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Collision statistics of inertial particles in two-dimensional homogeneous isotropic turbulence with an inverse cascade RYO ONISHI, Japan Agency for Marine-Earth Science and Technology, J.C. VASSILICOS, Imperial College London — This study investigates the collision statistics of inertial particles in inverse-cascading 2D homogeneous isotropic turbulence by means of a direct numerical simulation (DNS). A collision kernel model for particles with small Stokes number (St) in 2D flows is proposed based on the model of Saffman & Turner (1956) (ST56 model). The DNS results agree with this 2D version of the ST56 model for St <0.1. It is then confirmed that our DNS results satisfy the 2D version of the spherical formulation of the collision kernel. The fact that the flatness factor stays around 3 in our 2D flow confirms that the present 2D turbulent flow is nearly intermittency-free. Collision statistics for St = 0.1, 0.4 and 0.6, i.e. for St <1, are obtained from the present 2D DNS and compared with those obtained from the three-dimensional (3D) DNS of Onishi et al. (2013). We have observed that the 3D radial distribution function at contact (g(R), the so-called clustering effect) decreases for St = 0.4 and 0.6 with increasing Reynolds number, while the 2D g(R) does not show a significant dependence on Reynolds number. This observation supports the view that the Reynolds-number dependence of g(R) observed in three dimensions is due to internal intermittency of the 3D turbulence. We have further investigated the local St, which is a function of the local flow strain rates, and proposed a plausible mechanism that can explain the Reynolds-number dependence of g(R).

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