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Self-Preserving Velocity Properties of Steady Round Buoyant Turbulent Plumes in Uniform Crossflows FRANCISCO J. DIEZ, Rutgers University, LUIS P. BERNAL, University of Michigan — The velocity properties of steady round buoyant turbulent plumes have been studied, motivated by applications to the dispersion of heat and potentially harmful substances from steady exhaust flows. The experiments involved salt water sources injected into uniform crossflows in a water channel. Mean and fluctuating velocity fields were measured over cross sections of the flow using Particle-Image-Velocimetry (PIV). Matching the index of refraction of the source and ambient fluids was required in order to avoid image distortion and scattering the laser beam away from the buoyant flow. The self-preserving structure properties of the flow are correlated successfully based on the scaling analysis of Fischer et al. (1979). The resulting self-preserving structure consists of two counter-rotating vortices having their axes nearly aligned with the crossflow direction, which move away from the source in the streamwise (vertical) direction due to the action of buoyancy. This alignment is a strong function of the source/crossflow velocity ratio, u_o/v_∞. Finally, the counter-rotating vortex system is responsible for substantial increases in the rate of mixing of the source fluid with the ambient fluid compared to axisymmetric round buoyant turbulent plumes in still environments.

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