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Evaluation of the tropospheric aerosol number concentrations simulated by two versions of the global model ECHAM5-HAM

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Since its first version developed by Stier et al. (2005), the global aerosol-climate model ECHAM5-HAM has gone through further development and updates. The changes in the model include (1) a new time integration scheme for the condensation of the sulfuric acid gas on existing particles, (2) a new aerosol nucleation scheme that takes into account the charged nucleation caused by cosmic rays, and (3) a parameterization scheme explicitly describing the conversion of aerosol particles to cloud nuclei. In this work, simulations performed with the old and new model versions are evaluated against some measurements reported in recent years. The focus is on the aerosol size distribution in the troposphere.

Results show that modifications in the parameterizations have led to significant changes in the simulated aerosol concentrations. Vertical profiles of the total particle number concentration (diameter > 3nm) compiled by Clarke et al. (2002) suggest that, over the Pacific in the upper free troposphere, the tropics are associated with much higher concentrations than the mid-latitude regions. This feature is more reasonably reproduced by the new model version, mainly due to the improved results of the nucleation mode aerosols. In the lower levels (2-5 km above the Earthś surface), the number concentrations of the Aitken mode particles are overestimated compared to both the Pacific data given in Clarke et al. (2002) and the vertical profiles over Europe reported by Petzold et al. (2007). The physical and chemical processes that have led to these changes are identified by sensitivity tests.

References:

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