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Using direct numerical simulation to improve experimental measurements of inertial particle radial relative velocities PETER J. IRELAND, LANCE R. COLLINS, Cornell University — Turbulence-induced collision of inertial particles may contribute to the rapid onset of precipitation in warm cumulus clouds. The particle collision frequency is determined from two parameters: the radial distribution function $g(r)$ and the mean inward radial relative velocity $\langle w_r^{(-)} \rangle$. These quantities have been measured in three dimensions computationally, using direct numerical simulation (DNS), and experimentally, using digital holographic particle image velocimetry (DHPIV). While good quantitative agreement has been attained between computational and experimental measures of $g(r)$ (Salazar et al. 2008), measures of w_r have not reached that stage (de Jong et al. 2010). We apply DNS to mimic the experimental image analysis used in the relative velocity measurement. To account for experimental errors, we add noise to the particle positions and 'measure' the velocity from these positions. Our DNS shows that the experimental errors are inherent to the DHPIV setup, and so we explore an alternate approach, in which velocities are measured along thin two-dimensional planes using standard PIV. We show that this technique better recovers the correct radial relative velocity PDFs and suggest optimal parameter ranges for the experimental measurements.

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