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Impact of entrainment and mixing on trade-wind shallow convection: implications for indirect aerosol effects

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Chosson et al (J. Atmos. Sci., 2007; p. 2670-2682), Grabowski (J. Climate, 2006; p. 4664-4682), and Slawinska et al (J. Climate, 2008; in press) all showed that assumptions concerning microphysical transformations during entrainment and mixing (i.e., the homogeneous versus inhomogeneous mixing) have a dramatic impact on the albedo of a field of convective clouds. This is because of a significant dilution of these clouds due to entrainment of dry environmental air and the complexity of the small-scale mixing and homogenization. This aspect is especially relevant for the estimate of the indirect aerosol effects, that is, the change of the mean albedo (either through the changes of cloud properties or changes of the cloud fraction) as a result of the change of cloud condensation nuclei. To simulate the indirect effects on shallow warm (ice-free) clouds, a two-moment bulk warm-rain microphysics scheme has been recently developed by Morrison and Grabowski (J. Atmos. Sci. 2007; p. 2839-2861 and 2008, in press). A novel feature of the scheme is that it allows prescribing the homogeneity of the mixing, from the homogeneous to extremely inhomogeneous. This paper will present results of the application of the scheme to the nonprecipitating shallow convection case based on the observations collected during the BOMEX experiment (Siebesma et al., J. Atmos. Sci. 2003; p. 1201-1219) and to the precipitation shallow convection case based on the RICO observations (see http://www.knmi.nl/samenw/rico/). The emphasis will be on the effects of the mixing characteristics on mean properties of clouds, spatial variability of the effective radius in particular. Comparison with the in-situ and romote-sensing observations will

be presented.