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Aerosol Activation in simulations of fog - why a new parameterisation is needed

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Aerosols play a major role in cloud and fog formation. Traditionally, aerosol-activation parameterisation schemes calculate the number of droplets by assuming that supersaturation is reached through adiabatic lifting. Furthermore, many activation schemes impose a minimum vertical velocity e.g. 0.1 m/s. In radiation fog, the measured updrafts are often below such updraft thresholds, introducing a major source of error. Furthermore, the main source of atmospheric saturation production in radiation fog formation is radiative cooling and not adiabatic lifting. Consequently, aerosol activation schemes provide inaccurate cooling rates and generally result in too many droplets.

To investigate the error associated with the assumptions used in current schemes, we introduce an amended aerosol activation framework that incorporates a radiative cooling effect. Our results show that the minimum updraft velocity threshold over-predicts the fraction of activated aerosols by up to 70%. In addition, simply using an adiabatic cooling rate can underpredict the same fraction by up to 20%. Further tests are presented based on these results, with this framework applied to the Met Office NERC Cloud (MONC) LES model using the results of a radiation fog case study based in Cardington, UK. These tests will enhance our understanding of the impact that the cloud droplet number has on processes linked to the formation and development of radiation fog.