ABSTRACTS

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and

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in alphabetical order by presenter

ORAL title
POSTER title

Albani, Samuel

Integrating models and observations for a better representation of the global dust cycle

Changing climate conditions affect dust emissions and the global dust cycle, which in turn affects climate and biogeochemistry. Mineral dust is a major component of the global aerosol load, and its current representation in global climate and earth system models contributes to the significant uncertainties that still characterize this field of research. Modern in situ and remote sensing measurements, as well as paleodust records offer the chance for comparing observations with model simulations from multiple points of view, challenging the representation of the different processes embedded in dust models. We present model-observation comparisons for different simulations of the global dust cycle, and try to derive general lessons that can be learned from this kind of activity.

Allen, Robert

An Increase in Aerosol Burden in a Warmer World

Atmospheric aerosols are of significant environmental importance, due to their effects on air quality, as well as their ability to alter the planet's radiative balance. Recent studies characterizing the effects of climate change on air quality and the broader distribution of aerosols in the atmosphere show significant, but inconsistent results, including the sign of the effect. Using a suite of state-of-the-art climate models, we show that climate change is associated with a negative aerosol–climate feedback of −0.02 to −0.09 W m−2 K−1 for direct radiative effects, with much larger values likely for indirect radiative effects. This is related to an increase in most aerosol species, particularly over the tropics and Northern Hemisphere midlatitudes, largely due to a decrease in wet deposition associated with less large-scale precipitation over land. Although simulation of aerosol processes in global climate models possesses uncertainty, we conclude that climate change may increase aerosol burden and surface concentration, which may have implications for future air quality.

Andrews, Betsy

AeroCom INSITU Project: Comparison of aerosol optical properties from in-situ surface measurements and model simulations

In the spring of 2015 AeroCom initiated a project 'INSITU' comparing model output to in-situ, surface-based measurements of aerosol optical properties. The model/measurement comparison project, called INSITU, aims to evaluate the performance of a suite of AeroCom aerosol models with observations from the approximately 60 surface sites which have submitted their data to the World Data Centre for Aerosols (http://ebas.nilu.no/). The three tiers of the INSITU project are intended to look at how well models reproduce (i) observed in-situ aerosol optical property climatologies and co-variances; (ii) aerosol hygroscopicity; and (iii) aerosol trends. Previously, we've presented comparisons

of annually averaged aerosol properties and demonstrated that model single scattering albedo and scattering Angstrom exponent values tend to be lower (i.e., aerosol is darker and larger) than the in-situ measurements when comparing measurements and model simulations at over 60 sites with output from ~10 AeroCom models. Here we explore seasonal comparisons to identify whether there are discrepancies in key aerosol optical parameters as a function of time of year and location. We utilize Taylor diagrams as a metric to evaluate how well models are doing for different sites, variables and seasons. Finally we hope to announce the initial availability of the benchmark data set of in-situ measurements.

Aoki, Kazuma

Columnar aerosol optical properties at Hokkaido site in North part of Japan

Aerosols play an important role in the climate change and the radiative balance of the atmosphere. We provide the information, in this presentation, on the aerosol optical properties with respect to their temporal and spatial variability in North part of Japan site. We started the measurements of aerosol optical properties by using sky radiometer (POM-01: PREDE Co. Ltd., Japan) at Sapporo (43.1N, 141.3E) since 1997, at Abashiri (44.0N, 144.3E) since 2012, at Takikawa (43.6N, 141.9E) since 2013, and at Tomakomai (42.7N, 141.6E) since 2015, four Hokkaido site. The sky radiometer is an automatic instrument that takes observations only in daytime under the clear sky conditions. Observation of diffuse solar intensity interval was made every ten minutes by once. The aerosol optical properties were computed using the SKYRAD.pack version 4.2. The obtained Aerosol optical properties (Aerosol optical thickness, Ångström exponent, Single scattering albedo, and etc.) and size distribution volume clearly showed seasonal and temporal variability, with a vernal maximum (e.g. Asian dust) and an autumnal to winter minimum. Sometimes we observed forest fire events from Siberia. In this study, we present the temporal and spatial variability of Aerosol optical properties at Hokkaido sites, applied to validation plan of satellite and numerical models. The GCOM-C/SGLI, JAXA satellite scheduled to be launched in 2017 JFY.

Bellouin, Nicolas

The Copernicus Atmosphere Monitoring Service for Climate Forcings

The Copernicus Atmosphere Monitoring Service (CAMS) for Climate Forcings aims at delivering routine estimates of the radiative forcing of greenhouse gases, ozone, and aerosols, based on the CAMS Global Reanalysis of Atmospheric Composition. Quantification of radiative forcing of aerosol-radiation and aerosol-cloud interactions is based on methods previously applied to satellite retrievals, but adapted to benefit from a data-assimilated global model. In this talk, I will present the latest CAMS Climate Forcings estimates and their uncertainties. I will focus on discussing how those estimates and the multiple pre-industrial states that we produced can be used as benchmarks by AeroCom modellers. In the other direction, I will also suggest ways for AeroCom research to feed into CAMS Climate Forcing estimates, especially as we try to quantify rapid adjustments (semi-direct and 2nd indirect effects).

Bergman, Tommi

Evaluation of a new secondary organic aerosol formation scheme in TM5

We have implemented a new secondary organic aerosol scheme in the chemistry transport model TM5. In this scheme we calculate the formation of extremely low volatility organic compounds (ELVOCs) and semi-volatile organic compounds (SVOCs) from isoprene and monoterpene reactions with ozone and hydroxyl radicals online using detailed chemistry. We follow the work by Jokinen et al. (2015) and assume that the total molar yield from these reactions to be 15% for reactions with monoterpenes and 1% for reactions with isoprene. The produced ELVOCs are assumed to participate in the new particle formation and particle growth while SVOCs are assumed to participate only in the growth of particles. We parameterize the new particle formation by the schemes described by Riccobono et al. (2014) and Paasonen et al. (2010). For the condensation we assume that the ELVOCs condense depending on condensation sink, while SVOCs will be distributed according to existing organic mass. We will show the detailed model description and analyze how the model performs compared with AOD from satellite retrievals and in-situ observations, as well as comparisons with in-situ observations of particle number and mass concentrations.

Bian, Huisheng

First look of atmospheric aerosol and CO using ATom measurements and GEOS5 model: introducing an ATom-AeroCom activity

We use the NASA GEOS-5 model to conduct a quick "first look" analysis of the ATom data with respect to the origin of aerosols and related trace gases. This work responds to the protocol of an AeroCom-ATom experiment that aims at engaging the international AeroCom community to work with the ATom data. The GEOS-5 model is used to demonstrate the approach and content of the experiment. In this study, we will first evaluate the GEOS-5 aerosol simulation using ATom measurements. This is for GEOS-5 the first time that modeled aerosol compositions have been evaluated thoroughly in remote areas of the open ocean, from the surface to the lower stratosphere, which is possible thanks to the unique dataset ATom provides. We will report differences in the model simulation from the observations, and discuss the potential causes behind them. We will combine the ATom measurement and the GEOS-5 simulation to reveal the source origin of aerosol composition over different regions of the Pacific and Atlantic oceans, and examine how chemical and physical processes impact the composition.

Bing, Xie

Effective radiative forcing and climate response due to short-lived climate pollutants in different scenarios

An aerosol-climate coupled model system BCC_AGCM2.0_CUACE/Aero, combined with the Representative Concentration Pathways (RCPs), was used to simulate the effective radiative forcing (ERF) and climate responses due to the change in the concentration of short-lived climatic pollutants (SLCPs) from 2010 to 2050 in different emission scenarios (RCP8.5, RCP4.5 and RCP2.6). As the results shown, in RCP8.5 scenario, the ERF of SLCPs was increased by 0.15 W m-2 due to the change of SLCPs, which led to an increases in global mean temperature of 0.27°C and in precipitation of 0.02 mm d-1. In RCP4.5 scenario, the reduction of SLCPs caused a decrease in the ERF by 0.24 W m-2, but it had little effect on the global mean surface temperature and precipitation. The concentration of SLCPs was further reduced in the scenario of RCP2.6, and it resulted in the ERF reduction by 0.40 W m-2, and the global mean surface temperature reduction by 0.20 °C, but the global average precipitation was almost unchanged. In all three emission scenarios, the changes of cloud cover due to the SLCPs changes were similar. The low cloud covers obviously increased in the Arctic region, but generally reduced near the 60° of both hemispheres. And the high cloud covers generally increased in the poles and subtropical regions, but significantly reduced near the 60° of both hemispheres.

Brühl, Christoph

Stratospheric and tropospheric aerosol 2002 to 2012, EMAC chemistry climate model simulations and GOMOS, IASI and ATSR satellite observations

Simulations with the atmospheric chemistry - general circulation model EMAC, with modal interactive aerosol, and observations by GOMOS show that sulfate particles from about 230 volcanic eruptions dominate the interannual variability of aerosol extinction in the lower stratosphere and of radiative forcing at the tropopause. To explain the observations, desert dust and organic and black carbon, transported to the lowermost stratosphere by the Asian summer monsoon and tropical convection, are important. This holds also for radiative heating by aerosol in the lowermost stratosphere. Comparison with ATSR total aerosol optical depth and IASI dust optical depth at different wavelengths shows, that the model is able to represent stratospheric and tropospheric aerosol in a consistent way.

Burgos, Maria

Evaluation and improvement of the parameterization of aerosol hygroscopicity in global climate models using in-situ surface measurements

Ambient aerosol particles can take up water and thus change their optical properties depending on the hygroscopicity and the relative humidity (RH) of the surrounding air. Knowledge of the hygroscopicity effect is of importance for radiative forcing calculations but is also needed for the comparison / validation of remote sensing and model results with in situ measurements. In this project, the ultimate goal is to assess how well global models simulate the aerosol/water interaction using in-situ measurements of aerosol hygroscopicity. The particle light scattering depends on RH and can be

described by the scattering enhancement factor f(RH), which is defined as the particle light scattering coefficient at a given RH divided by its dry value. In a first step and with the aim to create a harmonized benchmark data set, surface based f(RH)-measurements provided by more than 25 sites (with a wide global coverage) have been re-analyzed. These sites pertain to different networks such as DOE/ARM and AMF deployments, ACTRIS or NOAA and represent a large variety of aerosol types. An identical data treatment process has been applied to all sites in terms of instrument corrections, calibrations, fitting assumptions, etc. Moreover, data quality is assured by a thorough inspection of each site, where instrument metadata is reviewed, failures or malfunctions are removed, flags due to differences in the measurement cycles or size cut are added and site dependent corrections are taken into account. In this presentation, we will show first results of the high-frequency humidograph analysis of our global dataset as well as provide insights into the valid definition of RH at dry measurement conditions for the different sites. Future steps aim to review and validate the data set by means of optical closure studies and, as a final goal, to compare this benchmark dataset with AeroCom model outputs.

Che, Yahui

Aerosol properties retrieved over land with AVHRR sensor data

Aerosol as one part of atmosphere plays an important role in Earth's climate system. The fifth IPCC (2014) assessment report re-emphasizes the uncertainty in evaluating its direct and indirect effects and the importance of deeper understanding on its possible feedback mechanism. Satellites provide researchers an effective way to observe and study aerosol from space both for scales at regional area or the global with exceptional advantages. The Advanced Very High Resolution Radiometer (AVHRR) on-board National Oceanic and Atmospheric Administration (NOAA) series satellites is the only space-borne instrument which can provide users continuous long time series global coverage for almost 40 years since 1979. Under this background, we build an Algorithm for the retrieval over Land of the Aerosol Optical Depth (ALAD), aiming at producing continuous 35-long-time-series product of aerosol properties globally with its maximum advantages and great potentials, further to help people take deeper insight and understanding of aerosol and relevant fields. The core of ALAD is to assume that the contribution of aerosol at 3.75μm wavelength to reflectance at top of the atmosphere (TOA) is negligible. At this basis, the stable and firm relationships between surface reflectance at 0.64μm and 3.75μm have been found by regression analysis at different land types after separating reflectance from radiance at 3.75μm. Then, an atmospheric transfer model is applied to calculate AOD at 0.64μm. ALAD has been applied to produce AOD dataset over North China (35°N to 45°N, 110°E to 120°E) successfully from 1981 to 2015 (Xue et al., 2017). In this study, we expand ALAD dataset to whole China region in 1980s, aiming at finding changes of aerosol properties in that period when there're no other continuous satellite-retrieved aerosol products. Cross-validation has been conducted by comparing ALAD product with newly-released AVHRR DB (V001) dataset (only in 1989). The results show these two datasets are quite comparable. However, lack of ground-based data makes corresponding validation work more challenging. Our focus will be placed on validation of ALAD before 1990.

Chen, Cheng

A satellite view of global desert dust and primary carbonaceous

aerosol emission database, 2006-2011

Our understanding of the role atmospheric aerosols play in the earth-atmosphere system is limited by the uncertainties in our knowledge of the distribution, composition and sources of atmospheric aerosols. In this study, we develop an algorithm based on adjoint GEOS-Chem model to determine desert dust (DU) and primary carbonaceous (BC and OC) aerosol emission sources simultaneously from recent aerosol data retrieved using GRASP algorithm (Dubovik et al. 2011) from the POLDER/PARASOL polarimetric observations. Numerical tests are performed to validate the algorithm using synthetic measurements. The test conducted with synthetic PARASOL-like data showed that the designed approach allows for accurate retrieval of distribution and strength of aerosol emissions with about 30% uncertainty for daily DU emission, 15% for daily BC emission and 25% for daily OC emission. In addition, BC refractive index is sensitive to BC emission retrieval, which could produce ~2 times uncertainty for total BC emission. We then perform our retrieval over global using PARASOL/GRASP spectral Aerosol Optical Depth (AOD) and Aerosol Absorption Optical Depth (AAOD) at six wavelengths (443, 490, 565, 670, 865 and 1020nm). The retrieved emission sources indicate a reduction of ~30% for annual DU emission, while an increment of ~2 times for total BC and OC emissions in comparison to "prior model" emissions (here the prior model DU emission is from online dust entrainment and mobilization module, the anthropogenic BC and OC from Bond inventory, and the biomass burning inventory from the daily GFED3 database). The model posterior simulation with retrieved emission sources shows very good agreement both with fitted AOD and AAOD PARASOL products. The fidelity of the results is confirmed by comparison of posterior simulations with the measurements from AERONET that are completely independent and more frequent than PARASOL observations. Overall, implementing on GEOS-5/GOCART model robustly tests our PARASOL/GRASP based aerosol emission database, and the consistency of simulated AOD and AAOD with other independent measurements (MODIS and OMI) demonstrates promise in applying this database for modeling studies.

Chin, Mian

Aerosols in the upper troposphere and lower stratosphere (UTLS): Composition, origin, and convective transport from the AeroCom3/HTAP2 model experiments

We present a study on the aerosol composition at the UTLS region from several global models participated in the AeroCom3/HTAP2 coordinated model experiments. The model results will be compared with the aircraft observations from CARIBIC in the upper troposphere and satellite observations in the UTLS region. With tagged emissions from anthropogenic and biomass burning emissions, we attribute the origin of the UTLS aerosols in terms of the source location (polluted regions) and source type (anthropogenic, biomass burning, volcanic or other natural sources). We will further examine the role of monsoon system that transports materials from the lower atmosphere to the UTLS, and volcanic eruptions that inject materials directly in the UTLS. Finally, we will discuss the idea on the proposed UTLS experiments that can be coordinated with the SSiRC and ACAM communities.

Aerosol radiative effects through aerosol-cloud-radiation interactions

(ACRI) in a changing climate – a proposal for AeroCom model experiment/analysis

We propose a model simulations targeting to assess the aerosol radiative effects through aerosol-cloud-radiation interactions. To provide a context of background, we will first show our study on multi-decadal trends on solar radiation reaching the surface and the effects of aerosol through direct scattering/absorbing of sunlight, then we will introduce the necessity of including the ACRI in assessing the aerosol effects because of the trend of clouds that seems dominates the change of surface radiation, which could linked to both the aerosol trends and a warming climate. We will present the objectives and proposed model experiments/output, and discuss the coordination with other AeroCom model experiments (e.g., historic, volcanic) as well as other communities' efforts (e.g., ACAM, SSiRC).

Christensen, Matt

Cloud contamination in satellite products enhances the aerosol indirect forcing estimate

Anthropogenic aerosols may significantly affect the rate of global warming through their cooling potential and influence on clouds. Although, obtaining accurate estimates of the so-called aerosol indirect effect remains a major challenge in both satellite and general circulation model (GCM) based estimates. To pin down this uncertainty reliable satellite observational constraints are needed to evaluate GCM's. Here, observational constraints are computed using the newly developed Cloud-Aerosol Pairing Algorithm (CAPA) applied to state-of-the-art high-resolution retrievals from the Advanced Along Track Scanning Radiometer (AATSR) Optimal Retrieval for Aerosol and Cloud (ORAC) product and the MODerate Resolution Imaging Spectroradiometer (MODIS) Collection 6 product. Several key attributes are offered by CAPA, namely: 1) aerosols and clouds are paired together at the nominal resolution of the satellite instrument (typically ~1 km), 2) the algorithm matches the cloud and aerosol retrievals together using a nearest neighbour algorithm to ensure the closest possible spatial association between the retrievals, 3) the pairing distance can be adjusted to limit artefacts in the satellite retrieval of aerosol near clouds caused by cloud contamination, particle swelling by humidification, shadows, and enhanced scattering into the aerosol field (3D radiative transfer), 4) seasonally-mean aerosol-cloud susceptibilities can be calculated from several thousand high-resolution samples over 1x1 degree globally gridded regions, and 5) two-dimensional histograms of aerosol and cloud properties facilitate seamless comparison between other satellite and modelling data sets. The application of CAPA suggests that previous satellite-based radiative forcing estimates represented in key climate reports may be exaggerated due to including retrieval artefacts in the aerosol located near clouds. Comparisons with the ECHAM6-HAM2 model also reveal that the global aerosol indirect radiative effect remains overly exaggerated in current model simulations of warm low-level clouds compared to satellite observations.

Chubarova, Nathalia

Radiative and temperature effects of the application of different

aerosol climatologies in COSMO-RU model and comparisons with the observations

I will show several results of radiative and temperature effects obtained by COSMO-Ru model with different aerosol climatologies (Tegen, MACv2, Tanre) and discuss the uncertainties due to radiative code and due to the difference in aerosol properties. The comparisons with Moscow and Lindenberg radiative and aerosol observations will be shown as well.

Clarisse, Lieven

Measuring dust optical depth with IASI

The added value of the thermal infrared for measuring aerosols is increasingly being recognized by the community as a valuable complement to the visible/near infrared. Here we give an overview of the strengths and challenges associated with retrieving dust optical depth from the hyperspectral infrared sounder IASI. Next, ULB's neural network retrieval approach is introduced. We briefly outline the algorithm and present examples, from short dust outbreak events to monthly and seasonal averages. Measurements are compared with the ECMWF-MACC model. A preliminary validation of the algorithm is presented using AERONET observations.

Di Noia, Antonio

Unsupervised aerosol classification from POLDER data using self-organizing maps

Aerosol typing is an important step in relating satellite aerosol measurements to specific aerosol sources and in identifying the anthropogenic component of atmospheric aerosols. Satellite measurements of a.o. aerosol size, shape and absorption properties with sufficient accuracy contain valuable information on the aerosol type. Multi-angle spectropolarimetric instruments, such as the Polarization and Directionality of Earth's Reflectances (POLDER) instrument, can provide accurate information on these aerosol properties (Hasekamp et al., 2011; Lacagnina et al. 2015). We have developed an aerosol typing algorithm which makes use of Single Scattering Albedo (SSA), Ångström exponent and fraction of spherical particles retrieved from POLDER-3 measurements in order to distinguish between nine different aerosol types. The algorithm is based on Self Organizing Maps (SOMs), a learning algorithm which belongs to the class of unsupervised neural networks. The particularity of the unsupervised approach lies in the fact that the aerosol classes do not have to be specified before performing the classification, but are defined a posteriori based on the results of the neural network. The application to our algorithm to a year of POLDER data suggests a promising capability of identifying desert dust, sea salt as well as fine inorganic and smoke aerosols

Doherty, Sarah

Modeling comparisons to new observations from the southeast Atlantic, Part 3: Vertical structure

We will present the initial results of a comparison between measured and modeled vertical distributions of aerosols and clouds and thermodynamic profiles in the Southeast Atlantic during September, 2016, from the NASA-ORACLES project. ORACLES is a 5-yr project with approx. one month of field measurements in each of three years: 2016 (September), 2017 (August) and 2018 (October). These months coincide with the peak in central African biomass burning. The goal of ORACLES is to better quantify the sign and magnitude of aerosol radiative forcing in the SE Atlantic region. A critical feature of this study area is that the biomass burning aerosol overlays a persistent stratocumulus-to-cumulus cloud deck. The degree to which aerosols and clouds coincide both horizontally and vertically is perhaps the greatest uncertainty in both the sign and magnitude of forcing for both aerosol-radiation ("direct forcing") and aerosol-cloud interactions. This uncertainty is due to the wide diversity in aerosol/cloud coincidence across the different models, and – until now – poor observational constraints, in particular on aerosol vertical distributions in the region. This presentation will be accompanied by two others which will describe the comparison protocol and a statistical comparison of aerosol and cloud properties across the study region.

Dubovik, Oleg

Versatile GRASP algorithm: Application to POLDER/Parasol and MERIS/Envisat satellite observations

The presentation discusses aerosol satellite products produced by the recently developed algorithm of new generation GRASP (Dubovik et al. 2011, 2014). GRASP is complex algorithm realized as open source software (http://www.grasp-open.com/). It is applicable both to satellite and ground-based observations. The particularity of GRASP is that it allows for implementing advanced retrieval scenarios. In most of application GRASP doesn't utilize look-up-tables and searches in continuous space. In all applications GRASP realizes rigorous statistically optimized fitting based on multi-term LSM approach (Dubovik 2004) that includes several original features. For example, GRASP satellite retrieval is based on multi-pixel concept when the optimized retrieval is implemented simultaneously for a large group of measurements, such as a group of satellite pixels or a group of coordinated ground-based observations. This approach helps to use additional a priori information about limited variability of aerosol of surface properties in time and/or space that stabilize the retrieval. Since the retrieval it is designed as statistically optimized LSM approach GRASP can provide full covariance matrix of all retrieved parameters. In addition, GRASP generates several radiatively consistent products by retrieving both aerosol and underlying surface properties simultaneously from satellite observations using the same retrieval assumptions globally. As a result, GRASP provides reliable retrieval of some detailed aerosol properties that are traditionally difficult to obtain from remote sensing. For example, from the observations of PARASOL polarimeter GRASP retrieves not only spectrally dependent aerosol optical thickness and also spectra aerosol absorption and even some information about aerosol vertical distribution. Also, the basic aerosol retrieved parameters as aerosol optical thickness and its spectral dependence are expected to be retrieved with the enhanced accuracy. The results of retrievals from two rather different satellite missions: PARASOL and MERIS/Envisat will be discussed

Eck, Thomas

AERONET Version 3 Data Update

Products and accuracies of new AERONET version 3 products are explained

Ekman, Annica

Partitioning aerosol optical depth between the boundary layer and the free troposphere

Felix, Ebojie

Measurements of winds and turbulence in the atmospheric boundary layer using Doppler Lidar and sonic anemometer

Boundary layer wind data observed by a Doppler lidar and sonic anemometers have been analysed to study the variability of meteorological phenomena and their impacts on air pollution and characterise airflow over Dunkerque, France. Distinct meteorological phenomena such as nocturnal low-level jets (LLJ), fogs, storms, fronts and sea breezes were observed during 2013 and 2014.
The combination of observations from both the sonic anemometer and Doppler lidar in the urban and suburban areas were used to investigate the boundary layer turbulence produced in the LLJ-dominated atmospheric boundary layer. This reveals high turbulence kinetic energy over the urban domain, which could probably be a result of the shear produced from building surfaces and building wakes. Furthermore, the profiles of variances of wind speed components from the Doppler lidar and the profiles of temperature from the sonic anemometer were used to quantify turbulence and thermal stratification. Typical standard deviation of the vertical wind component σw within the LLJ of 3 – 5 % of the maximum wind speed in the jet with no noticeable vertical variation of σw across the jets were detected.

Fiedler, Stephanie

On the sensitivity of the effective radiative forcing of anthropogenic aerosol to the spatial shift of pollution between the 1970s and 2000s

The persistently large model spread in the effective radiative forcing (ERF) of anthropogenic aerosol requires a better understanding of its reasons. In this presentation we see how the spatial shift of anthropogenic aerosol pollution between the 1970s and 2000s has changed ERF considering natural atmospheric variability and different magnitudes of aerosol-cloud interaction (Fiedler et al., 2017). The work is based on ensembles with atmosphere-only simulations with our Earth system model MPI-

ESM1.2 for usage in CMIP6. The configuration uses the new parameterisation MACv2-SP (Stevens et al., 2017) that prescribes observationally constrained anthropogenic aerosol optical properties and an associated Twomey effect to induce radiative effects in the model. Our results suggest that the substantial difference in the spatial pattern of pollution between the 1970s and 2000s has a negligible impact on the global mean ERF, when the natural variability of the atmosphere is considered. A moderate change (15%) in the ERF of anthropogenic aerosol is achieved when the magnitude of aerosol-cloud interaction is strengthened by prescribing an enhanced Twomey effect. Whether the rather small differences in ERF are specific for our model is currently investigated by using MACv2-SP in aerosol-climate models as contribution to the EU-funded project BACCHUS. These simulations will be distributed via AeroCom in the future.

Garay, Mike

The MISR 4.4 km Aerosol Product: Development and Uses

Since early 2000, the Multi-angle Imaging SpectroRadiometer (MISR) instrument on NASA's Terra satellite has been providing operational Level 2 (swath-based) aerosol optical depth (AOD) and particle property retrievals at 17.6 km spatial resolution. We will describe the major upgrades incorporated into the higher resolution, 4.4 km resolution, operational Level 2 aerosol product, including simplified content and retrieval uncertainty, and show comparisons with the previous, Version 22, results.

Gharibzad, Maryam

Study of aerosol optical properties and direct radiative forcing in Zanjan, Iran

To better understand the effects of aerosols, aerosol optical properties and radiative forcing over Zanjan in northwest of Iran have been studied during 2013. Using the ground-based AErosol RObotic NETwork (AERONET) data, aerosol optical properties like Aerosol Optical Depth (AOD), Angstrom Exponent (AE), ASYmmetry parameter (ASY), Single Scattering Albedo (SSA), phase function and Aerosol Volume Size Distribution (AVSD) have been analyzed. High values for AOD and low values for AE were observed in the spring and summer due to presence of dust. An obvious increase of coarse mode particles in AVSD distribution, as well as a higher value of SSA represents considerable addition of coarse mode particles like dust into the atmosphere of Zanjan. Domination of absorbing aerosols, leads to a lower value of SSA in the winter. One year period has been selected for calculating ARF using the Santa Barbara DISORT Atmospheric Radiative Transfer (SBDART) model. A negative value was obtained for surface ARF that showed cooling of the earth's surface because of the loss of radiation caused by the aerosols. While, the positive values of ARF within the atmosphere showed heating of the atmosphere. The correlation coefficient between the ARF obtained from the AERONET inversion products and ARF that was calculated using SBDART showing the accuracy of the SBDART model in this study.

P. Ginoux

Preliminary results of Anthropogenic Dust Experiment

The goal of the anthropogenic dust experiment is to evaluate from different aerosol models the contribution of agricultural sources to dust load and consequently their impact on radiative forcing and terrestrial biogeochemistry. Results from participating models are first compared with observations. The contribution of anthropogenic sources to dust concentration, optical depth, and deposition are then evaluated between models.

Goto, Daisuke

Aerosol climatology with 14km grid spacing using a non-hydrostatic global atmospheric transport model

A high-performance computing resource allows us to conduct numerical simulations with a horizontal grid spacing that is high enough to resolve cloud systems. The cutting-edge computational capability, provided by K computer at RIKEN in Japan, enables the authors to perform long-term, global simulations of air pollutions and clouds with unprecedentedly high horizontal resolutions. In this study, we have developed a next generation model that is capable of simulating global air pollutions with O(10km) grid spacing by coupling an atmospheric chemistry model to Non-hydrostatic Icosahedral Atmospheric Model (NICAM; Tomita and Satoh, 2004; Satoh et al., 2008; 2014). The atmospheric aerosol-chemistry model is called NICAM-Chem (Suzuki et al., 2008; Goto, 2014; Goto et al., 2015, 2016, 2017). We have performed 3-year integrations with 14 km grid spacing on K computer (proposal numbers in 140046, 150156, 160004, and 170017). The simulated results of the basic meteorological fields, clouds, precipitation, aerosols and radiation fluxes are compared with various measurements including reanalysis data, in-situ measurements and satellite observations. Their global distributions of simulated parameters are generally agreement in the measurements and better performances compared to the other simulations with lower-resolved horizontal grid sizes. Around the polar areas, for example, the aerosol distributions with the higher-resolved horizontal grid spacing are much closer to the measurements than those with lower-resolution, as shown by Sato et al. (2016). The further model evaluation will be presented.

Govaerts, Yves

Hourly retrieval of aerosol properties over sea and land from MSG/SEVIRI observations in the framework of the aerosol_cci project

A new versatile algorithm for the joint retrieval of surface reflectance and aerosol properties has been developed and tested at Rayference. This algorithm, named Combined Inversion of Surface and Aerosols (CISAR), includes a fast physically-based Radiative Transfer Model (RTM) accounting for the surface reflectance anisotropy and its coupling with aerosol scattering. This RTM explicitly solves the radiative transfer equation during the inversion process, without relying on pre-calculated integrals stored in LUTs, allowing for a continuous variation of surface and atmospheric state variables in the solution space. The inversion is based on an Optimal Estimation (OE) approach, which seeks for the best

balance between the information coming from the observation and the a priori information. The a priori information concerns both the magnitude of the state variable and constraints on their temporal and spectral variability. For each processed spectral band, CISAR delivers the surface Bidirectional Reflectance Factor (BRF), aerosol optical thickness, discriminating the effects of small and large particles and finally aerosol single scattering properties. It also provides for every processed pixels the associated uncertainty covariance matrix and an advanced quality indicator value. In the framework of the ESA aerosol_cci project, CISAR has been applied on TOA BRF acquired by SEVIRI onboard MSG in the VIS0.6, VIS0.8 and NIR1.6 spectral bands. SEVIRI observations are accumulated during several days to document the surface anisotropy and minimize the impact of clouds. While surface radiative properties are supposed constant during this accumulation period, aerosol properties are derived on an hourly basis. Information content of each MSG/SEVIRI band is provided based on the analysis of the prior and posterior uncertainty covariance matrix. The evaluation of the algorithm has been performed comparing the results with independent data sets of AOD and surface reflectance. Comparison with ground observations from the AERONET network shows a good agreement between these data. Displayed results focus on Europe and will demonstrate the capability of CISAR to retrieve accurately hourly aerosol optical depth over both sea and land surfaces. Examples of small and large scale events will be shown. The retrieved aerosol optical depth and surface reflectance appear to be consistent in terms of spatial distribution, being comparable in terms of geographical location and intensity. This product has also been compared with the reanalyzed MACC aerosol total optical thickness.

Granday, Benjamin

Performance of the two-Moment, Multi-Modal, Mixing-state-resolving Aerosol model for Research of Climate (MARC)

The two-Moment, Multi-Modal, Mixing-state-resolving Aerosol model for Research of Climate (MARC), developed at MIT, has been coupled to the Community Earth System Model (CESM). In order to compare the performance of MARC with the Modal Aerosol Model (MAM3, MAM7), we perform CESM simulations using both year-2000 and year-1850 aerosol emissions. We will present results related to (1) the aerosol fields, (2) cloud microphysical and macrophysical fields, (3) radiative flux perturbations (RFPs), and (4) computational performance. As an application of MARC, we will also present work investigating the impact of shipping emissions.

Gryspeerdt, Edward

Developing observational constraints of the aerosol influence on liquid water path

Aerosol-cloud interactions are one of the largest uncertainties in the anthropogenic radiative forcing. Their strength and the resultant impact on cloud properties remains difficult to constrain, particularly the impact of aerosol on the cloud liquid water path (LWP). One of the most significant issues is determining causality in observed relationships. For example, relative humidity (RH) is a strong confounder in the aerosol optical depth-cloud fraction (AOD-CF) relationship, but as CF is correlated to LWP, RH also acts as a confounder on the AOD-LWP relationship. Previous studies of the AOD-CF

relationship have suggested that using cloud droplet number concentration (CDNC) as a mediating variable is able to account for a large part of the confounding influence of RH. In this work, we investigate possible ways of constraining the aerosol impact on LWP using output from the AeroCom indirect effect experiment. By comparing the ability of aerosol-cloud relationships to 'diagnose' the pre-industrial to present day change in LWP, the ability of different relationships for constraining the aerosol-LWP relationship is investigated. We show that the CDNC-LWP relationship is a good proxy for the aerosol effect on LWP in many models. We also look at how this relationship can be determined in observations, where the effect of entrainment can impact both CDNC and LWP confounding the relationship in a way that is not included in the current generation of aerosol-cloud models.

Guang, Jie

Retrieval of atmospheric particulate matter using satellite data

Over the past few decades, regional air pollution has frequently occurred in Mid-Eastern China. As the primary pollutants in urban air, Particulate Matter (PM) contributes a lot to global climate change, local atmospheric environment and human health. In order to estimate the concentration, distribution and other properties of PM, the general retrieval models built by establishing the relationship between aerosol optical depth (AOD) and PM has been widely used in many studies, including experimental models via statistics analysis and physical models with certain physical mechanism. The statistical experimental models can't be extended in other areas due to its dependence on the ground-based observations and necessary auxiliary data, which limits its further application. Here, instead of empirical statistical approach, we describe a physical-based approach that reduces the uncertainty of surface PM2.5 estimation from satellite data. In our approach, particulate matter mass concentration retrievals require the inclusion of optical properties of aerosol particles (such as AOD, particle sizes, the extinction efficiency et al.) and meteorological parameters. We use one year of MODIS AOD data at 550 nm and meteorological analyses from the rapid update cycle to estimate surface level PM2.5. The physical-based approach derives hourly PM25 data that compare with ground-based measurements with R = 0.74, this study demonstrates the potential for using physical-based approach for operational air quality monitoring. These results and analysis are useful to research and operational communities that seek to improve the use of satellite information for assessing surface PM2.5.

Gunaseelan, Indira

Aerosol interaction with clouds and meteorology over Madurai, India

Aerosol data were collected using a sun photometer at two different wavelengths and also retrieved from the satellite. The data taken for a sampling time of 8 hours on a daily basis and the data calculated from monthly, seasonal and annual variations. Meteorological data were taken from weather station and cloud parameters are retrieved from satellite. Annual variations of these parameters showed that an average of AOD, temperature, wind speed, pressure was higher in 2012 whereas rainfall and humidity was higher on 2013. Correlation results showed that, during both the years 2012 and 2013 AOD is strongly correlated with temperature, wind speed and rainfall whereas negative correlation was found between humidity and pressure. Considering annual averages for all these parameters, most

often the year 2012 was dominated with a higher presence of AOD, COD, CER, CTT, CTP whereas rainfall and CF were found to be dominated in 2013. The presence of higher CF in 2013 may be a cause for the higher rainfall and the lower level of CF in 2012 may be a cause for less rainfall. In the study site, the influence of temperature and wind speed brought more rainfall, whereas pressure and humidity obstructs the rainfall. Higher rainfall in 2013 may be due to the enhance amount of humidity and less AOD whereas higher AOD and less humidity in 2012 obstruct the formation of rainfall. High aerosol loading in this area is due to biomass burning and urban air pollution which may significantly suppress precipitation. Increased aerosols and the local aerosol emissions may reduce the precipitation efficiency, which is responsible for the precipitation reduction and vice-versa.

Henrikson, Swante

Degrees of freedom and model-satellite comparisons

Correlation lengths are estimated for aerosol optical depth fields. MODIS satellite measurements are compared to simulations with different versions of the global climate-aerosol model ECHAM-HAM. Several features of the MODIS data can be interpreted more easily with the help of model results while some unexplained discrepancies also remain. Sensitivity to choices in the statistical modeling is high and attributed to varying mechanisms affecting correlations of spatiotemporal aerosol signals. The important and highly non-trivial general task of establishing the number of degrees of freedom in a spatiotemporal field is discussed in this context.

Ji, Duoying

Simulated impacts of volcanic eruptions on tropical cyclogenesis potential

Injection of long-lived sulfate aerosols into the stratosphere following major volcanic eruptions alters the radiation distribution. The sulfate aerosol cools the tropical ocean surface and warms the lower stratosphere through the aerosol direct effect, which could reduce the genesis of tropical cyclone and its potential intensity. Observations show decreased North Atlantic hurricane activity following the El Chichón (1982) and Mount Pinatubo (1991) eruptions. In this study, we make use of Genesis Potential Index (GPI) to analyze tropical cyclogenesis potential change following the El Chichón and Mount Pinatubo eruptions simulated by 12 CMIP5 coupled climate models. Due to different parameterization schemes for volcanic sulfate aerosol, the models show diverse aerosol radiative effects on tropical ocean surface temperature and outflow temperature of tropical cyclones. The models also show large inter-basin variations on the tropical cyclogenesis change following the volcanic eruptions due to internal variabilities. Globally, the multi-model ensemble shows an average reduction of GPI by 2.3SD (standard deviation) during the 3 years following the El Chichón or the Mount Pinatubo eruptions compared to the preceding 3 years. The determination of the effects of each eruption on tropical cyclone activity is also complicated by model simulated ENSO strength and phase during the eruptions. With ENSO signals removed from GPI time series, the CMIP5 models give an average global GPI reduction of 3.2SD during the 3 years following the eruptions compared to the preceding 3 years.

Ben Johnsen

Black carbon impacts on clouds and radiation in HadGEM3

Black carbon strongly absorbs solar radiation and is generally expected to warm climate, yet model results differ with some showing little or no impact on global-mean temperature. Much of the diversity stems from differing impacts on clouds and other so-called rapid responses. We investigate such impacts in the latest configuration of HadGEM3 (GA7.1) where BC absorption properties have been improved and evaluated. This model predicts a modest effective radiative forcing for black carbon (0.17Wm-2 2000 vs 1860) due to direct radiative interactions (0.21Wm-2) and a small offset (-0.04Wm-2) from aerosol-cloud interactions. However, we find much larger opposing changes in the shortwave and longwave budgets, and large changes in net TOA and surface radiation at regional scales due to changes in the distribution of clouds. We also note significant changes in convection, turbulent fluxes, and the hydrologic cycle. For instance, increasing present-day emissions of black carbon by a factor of ten in these simulations suppresses deep convection (frequency, mass flux, precipitation) by around 4% globally, leading to commensurate decreases of high cloud in the tropics and a 2.5Wm-2 decrease in latent heat release in the atmosphere. On the other hand, low cloud cover in HadGEM3 increases as black carbon increases the static stability of the lower troposphere promoting fractional cover of marine stratocumulus, a semi-direct aerosol effect that has been shown in Large-Eddy-Simulations and hinted at by observations. Understanding such processes may be key to unlocking why models differ in their climate's response to black carbon forcing.

Kahn, Ralph

AeroCom Biomass Burning Emissions Experiment: Satellite Constraints on Fire Emission Source Strength and Plume Injection Height

The combination of source strength and injection height is used to characterize aerosol sources in chemical transport, climate, and air quality models. Currently, a wide range of poorly constrained or unconstrained assumptions is used to represent the amount and vertical distribution of fire emissions. The AeroCom multi-model Biomass Burning (BB) experiment aims to put biomass burning aerosol emission parameterizations on firmer ground, by applying global constraints on source strength and injection height from MODIS and MISR satellite observations. We will report the progresses in Phase 1 (source strength) of the BB experiment and discuss plans for the Phase 2 (injection height) effort. Phase 1 of the BB experiment involves comparing 13 AeroCom model ensemble runs, initialized using multiples of the daily GFED3 emissions, with MODIS AOD snapshots, to help constrain smoke source strength. In the past years we have (1) expanded the database of cases to over 900 (over 400 in the AeroCom benchmark year 2008), refined the MODIS data processing to (2) fill in missing retrievals using scaled model results and (3) subtract estimated background AOD from the plume observations, and (4) included fire sources too small to be included in GFED3 in a run of the GoCART model, based on the GFED4.1s inventory. This work is reported in Petrenko et al. [2017, in review]. We have also begun the

statistical analysis of the 13-model Phase 1 results with GFED3, and will present a preliminary summary of results [Petrenko et al., 2017, in preparation]. For Phase 2 of the BB experiment, we have developed a plume-height parameterization from statistical summaries of worldwide, region-specific, multi-year MISR plume height stereoscopic retrievals [Val Martin et al., 2017, in preparation]. The parameterization consists of fire emission fractions based on plant functional types or land cover units, and is stratified by altitude and region. We have implemented the scheme in the Community Earth System Model and will present preliminary results. The parameterization is available for testing with other models as part of BB Phase 2 experiment, and we will discuss plans for a coordinated AeroCom plume-height effort.

Kalashnikova, Olga

Size and type characterization of particulate matter (PM) with MISR multiangle and AirMSPI polarimetric imagery

The Multi-Angle Imager for Aerosols (MAIA) investigation is currently in development as part of NASA's Earth Venture Instrument Program to improve particle type characterization throughout the atmospheric column as well as near the surface. The MAIA satellite instrument is a targeted multiangle spectropolarimeter for retrieval of speciated (size- and particle type- stratified) surface particulate matter (PM) from space over major cities around the globe. The investigation will enable improved associations between particulate air pollution and human health. We evaluate the MAIA near-surface and atmospheric airborne PM size- and type- characterization approach using aerosol type information contained in the Multi-angle Imaging SpectroRadiometer (MISR) newly released high-resolution 4.4 km aerosol product, as well as from Airborne Multiangle SpectroPolarimetric Imager (AirMSPI) imagery MISR flies on NASA's Terra satellite and AirMSPI flies on NASA's high-altitude ER-2 aircraft. Speciated PM2.5 data from the IMPROVE monitoring network and the WRF-Chem 4-km resolution model were used to support the analysis. In addition, using AirMSPI and in-situ data from the MAIA-pathfinder Imaging Polarimetric and Characterization of Tropospheric Particular Matter (ImPACT-PM) field campaign, we investigate how multi-angle, spectropolarimetric remote sensing imagery constrains the relative contribution of organics, non-organic and black carbon particles to airborne particle composition. This evaluation was done using collocated in-situ low altitude CIRPAS Twin Otter aircraft data and AirMSPI measurements. In-depth analysis was done for the Lebec fire event that occurred in Sothern California on July 8, 2016. We assessed the sensitivity of the remote sensing observations to the amount of black carbon (BC) in the smoke plume, and found that the multi-angle spectropolarimetric observations provide a valuable capability for distinguishing particle type.

Keskinen, Jukka-Pekka

Marine Organic Aerosol Sources in a Global Chemistry Transport Model

The breaking of ocean waves by wind creates bubbles, which then burst and release aerosols to the air. The created sea spray aerosol (SSA) contains sea salt and a mixture of organic matter. Several different

approaches to include organic SSA in climate models have been proposed. We carried out simulation with the global chemistry transport model TM5 using two different approaches for the organic fraction of the SSA. The parametrization by Vignati et al. used chlorophyll a concentrations as a proxy while a more detailed approach by Burrows et al. utilized the sea surface concentrations of five different classes of macromolecules. According to our simulations, the largest impact of the inclusion of an organic fraction to SSA can be seen on the Southern Ocean and during DJF.

Kim, Dongchul

A multi-model analysis and comparison with remote-sensing data of Asia and Northern Pacific dust

A number of modeling and observational studies have shown that dust is one of the most dominant aerosols over Asia and Northern Pacific. However quantitative estimations of dust distribution and its relative contribution to the total aerosols are challenging tasks due to frequent cloudy conditions and significant presence of anthropogenic and sea-salt aerosols over the region. This study investigates Asia and Northern Pacific dust using five global models that participated in the AeroCom phase II model experiments and multi remote-sensing observations of aerosol optical depth (AOD) data from MODIS, MISR, and CALIOP, dust optical depth (DOD) derived from MODIS, AOD and coarse-mode AOD (as a proxy of DOD) from ground-based AERONET sun-photometer measurements, and dust vertical distributions from CALIOP. Similarly to our previous inter-comparison study which was conducted over North Africa Northern Atlantic ocean (Kim et al., 2014), we show various analysis of AOD and DOD from the observations and models: (1) the magnitudes in our study domain, (2) the longitudinal gradient of dust during North Atlantic transport, (3) seasonal variations at different locations, and (4) the dust vertical profile. In the study, we have improved remote-sensing data by explicitly estimating dust in CALIOP and MODIS AOD and DOD data is updated to collection 6. This study highlights the challenges in simulating the dust physical and optical processes in this environment, and it stresses the need for observable quantities.

Kinne, Stefan

Aerosol climatology – MACv2

For a simplified aerosol representation in global modeling an in-house aerosol climatology of aerosol optical properties MAC (Max-Planck Aerosol Climatology) was developed during the last decade and is now further improved in its second version. Based on the concept of merging monthly statistics of local quality data on monthly statistics of spatial distribution by global modeling for aerosol amount, aerosol absorption and aerosol size, an improved merging technique is applied. This technique gives a stronger weight to quality data, which now, in addition to AERONET data over continents, also consider oceanic reference data of the Marine Aerosol Network (MAN). Another element is a reduced anthropogenic AOD, with a better consideration of man-made contributions prior to the 1850 reference year. When applied in a radiative transfer code both changes resulted in a less negative aerosol direct forcing, now globally averaged at -0.2W/m2. Other new elements are (1) the extraction of contributions by pre-defined aerosol components of dust, sea-salt, sulfate, organic matter and soot (or BC), what are now

applied to perform the spectral extension and (2) via the determination of associated CCN a simple path is offered to account for CDNC changes are function of the changes in anthropogenic aerosol for estimates of the aerosol indirect forcing. When applied in a radiative transfer code, this indirect forcing is particularly strong over oceanic regions at northern mid-latitudes and around SE Asia and on average at -0.8W/m2 is more negative (climate cooling) than the direct effect.

Kipling, Zak

Beyond MACC: reanalysis and forecasts of atmospheric composition from the Copernicus Atmosphere Monitoring Service

In 2010, production began on the MACC global reanalysis of atmospheric composition. Covering the years from 2003 to 2012, this has become a widely-used reference dataset combining physical and chemical modelling with satellite remote sensing via a 4D-Var data assimilation system to estimate the historical distribution of aerosols, reactive gases and greenhouse gases in the atmosphere during the modern satellite era. The global near-real-time composition forecasts begun under GEMS and MACC continue to be developed and produced under the banner of the Copernicus Atmosphere Monitoring Service (CAMS) operated by ECMWF on behalf of the European Commission. Following an interim reanalysis to provide continuity during this transition, work is now under way on a new reanalysis of atmospheric composition covering 2003 to the present at 80km resolution. These are built around ECMWF's Integrated Forecasting System (IFS) as used for numerical weather prediction, but the additional modules for atmospheric composition now all run online within the meteorological model, removing the need to couple to a separate offline chemical transport model as in the MACC reanalysis and leading to a more consistent overall system. From an aerosol perspective, the most significant changes are updated optical properties for sulphate and organic aerosol, inclusion of the temperature and humidity dependence of SO2->SO4 oxidation, and an additional source of secondary organic aerosol from anthropogenic pollution. These lead to a significant shift in speciation between sulphate and organic aerosol, which is unconstrained by the assimilation of satellite total AOD products, but bring improved comparisons to AERONET and surface PM observations. The prognostic aerosols are also now coupled to the radiation scheme for the direct effect, and to the chemistry scheme for heterogeneous reactions, and the new system benefits from numerous improvements which have been made to the meteorological model and data assimilation system in recent years. The first year of data from the new CAMS reanalysis is due to be validated and released in October and will be presented here, with the remainder to be released next year and then continued in near real time.

Kirkevag, Alf

Aerosol validation and effective radiative forcing estimates from CAM5.3-Oslo

We present updated results of aerosol validation and effective radiative forcing (ERF) estimates from simulations with CAM5.3-Oslo using nudged meteorology and IPCC AR5 emissions of aerosols and precursors for present day (2000) and pre-industrial (1850) conditions. CAM5.3-Oslo is participating in

the ongoing AeroCom Control Experiment 2016, the In-Situ Measurement Comparison for Optical Properties, and the Remote Sensing evaluation for AeroCom Control 2016, and is an early (pre-CMIP6) version of the next generation atmosphere module of the Norwegian Earth System Model, NorESM2. The aerosol validation consists of comparison of modeled aerosol concentrations and gross optical parameters with observations and remote sensing results. The ERF estimates are compared to IPCC AR5 results, following the ERF terminology and method of Ghan (2013). CAM5.3-Oslo is basically an extended version of CAM5 (Liu et al., 2012) where schemes for aerosol chemistry, physics and interaction with clouds originally developed for NorESM1 (Bentsen et al., 2013; Iversen et al., 2013; Kirkevåg et al, 2013) exist as options alongside the modal aerosol modules of CAM5. Important upgrades in aerosol chemistry and physics since NorESM1 are: revised sea-salt aerosol treatment (Salter et al., 2015), explicit nucleation (based on Makkonen et al., 2014) and SOA, interactive DMS and marine POM. Development of nitrate aerosol as part of the aerosol scheme is still ongoing.

Kokkola, Harri

Finnish perspective on aerosol research

The Finnish aerosol community has a prominent role in aerosol science being involved in all aspects of aerosol research. This research includes laboratory measurements, modeling, and in situ observations of atmospheric aerosol extending to global scale satellite observations and modelling of the composition of atmosphere. In my presentation, i will give an overview of these activities and how these different scales of observations and modelling are linked within the Finnish aerosol science community.

Krishnan, Srinath

Aerosol impacts on ocean heat transport at the Arctic in Norwegian Earth System Model (NorESM)

Navarro et al. (2016) studied the impacts of reduced European sulfur emissions since 1980 using NorESM and noted an increase in both atmospheric and ocean heat transport at the high Arctic latitudes, associated with rapid Arctic warming. Results from a subsequent study on the response of NorESM to two different future aerosol emission scenarios indicate that the changes in ocean heat transport are potentially sensitive to the zonal changes in energy fluxes and ocean heat uptake - both related to the different aerosol emissions (Navarro et al., 2017). These studies suggest that aerosol-driven changes in ocean heat transport, uptake and circulation could play a role in high-latitude climate changes and Arctic amplification. However, the mechanistic links between aerosol changes and ocean heat transport is poorly understood. In this study, we will elaborate on these linkages between aerosol emissions and ocean heat transport changes at the Arctic by analyzing the simulations in further detail. Specifically, we will focus on circulation and heat transport changes in the North Atlantic. Similar analyses will also be presented for a suite of idealized simulations that have been conducted for different aerosol emission scenarios from Asia and Europe.

Thomas Kühn

Investigating The Efficacy Of Black Carbon Emission Reductions In Slowing Arctic Warming

Black carbon (BC) warms the atmosphere by absorbing incoming solar radiation. In the Arctic, where surface reflectance is high, this effect is greatly enhanced. Furthermore, as BC is deposited on snow, snowmelt is accelerated, which induces further albedo feedbacks. Mitigation of short-lived climate forcers (SLCP) could cut about 0.5° of the projected 2° warming by 2050, half of which stems from BC mitigation measures [AMAP 2015]. However, even though mitigation measures may target a specific substance, other substances (for instance sulphate, which cools the atmosphere), are affected as well and the overall effect is hard to assess. Although emission reductions in the Arctic Council region would only comprise a small fraction of the global emission total, their impact on the Arctic region may still be relatively high due to the proximity of the emission sources. We use the aerosol-climate model ECHAM-HAMMOZ with the aerosol microphysics module SALSA to simulate the near-future impact of BC mitigation strategies on Arctic climate. Using specially generated aerosol emission scenarios, which are based on the ECLIPSE emission inventories, we assess how the implementation of SLCP mitigation measures in different parts of the globe affects the future Arctic climate.

Kukkurainen, Antti

LibRadtran based tool for computing lookup-tables for satellite aerosol retrieval

A libRadtran based tool for computing the radiative transfer lookup-tables (LUT) for satellite aerosol retrieval was developed. The tool is written in Python and it takes aerosol properties and observation geometry information as inputs and computes the necessary LUTs to be used for computationally efficient satellite reflectance simulations. The tool can also take AERONET inversion products as inputs to simulate LUTs corresponding to aerosol properties measured by AERONET. We use our new tool to construct the LUTs corresponding to MODIS Dark Target LUTs and compare the results.

Lee, Lindsay

The AeroCom Multi-Model Perturbed Physics Experiment (MMPPE)

I will present the first two experiments to form part of the AeroCom MMPPE project. The project will use coordinated ensembles of multiple global aerosol models with statistical emulation and sensitivity analysis to diagnose the processes leading to uncertainty in aerosol effects on the climate. To begin six global aerosol models will carry out two 3-parameter MMPPEs designed to understand the sources of uncertainty in 1) atmospheric black carbon with respect to aerosol emission, deposition and optical properties, and 2) the second indirect effect with respect to aerosol number, activation and autoconversion. I will present the set-up of the experiments and the results of the initial high/low

perturbations as carried out in some of the participating models. Further participants would be welcomed.

Lee, Huikyo

Characterization of wildfire-induced aerosol emissions from the Maritime Continent peatland and Central African dry savannah with MISR and CALIPSO aerosol products

Aerosol plumes from wildfires affect the Earth's climate system through regulation of the radiative budget and clouds. However, optical properties of aerosols from individual wildfire smoke plumes and their resultant impact on regional climate are highly variable. Therefore, there is a critical need for observations that can constrain the partitioning between different types of aerosols. Here we present the apparent influence of regional ecosystem types on optical properties of wildfire-induced aerosols based on remote sensing observations from two satellite instruments and three ground stations. The independent observations commonly show that the ratio of the absorbing aerosols is significantly lower in smoke plumes from the Maritime Continent than those from Central Africa, so that their impacts on regional climate are different. The observed light-absorbing properties of wildfire-induced aerosols are explained by dominant ecosystem types such as wet peatlands for the Maritime Continent and dry savannah for Central Africa respectively. These results suggest that the wildfire-aerosol-climate feedback processes largely depend on the terrestrial environments from which the fires originate. These feedbacks also interact with climate under greenhouse warming. Our analysis shows that the optical properties of carbonaceous aerosol mixtures used by state-of-art chemistry climate models may overestimate emissions for absorbing aerosols from wildfires over the Maritime Continent. Therefore, aerosols optical properties observed by satellites will be critical in assessing climate sensitivity and uncertainty of future climate changes.

Lihavainen, Heikki

COARSEMAP: synthesis of observations and models for coarse-mode aerosols

Coarse mode aerosols influence Earth's climate and biogeochemistry by interacting with long-wave radiation, promoting ice nucleation, and contributing important elements to biogeochemical cycles during deposition. Yet coarse mode aerosols have received less emphasis in the scientific literature. Here we present first efforts to globally synthesize available mass concentration, composition and optical depth data and modeling for the coarse mode aerosols (<10 μm) in a new project called "COARSEMAP" (http://www.geo.cornell.edu/eas/PeoplePlaces/Faculty/mahowald/COARSEMAP/). We seek more collaborators who have observational data, especially including elemental or composition data, and/or who are interested in detailed modeling of the coarse mode. The goal will be publications synthesizing data with models, as well as providing synthesized results to the wider community.

Limbacher, James

A MISR Pixel-Level Aerosol Retrieval Algorithm for Turbid, Coastal, and Eutrophic Waters

In Limbacher and Kahn [2017], we presented a case I, self-consistent, Chlorophyll-a retrieval algorithm for use with Multi-angle Imaging SpectroRadiometer (MISR) data. Here, we extend those capabilities by demonstrating a pixel-level aerosol retrieval algorithm for use with MISR data over turbid, coastal, and eutrophic waters. Initial results are presented at both 275 meter and 1.1 km resolution, using MISR local mode (275 meter) data acquired during the 2011 D.C.-Baltimore DRAGON field campaign. Validation of aerosol amount and type is performed using the network of AERONET sun-photometers present during the campaign. As the surface retrieval is self-consistent, a validation of aerosol amount and type also serve as validation of the surface retrieval.

Lin, Zhaohui

Spatial and temporal variations of East Asian dust in CMIP5 models

Dust aerosol is a key component of earth system. However, dust budget in climate and earth system models are of larger uncertainties. In particular, the dust variability and its role in the global climate change during the 20th century are still poorly understood. In this study we use the historical simulations of 17 climate models from the Coupled Model Intercomparison Project phase 5 (CMIP5) to assess the spatial and temporal variations of dust aerosol over East Asia during 1961-2005. The simulations are compared to the number of dust weather days (in term of Dust Storm, Blowing dust, and Dust-in-Suspension) recorded at the surface weather stations. The results show that CMIP5 models well reproduce the observed largest dust emissions in the Taklimakan Desert (in Northwest China) and Gobi Desert (in the western Inner Mongolia of China and southern Mongolia). However, large disagreement amongst CMIP5 models can be found in the simulation of dust emission over the southern and eastern edges of main deserts, such as the Loess Plateau and western part of Northeast China, where some models simulate little emission while observations suggest more emission. In total, dust emission simulated by different CMIP5 models ranges from 94 Tg to 589 Tg in East Asia, which account for 5-19% of global dust emission. For the long-term variations of dust aerosols, dust storm activities have decreased significant from 1960s to 2000s in northern China, which can be mainly ascribed to the decrease in surface wind velocity. Compared to the observations, only 5 of 17 models can capture the decreasing trend of dust events although with weaker trends compared to the observations, and 4 models simulate the opposite trends (i.e., increasing trends). Further analysis shows that the models that correctly simulate the decreasing trends of surface winds can also simulate the decreasing trends of dust events. Finally, other factors (e.g., soil moisture and vegetation cover) that contribute to the decreasing trends of dust events in East Asia are also discussed. Overall our results highlight the urgent need to improve the simulation of long-term variations of dust aerosol in East Asia in climate and earth system models.

Lindquist, Hannakaisa

Nonspherical particles in the atmosphere: From single particles to global radiation

Recent computational and methodological advances in light scattering and radiative transfer have made possible the use of more morphologically faithful particle shape models in atmospheric radiation research. This poster summarizes three dissertations on the topic (Haapanala, 2017; Lindqvist, 2013; Merikallio, 2016) and demonstrates the advances all the way from single-particle scattering computations to radiative effects and even global climate models.

Lipponen, Antti

Bayesian Dark Target Algorithm for MODIS AOD retrieval and uncertainy quantification over land

Bayesian Dark Target (BDT) algorithm for MODIS aerosol retrieval over land was developed. In BDT algorithm, we carry out a multi-pixel retrieval and simultaneously retrieve all pixels in a granule, utilize spatial correlation models for the unknown aerosol parameters, use a statistical model for the surface reflectance, and take into account the uncertainties due to fixed aerosol models. The retrieved parameters are the total aerosol optical depth (AOD) at 550 nm, fine-mode fraction (FMF), and surface reflectances at four different wavelengths. The results show that the BDT significantly improves the accuracy of AOD retrievals over the Dark Target (DT) algorithm. A decrease of about 29 % in the AOD root mean squared error and decrease of about 80 % in the median bias of AOD were found globally when the BDT was used instead of the DT algorithm. Furthermore, the fraction of AOD retrievals inside the +-(0.05 + 15 %) expected error envelope increased from 55 % to 76 %. The BDT algorithm always results in physical, non-negative AOD values, and the average computation time for a single granule is less than a minute on a modern computer. In addition to retrieving the values of AOD, FMF and surface reflectance, the statistical approach used in BDT also quantifies the pixel-level uncertainties for the retrieved parameters. Similar Bayesian statistics based retrieval framework may be used for retrievals of other quantities and it may also be used with other instruments.

Liu, Xiaohong

Brown Carbon Radiative Effect due to Interactions with Radiation and Clouds Using the NCAR CESM Model

A recent development in the representation of aerosols in climate models is the realization that some components of organic carbon (OC), emitted from biomass and biofuel burning, can have a significant contribution to short-wave radiation absorption in the atmosphere. The absorbing fraction of OC is referred to as brown carbon (BrC). This study introduces one of the first implementations of BrC into the Community Earth System Model (CESM), using a parameterization for BrC absorption described in Saleh et al. (2014). 9-year experiments are run (2003-2011) with prescribed emissions and sea surface temperatures to analyze the effect of BrC in the atmosphere. Model validation is conducted via model comparison to single-scatter albedo (SSA) and aerosol optical depth from the Aerosol Robotic Network

(AERONET). Global annual average radiative effects are calculated due to aerosol-radiation interactions (REari; 0.129±0.021 W m-2), aerosol-cloud interactions (REaci; 0.073±0.056 W m-2), and surface albedo change (REsac; -0.060±0.035 W m-2). REari is similar to other studies' estimations of BrC direct radiative effect, while REaci indicates a global reduction in low clouds due to the BrC semi-direct effect. Lastly, the uncertainties associated with our estimate of BrC radiative effects are discussed.

Lyapustin, Alexei

Aerosol Product from Algorithm MAIAC and its Comparison with DT and DB

Multi-Angle Implementation of Atmospheric Correction (MAIAC) is a new algorithm which provides aerosol information from MODIS data globally over land and coastal oceans at high 1km resolution. The high resolution information is required in different applications such as urban air quality analysis, aerosol source identification etc. An emerging regional and global validation of MAIAC shows a high quality of aerosol retrievals, including its low spatial noise, general lack of springtime "snow" bias, good performance over both dark and bright surfaces etc. We will give an overview of MAIAC algorithm, describe AERONET validation studies, and compare MAIAC performance with DB/DT over American continents and Africa.

Makkonen, Risto

Global variability of cloud condensation nuclei concentrations

We assess global CCN variability with a climate model, and attribute potential trends during 2000-2010 to changes in emissions and meteorological variability. We have used the ECHAM-HAM model with M7 microphysics. The MODIS aerosol products are used to evaluate simulated anomalies. All analyzed regions show a generally decreasing CCN trend throughout the decade, and the simulations including the emission trends clearly improve the simulations with climatological emissions.

Malavelle, Florent

Using the 2014-15 volcanic eruption at Holuhraun to investigate Aerosol-Cloud Interactions

We know that aerosols potentially have a large effect on climate, particularly through their interactions with clouds. However, the magnitude of this effect is highly uncertain and there is little agreement in the estimates derived from state of the art General Circulation Models (GCMs). Effusive volcanic eruptions can provide a natural analogue to anthropogenic aerosol emissions. In a recent study published in 2017 by Malavelle et al., (10.1038/nature22974, M17 hereafter), we showed that the spectacular volcanic eruption at Holuhraun (Iceland) during 2014-15 may help to unlock the role aerosols play in climate change. In this study, we used data from the MODIS space borne instrument to

show that the effect of aerosols is clearly confined to the impact on cloud droplet effective radius (the so-called '1st indirect effect'). However, very little evidence of an increased persistence of the clouds via liquid water content adjustments, (the '2nd indirect effect' or 'cloud lifetime effect'), was observed. We used three GCMs (NorESM/CAM5-Oslo, NCAR/CAM5.3 and HadGEM3) to model the impact of the volcanic emissions and we showed that the three models tend to agree on the magnitude of the 1st indirect effect but their estimates of the cloud lifetime effect vary greatly. It was then possible to conclusively accept or reject the results from the different global climate models and aerosol models based on these robust observations. The analysis from M17 have wide scientific relevance as it highlighted potentially strong constraint on Aerosol-Cloud Interactions (ACI). In effect, the effusive eruption at Holuhraun is an excellent benchmark for challenging GCMs and their representation of ACI. It also provides an opportunity to evaluate the aerosol life cycle in high latitudes (nucleation rates, transport, removal, …) for various aerosol modules in different global climate models (see D. Partridge et al. abstract: Novel trajectory-based approach for evaluation of climate models against aerosol observations in a Lagrangian framework). We believe that extending the framework already established by M17 to a larger group of GCMs can deliver many informative results to the wider aerosol modelling community. For instance:

- What are the physical processes responsible for a strong cloud response to the volcanic emissions?
- Are the GCMs showing little cloud liquid water path sensitivity right for the right reason?
- Are we missing something that could counterbalance the aerosol perturbation i.e. role of subgrid processes?
- How does the cloud response to the volcanic emissions compare with natural variability?
- Is the sensitivity of the cloud properties comparable in the North Atlantic and other regions?
- How do different models transform and transport the volcanic emissions?

In this presentation, I will first summarize the results published in M17. Secondly, I will detail the experimental setup that I would like to be considered for coordinating a modelling inter-comparison based on the 2014-15 Holuhraun eruption.

Mallet, Marc

Direct and Semi-direct Radiative Effect of smoke aerosols over the Namibia region

The regional climate model ALADIN-Climat has been modified to better account the radiative effects of biomass burning aerosols. Smoke radiative and hygroscopic properties have been added for two new tracers for simulating the direct and semi-direct radiative forcing (DRF). This ALADIN-Climate configuration has been tested during the 2006-2012 period over the Namibia region. Analyses of results in terms of micro. and macrophysical (CF, LWP) properties of stratocumulus clouds as well as optical properties (AOD, ACAOD, SSA), transport and associated heating rate due to smoke will be presented.

Mei, Linlu

Recent progress of aerosol remote sensing over the Arctic in the AC3 project

Aerosols are one of the largest sources of uncertainty for the processes and feedbacks mechanisms due to limited spatial/temporal coverage and quality of the available observations. Aerosol Optical Thickness (AOT) over the Arctic is currently sparsely provided by ground-based measurements or active remote sensing observations like CALIOP with very limited spatial coverage. Arctic aerosol observations from passive remote sensing are needed to fill the data gaps both temporally and spatially to reduce the uncertainties of understanding the impacts of Arctic aerosol during the recent Arctic amplification. In this talk, the latest progress of aerosol remote sensing over the Arctic regions within the overarching Collaborative Research Center TR172 "ArctiC Amplification: Climate Relevant Atmospheric and SurfaCe Processes, and Feedback Mechanisms (AC3)", funded by the German Science Foundation (DFG) will be presented.

Merikato, Joonas

Regional climate signals of anthropogenic aerosols using MACv2-SP in ECHAM6 and NorESM

The scatter in regional impacts of aerosols remains large between different climate models. It remains unclear to which degree the differences in models arise from different aerosol microphysics versus the differences in the atmospheric response. In our ongoing project RECIA we carry out a systematic investigation of the local and remote regional climate impacts of aerosols using a standardized anthropogenic aerosol representation, MACv2-SP, in different climate models. Here, we will present our first results from the simulations with systematic perturbations to regional aerosol fields using ECHAM6 and NorESM models. We will discuss the similarities and variability in modelled regional temperature and pressure fields, circulation features and other meteorological parameters.

Michael, Ibrahim

Development of Satellite Technology and Its Impact on Social Life

The development of satellite is one of the latest technology invented by man in the telecommunication sector. Satellite Communication is a method of communication between terminals to their terrestrial networks. The satellite has it scope of coverage, global, regional, or national. The wider the areas of coverage, the more satellites are involved in a single network system to enable its coverage effectively. The satellite technology varies from its satellite-base and its terrestrial wireless communication that affect design. The heart of satellite communication system is its antenna in a stable orbit above the earth. Satellite technology came in various stages, thus Telstar, Synchronous orbit satellite Comsat, INTELSAT, and Domestic Satellite system. This paper will examine the satellite technology and how it affects our social life. The key operational definition will also be explained.

Michou, Martine

The CNRM climate model aerosol forcing for the historical CMIP6 simulations

For the CMIP6 simulations, the CNRM climate model will be run in two configurations : (1) the CNRM-CM6-1 configuration will use prescribed aerosols and a linear ozone scheme, and (2) the CNRM-ESM2-1 configuration will include interactive descriptions of both the chemistry and the aerosols. Prescribed aerosols, namely dust, sea-salt, organic matter, black carbon and sulfate (see Michou et al., 2015) for CNRM-CM6-1 have been prepared with CNRM-ESM2-1 to ensure to the extent possible comparability between the two models. This poster presents an analysis of the CNRM aerosols and their forcing, and in particular a comparison with the MAC-v2 and MACv2-SP aerosols described in Stevens et al., GMD, 2017.

Mielonen, Tero

Does Increasing Temperature Increase Carbonaceous Aerosol Direct Radiative Effect over Forests?

Aerosols are an important regulator of the Earth's climate. However, the magnitude of aerosol radiative effects remains the single largest uncertainty in current estimates of anthropogenic radiative forcing. One of the key quantities needed for accurate estimates of anthropogenic radiative forcing is an accurate estimate of the radiative effects from natural unperturbed aerosol. The dominant source of natural aerosols over Earth's vast forested regions are biogenic volatile organic compounds (BVOC) which, following oxidation in the atmosphere, can condense onto aerosol particles to form secondary organic aerosol (SOA) and significantly modify the particles' properties. The main objective of this study was to investigate the causes of the observed effect of increasing temperatures on the aerosol direct radiative effect, and to provide a quantitative estimate of this effect and of the resulting negative feedback in a warming climate. More specifically, we have investigated the causes of the positive correlation between aerosol optical depth (AOD) and land surface temperature (LST) over the southeastern US and boreal forests in Russia and Canada where biogenic emissions are a significant source of atmospheric particles. The study was done using a combination of satellite data and climate modelling. Key remote sensing data used were the AOD and LST products available from the ESA Aerosol-CCI and GlobTemperature projects, together with ancillary data, such as column concentrations of carbon monoxide (CO) and nitrogen dioxide (NO_2). For the modelling work we used aerosol-chemistry climate model ECHAM-HAMMOZ, which describes all known relevant atmospheric aerosol processes. The observations and simulations produced corresponding results in the southeastern US and over the boreal forests in Canada and Russia. The main conclusions of this study are:

- *AOD exhibits temperature dependent behaviour which is most likely caused by biogenic emissions in all the studied regions*.
- *The temperature dependence of biogenic AOD is stronger in the presence of anthropogenic aerosols.*
- *The temperature dependent biogenic AOD has significant radiative effects in the present day climate but the significance decreases in the future, thus biogenic aerosols do not appear to produce a strong negative climate feedback.*

This contradicts with the hypothesis that increased biogenic emissions in the future could slow down global warming.

Mona, Lucia

Overview / introduction with contributions collected from AEROSAT participants, update on definitions and inventory

Aerosol typing has been recognized as one of its high-priority activities of the AEROSAT nitiative. In AEROSAT framework, a first critical review of aerosol typing procedures has been carried out. The review underlines the high heterogeneity in many aspects: approach, nomenclature, assumed number of components and parameters used for the classification. The harmonization of the aerosol typing procedures is a fundamental need in the aerosol studies for long-term perspectives, satellite validation, and accuracy. However, the possibilities and limits in defining a common set of aerosol types for satellite missions and ground-based measurements depends on different information content among measurement techniques, as well as different historical choices. The concept of a Reference database for aerosol typing (REDAT) is developed with the specific purpose of providing a dataset suitable for the comparison of typing procedures (from ground-based, and satellite measurements) and to be used as reference dataset for the modelling community. Updates on the status of this activity will be reported and open points discussed.

Muelmenstaedt, Johannes

Satellite-derived warm rain fraction as a constraint on the cloud lifetime effect

We present a global climatology of warm-rain occurrence fraction derived from CALIPSO-CloudSat satellite observations. (Warm rain is defined as liquid precipitation at the surface originating from pure liquid-water clouds.) This climatology shows that warm rain is rare over land compared to ocean, especially in the extratropics. In a subset of AeroCom and CMIP5 models, we can diagnose the warm-rain fraction and compare it to the satellite climatology. We find that the modeled land--sea contrast is smaller and the warm-rain fraction is larger by an order of magnitude in comparison to the satellite data. Our satellite climatology may provide a powerful observational constraint on the magnitude of the cloud lifetime effect. The more precipitating warm clouds are simulated in a model, the more opportunity aerosols have to influence the precipitation microphysics, since the aerosol influence is mainly implemented for autoconversion in liquid-water clouds in current models. We hypothesize that the strength of the cloud lifetime effect in models is therefore related to the warm-rain fraction. Here we present a test of this hypothesis based on sensitivity studies in ECHAM-HAM and several other AeroCom models where we tune the warm-rain fraction to match the satellite climatology.

Myhre, Gunnar

AeroCom historical aerosols

An update on the status and motivation for the AeroCom activity on historical evolution of aerosols. The main aims are to understand regional trends in aerosol from 1850 to 2015, establish a reference aerosol distribution dataset (1850-2015), and quantify evolution of aerosol impact on TOA and surface forcing.

Neubauer, David

Minimizing the effects of aerosol swelling and wet scavenging in ECHAM6-HAM2 for comparison to satellite data

Statistical relationships between cloud and aerosol properties vary in their strength (and sometimes also in their sign) between satellite and global model data. We used AATSR satellite data from the ESA Climate Change Initiative (CCI) projects Aersool_cci and Cloud_cci as well as MODIS-CERES satellite data for comparison to ECHAM6-HAM2 global model data. A new Cloud-Aerosol Pairing Algorithm (CAPA) was applied to the satellite data to minimize unwanted effects. For ECHAM6-HAM2 different cloud condensation nuclei (CCN) proxies were tested and sensitivity studies performed. We find that the strong liquid water path-aerosol relationship in ECHAM6-HAM2 is not due to an overestimation of autoconversion by the diagnostic precipitation scheme but rather by aerosol swelling. Dry aerosol index as a CCN proxy reduces the differences in the strength of the liquid water path-aerosol relationship between ECHAM6-HAM2 and the satellite data. Similar reduced differences are found for the relationships of cloud droplet number concentrations and cloud albedo which reduces also the differences in effective radiative forcing due to aerosol-cloud interactions between ECHAM6-HAM2 and AATSR-CAPA as well as MODIS-CERES satellite data. Furthermore we find that wet scavenging and aerosol processing can impact aerosol-cloud relationships and their impact should also be minimized in statistical analysis of aerosol-cloud relationships.

Olivie, Dirk

Nitrate aerosol in the Norwegian Earth System Model

In recent years, the aerosol description in many climate models has been extended with nitrate. Also in the Norwegian Earth System Model (NorESM) the aerosol scheme is now treating explicitly ammonium and nitrate aerosol. Whereas sulfate aerosol is assumed to decrease in the next decades due to strong reductions in sulfur dioxide emissions, no strong downward trend is expected for nitrate. To asses the quality of the implemented nitrate aerosol description in NorESM, we compare for present-day conditions the modelled aerosol concentration with ground-based and airborn observational data. We further estimate the aerosol effective radiative forcing using the extended aerosol scheme. For this purpose, NorESM is run with a horizontal resolution of 1.9x2.5 degrees, and 30 layers. The inclusion of nitrate aerosol increases the number of chemical tracers in the model from twenty-nine to forty, allowing the scheme still to be used for long climate scenario simulations.

Partridge, Daniel

Novel trajectory-based approach for evaluation of climate models against aerosol observations in a Lagrangian framework

Aerosols are important components of the climate system; however, the impact of aerosols on climate remains is highly uncertain due to the limited understanding of processes governing atmospheric aerosol sources and sinks. This is particularly true for the Arctic, a region where aerosols are believed to play a key role in controlling the radiative budget yet global climate models (GCMs) describe aerosols poorly. Increasing the current state-of-the-art understanding of how the Arctic environment will respond to a warming climate requires a more accurate representation of aerosols by GCMs. To achieve this new novel methods are required to highlight discrepancies compared to observations and concurrently isolate the structural deficiencies in the models associated with the aerosol life cycle during transport that results in the observed differences. Historically, trajectory models have been used to study role of transport in a Lagrangian framework and interpret source-receptor relationships and atmospheric processes for experimental data using meteorological fields from reanalysis data. However, GCMs provide the same output necessary for trajectory calculations to examine source and transport dependence of any simulated atmospheric constituent at any location for which we have corresponding observations. Accordingly, trajectory analysis has been successfully applied to three GCMs that participated in the AeroCom Indirect Experiment (ECHAM6-HAM2; CAM5; HadGEM3-UKCA) to study how source-receptor relationships derived from simulated aerosol properties compare in the Arctic environment to observations from the Zeppelin station during 2001-2010 (Partridge et al., in prep, 2017; P17 hereafter). In P17 we have performed a potential source contribution function analysis to reveal emission hotspots influencing the Zeppelin receptor station. By using trajectory information together with observed/simulated aerosol mass we reveal large discrepancies between modeled and measured source functions. Whilst experimental data suggests major sources to be located in Russia/Siberia, model derived results suggest major contributions arrive from Western Europe.
The analysis technique will have wide scientific relevance as it facilitates tracing the aerosol evolution during transport to investigate the role of sources, dynamical processes and sinks on the aerosol properties in the model. By evaluating this information against observations we will be able to pinpoint where, why and when the models underperform. We believe that extending the framework already established in P17 to a larger group of GCMs and measurement stations within the ACTRIS framework can provide numerous informative results to the wider aerosol modelling community. We propose initially targeting aerosol transport and transformation into the Arctic and sub-Arctic regions during the Holuhraun volcanic eruption in co-ordination with the proposed experiment by F. Malavelle et al. (see abstract: Using the 2014-15 volcanic eruption at Holuhraun to investigate Aerosol-Cloud Interactions). This will provide a better understanding of discrepancies between GCM simulated aerosol properties and observations to facilitate efficient model improvement, for instance:

- Are the models capable of reproducing observed flow patterns in the atmosphere, and hence the role of emissions, processes and timescales?
- How to the different models represent source-receptor relationships for simulated aerosol properties compared to observations?
- What is the role is of sink mechanisms for aerosols in the different models?
- Will the models be able to describe atmospheric transport, and thus sources influencing the Arctic and sub-Arctic regions in a changing climate?

In this presentation I will begin by summarizing the results within P17. I will then outline the experimental setup that I would like to be considered for coordinating a Lagrangian modelling inter-comparison of aerosol sources and sinks to ground-based measurement stations within the ACTRIS

network.

Patadia, Falguni

What is the uncertainty in MODIS aerosol optical depth in the vicinity of clouds?

The dark-target MODIS aerosol product has been validated extensively against ground based AERONET data. About 68% of the ocean retrievals match AERONET data to within 0.03± 10%. Since the MODIS retrievals follow a LUT approach, there are several sources of uncertainty associated with the retrievals. Data filtering is another source of uncertainty and it includes filtering out clouds from the retrieval area. Any residual cloud contamination or cloud adjacency effects can result in biased retrievals. A meaningful use of AOD uncertainties (e.g in data assimilation, aerosol indirect effect studies) requires information on these effects on AOD retrievals. We explore the possibilities of quantifying the uncertainty in AOD in the vicinity of clouds by performing multiple retrievals at varying distances from clouds. We use our cloud distance product for this. When we limit retrievals to pixels that are > 20 pixels from nearest cloud and compare them against standard retrievals, our preliminary results show that the differences can range from 0.01 to 0.05. We continue to explore the differences over global oceans and will present findings from this study. We will also provide a comparison of AOD uncertainty from different sources of uncertainty in the algorithm.

Pitkanen, Mikko

Investigation of AERONET single scattering albedo in low aerosol optical thickness conditions based on surface solar flux comparison

Aerosol Robotic Network (AERONET) inversion products provide information on aerosol light scattering and absorbing properties. One interesting quantity is single scattering albedo (SSA), that describes how much aerosols can scatter light in proportion to total light extinction. Due to increasing SSA uncertainties in low aerosol optical thickness (AOD) conditions, however, large amounts of SSA data is discarded from the official level 2.0 dataset. Currently, inversion data level 2.0 requires AOD(440 nm) > 0.4 to obtain reliable SSA, which removes a significant portion of the total level 1.5 SSA data and leaves low AOD regions and seasons with no level 2.0 SSA. The question how the data user can best overcome the data gap does not yet have a definitive answer and one of the suggested approaches has been to evaluate and try to use level 1.5 SSA also for some low AOD cases, at the cost of higher SSA data uncertainties. In this work we investigate SSA data reliability in low AOD situations using simultaneous data from Solar Radiation Network (SolRadNet). SolRadNet provides accurate measurements of broadband surface solar flux, while also AERONET provides similar broadband fluxes based on AERONET inversion products and a radiative transfer model. As the AERONET flux estimates build on the retrieved scattering and absorption properties of aerosols, the uncertainties in SSA propagate to flux estimates. Therefore, the matching of AERONET flux estimates vs. SolRadNet flux measurements would give an indication on the goodness of SSA. Thus, the goals of the work are to investigate how the flux comparison can give an indication on the goodness of SSA and then draw conclusions on the usability of

SSA data in low AOD conditions at the collocated AERONET and SolRadNet sites. Further, additional libRadtran radiative transfer simulations illustrate the sensitivity of the flux comparison on SSA uncertainties.

Povey, Adam

Cloud-aerosol interactions downwind of localised aerosol sources

This study uses geographically constrained sources of aerosol, such as volcanoes or large factories, as a natural laboratory to investigate aerosol-cloud interactions. AATSR retrievals near almost 100 sites were classified by meteorological conditions and rotated into the prevailing wind direction and then averaged over a year. Reductions in cloud effective radius are often observed, but with a sensitivity that depends on the type of aerosol emitted. The change in TOA flux downwind is broadly consistent with other studies.

Quaas, Johannes

Constraints on aerosol forcing from the 20th century?

In the early industrial period, the aerosol effective forcing was more important relative to the greenhouse gas forcing than it is today. Still, a temperature increase was observed. It has been proposed that this may help to assess a lower bound on the aerosol effective forcing. Unfortunately, the available CMIP5 models do not provide a meaningful constraint. The presentation will present this discussion and the relevant results and propose that an AEROCOM project might perform simulations (coupled 20th century) that can help to provide such a constraint.

Ram, Kirpa

Surface measurements of aerosol chemical composition and optical properties in the Indo-Gangetic Plain

The Indo-Gangetic Plain (IGP), extending along the Himalayas from 21.75°N - 74.25°E to 31.0°N-91.5°E, is one of the most populated and polluted regions in northern India. The fog and haze formation, a common phenomenon observed during wintertime in the IGP, is associated with high aerosol loading from anthropogenic emission sources as well as formation of secondary aerosols via gas to particle conversion under favourable meteorological conditions. Several short-term field campaigns and long-term surface measurements, satellite retrievals as well as modelling studies, have revealed that the entire stretch of the IGP suffers from high level of atmospheric pollutants (both gases and particulates). Models severely underestimate PM2.5, especially in winter season (November-January), mostly due to underestimated emissions of carbonaceous aerosols from many unaccounted sources such as bio-fuel and agricultural burning, brick-kilns, diesel generators set etc. In addition, enhancement in absorption due to black carbon (BC), especially in winters, have been attributed to high emissions and favourable

inter mixing state of BC with soluble organic and inorganic species of primary and secondary origins. I will present results of our studies on chemical and optical properties conducted over the IGP and will discuss future research in order to improve our understanding of optical, microphysical, radiative and cloud activation processes over northern India.

Redemann, Jens

Combined A-Train aerosol observations to constrain direct aerosol radiative effects (DARE) in AeroCom models at different spatial and temporal averaging scales

We describe a technique for combining multiple A-Train aerosol data sets, namely MODIS spectral AOD (aerosol optical depth), OMI AAOD (absorption aerosol optical depth) and CALIOP aerosol backscatter retrievals (hereafter referred to as MOC retrievals) to estimate full spectral sets of aerosol radiative properties, and ultimately to calculate the 3-D distribution of direct aerosol radiative effects (DARE). We compare the spatio-temporal distribution of the MOC retrievals and MOC-based calculations of seasonal clear-sky DARE to values derived from four models that participated in the Phase II AeroCom model intercomparison initiative. Overall, the MOC-based calculations of clear-sky DARE at TOA over land are smaller (less negative) than previous model or observational estimates due to the inclusion of more absorbing aerosol retrievals over brighter surfaces, not previously available for observationally-based estimates of DARE. MOC-based DARE estimates at the surface over land and total (land and ocean) DARE estimates at TOA are in between model and observational results previously published. Because the MOC retrievals are spatially sparse, we use model results of higher temporal resolution (i.e., 3-hourly) than the phase II models to assess the uncertainty in aerosol properties and DARE induced by the MOC sampling alone. In addition to the uncertainties due to sampling, we present estimates of uncertainties in DARE that stem from the spatial averaging of aerosol and cloud properties, and from the non-linear propagation of uncertainties in the retrieved aerosol properties.

Rosenfeld, Daniel

What can we do on CCN with satellite observations?

Satellite retrieved aerosol optical properties have been used for assessing their CCN activity. Passive measurements such as optical depth have been fraught with issues that limited their usefulness for CCN derivations. Active measurements by lidar solved some of the problems, but have very limited coverage in time and space. Both passive and active methods of retrieving the optical signal of aerosols are limited by sensitivity at very low CCN concentrations, where clouds are most sensitive to large relative changes in CCN concentrations which represent very small absolute changes which are not discernible by their satellite retrieved optical signals. These limitations can be overcome by a new approach that uses clouds as CCN chambers. This requires retrieving simultaneously cloud base drop concentrations and updrafts. Methodologies to do that are being developed for both continental convective clouds and marine stratocumulus. Capabilities and limitations of these methodologies will be presented.

Sawyer, Virginia

Dark Target Aerosol Retrieval for VIIRS with MODIS Continuity

The radiative impact of aerosols remains one of the most difficult components to quantify in the global climate system, with contributions from both natural and anthropogenic sources, and consequences for air quality as well as cloud and precipitation interactions. Global satellite measurements of aerosol optical depth and other properties are necessary for a number of applications, but in order to detect climate trends over time they must maintain continuity on a multidecadal scale. The Dark Target algorithm for MODIS has been used to retrieve aerosol optical depths since 1999; it can continue the data record beyond the life expectancy of the two MODIS instruments if it can be ported to newer instruments such as VIIRS. The Intermediate File Format retrievals for VIIRS and Aqua-MODIS used a slightly simplified version of the Dark Target algorithm for testing purposes. As the VIIRS Dark Target product nears operational status, the MODIS-VIIRS Cloud Mask has been added to the retrieval input, the output has been adapted to netCDF-4 format, and we are considering calibration adjustments to bring the VIIRS results in line with the AERONET-validated MODIS record.

Sayer, Andrew

New AVHRR, MODIS, and VIIRS aerosol products from Deep Blue

The Deep Blue aerosol project (https://deepblue.gsfc.nasa.gov) provides aerosol optical depth (AOD), Ångström exponent, and other quantities from a variety of satellite instruments. This presentation will present updates about the status of the project, with a focus on new and forthcoming data sets: AVHRR, MODIS Collection 6.1, and VIIRS. Our new AVHRR AOD retrievals, providing near-global coverage over both land and ocean for the first time from these sensors, are of particular interest to the AeroCom community. They will eventually provide a time series of around 40 years, providing aerosol modellers with new observational constraints on aerosol loading back before the EOS era to the 1980s.

Schulz, Michael

AeroCom achievements 2016/17

Overview on AeroCom activities and future plans

Schuster, Greg

Laboratory Evaluation of the AERONET and GRASP Retrieval Algorithms

We have developed a method for validating aerosol retrieval algorithms by mimicking atmospheric extinction and radiance measurements in a laboratory experiment with real aerosols. This enables radiometric retrievals that utilize the same sampling volumes, relative humidities, and particle size ranges as observed by other in situ instrumentation in the experiment. We utilize three Cavity Attenuated Phase Shift (CAPS) monitors for extinction and UMBC's three-wavelength Polarized Imaging Nephelometer (PI-Neph) for angular scattering measurements. We subsample the PI- Neph radiance measurements to angles that correspond to Aerosol Robotic Network (AERONET) almucantar scans with solar zenith angles ranging from 50◦ to 77◦. These measurements are then used as input to the Generalized Retrieval of Aerosol and Surface Properties (GRASP) algorithm, which retrieves size distributions, complex refractive indices, single-scatter albedos (SSA), and lidar ratios for the in situ samples. We tested 285 aerosol samples in our experiment; the PI- Neph provided quality radiances for 232 of those samples, and the GRASP retrieval code provided retrievals with residuals R < 10% for 93-100 of those samples, depending upon the simulated solar zenith angle. The samples that we tested include Arizona Test Dust, Arginotec NX, Senegal clay, Israel clay, Montmorillonite, Hematite, Goethite, volcanic ash, ammonium nitrate, ammonium sulfate, and fullerene soot. Samples were alternately dried or humidified, and size distributions were limited to diameters of 1.0 or 2.5 µm by using a cyclone. The SSA at 532 nm for these samples ranged from 0.59 to 1.00 when computed with CAPS extinction and PSAP absorption measurements. The GRASP retrieval provided SSAs that are highly correlated with the in situ SSAs, and the correlation coefficients ranged from 0.955 to 0.976, depending upon the simulated solar zenith angle. The GRASP SSAs exhibited an average absolute bias of +0.023±0.01 with respect to extinction and absorption measurements for the entire dataset. We also compared the GRASP size distributions to aerodynamic particle size measurements, utilizing densities and aerodynamic shape factors that produce extinctions consistent with our CAPS measurements. The GRASP effective radii are highly correlated (R = 0.88) and biased high of the corrected aerodynamic effective radii by 1% (for a simulated SZA of 50 degrees). The effective variance indicated a correlation of R = 0.72 and a relative bias of 116%. Finally, our apparatus was not capable of measuring backscatter lidar ratios, so we measured bistatic lidar ratios at a scattering angle of 173 degrees. The GRASP bistatic lidar ratios had correlations of 0.488 to 0.735 (depending upon simulated SZA) with respect to in situ measurements, positive relative biases of 6-10%, and average absolute biases of 4.0-6.6 sr.

Schutgens, Nick

Progress on AEROCOM remote sensing intercomparison

Temporal and spatial matching AOD comparisons of satellite data and global modeling to AERONET reference data

Shinozuka, Yohei

An uncertainty analysis for satellite-based estimates of cloud condensation nuclei

Aerosol-cloud interactions (ACI) are the largest source of uncertainty in estimates of radiative forcing

responsible for the on-going climate change. ACI for warm clouds depend on the number concentration of cloud condensation nuclei (CCN), not on aerosol optical properties. Yet, aerosol optical depth (AOD) and its variants weighted by the spectral dependence over visible and near infrared wavelengths are commonly substituted for CCN in ACI studies. The substitution is motivated by the wide availability in space and time of satellite retrievals, an advantage over the sparse CCN measurements. If satellite-based CCN estimates are to continue to complement purely model-based ones, what CCN-AOD relationship should we assume and how large is the associated uncertainty? The paper by Shinozuka et al. [2015] examines airborne and ground-based observations of aerosols to address these questions, focusing on the relationship between CCN and light extinction, σ, of dried particles averaged over one-kilometer horizontal distance. That paper discusses the way the CCN-AOD relationship is influenced not only by the CCN-σ but also by the humidity response of light extinction, the vertical profile, the horizontal-temporal variability and the AOD measurement error. In this presentation, we apply these findings to passive satellite data to analyze the uncertainty in CCN estimates.

Modeling comparisons to new observations from the southeast Atlantic, Part 2: ORACLES Spatial distributions and sampling considerations

Smoke from biomass burning is a global scale pollutant generating deep impacts to our society and planet. Smoke interactions with the cloudy boundary layer of the southeast Atlantic, both radiative and microphysical, affect the regional radiative climate, with implications for the regional distribution of precipitation. Thus, advancements in our ability to model and forecast this phenomenon is crucial to further our understanding of the impacts. We study how well the simulated properties of the smoke match the observations over the southeast Atlantic during the first deployment of the NASA ORACLES (ObseRvations of Aerosols above CLouds and their intEractionS) field experiment (August-September 2016). We sample model results from the locations and timings of our flights and calculate their mean, median, standard deviation and percentiles for 2x2 degree longitude-latitude boxes. Viewed this way, the geographical distribution of the aerosol extinction coefficient generally agrees between the airborne in situ observations and the WRF-CAM5 model. We present observation-model comparisons for a wide range of aerosol and related properties including organic aerosol mass, aerosol optical depth and carbon monoxide mixing ratio. We also include model-observational comparisons on the cloud liquid water path and droplet number concentrations. This poster is one of three focusing on this modeling-observational comparison exercise. Results from multiple models beyond the WRF-CAM5 will be included as they become available.

Skeie, Ragnhild

Comparing modeled and observed BC concentrations from flight campaigns – the role of sampling issues

A recent study indicated that a relatively short global lifetime of BC is necessary for an agreement between modeled BC vertical profiles and flight measurements over the Pacific. This study compared high resolution observations from the flight campaigns with monthly mean model data averaged over

larger geographical areas. Here, we investigate potential sampling issues arising from differences in spatial and temporal resolution using the OsloCTM3 model. We compare modeled and observed BC concentrations from a broader set of flight campaigns over the period 2009 to 2013. We follow the flight track online in the model and compare the resulting vertical BC profiles with profiles obtained by interpolating monthly mean model data to the flight track and averaging monthly mean model data over a larger area. We perform three sensitivity tests related to uncertain scavenging processes to obtain a large spread in BC lifetime, and assess the impacts of sampling errors on the estimate of BC lifetime.

Sogacheva, Larisa

Long-time series (1995-2015) of satellite observations of AOD over China combined from ATSR and MODIS.

Aerosol optical depth (AOD) over China has been combined from three environmental satellites: ATSR2 aboard ERS2 (1995-2002), AATSR aboard ENVISAT (2002-2012) and MODIS aboard NASA's Terra satellite (2000-2015). Altogether, the combined AOD data set covers the period of 21 years, from 1995 until 2015. Short-time trends in AOD during that period have been revealed, which reflect mostly the changes in economic situation and air pollution regulation in China.

Sofiev, Mikhail

On long-term simulations of aerosol and gaseous tracers in the troposphere and the stratosphere

A multi-scale SILAM model computations covering the period 1980-2016 are presented and their outcome and first evaluation discussed. The goals of the re-analysis were to assess the multi-decade evolution of atmospheric composition and air quality at several spatial scales and to evaluate the performance of SILAM dispersion model. This dataset also sets the starting point for episodic and meso-to-local-scale studies, which will refine its predictions. The re-analysis is made with SILAM model v.5.5 at three spatial scales: global (1.44deg resolution, the troposphere and the stratosphere), European (0.5deg, troposphere), and Northern Europe (0.1 deg, troposphere). The first round of the re-analysis did not involve assimilation of the composition data, rather focusing on the free-run model evaluation. The emission information is compiled from the MACCITY and EDGAR anthropogenic, GEIA lightning and aircraft, ACCMIP biomass-burning, and MEGAN biogenic emission inventories. The emission of sea salt and wind-blown dust is computed with embedded SILAM modules. The driving meteorological datasets were ERA-Interim re-analysis (global and European domains) and UERRA re-analysis for the Northern European domain. The in-depth analysis and evaluation of the dataset is only at the beginning but the first outlook showed that the obtained patterns match the historical developments of air pollution: gradual decrease of concentrations in Europe (including Northern Europe) and Northern America, whereas a huge rise of concentrations is seen in Asia. At finer temporal scale (days/hours), individual episodes connected with the synoptic-scale meteorological processes, fire seasons, and storms are visible and can be related to the observed time series and satellite retrievals.

Stadler, Scarlet

Isoprene derived secondary organic aerosol in a global chemistry climate model (ECHAM6-HAMMOZ)

Within the framework of the global chemistry climate model ECHAM-HAMMOZ a new coupling between the aerosol bin model HAM-SALSA and the chemistry model MOZ was established to form isoprene derived secondary organic aerosol (iSOA). Isoprene oxidation in the chemistry model MOZ is following a semi-explicit scheme consisting of around 100 reactions, embedded in a detailed atmospheric chemical mechanism with a total of 779 reactions. Low volatile compounds (LVOC) produced during isoprene photooxidation were identified and explicitly partitioned by HAM-SALSA. Therefore, the group method by Nanoonlal et al. 2008 was used to estimate their evaporation enthalpies and corresponding saturation vapor pressures, which are used by HAM-SALSA to calculate the saturation concentration of each LVOC. With this method, every single precursor is tracked in terms of condensation and evaporation in each aerosol bin. Thus, particle phase molecular decay can be explored. Moreover, reactive uptake of isoprene epoxidiols (IEPOX) and isoprene derived glyoxal were included as iSOA sources. The novel parameterization of IEPOX reactive uptake requires knowledge of the aerosol pH value, assumptions of the global pH value alter the iSOA budget significantly. This model framework connecting semi-explicit isoprene oxidation with explicit treatment of aerosol tracers leads to a global, annual isoprene SOA yield of 16%. With 445 Tg (392 TgC) isoprene emitted, an iSOA source of 148 Tg (61 TgC) is simulated. The main sink process is particle wet deposition which removes 143 Tg (59 TgC) and the iSOA burden reaches 1.6 Tg (0.7 TgC) in the year 2012.

Stebel, Kerstin

What we have learned in validating Aerosol_cci pixel-level uncertainties

Pixel-level uncertainties are provided for all aerosol products that have been developed in the framework of the Aerosol_cci project within ESA's Climate Change Initiative (CCI). Validation of these estimated uncertainties is necessary to demonstrate that they provide a useful representation of the distribution of error. As validation data, we use direct-sun observations of AOD. Neglecting the uncertainty in AERONET observations and possible issues with their ability to represent a satellite pixel area, the error in the retrieval can be approximated by the difference between the satellite and AERONET retrievals (herein referred to as "error"). To evaluate how well the pixel-level uncertainty represents the observed distribution of error, we looked at the distribution of the ratio D between the "error" and the ATSR uncertainty. We present results obtained during the Aerosol_cci projects (2010 - 2017), i.e. statistics from the validation of the pixel level uncertainties for three (+1 ensemble) 17 year ATSR AOD datasets. We discuss the possibility to e.g. adapt the uncertainty validation concept to the IASI datasets. Experiences and lessons learned are summarized.

Stier, Philip

Observational constrains and metrics for (aerosol) model evaluations

Introduction and discussions

Suzuki, Kentaroh

Significance of cloud and precipitation processes in aerosol effect on climate

Recent advance in both satellite observations and global modeling provides us with a novel opportunity to investigate the long-standing aerosol-climate interaction issue at a fundamental process level, particularly with a combined use of them. In this presentation, we will highlight our recent progress in understanding the aerosol-cloud-precipitation interaction and its implication for global climate with a synergistic use of a state-of-the-art global climate model (MIROC), a global cloud-resolving model (NICAM) and recent satellite observations (A-Train). In particular, we explore two different aspects of the aerosol-climate interaction issue, i.e. (i) the global energy balance perspective with its modulation due to aerosols and (ii) the process-level characteristics of the aerosol-induced perturbations to cloud and precipitation. For the former, climate model simulations are used to quantify how components of global energy budget are modulated by the aerosol forcing. The moist processes are shown to be a critical pathway that links the forcing efficacy and the hydrologic sensitivity arising from aerosol perturbations. Effects of scattering (e.g. sulfate) and absorbing (e.g. black carbon) aerosols are compared in this context to highlight their distinctively different impacts on climate and hydrologic cycle. The aerosol-induced modulation of moist processes is also investigated in the context of the second aspect above to facilitate recent arguments on possible overestimates of the aerosol-cloud interaction in climate models. Our recent simulations with NICAM are shown to highlight how diverse responses of cloud to aerosol perturbation, which have been failed to represent in traditional climate models, are reproduced by the high-resolution global model with sophisticated cloud microphysics. We will also discuss implications of these findings for a linkage between the two aspects above to aid advance process-based understandings of the aerosol-climate interaction.

Takemura, Toshihiko

Climate responses of anthropogenic aerosols with a coupled-ocean general circulation model MIROC-SPRINTARS

To analyze the climate response of anthropogenic aerosols simulations with prescribed sea surface temperature and a coupled-ocean general circulation model are executed changing the ratios (0, 0.1, 0.3, 0.5, 0.8, 1.5, 2, 5, 10 times) of emission fluxes relative to the present for anthropogenic black carbon (BC) and sulfur dioxide (SO_2). Although the radiative forcing of the aerosol-radiation interaction both at the tropopause and surface has linear trends with the changes in BC and SO_2 emissions, the equilibrium experiments with the coupled-ocean model show no clear correlations of the change in BC emission with the change in the surface air temperature within the realistic emission (ratios between 0

and 2). The simulated results suggest that the change in the surface air temperature much depends on a change in the amount of water vapor, which implies that the variation of vertical profile of heating rate affected by the aerosol-radiation interaction is significant.
Acknowledgements: Simulations in this study were executed with the supercomputer system of the National Institute for Environmental Studies, Japan. This study is partly supported by the Environment Research and Technology Development Fund (S-12-3) of the Environmental Restoration and Conservation Agency, Japan and JSPS KAKENHI Grant Number JP15H01728.

Tan, Qian

Comparison of the vertical distribution of sulfur species in the AEROCOM-Phase II simulations

We compared the vertical profile of two sulfur species, SO2 (gas), SO4 (aerosol), simulated by AEROCOM Phase II models. Near the source regions in northern latitude, models agree near surface in general and diverge vertically upward. SO2 shows larger vertical gradient and model-to-model difference than SO4. In remote regions models differ from the surface. Comparison to satellite retrievals and aircraft measurements show better agreement in sulfate than SO2. Among the three recorded model diagnoses, i.e. emission flux, dry deposition, and wet deposition, wet deposition shows larger model-to-model difference, which might contribute more to the model divergence of vertical distribution.

Thomas, Gareth

Recent developments in the ORAC aerosol processor

The poster presents new developments in the ORAC (Optimal Retrieval of Aerosol and Cloud) aerosol processor, including improvements made to ATSR/SLSTR products following on from Aerosol_cci, and application of the algorithm to other instruments. Updated information on the status and availability of the ORAC Community Code will also be provided.

Tsyro, Sevetlana

Temporal and geographical variation of aerosol chemical composition in Europe from EMEP MSC-W model and observations

Information on the chemical composition of ambient aerosol is essential for source allocation and for investigating effects of PM on human health and on climate. The EMEP MSC-W model calculates PM consisting of sulphate, nitrate, ammonium, elemental and organic carbon, sea salt and mineral dust. The presentation summarizes the results of several studies of aerosol chemical composition based on EMEP model simulations and EMEP observations for Europe. We investigate the geographical differences in PM composition and the trends of the individual aerosol components in the 2000-s (and

also in the period of 1990-2010 based on model simulations only). These results are also compared with calculations from five other CTMs to characterize the degree of uncertainty of model simulations. Furthermore, recently available highly time resolved ACSM (Aerosol Chemical Speciation Monitor) data have been used to evaluate the model ability to reproduce observed diurnal variation of non-refractory sub-micron PM (i.e. concentrations of sulphate, nitrate, ammonium and organic mass) in different geographical locations in Europe.

Tuccella, Paolo

Global scale model simulations of anthropogenic dust: budget assessment and radiative forcing

Mineral dust particles affect climate by absorption and scattering of solar and planetary radiation, and by acting as cloud condensation nuclei (CCN) and ice nuclei (IN), they modify cloud optical properties and precipitation patterns. In addition, when aerosol dust is deposited on snow/ice pack by dry and wet removal processes, the surface albedo is reduced, thus favoring snowmelt with consequences on the radiation budget at surface, soil moisture and surface heat fluxes. Natural dust is emitted by mechanical action of winds on desert surfaces. Anthropogenic dust emission occurs on disturbed soils, deforested terrains, and desiccated water bodies. The budget of anthropogenic dust and the associated radiative forcing is still uncertain. The aim of this work is an assessment of the anthropogenic dust budget through global multi-year simulations conducted with the GEOS-Chem chemical-transport model. Natural and anthropogenic sources of dust have been included in the model following the work of Ginoux et al. [Rev. Geophys., 2012]. Model results have been compared with ground-based and satellite measurements, and are also used to study the dust atmospheric budget and deposition at surface. An offline estimate of the dust direct radiative forcing has been made for both solar and terrestrial radiation. This is the first step of a more general study. In the future, the indirect radiative forcing and perturbation to snow-ice albedo induced by anthropogenic dust will also be investigated.

Virtanen, TImo

Collocation mismatch uncertainty in validation of satellite AOD retrievals

Satellite-based aerosol products are routinely validated against AERONET sun photometer network. Although most of the present-day retrieval algorithms provide uncertainty estimates, the additional uncertainty due to collocation mismatch is often overlooked in the validation process. We study the collocation mismatch uncertainty in the validation of AATSR aerosol products against AERONET within the GAIA-CLIM project. The mismatch arises from the different spatial resolution of the data: a relatively large satellite footprint is compared to a point-like ground based measurement. The representativity of the point like measurement depends on the spatial aerosol variability. Our approach is to assess the aerosol spatial variability using the satellite data. To estimate the performance of the method, we compare the results to the aerosol variability obtained from a dense network of AERONET sites in the

AEROSOL DRAGON campaign. We also consider the different smoothing and sampling procedures involved in the retrieval, and their effects on the comparison against the reference data.

Wang, Zhili

Disentangling fast and slow responses of the East Asian summer monsoon to reflecting and absorbing aerosol forcings

We examine the roles of fast and slow responses in shaping the total equilibrium response of the East Asian summer monsoon (EASM) to reflecting (sulfate, SO4) and absorbing (black carbon, BC) aerosol forcings over the industrial era using the Community Earth System Model version 1. Our results show that there is a clear distinction between fast and slow responses of the EASM to aerosol forcings and the slow climate response due to aerosol-induced change in sea surface temperature plays an important role in the impacts of aerosols on the EASM. The EASM is weakened by a decrease in land-sea surface thermal contrast in the fast response component to SO4 forcing, whereas the weakening is more intensive by the changes in tropospheric thermodynamic and dynamic structures in the slow response component to SO4. The total climate adjustment caused by SO4 is a significant weakening of the EASM and a decrease in precipitation. The BC-induced fast adjustment strengthens the EASM both by increasing the local surface land-sea thermal contrast and shifting the East Asian subtropical jet northwards. BC-induced slow climate adjustment, however, weakens the EASM through altering the atmospheric temperature and circulation. Consequently, the EASM is slightly enhanced, especially north of 30°N, in the total response to BC. The spatial patterns of precipitation change over East Asia due to BC are similar in total response and slow response. This study highlights the importance of ocean response to aerosol forcings in driving the changes of the EASM.

Watson-Parris, Duncan

Aerosol evaluation using a global synthesis of aircraft measurements

Despite ongoing efforts (e.g. Kipling et al. 2016 and Koffi et al. 2016), the vertical distribution of aerosols globally is poorly constrained in many commonly used GCMs. This in turn leads to large uncertainties in the contributions of the direct and indirect aerosol forcing on climate. Using the GASSP database – the largest collection of in-situ aircraft observations currently available, with more than 1000 flights from 37 campaigns from around the world – we are investigating the vertical structure of aerosols across a wide range of regions and environments. These in-situ constraints are particularly valuable when investigating the dominant processes above or below clouds, where remote sensing data is limited. The application of this unique dataset to assess the vertical distributions of cloud condensation nuclei and number size distribution in the global aerosol-climate model ECHAM-HAM reveals that the model underestimates larger particles in the upper troposphere. The processes underlying this discrepancy are explored by comparing the full aerosol distributions as a function of altitude against a Perturbed Parameter Ensemble (PPE). We will propose an AeroCom Phase III experiment to use the GASSP database to evaluate the vertical distribution of aerosol across AeroCom models. We also discuss some of the sampling issues associated with this kind of evaluation, the need for high frequency model output and tools we have developed to facilitate this.

Welton, Ellsworth

NASA Micro Pulse Lidar Network: Overview of the new Version 3 Product Suite

The NASA Micro Pulse Lidar Network (MPLNET) is a global federated network of Micro-Pulse Lidars (MPL) co-located with the NASA Aerosol Robotic Network (AERONET). MPLNET began in 2000, and there are currently 22 long-term sites, numerous field campaigns, and more planned sites on the way. We have developed a new Version 3 processing system including the deployment of polarized MPLs across the network. In addition, we have improved existing products and added many new ones. Here we will present an overview of Version 3, discuss our status and future plans, and focus on presenting Version 3 changes relevant to use of MPLNET data by the AeroCom community.

Wild, Martin

Assessment of clear sky solar radiative fluxes in climate models using surface observations

Clear sky solar fluxes simulated by climate models vary greatly, particularly at the Earth's surface, so that for example the latest generation of Global Climate Models (GCM) from CMIP5 still cover a range of as much as 16 Wm-2 already in their global means. Here we assess these fluxes with monthly mean clear sky reference climatologies, newly derived at more than 40 Baseline Surface Radiation Network (BSRN) sites using the clear sky algorithm of Long and Ackermann (2000). The comparison is complicated by the fact that the monthly SW clear sky BSRN reference climatologies are derived from measurements under true cloud-free conditions, whereas the GCM clear sky fluxes are calculated continuously at every timestep solely by removing the clouds, yet otherwise keeping the prevailing atmospheric composition (e.g. water vapor, temperature, aerosols) during the cloudy conditions. This induces the risk of biases in the GCMs just due to the additional sampling of clear sky fluxes calculated under atmospheric conditions representative for cloudy situations. Thereby, a wet bias might be expected in the GCMs compared to the clear sky reference climatologies, which may induce spurious low biases in the downward clear sky SW fluxes. To estimate the magnitude of these spurious biases in the available monthly mean output from 40 CMIP5 models, we used their respective multi-century control runs, and searched therein for each month and each BSRN station the months with the lowest cloud cover. The deviations of the associated clear sky fluxes from their long-term climatological means have then be used as indicators of the magnitude of the abovementioned sampling bias and as correction factors for an appropriate comparison with the BSRN climatologies, individually applied for each model and BSRN site. The overall correction is on the order of 2 Wm-2. This revises our best estimate for the global mean surface downward SW clear sky radiation, previously at 249 Wm-2 inferred from the GCM clear sky flux fields and their biases compared to the BSRN climatologies, now to 247 Wm-2 including this additional correction. 34 out of 40 CMIP5 GCMs overestimate this reference. The overestimation of surface solar radiation in climate models is a long standing problem in climate models and may be related to inaccuracies in the representation of aerosols and water vapor absorption. With a global mean surface albedo of 13 % and a net TOA SW clear sky flux of 287 Wm-2 from CERES-EBAF this results in a global

mean clear sky surface and atmospheric SW absorption of 214 and 73 Wm-2, respectively. Thus, globally, about 3 quarters (75%) of the totally absorbed solar radiation under clear sky conditions occurs at the Earth surface, and about 1 quarter (25%) in the atmosphere. Further also changes in clear sky SW fluxes as determined at the BSRN sites covering the last one to two decades are discussed.

Winker, David

Recent Improvements in CALIPSO Aerosol Products

CALIPSO has now acquired 11 years of global aerosol and cloud profile data. This data set represents an important resource regarding global aerosol vertical distribution, aerosol type, and the evaluation of aerosol predictions from chemical transport models. Version 4 Level 1 products were released in 2015 with significantly improved calibration of both 532 nm and 1064 nm profile data. Version 4 Level 2 products were recently released, with numerous improvements due to the improved calibration and a variety of significant algorithm improvements. Development of Version 4 products involved extensive analysis and comparison of Version 3 and 4 products at Level 1, 2, and 3. This presentation will summarize significant changes, improvements, and remaining data quality issues.

Witek, Marcin

New approach to the retrieval of AOD and its uncertainty from MISR observations over dark water

A new method for retrieving aerosol optical depth (AOD) and its uncertainty from Multi-angle Imaging SpectroRadiometer (MISR) observations over dark water is outlined. MISR's aerosol retrieval algorithm calculates cost functions between observed and pre-simulated radiances for a range of AODs (from 0.0 to 3.0) and a prescribed set of aerosol mixtures. The previous Version 22 (V22) operational algorithm considered only the AOD that minimized the cost function for each aerosol mixture, then used a combination of these values to compute the final, "best estimate" AOD and associated uncertainty. The new approach considers the entire range of cost functions associated with each aerosol mixture. The uncertainty of the reported AOD depends on a combination of a) the absolute values of the cost functions for each aerosol mixture, b) the widths of the cost function distributions as a function of AOD, and c) the spread of the cost function distributions among the ensemble of mixtures. A key benefit of the new approach is that, unlike the V22 algorithm, it does not rely on arbitrary thresholds imposed on the cost function to determine the success or failure of a particular mixture. Furthermore, a new Aerosol Retrieval Confidence Index (ARCI) is established that can be used to screen high-AOD retrieval blunders caused by cloud contamination or other factors. Requiring ARCI≥0.15 as a condition for retrieval success is supported through statistical analysis and outperforms the thresholds used in the V22 algorithm. The described changes to the MISR dark water algorithm will become operational in the new MISR aerosol product (V23), planned for release in 2017.

Satellite assessment of sea spray aerosol productivity: Southern Ocean case study

Despite many years of observations by multiple sensors, there is still substantial ambiguity regarding aerosol optical depths (AOD) over remote oceans, in particular over the pristine Southern Ocean. Passive satellite retrievals (e.g., MISR, MODIS) and global aerosol transport models show a distinct AOD maximum around the 60°S latitude band. Sunphotometer measurements performed by the Marine Aerosol Network (MAN), on the other hand, indicate no increased AODs over the Southern Ocean. In this study elevated Southern Ocean AODs are examined from the modeling perspective. The primary aerosol component over the Southern Ocean is sea spray aerosol (SSA). Multiple simulations of SSA concentrations and optical depths are carried out using a single modeling framework, the Navy Aerosol Analysis and Prediction System (NAAPS) model. Several SSA emission functions are examined, including recently proposed formulations with sea surface temperature corrections. The differences between NAAPS simulations are primarily due to different SSA emission formulations. The results are compared against satellite-derived AODs from the MISR and MODIS instruments. MISR and MODIS AOD retrievals are further filtered to eliminate retrievals potentially affected by cloud contamination and cloud adjacency effects. The results indicate a very large impact of SSA emission parameterization on the simulated AODs. For some scenarios, the Southern Ocean AOD maximum almost completely disappears. Further MISR and MODIS AOD quality screening substantially improves model/satellite agreement. Based on these comparisons an optimal SSA emission function for global aerosol transport models is recommended.

Yadav, Kunvar

Removal of solar radiation effect based on nonlinear data processing technique for Seismo- Ionospheric Anomaly before few earthquakes in 2014-2016.

The study of ionospheric precursors of the earthquake has gained interest among many researchers, especially the precursor obtained in terms of anomalous variation in total electron content (TEC). If the earthquake occurs during a period of moderate to high solar activity, the TEC derived using global positioning system (GPS) measurements requires the elimination of solar effect so as to identify the precursory signature. This paper includes multi-resolution time series technique to remove the nonlinear effect from solar radiation on GPS-based TEC. The technique is based on wavelet transform applicable to RINEX TEC data. This technique is used to remove nonlinear background solar effect from TEC prior to four different earthquakes (M> 6.0). Further in order to evaluate the extracted TEC, we obtain the correlation between the decomposed TEC A6 and measured solar index (F10.7) and extreme ultraviolet (EUV). A good correlation is obtained between decomposed TEC A6 and EUV for all the cases. This suggests that this technique is useful for the removal of background solar effect for identifying earthquake precursor in TEC.

Yoshida, Mayumi

Common Retrieval of Aerosol Optical Properties Using Satellite Imaging Sensors for JAXA Earth Observation Products

Aerosol remote sensing studies have been carried out using low-orbital Earth observation satellites. In upcoming years, JAXA is planning to launch the low-orbital satellite imaging sensors such as Global Change Observation Mission-Climate (GCOM-C)/Second-generation GLobal Imager (SGLI), Greenhouse gases Observing SATellite-2 (GOSAT-2)/Cloud and Aerosol Imager 2 (CAI-2), and Earth Clouds Aerosols and Radiation Explorer (EarthCARE)/Multi-Spectral Imager (MSI). Moreover, the next-generation geostationary satellite of the Japan Meteorology Agency, Himawari-8/Advanced Himawari Imager (AHI) was launched on October 7, 2014. The AHI has six bands from visible to near-infrared wavelengths and observes the top of atmosphere radiance at the fine resolution of 0.5-2km at every 2.5/10-minutes, which enables the frequent aerosol observation at same ground points. The synergistic uses of these various imaging sensors on both geostationary and low-orbital satellites are helpful to understand a complete picture of aerosol distribution in the global scale. For this purpose, we developed the common retrieval algorithm of the aerosol optical properties to various satellite sensors and over both land and ocean, since the common algorithm provides consistent aerosol retrievals over the globe.
The algorithm is based on the method developed by Higurashi and Nakajima (1998) and Fukuda et al. (2013). The three main features in the concept of this algorithm are as follows: (1) automatic selection of the optimum channels for aerosol retrieval by introducing a weight for each channel to the object function, (2) setting common aerosol models over land and ocean, and (3) preparation of lookup tables for every 1 nm from 300 nm to 2500 nm and then weighted by the response function for each sensor. The method was applied to AHI, and the retrieved aerosol optical thickness was generally consistent with the products from Moderate Resolution Imaging Spectro-radiometer (MODIS) and Aerosol Robotic Network (AERONET). We also applied our algorithm to MODIS on board Aqua and compared to the results from AHI. The comparison results will be discussed in our presentation.

Yu, Hongbin

Dust deposition into tropical Atlantic Ocean: An evaluation of GEOS-5 model with satellite and aircraft observations

Massive dust emitted from deserts and semi-arid regions in North Africa can transport long distances across the tropical Atlantic Ocean and reach the Americas. Dust deposition along the transit adds essential nutrients to marine and terrestrial ecosystems, which could increase the productivity of the ecosystems and CO2 uptake, modulate biogeochemical cycle, and influence climate. Assessment of the dust-biogeochemistry–climate interactions has been in part hindered by the paucity of dust deposition measurements, particularly in open oceans, and large uncertainties associated with representing dust processes in models. The objectives of our study are to quantify the dust transport and deposition and to assess and eventually improve model representations of dust processes through exploring the use of a suite of satellite remote sensing measurements and aircraft observations. Based on the 8-year (2007-2014) record of aerosol observations from CALIOP/CALIPSO, we estimate that the yearly dust deposition is 102, 20, and 28 Tg into the tropical Atlantic Ocean, Caribbean Basin, and Amazon Basin, respectively. The GEOS-5 model overestimates the dust deposition. The CALIOP observations yields a dust residence time of about 10 days in the trans-Atlantic region, which is about a factor of 2 longer than GEOS-5 model and other AeroCom models. We further evaluate the GEOS-5 model representations of size-dependent

dust processes through comparing the model results against Fennec aircraft observations and satellite observations of dust optical depth (DOD) in the mid-visible (VIS) and thermal infrared (TIR). The GEOS-5 model considering dust particles of 0.2 – 20 μm in diameter only accounts for about 50% of observed dust mass over the Sahara. The model also substantially overestimates the mass fraction for small particles (< 6 μm) but underestimates the fraction for large particles (> 6 μm). The DOD gradient along the trans-Atlantic transit reflects the removal efficiency of dust during the transport. The larger the DOD gradient, the faster the dust removal is. We found that the VIS DOD gradient as revealed by MODIS, MISR, and CALIOP is significantly smaller than the TIR DOD gradient by IASI. This satellite-observed VIS and TIR difference appears to be consistent with the understanding of preferential removal of large particles from the atmosphere, because IASI is mainly sensitive to large particles. However, the GEOS-5 model shows negligible difference in the DOD gradient between VIS and TIR. This satellite-model discrepancy may suggest model deficiencies in representing the size dependence of dust removal processes.

Zhang, Hua

The effective radiative forcing of partial internally and externally mixed aerosols and their effects on global climate

The total effective radiative forcing (ERF) due to partial internally mixed (PIM) and externally mixed (EM) anthropogenic aerosols, as well as their climatic effects since the year of 1850, were evaluated and compared using the aerosol–climate online coupled model of BCC_AGCM2.0_CUACE/Aero. The influences of internal mixing (IM) on aerosol hygroscopicity parameter, optical properties, and concentration were considered. Generally, IM could markedly weaken the negative ERF and cooling effects of anthropogenic aerosols. The global annual mean ERF of EM anthropogenic aerosols from 1850 to 2010 was -1.87 W m–2, of which the aerosol-radiation interactive ERF (ERFari) and aerosol-cloud interactive ERF (ERFaci) were -0.49 and -1.38 W m−2, respectively. The global annual mean ERF due to PIM anthropogenic aerosols from 1850 to 2010 was -1.23 W m–2, with ERFari and ERFaci of -0.23 and -1.01 W m−2, respectively. The global annual mean surface temperature and water evaporation and precipitation were reduced by 1.74 K and 0.14 mm day–1 for EM scheme, and 1.28 K and 0.11 mm day–1 for PIM scheme, respectively. However, the relative humidity near the surface was slightly increased for both mixing cases. The intertropical convergence zone (ITCZ) was southwardly shifted for both EM and PIM cases, but was less southwardly shifted in PIM scheme due to the less reduction in atmospheric temperature in the mid and low latitudes of the Northern Hemisphere.

Kai Zhang

Towards process-level evaluation of aerosol effects on ice clouds in global aerosol-climate models

Ice clouds play an important role in regulating the Earth's radiative budget and influencing the hydrological cycle. Aerosols can influence the local circulation, especially the vertical motion, and affect the moisture source for ice cloud formation. On the other hand, aerosols can also act as solution droplets or ice nuclei for ice crystal formation, thus affecting the physical properties of ice clouds. To

disentangle the complex interactions and obtained detailed process-level understanding, we propose various new modeling strategies to quantify the dynamical and microphysical impact of natural and anthropogenic aerosols on ice clouds and their radiative effects. The focus on short time scales facilitates comparison with observations and substantially reduces the computational cost. We show examples using two global aerosol-climate models to demonstrate the effectiveness of the method. Results from the AeroCom inter-comparison of aerosol indirect effect on ice clouds will be also discussed.

Zieger, Paul

Linking recent findings from the Stockholm sea spray chamber to global climate models

Sea spray is one of the largest natural aerosol sources and plays an important role in the Earth's radiative budget. Here, we will describe the most recent in a series of laboratory systems built at Stockholm University to simulate the process of sea spray aerosol formation – the Stockholm sea spray aerosol simulation chamber. We will present results from a series of experiments that we have conducted in recent years with the aim of improving our understanding of the physical drivers of sea spray aerosol production and the physical and chemical properties of nascent sea spray aerosol. We will show our results linking seawater temperature, bubbles at the seawater surface and the size and number of aerosols produced. Further, we will discuss our approach to parameterizing our laboratory results for use in global climate models (Salter et al., 2015). We will also present our recent findings on the chemical composition of nascent sea spray aerosol – the significant enrichment of calcium in submicrometer nascent sea spray aerosols as well as a tendency for increasing calcium enrichment with decreasing particle size (Salter et al., 2016). Finally, we will describe our recent work determining the hygroscopicity of inorganic sea spray aerosol along with the implications of our results within global climate models (Zieger at al., 2017).

Zuidema, Paquita

Modeling comparisons to new observations from the southeast Atlantic, Part 1: Methodology and Ascension Island comparisons

Ongoing fieldwork and modeling exercises focused on the southeast Atlantic are aimed at improving process understanding of the interactions between sunlight-absorbing aerosol emitted by biomass burning on continental Africa with the cloudy boundary layer of the remote Atlantic ocean. Important intermediate steps are to: 1. evaluate the ability of model simulations to realistically represent intrinsic aerosol and cloud properties, 2. evaluate the ability of model simulations to capture the thermodynamic and dynamic vertical structure and the aerosol-cloud vertical structure, and 3. use model output to evaluate whether the in-situ and surface-based sampling is sufficient for representing monthly-means, by also sampling models similarly to the observations. This poster will present the protocol we have developed for the model-observational comparison, and will include comparisons done using data from the LASIC DOE ARM Mobile Facility site at Ascension Island (8S, 14.5W). This poster is the part 1 introduction to a three-part series, complementing Shinozuka et al. (Part 2, focusing on objectives 1 and

3) and Doherty et al. (Part 3; focusing on objective 2). A written version of the protocol will be made available towards facilitating the involvement of multiple models. Note to organizers: 3 posters represent Parts 1,2, and 3 of the same exercise. The other 2 are lead by Yohei Shinozuka and Sarah Doherty. Should one be selected for oral we will combine material from all 3, and decide amongst ourselves who will present it. I would be happy for that to be Sarah Doherty. Also, this abstract overrides a previous abstract from me (I will only bring one poster).