

Referring to the Srivastava model of a precipitation downdraft, Eqs. 6.27-6.28 in particular, determine the downdraft speed that must be attained for buoyancy to equal entrainment; assume that the entrainment term can be written as $+\Lambda w^2$ (see also the Errata).

In this problem, let the specified rain core be from a monodisperse size distribution such that $q_r = 2 \text{ g kg}^{-1}$, and use $r_c = 2 \text{ km}$ and $\alpha_e = 0.1$ in Eq. 6.24. Assume that only rainwater loading contributes to buoyancy, and that the rain does not evaporate or is otherwise modified during its descent.

Comment on whether or not this downdraft speed is reasonable, and discuss how the neglect of the pressure gradient force in Eq. 6.27, and the assumed height-independency of r_c in Eq. 6.24, might have affected the result.