Specification for SPARC/SSiRC Model Intercomparison Project - Part III: Model Intercomparison of the Transient Aerosol Record (MITAR)

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1   Overall objective

Intercompare and evaluate the transient stratospheric aerosol load between January 1998 and December 2011 across global models with prognostic stratospheric aerosol modules. Focus is on studying processes that maintained the stratospheric aerosol load, in particular during the last decade, by comparing modelled key parameters of stratospheric aerosol properties and precursor gas abundances.

2   Key aims

i)   compare and evaluate the simulated aerosol record between the models by means of key aerosol parameters (specified below)
ii)   examine the pathways transporting the volcanic material into the stratosphere
iii)   examine the model's ability to reproduce specific features of stratospheric aerosol dynamics that have been observed during the last decade, e.g. Asian tropopause aerosol layer (ATAL)
iv)   assess the relative contributions of anthropogenic and volcanic emissions to the stratospheric aerosol
v)   ~~examine the influence of emission scenarios on the simulated aerosol~~

3   Specific Plan for studies

a.   Each model performs two experiments
        E1) Transient background without volcanoes but with anthropogenic emissions
        E2) Prescribed direct volcanic injections ~~to study the model's sensitivity to volcano injection height.~~
        Participants can choose from 3 different forcing tables, which will be supplied; brief descriptions are given in Section 9 below.

b.   ~~2 Parameter to vary~~
        ~~P1)~~ ==Injection height:== ~~free troposphere~~, ~~tropopause~~, ~~lower stratosphere: 3 runs. Details on the injection table are given in Section 9.~~
        ~~P2) Nucleation rate scaling (represent uncertainty in nucleation rate in the stratosphere): 2 runs~~

b.   Output agreed set of diagnostics matching AeroCom phase 2 protocol (CF-netCDF), see also BG and POEMS protocols

4   Experiment specification

A) Supply of emissions

A1. Anthropogenic:

-   ACCMIP emissions (available) *… do we all agree??*
-   update of Neely et al. (2013)   *… Ryan: is this an alternative option?*

A2. Volcanic:

    Models are free to select a table which matches best their specific requirements.

-   AeroCom/HTAP volcanic SO2 amount and injection height from Thomas Diehl (Diehl et al., ACPD 2012; (http://www.atmos-chem-phys-discuss.net/12/24895/2012/acpd-12-24895-2012.pdf). Datasets accessible from AeroCom (1979-2010)   *… Mian: I still have doubts how this table fits our needs; e.g. does it end in 2010?*
-   C. Brühl, MPI-C (update of ACPD 2013, based on MIPAS and TOMS)
-   R. Neely, NCAR (Neely et al., GRL, 2013)

A3. Other:
-   Seawater DMS: Lana et al., 2011
-   OCS: subscribe surface concentrations at 510 pptv *... still not consolidated but I think that is the most convenient option for all*

B) Host model dynamics
        - we recommend a host model configuration that reproduces the QBO in the tropical stratosphere (free running, nudging, reanalysis meteorology), but this is not mandatory
        - transient SST/SIT records *… climatology not specified yet !! note: AMIP2 (widely used) ends in 2006!!!*

~~C) Aerosol module~~
        ~~As specified in Pt.I – Stratospheric Background / Control Model Study.~~

Each run covers 14 years. Two experiments have to be conducted, so that the resulting model years to run is 28 + spin up (spin up: 3 to 6 years, model specific).

5 Diagnostics to output

Following Pt.I and Pt. III protocols and comply with standards implemented through the AeroCom protocol.

- Complete the AeroCom protocol (baseline diagnostics) by specific diagnostics related to stratospheric aerosol
- Monthly-mean 2D tropopause height & height/pressure level of the 380K isentrope
- Monthly-mean 2D strat-trop exchange of diagnosed sulfur compounds at specified pressure level/geometric altitude
- Monthly-mean 2D AOD

- Monthly-mean 3D geopotential height
- Monthly-mean 3D aerosol extinction at 470[3] , 525[1], 750[2,3] ,1020[1] , 1064[4] nm ([1] SAGEII; [2] OSIRIS; [3] SCIAMACHY; [4] CALIOP)
- Monthly-mean 3D aerosol surface area density, effective radius (*** size range to be specified***; by mode? … consolidate with BG & POEMS protocols)
- Monthly-mean 3D precursor mixing ratios (SO2, OCS, DMS, gaseous H2SO4)
- Monthly-mean 3D number densities across bins/modes
- Monthly-mean 3D cumulated particle concentration, mimicking OPC counter (*** to be discussed ***)
- Monthly-mean 3D nucleation rate
- Monthly-mean 3D chemical fields if available (O3, HNO3, NO, NO2, N2O, N2O5)

6 Implementation plan

to be specified

7 Observational Data for Comparison

Data sets are provided by the SSiRC community following the protocol on the use of observational data.

A) Space borne:
  Aerosol: 1) NASA's Stratospheric Aerosol Database prepared by J. P. Vernier (includes SAGEII, CALIOP,and GOMOS)
  2) OSIRIS
  3) SCIAMACHY

  SO_2: MIPAS (profiles); IASI, AIRS, OMI, SCIAMACHY (total column)
B) In-situ:
  Aerosol: Wyoming OPC, NOAA lidar
C) Misc.
  Aerosol: 4-lambda SAGE II extinctions/effective radius (ETH)
  SO_2: ATMOS (provided by IUP and Michael Hoepfner, KIT)

8 Timeline

to be specified

9 Volcanic injection table

Models are free to select a table according their specific requirements. Changes on the table should be avoided without reporting. Three tables are supplied and will be accessible from SSiRCMIP websites. File format is ….??? **… need your statements here!!!**

a. AeroCom/HTAP volcanic SO2 amount and injection height for the years 1979 – 2010 from Thomas Diehl (Diehl et al., ACPD 2012; http://www.atmos-chem-phys-discuss.net/12/24895/2012/acpd-12-24895-2012.pdf)
b. C. Brühl, MPI-C (update of ACPD 2013, based on MIPAS and TOMS)
c. R. Neely, NCAR (Neely et al., GRL, doi:10.1002/grl.50263, 2013)

Comments:

a. The table may be updated for the years 2011 / 12 in near future ***@Mian: would it be possible to mirror the data set from the AeroCom websites in order to avoid confusion?***
b. Christoph Brühl (MPI-C Mainz) complied an injection table for volcanoes based on MIPAS, OMI and TOMS observations of SO2 **???** for the years 2001 – 2011. The table provides the total injected SO2 mass (in kilotons) at its geolocation and altitude. Emissions for some volcanoes are scaled by factor 2.5 to …why???.... Some tropical volcanoes are represented by vertical integrals between 15 – 22km *… @Christoph: please refine!!!*

Still not sorted out yet:
1) we proposed to conduct experiments between January 1998 and December 2011. How do we handle the years 1998-2000? Who knows which eruptions during that time should be considered too?
2) SSTs!!!