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Is Stokes number an appropriate indicator for turbulence modulation by particles of Taylor-length-scale size? F. LUCCI, University of California, Irvine, A. FERRANTE, University of Washington, S. ELGHOBASHI, University of California, Irvine — It has been established both experimentally and numerically (e.g. Ferrante and Elghobashi (Phys. Fluids 2003)), that the Stokes number, τ_p/τ_k, can be used as an indicator to determine the extent to which small particles, $d_p < \eta$, modify the turbulence structure, for fixed values of their volume fraction, and mass fraction. Here, τ_p, d_p, η and τ_k are respectively the particle's response time and diameter, the Kolmogorov length- and time-scales. The objective of the present study is to investigate whether τ_p/τ_k can also be used as an indicator for the modulation of turbulence by particles of the Taylor-lengthscale size, i.e. $d_p \sim \lambda >> \eta$. We employ DNS with an immersed boundary method to fully resolve the flow around thousands of freely moving particles of Taylor-lengthscale size ($d_p \sim \lambda$) in decaying isotropic turbulence with initial $Re_\lambda = 110$. Our results show that although the particles in different test cases have identical Stokes number and volume fraction, they have different effects on the turbulence kinetic energy, $E(t)$ and its dissipation rate $\varepsilon(t)$. For example, particles with smaller diameter and larger density ratio, ρ_p/ρ_f, augment $\varepsilon(t)$, resulting in a faster decay of $E(t)$. Our conclusion is that τ_p/τ_k is not an appropriate indicator for determining the extent of turbulence modulation by particles with $d_p \sim \lambda$.

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