Abstract Submitted
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Three-dimensional Measurements of Flow Field and Contaminant Dispersion in Urban Environments using Magnetic Resonance Imaging DIPAK PRASAD, NICHOLAS DIVITO, MATTHEW BYERS, WILLIAM WHITE, MICHAEL BENSON, BRET VAN POPPEL, United States Military Academy, CHRISTOPHER ELKINS, Stanford University, CONTAINMENT DISPERSION TEAM — The dispersion of a scalar contaminant through an urban environment is complex to simulate and current modeling techniques lack detailed validation data necessary to assess accuracy. This work provides a detailed data set for Computational Fluid Dynamic simulations as well as an analysis of fluid flow and contaminant dispersion across two incident angles, 0 and 45 degrees from the freestream, across an array of cubical buildings, with one building in the center column three times as tall. The contaminant is injected from the base behind the tall building. Magnetic resonance imaging techniques are used to collect three-dimensional, time-averaged, three-component velocity and concentration field data. The flow is conducted in a water channel at a fully turbulent condition. The 0 degree case shows symmetrical velocity flow around each building with counter-rotating vortices immediately behind the tall building. Scalar contaminant dispersion in this array shows a rapid draw of higher concentration fluid up the back of the tall building, which is advected downstream. The 45 degree array shows similar patterns with vortices covering a larger area in the wake of the tall building. Analysis of the streamlines around the tall building indicate more 'mechanical' dispersion due to the lateral spreading of the streamlines. These experiments should help improve prediction performance.

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