Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 4, 1869-1883, 2004
www.atmos-chem-phys.net/4/1869/2004/

Implementing growth and sedimentation of NAT particles in a global Eulerian model

M. M. P. van den Broek[1], J. E. Williams[2], and A. Bregman[3]
[1]Space Research Organization of the Netherlands (SRON), Utrecht, The Netherlands
[2]Eindhoven University, Eindhoven, The Netherlands
[3]Royal Netherlands Meteorological Institute (KNMI), De Bilt, The Netherlands

Abstract. Here we present a concise and efficient algorithm to mimic the growth and sedimentation of Nitric Acid Trihydate (NAT) particles in the polar vortex in a state-of-the-art 3D chemistry transport model. The particle growth and sedimentation are calculated using the microphysical formulation of Carslaw et al. (2002). Once formed, NAT particles are transported in the model as tracers in the form of size-segregated quantities or size bins. Two different approaches were adopted for this purpose: one assuming a fixed particle number density ("FixedDens") and the other assuming a discrete set of particle diameter values ("FixedRad"). Simulations were performed for three separate 10-day periods during the 1999-2000 Arctic winter and compared to the results of an existing Lagrangian model study, which uses similar microphysics in a computationally more expensive method for the simulation of NAT particle growth. The resulting particle sizes for both our approaches compare favourably at 430K with those obtained from this previous model study, and also in-situ observations related to the size of large NAT particles. The particle growth is faster for "FixedDens" resulting in a difference in (de) nitrification by a factor of ~2 for all three simulation periods. Comparisons were made with a standard equilibrium approach and the differences in the redistribution of HNO_3 were found to be substantial. For both approaches the performance of the algorithm is rather insensitive to both the number of size bins and the shape of the size distribution, and show a weak dependence on the prescribed total particle number density during the coldest period. This results in an increase of 7% for the "FixedRad" approach and 17% for the "FixedDens" approach when increasing the total particle number density by a factor of 2.5.

Final Revised Paper (PDF, 1012 KB) Discussion Paper (ACPD)

Citation: van den Broek, M. M. P., Williams, J. E., and Bregman, A.: Implementing growth and sedimentation of NAT particles in a global Eulerian model, Atmos. Chem. Phys., 4, 1869-1883, 2004. Bibtex EndNote Reference Manager