Abstract Submitted
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The Fluid Mechanics of Fires HOWARD BAUM, National Institute of Standards and Technology — The transport of heat and mass by fire induced flows is discussed with emphasis on the role of fire plumes. The fire plume provides the positive feedback mechanisms that determine the fire strength. It also acts as the pump which mixes the fuel and oxidizer distributes the combustion products in space and time. A brief description of some of the observed properties of isolated fire plumes in the laboratory is followed by a "kinematic" representation of plume fluid dynamics. In this model, entrainment is related to the vorticity and heat distributions generated by the fire. The utility of this approach is illustrated by appeal both to experiments on individual laboratory plumes and simulations of mass fires. The interaction of fire plumes with atmospheric winds is illustrated by a smoke dispersion model that couples a simplified description of the stratified atmosphere with a CFD based simulation of the large scale fire induced motions. Fire whirls are a rare but potentially catastrophic phenomenon controlled by the interaction of buoyancy with imposed angular momentum. An "exact" solution of the low Mach number combustion equations illustrates the changes induced by rotation. Finally, the simulation fire dynamics in enclosures is illustrated with results from the NIST investigation of the collapse of the World Trade Center towers.

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