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Modified Aerosol Activation Parameterization

F. Müller (1) and A. Chlond (2)

(1) Bundeswehr GeoInformation Office, Traben-Trarbach, Germany (FrankMueller@awg.dwd.de), (2) Max Planck Institute for Meteorology, Hamburg, Germany (Andreas.Chlond@zmaw.de)

All airborne particles obey one and the same growth law. Assumptions to the growth law are made to reduce complexity and to make it more suitable for special applications (aerosols, cloud and rain drops, ice crystals, etc.). To completely describe related changes caused/induces by particle growth the growth equations are coupled to equations for energy, momentum, trace gases (including water vapor) and chemical species inside the particles, etc. Artificial discrimination between aerosols in equilibrium with the environment and droplets in non-equilibrium with the surrounding environment is based on Köhler's equilibrium equation, which follows from the stationary particle growth equation, and is call activation. The original Twomey parameterization for the activation of aerosols to cloud droplets, i.e. the production of cloud droplets, is extended to be applicable also for the more general case of aerosol activation in the presence of pre-existing cloud droplets. The advantages of the proposed modifications are demonstrated in the framework of an entraining air parcel model as well as in an Large-Eddy Simulation (LES) model. From the LES simulations statistics of both vertical velocity and combined vertical velocity-supersaturation are derived for use in larger scale models.