Atmos. Chem. Phys. Discuss., 7, S6774–S6775, 2007
www.atmos-chem-phys-discuss.net/7/S6774/2007/

Atmospheric Chemistry and Physics Discussions

Interactive comment on “The validity of the kinetic collection equation revisited” *by* L. Alfonso et al.

Anonymous Referee #1

Received and published: 12 November 2007

The paper is dedicated to the analysis of the properties of the kinetic collection equation (KCE) for several types of kernels allowing the analytical solution. The solution of the KCE is compared with a more precise solution of the stochastic collision equation. To estimate the validity of KCE, the stochastic collision equation is solved by the Monte Carlo method. The analysis of the behavior of the equation when particle concentration becomes very low is of special interest. The mass loss in the KCE in case of the formation of a few largest particles collecting all other particles is analyzed. Since the KCE is widely used in different branches of Physics, the results showing some unknown properties of the KCE are of interest, and I would like to recommend the paper for publication.

At the same time, I suppose that some important questions should be clarified and discussed in more detail. In the paper the application of the results to droplet collisions in clouds is claimed. For instance, the authors consider initially monodisperse

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suspension with particles of the same size (for instance, 100 droplets of 14 μmin diameter in 1 cm^{-3}). Using the polynomial form of the kernel, the authors evaluate that the KCE will provide correct results in this case for about 1200s. At the same time, the collisions of droplets in clouds are usually calculated using the gravitation kernel, which is equal to zero for droplets of the equal size. So, no drop collisions should be expected in the example presented. The question arises: to what extent the results of the study can be extended to the collisions described by the gravitation kernel, as well as to multi-dispersion suspensions containing particles of different size (similar to clouds). Another important problem is related to the choice of the volume, in which the collisions are modeled (i.e. the KCE is solved). The formation of one single particle (drop) in 1 cm^{-3}does not mean that process of collisions stops, because it means the existence of $10^6 m^{-3}$ drops, which can collide taking into account significant differences in drop sedimentation velocity. In case raindrops are considered, much larger volumes should be used to get statistically significant results. Drop size distributions in clouds hardly can evolve to the stage, when only a few drops or only one large drop remain in the "collisional volume". Raindrops will fall out from the cloud earlier than the stage with a few large drops in corresponding volume will be achieved. Besides, large drops become unstable and can break up. Hence, the question arises: to what extent the analysis presented in the study can be applied to collisions in clouds? This problem becomes even more difficult, when turbulent effects on the collision rates are considered. For instance, in turbulent flow changes of the kernel can be correlated to fluctuations of drop concentration. It is also important to discuss, to what extent the problem of the formation of a few or one single particle as a result of collisions is actual for different branches of Physics mentioned in the paper. The response of the authors is appreciated.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 13733, 2007.