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Dynamic effects of inertial particles on the wake recovery of a model wind turbine MARTIN OBLIGADO, LEGI - Université Grenoble Alpes, SARAH E. SMITH, KRISTIN N. TRAVIS, Department of Mechanical and Materials Engineering, Portland State University, HENDA DJERIDI, LEGI - Grenoble INP, RAÚL BAYOÁN CAL, Department of Mechanical and Materials Engineering, Portland State University — Impacting particles such as rain, dust, and other debris can have devastating structural effects on wind turbines, but little is known about the interaction of such debris within turbine wakes. This study aims to characterize behavior of inertial particles within the turbulent wake of a wind turbine and relative effects on wake recovery. Here a model wind turbine is subjected to varied two-phase inflow conditions in a wind tunnel, with air as the carrier fluid (Re_λ = 49-88) and polydisperse water droplets (26 to 45 μm in diameter) at varied volume fractions ($\Phi_v = 0.24 \times 10^{-5}$ - 1.3×10^{-5}), comparing with sub-inertial particles [*i.e.,* tracers] that follow the inflow streamlines. Phase doppler interferometry and particle image velocimetry were employed at multiple downstream locations, centered with respect to turbine hub height. Analysis considers energy and particle size distribution within the wake focusing on turbulence statistics and preferential concentration. Near wake statistics show similarities to those of turbines in single-phase flows, and show persisting velocity deficits at least as far as 9.5 rotor diameters downstream.

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