aerosols are emitted directly from the surface (primary organic aerosols, POA) and are also formed in the atmosphere from gaseous precursors by oxidation reactions (secondary organic aerosols, SOA). Both biogenic and anthropogenic precursors have been identified. Biogenic emissions of aerosol precursors are known to be climate-dependent. Thus, a bi-directional dependency exists between the biosphere and the atmosphere, whereby aerosols of biogenic origin influence the climate system, which in turn affects biogenic aerosol precursor production.

This study builds upon the global aerosol-climate model ECHAM5/HAM and adds techniques to model SOA as well as the necessary global emission inventories. Emission of biogenic precursors is calculated online. Formation of SOA is modeled by the well-known two-product model of SOA formation. SOA is subject to the same aerosol microphysics and sink processes as other modeled species (sulphate, black carbon, primary organic carbon, sea salt and dust). The aerosol radiative effects are calculated on a size resolved basis, and the aerosol scheme is coupled to the model cloud microphysics, permitting estimation of both direct and indirect aerosol effects.

The following results will be discussed:

Estimation of the direct and indirect effects of biogenic and anthropogenic SOA

Identification of physical processes and aerosol physical properties that need further experimental investigation in order to improve our understanding of the climate impact of SOA

10:30 AM-5:30 PM

PM08

Title: Cirrus clouds in a global climate model with a statistical cloud scheme

Authors: Minghuai Wang (1) and Joyce E Penner (1)

(1) University of Michigan, Ann Harbor, MI, USA

Abstract: A statistical cirrus cloud scheme that accounts for mesoscale temperature perturbations is implemented into a coupled aerosol and atmospheric circulation model to better represent both cloud fraction and subgrid-scale supersaturation in global climate models. This new scheme is able to better simulate the observed probability distribution of relative humidity than the scheme that was implemented in an older version of the model. Heterogeneous ice nuclei (IN) are shown to affect not only high level cirrus clouds through their effect on ice crystal number concentration but also low level liquid clouds through the moistening effect of settling and evaporating ice crystals. As a result, the change in the net cloud forcing is not very sensitive to the change in ice crystal concentrations associated with heterogeneous IN because changes in high cirrus clouds and low level liquid clouds tend to cancel. Nevertheless, the change in the net radiative flux at the top of the atmosphere due to changes in IN is still large because of changes in the greenhouse effect of water vapor caused by the changes in ice crystal number concentrations. Changes in the magnitude of the assumed mesoscale temperature perturbations by 25% alter the ice crystal number concentrations and radiative fluxes by an amount that is similar to that from a factor of 10 change in the heterogeneous IN number.

10:30 AM-5:30 PM

PM09

Title: The global aerosol-climate model ECHAM5/MESSy1-MADE(soot)

Authors: M. Righi(1), V. Aquila(1), J. Hendricks(1), V. Eyring(1), A. Lauer(2), and other co-authors (to be included)

(1) DLR-Institut für Physik der Atmospäre, Oberpfaffenhofen, Germany,
(2) (2) International Pacific Research Center, University of Hawaii,Honolulu, USA

Abstract: We present the new global aerosol model ECHAM5/MESSy/MADE which consists of the ECHAM5 general circulation model, coupled to the aerosol microphysics module MADE within the framework of the Modular Earth Submodel System MESSy. Aerosols are described by three log-normally distributed modes and include sulphate, nitrate, ammonium, aerosol liquid water, mineral dust, sea salt, black carbon (BC) and particulate organic matter. The model includes aerosol microphysical processes (coagulation, condensation, nucleation, wet and dry deposition etc.) as well as tropospheric aerosol precursor chemistry. As an example of application, we show the results of global simulation to characterize the impact of international shipping on aerosol, clouds and the Earth's radiation budget. An indirect aerosol radiative forcing in the range [-0.19, -0.60] W/m2 is estimated, with SO4 being the most important aerosol component from shipping. We also illustrate the new aerosol submodule MADEsoot, which includes separate aerosol modes to characterize BC and dust particles in their different state of mixing (internally or externally mixed) and BC and dust free aerosols, as well as the relevant aging processes of externally mixed particles. MADEsoot was implemented in ECHAM5/MESSy and applied to assess the global variation of the number concentration, size distribution and mixing state of BC and dust particles as well as the timescales of the transformation of externally mixed BC and dust into an internal mixture. A special focus is the investigation of BC and dust properties in the middle and upper troposphere since here these particles can be important agents in the formation of ice clouds.

10:30 AM-5:30 PM

PM10

Title: Source-receptor studies of global aerosol transport in the Met Office Unified Model.

Authors: Steve Rumbold (1), Bill Collins (1)

(1) UK Met Office, Exeter, UK

Abstract: Source-receptor sensitivity experiments of global aerosol transport are performed using the UK Met Office HadGEM2-A model. Experiments consist of perturbing the aerosol related emissions from different regions of the globe and examining impacts on surface concentration, column burden and deposition of aerosol both locally and in remote areas. The experiments are performed using the standard aerosol types contained within HadGEM2-A. This includes sulphate, biomass burning and fossil fuel burning soot and organic carbon aerosols. The differences between using prescribed oxidants and those generated from the coupled chemistry scheme are also examined.

10:30 AM-5:30 PM

PM11

Title: Simplicity versus accuracy in global Secondary Organic Aerosol modeling

Authors: K. Tsigaridis (1), S. Myriokefalitakis (2), M. Kanakidou (2)
(1) NASA Goddard Institute for Space Studies, New York, USA;
(2) Environmental Chemical Processes Laboratory, Department of Chemistry, University of Crete, Heraklion, Greece.

Abstract: Atmospheric aerosols consist of a large number of components with an important fraction in organic form produced by oxidation of gaseous precursors, namely secondary organic aerosols (SOA). The significant contribution of SOA to the total aerosol mass and their effect on the physical and optical properties of aerosols has now been acknowledged.
For the SOA parameterization in global atmospheric models, an independent aerosol module has been developed accounting for SOA production from both biogenic and anthropogenic precursors. This module is suitable to simulate aerosol production from clean to polluted environments. Various configurations exist, with different degrees of complexity; from the simplest ones with the minimum number of species for models where CPU time and memory are vital, to others with more species and processes included, for models that demand a detailed representation of SOA.

The effect of the degree of complexity of the module on the present day SOA production and burden is investigated by performing global 3-d chemistry transport simulations. The lumping methodology which is computationally efficient and provides similar results with the most detailed SOA production scheme is demonstrated. This method is flexible and compatible with the newly developed volatility-basis set method for the total organic aerosols.

10:30 AM-5:30 PM

PM12

Title: Comparisons of Aerosol Type Derived from the CALIPSO Level 2 Feature Mask and GEOS-5

Authors: Ellsworth Judd Welton (1)

(1) NASA Goddard Space flight center, Greenbelt, MD, USA

Abstract: A-train sensors such as MODIS, MISR, and CALIPSO are used to determine aerosol properties, and in the process a means of estimating aerosol type (e.g. smoke vs. dust). Correct classification of aerosol type is important for climate assessment, air quality applications, and for comparisons and analysis with aerosol transport models. The Aerosols-Clouds-Ecosystems (ACE) satellite mission proposed in the NRC Decadal Survey describes a next generation aerosol and cloud suite similar to the current A-train, including a lidar. The future ACE lidar must be able to determine aerosol type effectively in conjunction with modeling activities to achieve ACE objectives. Here we examine the current capabilities of CALIPSO and the NASA Goddard Earth Observing System general circulation model and data assimilation system (GEOS-5), to place future ACE needs in context. The CALIPSO level 2 feature mask includes vertical profiles of aerosol layers classified by type. GEOS-5 provides global 3D aerosol mass for sulfate, sea salt, dust, and black and organic carbon. A GEOS aerosol scene classification algorithm has been developed to provide estimates of aerosol mixtures and extinction profiles along the CALIPSO orbit track. In previous work, initial comparisons between GEOS-5 derived aerosol mixtures and CALIPSO derived aerosol types were presented for July 2007. In general, the results showed that model and lidar derived aerosol types did not agree well in the boundary layer. Agreement was poor over Europe, where CALIPSO indicated the presence of dust and pollution mixtures yet GEOS-5 was dominated by pollution with little dust. Over the ocean in the tropics, the model appeared to contain less sea salt than detected by CALIPSO, yet at high latitudes the situation was reserved. Agreement between CALIPSO and GEOS-5 aerosol types improved above the boundary layer, primarily in dust and smoke dominated regions. At higher altitudes (> 5 km), the model contained aerosol layers not detected by CALIPSO. Here we investigate potential causes of poor agreement in the previous study. CALIPSO derived aerosol types are separated into day and night to assess the impact of undetected layers by the lidar during noisier daytime data. In addition, a sensitivity study was performed to determine if the GEOS-5 scene classification algorithm is generating layers with negligible optical depth (model noise), particularly at high altitude. Finally, we will discuss sources of the poor agreement in the boundary layer over Europe.

10:30 AM-5:30 PM

PM13

Title: Tests and implementation of an aerosol activation scheme in the UK Met Office Unified Model

Authors: R. E. L. West (1), P. Stier (1), A. Jones (2), C. E. Johnson (2), G. W. Mann (3), R. G. Grainger (1)

(1) University of Oxford, Oxford, UK
(2) UK Met Office, Exeter, UK
(3) University of Leeds, UK

Abstract: A crucial link between aerosols and clouds is the ability of aerosols to act as cloud condensation nuclei on which cloud droplets form. In this study we have examined the behavior of two aerosol activation parameterisations in a box model setup, and find the fraction of activated particles as a function of size and updraught velocity to differ significantly between parameterisations. Based on these tests we implemented one scheme into the UK Met Office Unified Model (HadGEM2) coupled to UKCA-MODE (UK Chemistry and Aerosols community model with a modal aerosol size distribution scheme). Preliminary evaluation of cloud droplet number concentration is presented here.

10:30 AM-5:30 PM

PM14

Title: The fate of a Saharan dust event during the NASA TC-4 field campaign

Authors: Ed Nowottnick (1)

(1) Department of Atmospheric and Oceanic Science, University of Maryland

Abstract: During the NASA TC-4 field campaign (San Jose, Costa Rica, July August 2007), Saharan dust was observed over the Caribbean and Central America. Satellite and airborne observations suggest a barrier to dust transport across Central America and into the Pacific. We hypothesize that local atmospheric dynamics and/or removal processes occurring within the cloudy maritime environment may be responsible. Here, we use the NASA GEOS-5 atmospheric general circulation model and assimilation system to track a single dust event during the journey from the source region of North Africa across the Atlantic Ocean to the Caribbean. We utilize observations from the MODIS and CALIOP sensors, as well as ER-2 based Cloud Physics Lidar observations from the TC-4 field campaign to validate simulated horizontal and vertical dust distributions during transport. Additionally, in an effort to understand how the Caribbean environment influences transported Saharan dust, we perform sensitivity tests by turning off cloud scavenging and washout processes in the model and compare differences in our simulated dust distributions.

10:30 AM-5:30 PM

PT01

Title: How well do we simulate Arctic aerosol? : Comparing 10 years of aerosol observations with a global model of aerosol processes (GLOMAP)

Authors: Jo Browse (1)

(1) University of Leeds, Leeds, UK

Abstract: The Arctic is warming at an accelerated rate to the rest of the planet and aerosol forcing has been suggested as a possible cause. Quantification of the temperature increase attributable to aerosol is highly uncertain and varies greatly between models. Due to the recent international polar year new data has become available allowing detailed evaluation of aerosol microphysics in models. This poster presents comparisons of aerosol mass concentration and size distribution data from 1994 to 2004 with a 10 year run of the Leeds university global model of aerosol processes (GLOMAP). In the winter/spring period the model was found to underestimate concentrations of black carbon and sulphate by a factor of approximately 4 and 8 respectively and underestimate the average particle diameter by an order of 10. Methods to determine possible causes of discrepancies between the model and observations will also be discussed.

10:30 AM-5:30 PM

PT02

Title: Inferring the composition and concentration of aerosols by combining the AERONET, MPLNET and CALIOP data: comparison with in-situ measurements and utilization to evaluate and improve GCM results.

Authors: Dilip Ganguly (1)(2), Paul Ginoux (2)and V. Ramaswamy (2)
(1) Princeton University, Princeton, NJ
(2) NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ, USA

Abstract: We present a method to derive the concentration of aerosol components from the spectral measurements of AOD (aerosol optical depth) and single scattering albedo along with their size distribution and extinction profile available from AERONET (Aerosol Robotic Network) and MPLNET (Micro-pulse Lidar Network) stations or the space borne CALIOP (Cloud-Aerosol Lidar with Orthogonal Polarization) lidar. The technique involves finding the best combination of aerosol concentration by minimizing differences between measured and calculated spectral variation in AOD and single scattering albedo along with the size distribution of aerosols over specific locations. Lidar data on extinction profile provides the vertical constraint on the distribution of aerosols in the atmosphere. Relative humidities from NCEP reanalysis are used to compute the hygroscopic growth factors and associated changes in the optical properties of aerosol components at all vertical levels. The technique has been successfully applied over different regions around the world such as North America, Southern Africa and South Asia. The results have been validated using in-situ measurements of aerosol composition available from the first two regions. Finally, we show how these results are being used to evaluate and improve the GFDL-AM2/AM3 climate model simulations.

10:30 AM-5:30 PM

PT03

Title: Using MIE Raman S ratio lidar measurements to explore cloud droplet properties and the aerosol indirect effect

Authors: Barry Gross (1)(2)
(1) Optical Remote Sensing Laboratory, Electrical Engineering
(2) The City College of New York, CUNY, New York, NY 10031

Abstract: In this paper, the properties of Low-level clouds are explored with a Raman-elastic lidar. In particular, we examine two complementary methods to measure thin cloud optical depth (COD). The first is direct integration of Raman Derived extinction while the second method utilizes a regression technique. We show that if we correct for aerosol influences the regression method for low cloud optical depth can be dramatically improved. Furthermore, estimates of extinction to backscatter ratio can be made within the cloud. We find that when the lidar ratio in cloud is averaged over the vertical extent, an S ratio on the order of 20 sr is found which is consistent with conventional water phase cloud droplet models. Finally, we explore the possibility of using the cloud S ratio as a way of looking at small droplets within clouds and how this may be used to explore the aerosol-cloud indirect effect.

10:30 AM-5:30 PM

PT04

Title: Status of satellite fire emissions estimation for modeling

Authors: Charles Ichoku (1)

(1) NASA Goddard Space Flight Center, Greenbelt, MD, USA

Abstract: Various types of models require accurate estimates of smoke emissions for forecasting smoke plume transport and impacts on air quality, human health, clouds, weather, radiation, and climate. Over the years, a variety of approaches have been employed to estimate smoke emissions from satellite fire observations, with limited success. Fire radiative power (FRP) measurements from powerful space-borne sensors, such as the Moderate-resolution imaging spectro-radiometer (MODIS) aboard the Terra and Aqua satellites, have been shown to be effective for estimating smoke emission rates. In this presentation, we will report the status of the effort being made to develop reliable FRP-based emissions products for modeling applications.

10:30 AM-5:30 PM

PT05

Title: A generic global monthly aerosol climatology

Authors: Stefan Kinne (1)

(1) Max Planck Institute, Hamburg, Germany

Abstract: A generic 1x1 deg monthly climatology for single scattering properties of tropospheric aerosol has been developed, as a place-holder in climate simulations of reduced complexity with respect to aerosol. The climatology is based on a merged product, whereby high quality data of spatially sparse AERONET sun-/sky-photometer monthly statistics are projected onto AeroCom median global maps for mid-visible aerosol properties of AOD (aerosol optical depth), SSA (single scattering albedo) and ANG (Angstrom parameter). Hereby single scattering properties are size-stratified into fine mode (radius <0.5μm) and coarse mode (radius>0.5μm) and also into natural and anthropogenic contributions. The stratification on size assumes a bi-modal distribution and a prescribed Angstrom parameter for the fine aerosol sizes so that AOD-fractions can be attributed to each of the two modes. Overall values for single scattering albedo define the coarse mode composition of either sea-salt or dust (and even the dust size), so that single scattering properties (AOD,SSA and g) of the coarse mode are locally defined for the entire solar and infrared spectrum. This in turn now allows to determine the single scattering properties of the fine mode, which are only needed for the solar spectral region (as these aerosol sizes are small). Hereby the asymmetry-factor g is derived from the Angstrom parameter. Data on the anthropogenic fraction are derived from AeroCom model simulations with current and pre-industrial aerosol and pre-cursor emissions. The anthropogenic fraction, hereby, is linked to the fine mode only, to minimize undesired influences or coarse mode variability by meteorological influences (e.g. near surface winds). AeroCom global modeling also supplies data for temporal changes in anthropogenic amounts since pre-industrial times and data on vertical distribution. (In future though, data on vertical distribution are expected be replaced by statistics of CALIPSO lidar data.)

Tuesday, October 6, 2009
Poster Session: Data

10:30 AM-5:30 PM

PT06

Title: Comparison of Model Predictions of Aerosol Radiative Properties with Long-term Measurements

Authors: Patrick Sheridan (1), John A. Ogren (1), Elisabeth Andrews (1)(2), Anne Jefferson (1)(2), Paul Ginoux (3), and M. Chin (4)

(1) NOAA Earth System Research Laboratory, Boulder, CO, USA
(2) University of Colorado, Cooperative Institute for Research in Environmental Science, Boulder, CO, USA
(3) NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ, USA
(4) NASA, Goddard Space Flight Center, Greenbelt, MD, USA

Abstract: Evaluation of the direct radiative forcing by atmospheric aerosols requires knowledge of both the quantity and the radiative properties of the particles. Quantity is generally described by aerosol optical depth, which can be measured globally from space, or by the extinction coefficient, which can be measured locally with in-situ methods. Satellite sensors are not well suited for measuring the needed radiative properties of the particles, in particular, the relative amounts of scattering versus absorption and the angular distribution of the scattered light. This poster presents a compilation of long-term, in-situ measurements of aerosol radiative properties from ground stations in the NOAA-federated aerosol monitoring network.

The long-term measurements of aerosol radiative properties reveal systematic dependencies on aerosol loadings, for a wide range of locations and aerosol types. Aerosols in the cleanest air at any given location tend to be more highly absorbing and more effective at scattering radiation back to space, i.e., they have the lowest single-scattering albedos and the highest hemispheric backscattering fractions. One hypothesis for this behavior is that the cleanest air is a result of scavenging by clouds followed by removal by precipitation. Field studies in a number of locations have shown that the unscavenged particles in clouds indeed have lower single-scattering albedos and higher backscattering fractions than the particles in adjacent, cloud-free air. As a further test of the hypothesis, the statistical behavior of aerosol radiative properties calculated with two global chemical transport models (GFDL AM2 and NASA GOCART) are compared with the long-term observations at sites representative of Arctic, rural continental, marine, and free tropospheric aerosols.

10:30 AM-5:30 PM

PT07

Title: 10-year Assessment of MISR and MODIS Retrievals using AMAPS

Authors: Susan Paradise (1)

(1) Jet Propulsion Laboratory, Pasadena, CA, USA

Abstract: The Aerosol Measurement and Processing System (AMAPS) is used to co-locate MISR and MODIS data to AERONET and collect statistics in a uniform way for both instruments, for the lifetime of the Terra mission. The results of the study are presented.

10:30 AM-5:30 PM

PT08

Title: Remote Sensing of Aerosol Water Uptake

Authors: Greg Schuster (1)

(1) NASA Langley Research Center, Hampton, VA, USA

Abstract: Aerosol water content is an important component of aerosol radiative forcing, but the effect of water uptake on aerosols throughout the atmospheric column is not monitored at the present time. We present a technique for retrieving the volume fraction of water in atmospheric aerosols, and apply the technique to the AERONET database. We estimate that the volume fraction of water and the geometric hygroscopic growth factor (gHGF) can be retrieved to within 0.3 using this retrieval. The growth factors we obtain are consistent with published measurements, and indicate that aerosol water uptake is high in humid continental regions (gHGF ~ 1.3 along the U.S. East Coast in August) and low in regions dominated by desert dust (gHGF ~ 1.04 in Saudi Arabia).

10:30 AM-5:30 PM

PT09

Title: GlobAEROSOL: A 12 year aerosol dataset from European sensors

Authors: Gareth Thomas, Caroline Poulsen, Richard Siddans, Don Grainger, Brian Kerridge, Andy Sayer, Elisa Carboni, Pierre-Yves Deschamps, Óscar Navarro, Simon Pinnock

(1) University of Oxford, Oxford, UK

Abstract: The GlobAEROSOL dataset provides aerosol properties derived from the ASTR-2, AATSR, MERIS and SEVIRI satellite sensors, all in a common format and on the spatial grid. The primary products are aerosol optical depth at 550 and 870 nm, the Ångström coefficient and an indication of aerosol type. In addition to products derived from each instrument individually, a merged product, which combines information from all instruments, has also been produced .The project came to an end in September and the full dataset is now available. This talk will introduce the dataset and the algorithms used in its derivation. The talk will also go into the comparison of different aerosol datasets and how well they can be expected to agree with each other.

10:30 AM-5:30 PM

PT10

Title: MPLNET Products for AeroCom validations

Authors: Ellsworth Welton (1)

(1) NASA Goddard Space Flight Center, Greenbelt, MD, USA

Abstract: The NASA Micro Pulse Lidar Network (MPLNET) is a world wide, federated collection of micro pulse lidar sites co-located with AERONET sunphotometers. MPLNET began in 2000, and there are currently 18 active long term MPLNET sites and several more that will come online during the next year. Data from numerous field campaigns are also available. MPLNET data include level 1 signal and instrument diagnostics that provide qualitative information on atmospheric structure to 20 km. AeroCom participants may be familiar with our older Level 1.5A Version 1 products, that included only aerosol height and aerosol properties at coincident AERONET observation times. New, more expansive Version 2 algorithms were developed in 2007 and results went online in January 2008. All older data have been reprocessed with Version 2 algorithms. Version 2 Level 1.5 data include detection of cloud, aerosol, and PBL heights and retrievals of aerosol properties (backscatter, extinction profile and column lidar ratio). The data now include continuous, day/night products re-gridded to 1 minute temporal resolution. Level 2 quality assured data products are expected to be available starting in Fall 2009. All of these new data products will be presented along with their potential for AeroCom validation, including new batch data delivery currently under development.

10:30 AM-5:30 PM

PT11

Title: MODIS Deep Blue aerosol products over bright surfaces

Authors: C. Salustro (1)(2), C. Hsu (2), M.-J. Jeong (2)(3)

(1) Science Systems and Applications, Inc., Lanham, MD, USA
(2) NASA Goddard Space Flight Center, Greenbelt, MD, USA
(3) Goddard Earth Sciences and Technology Center, University of Maryland, Baltimore County, Baltimore, MD, USA

Abstract: Because of the difficulty in separating the signals of aerosols from those of highly reflective surfaces, aerosol retrievals over bright surfaces, such as deserts, have been limited. The MODIS Deep Blue aerosol retrieval algorithm expands the coverage of the MODIS instrument over bright surfaces, previously excluded from the MODIS aerosol products. The latest version of the Deep Blue algorithm, contained in MODIS-Aqua Collection 5.1 Level 2 and Level 3 aerosol products, has recently become available, with the analogous MODIS-Terra dataset forthcoming. Areas of improvement in this new version include substantive updates to surface bidirectional reflectance distribution function (BRDF) characterization, cloud-screening techniques, and quality assurance (QA) determination.

Here we use AERONET sunphotometer data to validate this latest version over the available MODIS-Aqua time series (July 2002 - present). We also show preliminary comparisons with MISR-Terra retrievals. Appropriate use and potential applications of this emerging dataset, particularly for constraining aerosol transport models and reducing the uncertainty in climate forcing due to tropospheric aerosols, will also be addressed.

10:30 AM-5:30 PM

PW01

Title: Online Interactive Simulations of Tropospheric Aerosols in the NASA GEOS-5 Model

Authors: Peter Colarco (1), Cynthia Randles (1), Arlindo da Silva (1), Amelia Colarco (1), Ravi Govindaraju (1)
(1) NASA Goddard Space Flight Center, Greenbelt, MD, USA

Abstract: We have recently implemented a version of the Goddard Chemistry, Aerosol, Radiation, and Transport (GOCART) module in the NASA Goddard Earth Observing System version 5 (GEOS-5) model. GEOS-5 is an integrated Earth simulation system, including components for atmospheric and oceanic general circulation and physics, atmospheric chemistry and oceanic biogeochemistry, land surface modeling, and data assimilation. We summarize results of a previous version of this modeling system in which we evaluated the global distributions of aerosols for simulations run with assimilated meteorology and prescribed sea surface temperatures. The evaluation was performed in the context of ground-based and satellite observations, as well as relative to the suite of AEROCOM models. This model has recently been improved to incorporate new physical parameterizations. Here we discuss preliminary results of a set of climate simulations in GEOS-5 that include the aerosol direct and semi-direct radiative effects. The distributions of aerosols are allowed to evolve according to the model climate in a run with sea surface temperatures prescribed from observations. Three cases of radiative forcing by aerosols are considered: no radiative forcing, forcing by a prescribed climatology of aerosols, and fully interactive forcing by the online aerosol distributions. The simulations are evaluated for their representativeness with climatological aerosol observations from MODIS and AERONET.

10:30 AM-5:30 PM

PW02

Title: Near-real time estimate of biomass emissions

Authors: Arlindo da Silva (1)

(1) NASA Goddard Space Flight Center, Greenbelt, MD, USA

Abstract: We will present an algorithm for estimating biomass emissions from MODIS Fire Radiative Power, including determination of the plume injection layer by means of a 1D PyroCu model. A bi-modal generalization of the classic Dozier algorithm provides estimates of ratio of energy emitted during smoldering/flaming phases of the fire. The impact of these emissions on the GEOS-5/GOCART aerosol forecasting system will be discussed.

10:30 AM-5:30 PM

PW03

Title: Towards understanding dust accumulation over Antarctica

Authors: F. Li (1), P. Ginoux (2), and V. Ramaswamy (2)
(1) Princeton University, Princeton, NJ
(2) NOAA GFDL, Princeton, NJ

Abstract: The effects of source, dynamics, and hydrological cycle on dust transport to Antarctica are investigated by using the Geophysical Fluid Dynamics Laboratory (GFDL) General Circulation Model. Sensitivity tests are performed for these processes to understand the high level of dust concentration in Antarctic ice cores during the Last Glacial Maximum (LGM). The results show that the source expansion, due to the reduced vegetation cover and lower sea level, can explain most of the observed increase of dust concentration during LGM. The stronger westerlies over Southern Ocean and reduced precipitation during LGM are less of a factor.

10:30 AM-5:30 PM

PW04

Title: Assessing the impact of aerosols on climate using NCEP CFS

Authors: Sarah Lu (1), Yu-Tai Hou (1), Suranjana Saha (1), Mian Chin (2) and Thomas Diehl (2)

(1) NOAA/NCEP, SIlver Spring, MD, USA
(2) NASA Goddard Space Flight Center, Greenbelt, MD, USA

Abstract : The NCEP Climate Forecast System (CFS) is a fully coupled atmosphere-land-ocean model. It was developed at NCEP EMC and became operational in August 2004. Here we present the CFS results conducted under the NOAA Climate Test Bed (CTB) program. Specifically, CMIP experiments are conducted to assess CFS response (global impact and regional differences) to different aerosol loading (OPAC climatology versus GOCART monthly data set). The CMIP study covers the 2000-2007 time period when stratospheric volcanic aerosols are close to the background level. In addition, CFS hindcast experiments are conducted to investigate the impact of aerosols on seasonal forecasts. The hindcasts include 5 members (with different initial conditions) and each reforecast runs for 9 months. The hindcasts are conducted for 2004 summer/fall and 2001 spring periods when strong aerosol events (Saharan dust outbreak, biomass burning over Amazon, and Asian dust storms) have been identified.

10:30 AM-5:30 PM

PW05

Title: Surface derived aerosol direct net shortwave radiative effect efficiency derived from measurements and a model.

Authors: J. Huttunen, A. Arola, T. Mielonen, A. Natunen, S. Mikkonen, G. Myhre (1),J. Schafer, S. N. Tripathi, M. Komppula, and K. E. J. Lehtinen

(1) Center for International Climate and Environmental Research – Oslo (CICERO) Oslo, Norway

Abstract: The preliminary results from Phase II direct aerosol effect radiative forcing will be discussed. These preliminary results from various models will be compared as well compared to previous published results. A main goal with this presentation is to get more modeling groups involved in the direct aerosol effect experiment.

10:30 AM-5:30 PM

PW06

Title: Attribution of climate forcing to human activity

Authors: Nadine Unger (1)(2)

(1) Columbia University, New-York, NY, USA
(2) NASA Goddard Institute for Space Studies, NY, USA

Abstract: A much-cited bar chart provided by the Intergovernmental Panel on Climate Change displays the climate impact, as expressed by radiative forcing in watts per meter squared, of individual chemical species. The organization of the chart reflects the history of atmospheric chemistry, in which investigators typically focused on a single species of interest. However, changes in pollutant emissions and concentrations are a symptom, not a cause, of the primary driver of anthropogenic climate change: human activity. In this paper, we suggest that organizing the bar chart according to drivers of change-that is, by economic sector results in a more physical and policy-relevant presentation. Climate impacts of tropospheric ozone, fine aerosols, aerosol-cloud interactions, methane and long-lived greenhouse gases are considered. Since the different chemical species have a wide range of atmospheric lifetimes from a few days to decades, we present the total radiative forcing due to current emissions from each of the 13 major economic sectors using a forward-looking perspective for 2 time horizons: 20- and 100-years. Sector profiles differ greatly. If the policy goal is to achieve rapid progress and avoid “tipping points” being reached in the climate system, then the most effective opportunities lie in reducing emissions from the on-road transportation, domestic biofuel and animal husbandry sectors. In order to protect the Earth’s climate in the longer term, emphasis must be placed on reducing emissions from the power and industry sectors. The sector-based approach is of great use in fostering the development of smart climate policy.

10:30 AM-5:30 PM

PW07

Title: Evaluation of aerosols radiative forcings with the model LMDZ-INCA

Authors: M.R. Vuolo (1), M. Schulz (1), Y. Balkanski (1), N. Yan (1)

(1) Laboratoire des Sciences du Climat et de l'Environnement, Gif-sur-Yvette, France

Abstract: We tested the new LMDZ-IPSL aerosol model prepared for the next IPCC runs at IPSL in several versions (offline, online, preindustrial, present day) to diagnose different aerosol radiative forcing components. These forcing components include the direct effects of all aerosol species, (clear sky, cloudy sky and all- sky) , the semi-direct effect, first indrect effect. We propose a way to diagnose the semi-direct effect of the absorbing aerosols. As a second step we have used AeroCom B, Aeronet and MODIS_CERES forcing estimates to investigate the results in terms of clear-sky forcing and forcing efficiency.

10:30 AM-5:30 PM

PW08

Title: Integrated aerosol-cloud-chemistry interactions for deep convective clouds

Authors: Tianle Yuan (1), Lorraine Remer (2)

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Abstract: Lightning is one of the largest, but least characterized natural sources of nitrogen oxides (NO_x) that are critical in atmospheric chemistry processes such as tropospheric ozone production and the oxidizing capacity of the atmosphere. While lightning is associated with deep convective clouds, maritime deep convection exhibits an order of magnitude less lightning activity than its counterpart over land, creating a paradox. Here we show aerosols significantly enhance lightning activity through modification of cloud microphysics, enhancing cloud mixed phase activity and invigorating convection, adding an anthropogenic component to the natural process. We estimate that a ~60% increase in aerosol loading leads to more than 150% increase in lightning flashes. We also show that increased lightning activity may have led to significant tropospheric ozone increase through production of NO_x. We thus propose a new pathway in which anthropogenic aerosols can indirectly affect ozone production, especially over the 'NO_x limited' maritime regions, and related atmospheric chemistry processes. With future aerosol changes due to industrial and agricultural activities in the tropics this aerosol-cloud-chemistry link has the potential to increase tropospheric ozone production over the tropics and perturb the mean state of tropical atmospheric chemistry, such as the ozone wave-one pattern.