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Near-wall turbulence modification by small, heavy particles in a horizontal channel flow JUNGHOON LEE, CHANGHOON LEE, Yonsei University — Near-wall turbulence modification by particles in a horizontal channel flow is investigated via direct numerical simulation coupled with a point-force approximation for small, heavy particles with a diameter smaller than the Kolmogorov length scale of the flow. The Stokes numbers considered are 0.72, 0.81 and 5.3 in wall units and the Froude number is much smaller than 1, indicating that the influence of gravity on particle motion is strong. Particle-particle collisions are not taken into account to focus on the interactions of particles with turbulence. Water droplets in air turbulence are considered. When a particle touches the wall, it is removed, and a new particle is introduced at a random location, with a velocity identical to the fluid velocity at the new position, maintaining a constant particle mass loading. It is shown that the turbulence intensities are enhanced near the bottom wall and reduced in the outer flow region due to the presence of particles, consistent qualitatively with the previous experimental observation by Li et al. (2012). The root-mean-squared vorticity, turbulence production and viscous dissipation are modified in a similar manner to the turbulence intensities. The physical mechanisms responsible for this turbulence modification behavior are discussed by examining the modification of coherent turbulent structures.

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