

# **AeroCom and ACAM – opportunities for collaboration**

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on behalf of AeroCom

# AeroCom: Aerosol comparisons between observations and models



3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup>, 8<sup>th</sup>, 9<sup>th</sup>, 10<sup>th</sup>, 11<sup>th</sup>, 12<sup>th</sup>, 13<sup>th</sup>,



# What is AeroCom?

- AeroCom is an open international initiative of scientists who are interested in understanding aerosol effects on climate with global models that are evaluated by satellite and other platform data
- More than 20 modeling groups have participated in coordinated model experiments, and many observational groups have contributed their data and expertise to the AeroCom activities
- Between 2003 and 2016, 15 AeroCom workshops took place, 8 in Europe, 5 in USA, and 2 in Asia
- AeroCom has become an prominent international aerosol research community, attracting many scientists contributing to AeroCom activities and forming several internationally collaborated projects
- Since 2014, AeroCom and AeroSAT have held their annual workshops back-to-back to ensure effective collaborations between the modeling and satellite communities
- This year, the 16<sup>th</sup> AeroCom workshop and the 5<sup>th</sup> AeroSAT workshop will be held in Helsinki, Finland (October 9-13, 2017)

# What has AeroCom achieved?

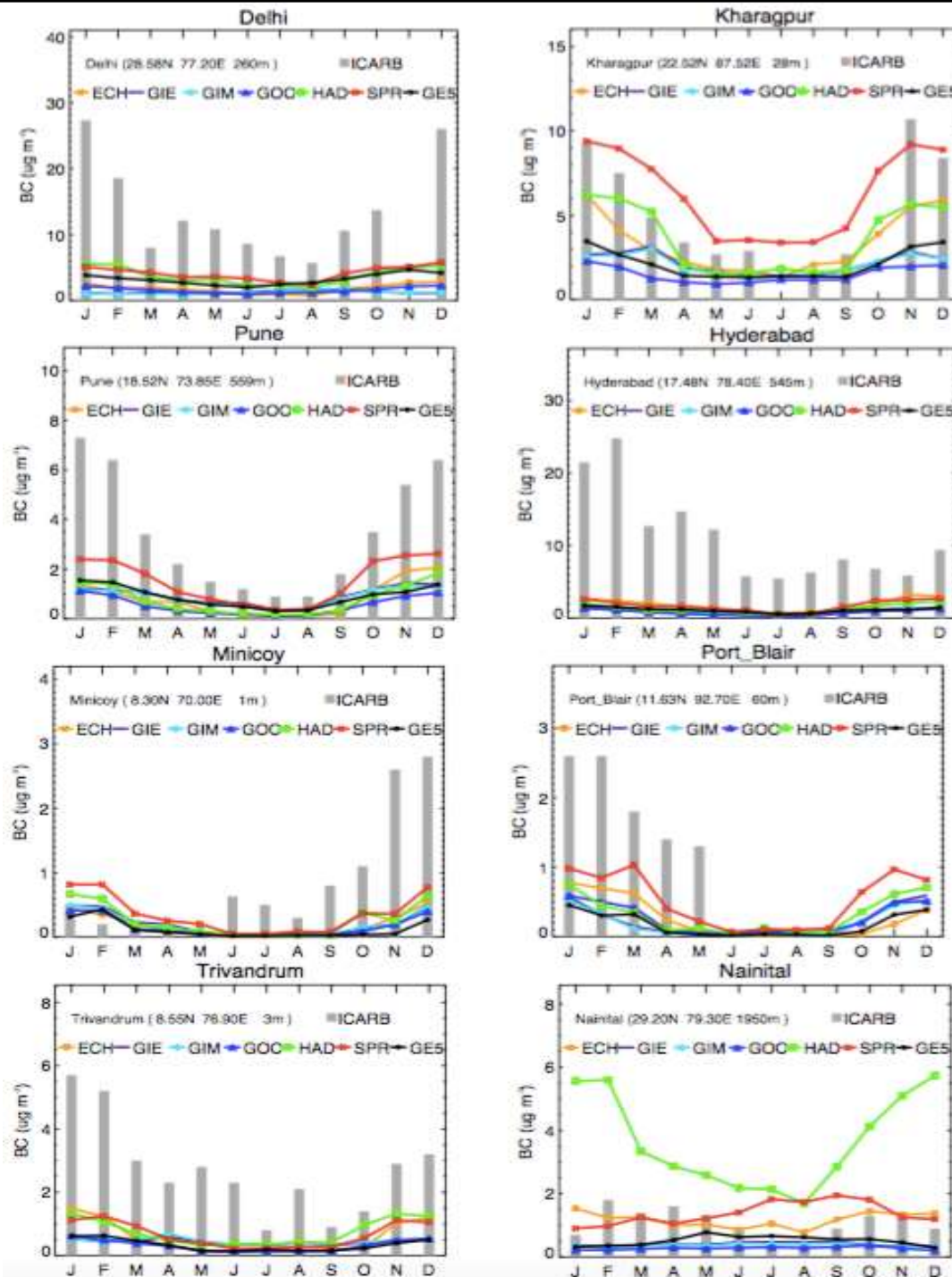
I believe the most important achievement of AeroCom is pursuing good, interesting joint international aerosol science projects in good humor and respect.  
– Michael Schulz

- Established very close and intimate collaborations between modeling and observational community
- Three phases of AeroCom model experiments with various focus (model diversity, aerosol direct and indirect radiative forcing, microphysics, decadal trends, vertical profiles, biomass burning, nitrate, organics, dust, long-range transport of pollutants (HTAP and Fukushima), in-situ, UTLs, etc.)
- Experiment is initiated by anyone who has idea(s); if a few modeling groups agreed to participate, it becomes an AeroCom model experiment – very democratic

# What has AeroCom achieved?

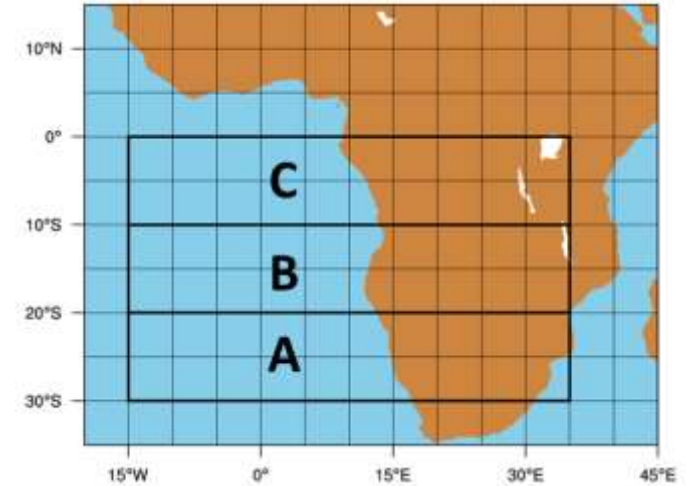
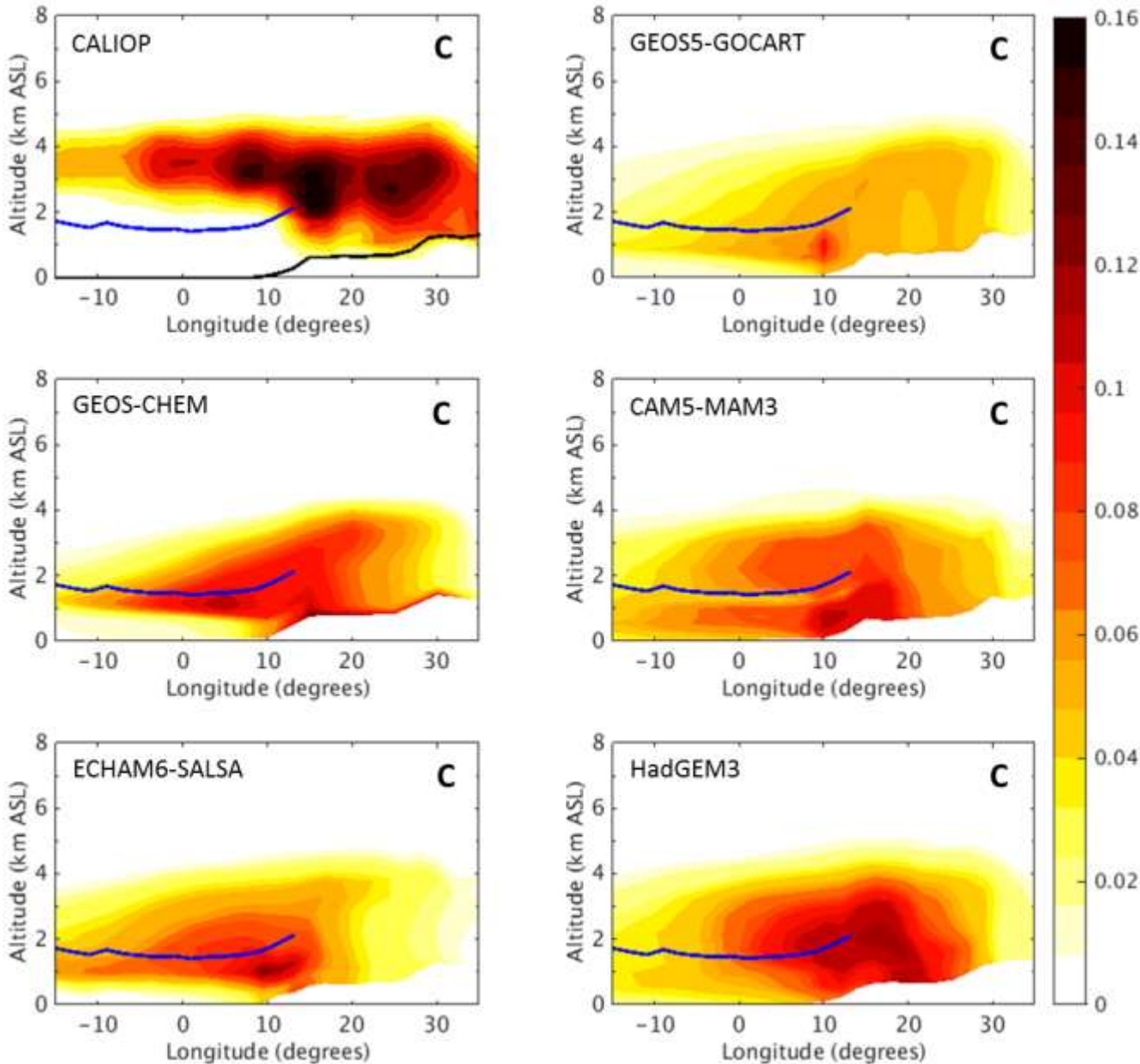
- Many model output and observation data have archived in the AeroCom server, and interactive tools to compare data and model have been developed
- Continuous model evaluation with consistent methods using historic and new data (e.g., new aircraft experiments of ORACLE and ATom and new satellite data from Suomi-NPP and Himawari)
- Close coordination with CMIP6 via AerChemMIP

# Example 1: Aerosol over India – BC concentrations



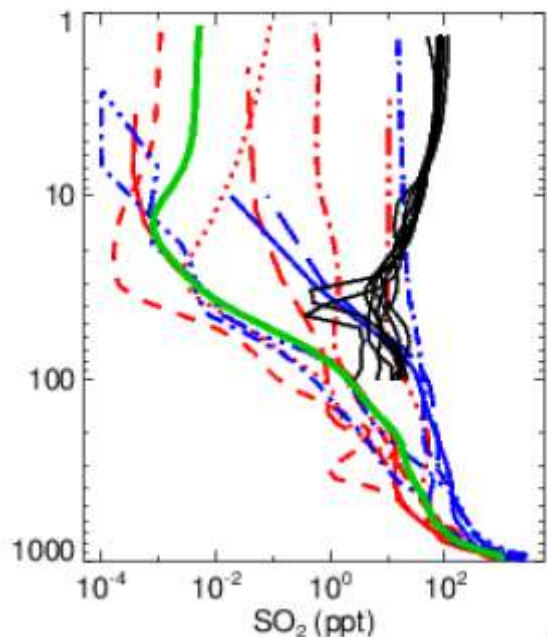
- Comparisons of model simulated BC concentrations with the ICARS observations have clearly shown that the models are unable to reproduce the high BC concentrations at most sites, especially in winter
- Possible explanations include the model missing agriculture burning emissions, underestimating anthropogenic emissions and not considering their seasonal cycles, problems with wintertime meteorological fields, etc.

## Example 2: Biomass burning aerosol transport over the South Africa-Atlantic region

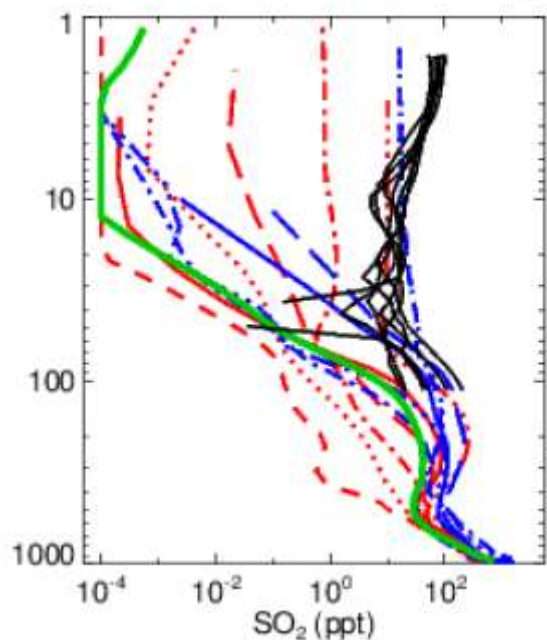


- Comparisons of aerosol vertical distributions off the coast in region C have revealed that models have difficulties in sustain the vertical extent of biomass burning aerosol plume height during transport
- CAM5 and HadGEM3 are doing better than other models

### Example 3: SO<sub>2</sub> in the UT and stratosphere – comparisons with MIPAS and aircraft data



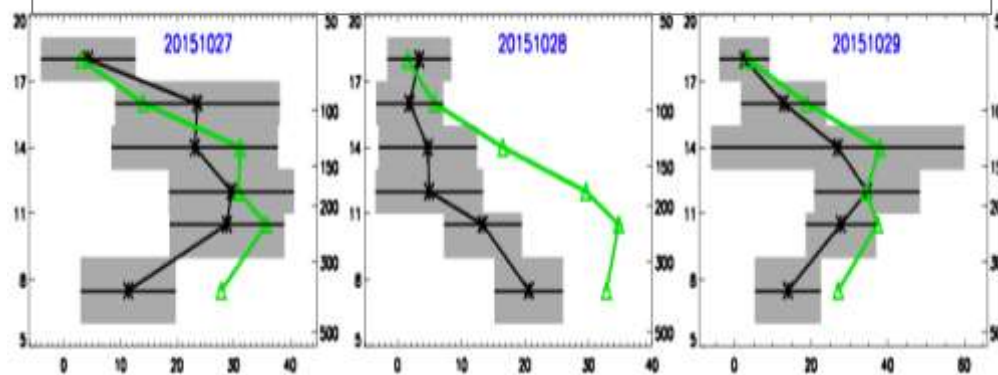
- The model simulated SO<sub>2</sub> shows very large spread of SO<sub>2</sub> in the UTS region with most model results are far below the MIPAS retrievals
- However, comparisons with the in-situ aircraft measurements in the UTLS suggest it that SO<sub>2</sub> from MIPAS maybe too high (sensitivity too low?)



- MIPAS (N America, 20-60N)
- CAM4-Oslo
- ..... GOCART-v4
- - - GOCART-v5
- - - OsloCTM2-v2
- ..... SPRINTARS-v385
- - - TM5-V3
- ECHAM-SALSA
- ..... GISS-MATRIX
- - - GISS-modelE
- - - HadGEM2
- ..... HadGEM3-A-GLOMAP
- - - MPIHAM\_V2\_KZ
- MERRA2

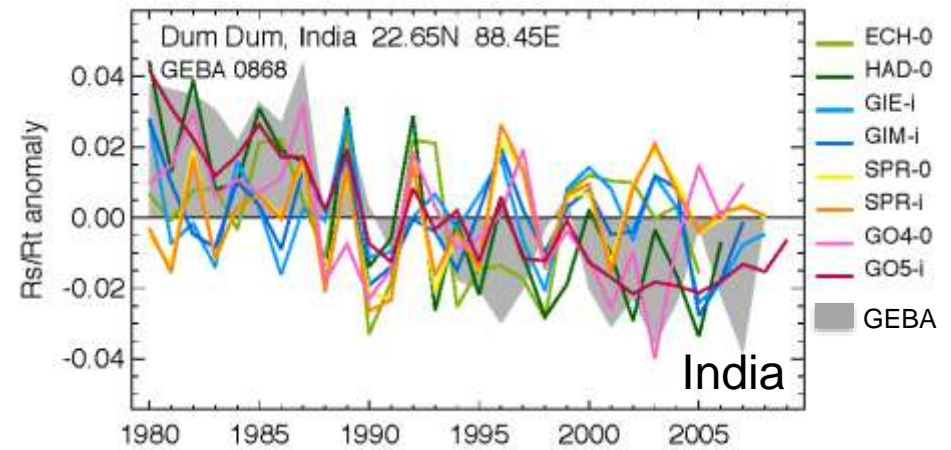
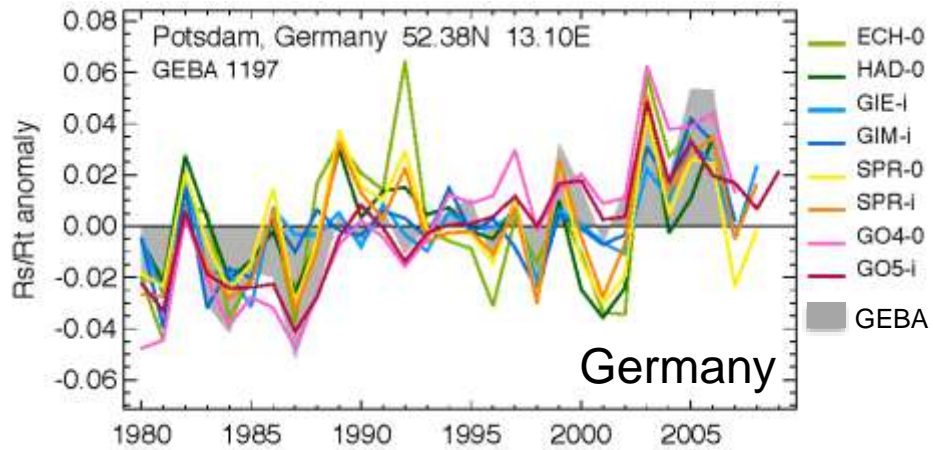
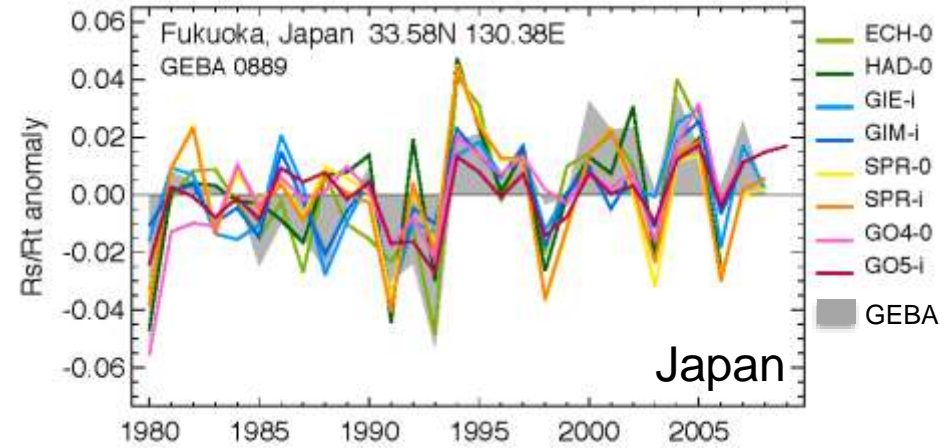
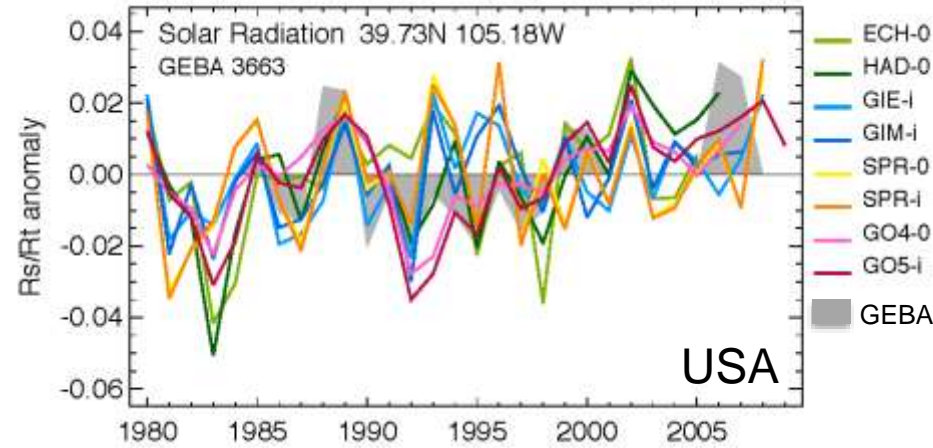
Figures from Qian Tan

Comparisons of MERRA2 with VIRGAS aircraft data over N America



(VIRGAS data from R Gao and A Rollins)

# Example 4: long-term trend of solar radiation reaching the surface



Models in general better represent the “brightening” trends of surface radiation over USA, Germany, and Japan but have large differences in capturing the “dimming” trend over India. The trends are mostly driven by the change of clouds

# How can AeroCom (+AeroSAT) and ACAM collaborate?

- Engaging ACAM community to be more actively involved in AeroCom with new ideas for model simulations and analysis
- Communicating between AeroCom and ACAM on key parameters to measure and quantities to output for ACAM-targeted analysis
- Discussing the near future plans and directions

# Next proposed comprehensive AeroCom model experiment – opportunities for ACAM

- Historic simulation
  - Anthropogenic emissions from the latest CMIP6
  - Biomass burning and natural sources will be provided
- Pre-industrial: 1750 or 1850
- Modern: 1980 – 2015, monthly output for every year or every 10<sup>th</sup> year, 3-D fields of major aerosol and related species
- GCM mode and/or CTM mode

# Proposed analysis with the new model simulation

- It has been discussed in the AeroCom community on topics of model analysis, including
  - Benchmark for model performance and improvements
  - Multi-decadal aerosol and cloud trends
  - Aerosol-cloud-radiation interactions and their effects on climate
  - Anthropogenic and natural contributions of UTLS aerosols and trends
  - Black carbon deposition on snow
- It is a good time to have input from the ACAM community on what variables are desired to obtain and what additional analysis can be made