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# The Role of Initial Cloud Condensation Nuclei Concentration in Hail Using the WRF NSSL 2-moment Microphysics Scheme

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The effects of the initial cloud condensation nuclei (CCN) concentrations (100–3000 $mg^{-1}$) on hail properties were investigated in an idealized hail storm experiment using the Weather Research and Forecasting (WRF) model, with the National Severe Storms Laboratory two-moment microphysics scheme. The initial CCN concentration had obvious non-monotonic effects on the mixing ratio, number concentrations, and radius of hail, both in clouds and at the surface, with a threshold CCN concentration between 300 and 500 $mg^{-1}$. An increasing CCN concentration is conducive (suppressive) to the amount of surface hail precipitation below (above) the threshold. The non-monotonic effects were due to both the thermodynamics and microphysics. Below the threshold, the mixing ratios of cloud droplets and ice crystals increased dramatically with the increasing CCN concentration, resulting in more latent heat being released from vapor condensation and intensified updraft volume. The extent of the riming process, which is the primary process for hail production, increased dramatically. Above the threshold, the mixing ratio of cloud droplets and ice crystals increased continuously, but the maximum updraft volume was weakened because of reduced latent heating, which was related to the reduced riming rate in the storm core area. The smaller ice crystals reduced the formation of hail and smaller clouds, with decreased rain water reducing riming efficiency so that graupel and hail also decreased with increasing CCN concentration, which is unfavorable for hail growth.