7th AeroCom Meeting

Rejkjavik, Iceland
8-10 October 2008

Location Hotel Cabin, Rejkjavik

Host Jon Egill Kristjansson, University of Oslo
Halldor Björnsson, Icelandic Meteorological Institute
AeroCom steering committee (Michael Schulz, Stefan Kinne, Mian Chin, Christiane Textor)

Financial support is acknowledged by University of Oslo
and Laboratoire des Sciences du Climate et de l'Environnement.

Logistics

Please do all registration for hotel and tour through registration website:
https://asp.artegis.com/lp/AeroCom2008/AeroCom2008?1=1
LATEST 30 September

Hotel Cabin
http://www.hotelcabin.is // phone number: +3545116030
Special room rates (indicate AeroCom meeting) for period 7-11 October:
- single room including breakfast is 6800 ISK (~55 Euro) per night
- double room is 7700 ISK (~65 Euro) per night.

Iceland Travel service http://www.icelandtravel.is
Björk Bjarkadóttir (BjorkB@Icelandtravel.is)
or Camilla Tvingmark (camilla@icelandtravel.is).

A registration fee of ISK 6 000 (~50 Euro) will be collected to support general costs of running the meeting.

Registration for excursion to Geysir geothermal field, Gullfoss famous waterfall and Thingvellir National Park via workshop registration site (cost 6900 ISK (~55 Euro) per person) Duration 9-17 on Saturday 11 October. http://www.re.is/golden-circle/

Goal of the meeting:

- Present progress with respect to aerosol modeling and data analysis
- Review status of model-data comparisons and aerosol model scoring and discuss AeroCom database and its further development
- Discuss joint analysis of aerosol model experiments in support of IPCC AR5 and the AC&C and HTAP initiatives (regional emission perturbations, indirect forcing, hindcast, prescribed forcing, interactive aerosol-climate simulations) including a review aerosol model diagnostics for future model experiments

Format of workshop:

Three full days starting Wednesday 9:00
Oral contributions should not exceed a presentation length 15 min
Powerpoint / PDF presentation format
Poster display possible
Joint Workshop Dinner Thursday evening (free)
Joint excursion on Saturday to Iceland

Themes

Contributions shall connect to the following themes of the workshop

Progress with respect to aerosol modeling and data analysis

New developments appear in the aerosol field which may help to reduce current uncertainties in the forcing estimate attributed to aerosols. This theme provides space to present new aerosol model concepts, new and reanalyzed aerosol data sets, aerosol climatologies, sensitivity analysis for a given process within a single model, suggestions for tests explored in one model but of broader interest to better understand intermodel differences, reports of new aerosol phenomena which require inclusion in global aerosol models

Status of model-data comparisons and aerosol model scoring

Previous work within AeroCom has shown the variable quality of models with respect to different observational data sets. This theme shall discuss possibilities to develop and establish aggregated scores for individual aerosol problems and their representation in models such as dust, aerosol size, hygroscopicity, first indirect effect, aerosol composition, clear-sky forcing, long-term trends of concentration and deposition, vertical distribution, absorption, optical depth. Scientists having analyzed AeroCom or HTAP model experiment data are encouraged to report under this theme.
The AeroCom database and technical facilities shall be discussed to achieve common understanding how scientists can make use of the archived model runs and how this shall be handled in the future.

Joint analysis of aerosol model experiments

The number of coordinated model simulations of interest to aerosol models has increased recently (HTAP, AC&C, AeroCom). Under this theme we suggest to discuss possible synergies and the specific role of AeroCom to help analyse aerosol simulations in support of the IPCC AR5 and the HTAP assessment. Experiments in view include regional emission perturbations and tracer studies (HTAP), experiments with additional diagnostics for the indirect forcing (AeroCom, Quaas et al), an aerosol hindcast for the period 1980-2007 (AeroCom with AC&C, Schulz&Chin et al), prescribed forcing (in preparation, Stier et al) and interactive aerosol-climate simulations(with AC&C activity 4). First results from this set of experiments shall be presented here. This theme involves a presentation and discussion of common AeroCom aerosol diagnostics needed to better score and diagnose aerosol models run within these different experiments.

program outline

Topic 1: aerosol modeling and data analysis

Wednesday morning

09:20	Bauer	sensitivity of Climate Forcings to Aerosol Physics and Chemistry
09:40	Gilardoni	black carbon simulations in TM5
10:00	Hoose	in-droplet / in-crystal aerosols in ECHAM5-HAM model

10:20 coffee&tea

10:50	Takemura	radiative forcing projections for the 21st century
11:10	Kristjansson	indirect effect sensitivities in the CAM-Oslo model
11:30	Lu	global aerosol modeling in NCEP GFS
11:50	Kristjansson	Reykjavík – what to see

12:00 lunch

Wesdnesday afternoon

15:30	Bellouin	diffuse radiation impact on continental carbon sink and GEMS aerosol
15:50	Diehl	multi-decadal variations of aerosol
16:10	Chin	development of a dynamic dust source function
16:30	Koch	attribution to 1980-2000 climate change

16:50 coffee&cake

17:20	Schulz	hindcast experiments in the context of HTAP and AC&C

Topic 2: status of model-data comparison and aerosol model scoring

Thursday morning

09:00	Tsigaridis	modeling organic aerosol – time to compare different approaches
09:20	Schulz	model evaluation through AeroCom
09:40	Diehl	emission recommendations for hindcast simulations

10:00 coffee&tea

10:30	dePaus	model output harmonization with CMOR
10:50	Braverman	AMAPS evaluation tool capabilities
11:10	Kinne	scoring concepts & data update

12:00 lunch

Thursday afternoon

13:00	Thomas	GlobAER: up to 12 years of aerosol properties by European sensors
13:20	Wild	examining BSRN data on dimming and brightening
13:40	Huneeus	defining a dust benchmark test
14:00	Ferrare	high resolution lidar and CALIPSO
14:20	da Silva	subgrid variability and AOD calculations

15:00 coffee&cake

15:30	Mann	aerosol microphysics modeling in GLOMAP
15:50	Seland	internal mixing effects on the direct effect of aerosols
16:10	Liu	sensivity of the indirect Effect in NCAR CAM to module complexity
16:30	Randles	present-day aerosol climatology
16:50	Paradise	AMAPS evaluation tool demonstration

19:30 workshop dinner at Cabin Hotel

Topic 3: joint analysis of aerosol model experiments

Friday morning

09:00	Feichter	nudging artifacts
09:20	Quaas	indirect effect – working group
09:40	Stier	radiative forcing – working group

10:00 coffee and tea

10:30	Myhre	radiative forcing
10:50	Koch	absorption – working group
11:10	Mann	microphysics and size – working group
11:30	Schulz	dust – working group

12:00 lunch

Friday afternoon

13:00	Chin for Chen	summarizing aircraft field experiment data for modeling
13:20	Schulz/Chin/Kinne	general discussions, outlook, upcoming events

17:00 bus departure for Blue Lagoon and late dinner

Saturday

08:15-18:00 excursion to (1) geothermal energy facility, (2) Geysir geothermal field, (3) Gullfoss waterfall and (4) Thingvellir National Park

Registered participants

Yyes Balkanski, CEA-LSCE, F
Susanne Bauer, NASA GISS, US
Nicolas Bellouin, MetOffice, UK
Terje Berntsen, Univ Oslo, NO
Halldór Björnsson, Iceland Metservice, ICELAND
Amy Braverman, NASA JPL, US
Gao Chen, NASA Langley, US
Mian Chin, NASA, Goddard, US
Arlindo da Silva, Nasa Goddard, US
Thomas Diehl, NASA GISS, US
Johann Feichter, MPIM, D
Rich Ferrare, NASA, Langley, US
Stefania Gilardoni, EU-JRC, IT
Jan Griesfeller, LSCE, F
Corinna Hoose, Univ Oslo, NO
Nicolas Huneeus, LSCE, F
Stefan Kinne, MPIM, D
Dorothy Koch, GISS, US
Jon Egill Kristjánsson, Univ Oslo, NO
Xiaohong Liu, PNNL, US
Sarah Lu, NOAA, US
Graham Mann, Univ Leeds, UK
Gunnar Myhre, CICERO, NO
Susan Paradise, NASA JPL, US
Tim de Paus, MPIM, D
Johannes Quaas, MPIM
Cynthia Randles, NASA Goddard, US
Michael Schulz, LSCE, F
Oyvind Seland, Norwegian MetOffice, NO
Philip Stier, Univ Oxford, UK
Toshi Takemura, Univ. Kyushu, JP
Gareth Thomas, Univ Oxford, UK
Kostas Tsigaridis, GISS, US
Rosaling West, Atm Phys, UK
Martin Wild, ETHZ, CH

submitted abstracts

Sensitivity of Climate Forcings to Aerosol Physics and Chemistry

S. Bauer and D. Koch

Aerosol effects on climate are sensitive to their composition, size and mixing state, however the character of atmospheric aerosols remains poorly constrained. A new detailed aerosol microphysical scheme, MATRIX, embedded within the global GISS modelE climate model provides the capability to probe a large range of possible aerosol climatologies, and then explore how these variations would affect climate. Aerosols are directly released as particles or formed through secondary particle formation in the atmosphere. Condensation and coagulation processes lead 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. MATRIX includes the above processes that determine the lifecycle and climate impact of aerosols. This study presents a quantitative assessment of the impact of single microphysical processes, such as nucleation, coagulation, emission size distributions etc. on aerosol cloud activation and radiative forcing. For example the different parameterization of new particle formation through ternary or binary nucleation theory can change the number concentration of cloud activating particles regionally by up to 20%. This study will summarize the sensitivity of aerosol-climate interactions to microphysical parameterizations.

Impact of Changes in Diffuse Radiation on the Global Land Carbon Sink

L. Mercado, N. Bellouin, S. Sitch, O. Boucher, C. Huntingford and P. M Cox.

Plant photosynthesis increases with irradiance, but is also more efficient under diffuse light conditions. We show that changes in diffuse fraction due to changes in aerosol loading during the 20th century contributed one-third to the global land carbon accumulation during that period. Projection into the 21st century shows a decline of that fertilisation effect, with consequences on CO2 emission reductions needed to avoid dangerous climate change.

Aerosol Measurement and Processing System

A. Braverman, O. Kalashnikova, G. Manipon, S. Paradise, J. Penner, B.Wilson, Z. Xing, L. Xu

The Aerosol Measurement and Processing System (AMAPS) is a grid based, distributed computing environment for aerosol science. AMAPS is motivated by the community's call for a modern infrastructure to access, manipulate and analyze aerosol data (see the Bulletin of the American Meteorological Society, October 2003). AMAPS offers access, subsetting, and data analysis functions for level 2 aerosol data products from MISR, MODIS, and AERONET. The system is available in two modes: service user mode and power user mode. Service user access data and computational capabilities

through preconstructed web pages that call workflows: web service functions chained together in XML documents. Power user access computational capabilities from the command line of AMAPS-enabled computers, by embedding web service calls directly in their python programs. The AMAPS python package also offers streamlined functions to read, extract and manipulate data over the internet. In this talk, we describe how the system can be used to compare the output of models to observations in level 2 MISR and MODIS data products. Examples are drawn from comparisons to the University of Michigan's IMPACT model.

Multi-decadal variations of atmospheric aerosols and their effects on climate and air quality

M. Chin, T. Diehl, H. Yu, H. Bian

We analyze 27-year (1980-2006) GOCART model simulations of multi-decadal variations of atmospheric aerosols. We will focus on the multi-decadal changes of surface PM concentrations, aerosol amount in the free troposphere, and long-range transport, and the implications for climate forcing. The model results will be compared with surface measurements and satellite data including the most recent data from CALIPSO.

Accounting for subgrid variability in aerosol AOD calculations

A. da Silva, P. Norris and P. Colarco

Typically, aerosol dry mass (or mixing ratio) is the prognostic variable in global aerosol transport models. For hydrophilic aerosols, the humidification effects are included during the calculation of aerosol optical depth through an empirical non-linear function of relative humidity. Given the availability of PDF-based cloud schemes in current GCMs, parameterizations do exist for capturing the subgrid variability of relative humidity, and these PDFs can be used for a more consistent evaluation of the humidification effects on aerosols. Starting with the output from a cloud resolving model as a testbed, we examine a sucession of parameterizations suitable for global models. In particular, the impact of cloudn overlap assumptions on clear-sky AOD measured by satellites will be discussed.

Analysis of the Multi-Decadal Variability of Aerosols Based on a GOCART Hindcast and Observations

T. Diehl and M. Chin

We have recently conducted a long term hindcast of the aerosol species dust, sea salt, black carbon, organic carbon, and sulfate for the period 1979 to 2006 using the offline chemical transport model GOCART. Preliminary results from this experiment will be presented, with a focus on the time series of the total aerosol optical depth at 550 nm evaluated over 7 land and 7 ocean regions, together with data from the Advanced Very High Resolution Radiometer (AVHRR) instrument. We will discuss the

relationships between changes of emissions, optical depth, and aerosol burden, both globally and regionally. Some details of the emission inventories used for this experiment will be presented as well.

Airborne High Spectral Resolution Lidar Aerosol Measurements and Comparisons with Transport Models and CALIPSO measurements

R. Ferrare, Hostetler, Hair, Cook, Harper, Burton, Obland, Rogers, Fast, Chin, Tang, Carmichael, Emmons, Pierce, Kittaka

The NASA Langley Research Center (LaRC) airborne High Spectral Resolution Lidar (HSRL) measured aerosol distributions and optical properties during several field experiments over the last three years. 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. The HSRL collected over 600 hours of aerosol measurements during these experiments. These HSRL data have been used for a variety of applications, including determination of boundary layer height, aerosol typing, partitioning of aerosol optical depth by type, and assessment of aerosol-cloud interactions. This presentation will focus on two additional applications; evaluating aerosol transport model simulations of aerosol extinction and optical thickness profiles and aerosol types, and evaluating the aerosol backscatter and extinction profiles measured by the Cloud-Aerosol LIdar with Orthogonal Polarization (CALIOP) sensor on the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite (CALIPSO).

Evaluation of Chemistry Transport Model TM5 in modeling black carbon concentration.

S. Gilardoni, E. Vignati, J. Wilson

A method to evaluate the performance of global Chemistry Transport Model TM5 in modeling black carbon concentration is proposed. The method is based on the comparison of frequency distribution of hourly data from field measurements and model results; data from Jungfraujoch and Mace Head are reported, from July 2002 to June 2003. The response of parametric and non-parametric statistical tests is compared to the proposed method.

Explicit representation of in-droplet and in-crystal aerosols in ECHAM5-HAM

C. Hoose, U. Lohmann, R. Bennartz, B. Croft and G. Lesins

Processing of aerosol particles in cloud droplets and crystals influences the particles' composition, mixing state and size distribution. We have introduced an explicit and detailed representation of in-droplet and in-crystal aerosol particles in stratiform clouds in the global aerosol-climate model ECHAM5-HAM. The new scheme allows an evaluation of the cloud cycling of aerosols, and leads to

important changes in the simulated fraction of aerosol scavenged in clouds, and consequently in the aerosol wet deposition.

On the definition of a benchmark test for global dust models

N. Huneeus, M. Schulz, Y. Balkanski, J. Griesfeller, and S. Kinne

Previous works on comparisons between models within AeroCom for different aerosol species presented large diversities in dust emissions, sinks, burdens and spatial distribution (Textor et al 2006, Textor et al. 2008). Based on that work, we have developed a benchmark tool that validates these models in terms of optical depth and Angström exponent from AERONET, surface concentration measurements from AEROCE network, total dust deposition data and satellite derived AOD fields. Results from these comparisons will be presented.

Attribution of 1980 to 2000 climate change to aerosol and long-lived greenhouse gas changes according to the GISS model.

D. Koch and many others

We simulated 20th century climate in the GISS ModelE, using fully coupled (on-line) aerosol-chemistry-climate including a deep ocean to allow full climate response. Aerosol and ozone direct effects, and the effect of black carbon on snow albedo is included, but not aerosol indirect effects. Beginning in 1980 and running to 2000, we initiated 4 more sensitivity experiments, one that kept long-lived GHG's at 1980 levels, one that held aerosols at 1980 levels, one that turned off the BC snow albedo effect and one that set all BC to zero; these were all expected to lead to cooler climates. The sensitivity experiments are indeed cooler within particular regions. We compare the model results with year 1980 to 2000 observed changes in surface air temperature, snow/ice, sea level pressure, and surface radiation. We also consider hydrological changes and their interactions with aerosols.

What is the indirect effect sensitive to and why?

J. E. Kristjánsson, A. Kirkevåg, C. Hoose, T. Iversen, Ø. Seland, T. Storelvmo, L. Donner

Model estimates of the aerosol indirect effect still vary greatly, and in some cases strongly disagree with results from inverse calculations. We will show results from model simulations using CAM-Oslo that shed a light on some of the causes of these variations. For instance, we show how imposed constraints on cloud droplet concentration strongly influence the aerosol indirect effect.

Indirect Effect In NCAR CAM: Sensitivity to the Treatment of Aerosols

X. Liu, S. Ghan, R. Easter, R. Zaveri, H. Morrison, A. Gettleman, P. Rasch, J.-F. Lamarque; P. Hess, N. Mahowald, F. Vitt, P. Cameron-Smith, C, Chuang, and A. Ekman

A modal aerosol treatment is implemented in the NCAR CCSM CAM model which predicts both aerosol mass and number, and internal mixing between aerosol components. Several new processes have been added to CAM: new particle formation, coagulation within and between aerosol modes, condensation of water vapor and trace gas on aerosols, aging of primary carbon to accumulation mode based on sulfate coating from condensation & coagulation, and aerosol activation. A number of other processes have been improved: in-cloud rainout based on activated (cloud phase) aerosol calculated, below-cloud impaction scavenging rates depending on particle sizes for mass and number of aerosols, optical properties of internally-mixed hydrated aerosol. In this presentation indirect effect using the benchmark modal aerosol treatment (with 7 modes) will be compared with simulation using the simplified modal aerosol treatment (with 3 modes), and with that using the bulk aerosol treatment (with only aerosol mass predicted). The sensitivity of indirect effect to aerosol emissions will also be discussed.

Aerosol Forecasting System: An overview and its applications for improving weather and air quality forecasts

S. Lu, Y.-T. Hou, R. Treadon, H.-C. Huang, J. McQueen, Y.Tang, H. Juang, S. Moorthi, M. Iredell, W. Stockwell, E. Joseph, M. Chin and A. da Silva

The NCEP Environmental Modeling Center (EMC) is developing a global aerosol forecasting and assimilation capability in GFS/GSI, via NCEP-GSFC-Howard University collaboration, to improve the treatment of radiation feedback in the GFS forecasts and to provide aerosols boundary conditions for the regional air quality forecast system. We will provide an overview of the NCEP global aerosol modeling system. Results of two impact studies will be discussed, including (1) the impact of lateral aerosol boundary conditions on aerosol air quality forecasts, and (2) the impact of improved aerosol treatment on medium range weather forecasts.

Global aerosol microphysics modeling: implications of simulating new particle formation and growth for aerosol-climate effects.

G. Mann

Almost all models participating in IPCC carry on mass concentration as aerosol tracers and characterise particle size assuming fixed size distributions. In this talk, we explore the impact of this assumption on simulated aerosol-climate interactions. New particle formation events have been observed to occur at a range of continental sites worldwide. However, the contribution of these events to global CCN and potential role in influencing aerosol-climate impacts has not so far been assessed. We include a semi-empirical new particle formation scheme into the GLOMAP global aerosol microphysics model (Spracklen et al, 2005) and estimate the contribution of boundary layer nucleation events to regional and global cloud condensation nucleii (CCN) concentrations. We go on to compare the simulated 1st indirect aerosol forcing in GLOMAP with and without boundary layer nucleation (BLN). We find that although on a global mean the change in cloud albedo is similar with or without BLN, the difference in simulation

regional albedo changes is different by over 30%. Northern Hemisphere cloud albedo changes tend to be reduced when BLN is included and Southern Hemisphere changes tend to be enhanced.

The radiative forcing experiment

G. Myhre

During 2009 the AeroCom radiative forcing experiment will start. Plans and diagnostics for the experiment will be presented. New radiative forcing results from Oslo CTM2 will be used to highlight some important issues. A new method for taking internal mixing of BC has been suggested and this has been tested in the updated radiative forcing calculations. Radiative forcing of secondary aerosol components as nitrate and secondary organic aerosols will be discussed.

Present-day aerosol climatology in the NASA GEOS-5 AGCM with climatological sea-surface temperatures.

C.A. Randles and P.R. Colarco

We present a present-day global aerosol climatology generated with the NASA GEOS-5 AGCM forced by climatological SSTs and comparisons to MODIS and AERONET observations. The GEOS-5 aerosol module implements a version of the Goddard Chemistry, Aerosol, Radiation and Transport (GOCART) model [Chin et. al., 2002; Colarco et. al., manuscript in preparation, 2008] that treats the sources, sinks, and chemistry of dust, sulfate, sea salt, and black and organic carbon aerosols.

Distributions and radiative forcings of aerosols during the 21st century

T. Takemura

I have recently simulated them based on SRES with the latest version of SPRINTARS.
It will be available as a reference when the new IPCC emission scenarios will be opened.

Evaluation of organic aerosol global simulations. Is there an efficient recipe to follow?

K. Tsigaridis and M. Kanakidou

Although organics are important components of the atmospheric aerosol, little attention has been paid to the accurate simulation of their distribution in the atmosphere. The main approaches in modeling the organic aerosol component in global models will be briefly presented and published results from the individual model comparisons with observations will be shown and discussed. Shortcomings in a meaningful evaluation of models against observational data will be highlighted. A strategy to follow for a OA AEROCOM model intercomparison will be outlined and open for discussion.

Two sources of uncertainties of modeling Black Carbon at global scale

E. Vignati, M. Karl, M. Krol, F. Cavalli, J. Wilson and P. Stier

Two different schemes of black carbon have been included in the TM5 global model (i) a simple approach considering BC as bulk aerosol and a simple treatment in the removal, and (ii) a more complete description of microphysical aging within an aerosol dynamics model, with the removal coupled to the microphysical properties of the aerosol. The sensitivity of the model to the schemes is investigated in view also of the uncertainties related to EC and BC measurements, which make a proper model evaluation rather difficult.

On the use of surface radiative flux data within AEROCOM

M. Wild

This presentation gives an overview over the data available on the worldwide measured surface radiative fluxes. They may be used for validation of the simulations carried out within AEROCOM. Also, the decadal simulations carried out within AEROCOM may help to interprete the substantial decadal variations that have been detected in these observations (“Global dimming and brightening”).