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Title: The effects of turbulent collision-coalescence on precipitation formation and precipitation-dynamical feedbacks in simulations of stratocumulus and shallow cumulus convection

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Specific Comments

lines 16-19: Franklin's empirical parameterization is based on four DNSs, each with different values of the Taylor microscale Reynolds number R_λ and the dissipation rate ϵ. The values are related by

$$R_\lambda = 21\epsilon^{0.12}.$$

Because R_λ and ϵ are uniquely related in the set of DNSs that Franklin used for her empirical parameterization, it does not appear possible to construct an empirical parameterization from them that is applicable to any flows other than ones that lie in the range of her DNS paired values of R_λ and ϵ. This would not be the case if the parameterization was based on a theory that applies to a large range of of R_λ and ϵ. In her parameterization, Franklin uses the relation between R_λ and ϵ given above and that was defined by her set of DNSs to replace the dependence on R_λ with one on ϵ. The physical justification for this replacement given in Franklin et al. (2007) is not convincing, however.

As illustrated in Figure 3 from Rosa et al. (2013), R_λ depends on the number of grid points N in each coordinate direction ($R_\lambda = 3N^{2/3}$), and weakly on the forcing method used, but not on ϵ. For example, Rosa et al. performed DNS for N ranging from 32 to 1024, all with $\epsilon \approx 400$ cm^2 s^{-3}, and for which R_λ varied from about 50 to 500. However, Franklin's formula gives a constant $R_\lambda = 43$ for all of these. Rosa et al. showed that the dependence of pair statistics on R_λ is of secondary importance, with saturation at $R_\lambda > 100$ leading to R_λ-independent results. Franklin's parameterization is empirically based on DNS with $R_\lambda \leq 55$ so it does not capture the saturation at $R_\lambda > 100$.

For an empirical parameterization to be applicable to the conditions in a cumulus cloud, for which R_λ is much larger than those in Franklin's DNSs, Rosa et al.'s study suggests that such a parameterization must be based on DNSs with $R_\lambda > 100$.

Perhaps the results presented in Rosa et al. could be used to modify Franklin's parameterization so that is applicable to this range of $R_\lambda > 100$. Without such modification, the results are difficult to interpret as anything other than a sensitivity study to autoconversion and accretion parameterizations modified so that they depend on the dissipation rate, but without a clear physical basis.

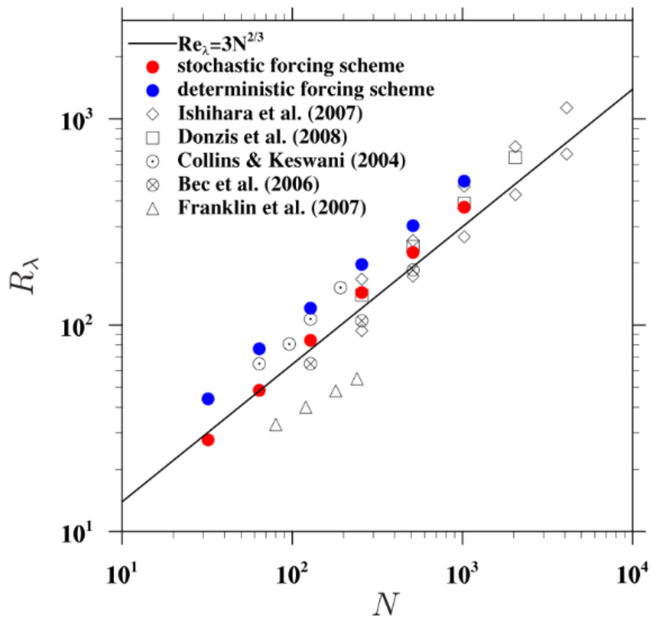

Figure 3. Simulated flow Taylor microscale Reynolds number R_λ as a function of grid resolution N. Blue markers represent values of R_λ obtained in our simulations with the deterministic forcing scheme. Red markers show our results using stochastic forcing.

References

Bogdan Rosa et al 2013 New J. Phys. 15 045032 doi:10.1088/1367-2630/15/4/045032