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Introducing the aerosol-climate model MAECHAM5-SAM2

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We are presenting a new global aerosol model MAECHAM5-SAM2 to study the aerosol dynamics in the UTLS under background and volcanic conditions.

The microphysical core modul SAM2 treats the formation, the evolution and the transport of stratospheric sulphuric acid aerosol. The aerosol size distribution and the weight percentage of the sulphuric acid solution is calculated dependent on the concentrations of H_2SO_4 and H_2O, their vapor pressures, the atmospheric temperature and pressure. The fixed sectional method is used to resolve an aerosol distribution between 1 nm and 2.6 micron in particle radius. Homogeneous nucleation, condensation and evaporation, coagulation, water-vapor growth, sedimentation and sulphur chemistry are included. The module is applied in the middle-atmosphere MAECHAM5 model, resolving the atmosphere up to 0.01 hPa ($\sim$80 km) in 39 layers.

It is shown here that MAECHAM5-SAM2 well represents in-situ measured size distributions of stratospheric background aerosol in the northern hemisphere mid-latitudes. Distinct differences can be seen when derived integrated aerosol parameters (surface area, effective radius) are compared with aerosol climatologies based on the SAGE II satellite instrument (derived by the University of Oxford and the NASA AMES laboratory). The bias between the model and the SAGE II data increases as the moment of the aerosol size distribution decreases. Thus the modeled effective radius show the strongest bias, followed by the aerosol surface area density. Correspondingly less biased are the higher moments volume area density and the mass density of the global stratospheric aerosol coverage. This finding supports the key finding No. 2 of the *SPARC Assessment of Stratospheric Aerosol Properties (2006)*, where it was shown that during periods of very low aerosol load in the stratosphere, the consistency between in-situ and satellite measurements, which exist in a volcanically perturbed stratosphere, breaks down and significant differences exist between the systems for key aerosol parameters including the aerosol surface area density.