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Collapsing plumes and resurrecting fountains TON VAN DEN BREMER, Department of Engineering Science, University of Oxford, GARY HUNT, Department of Civil and Environmental Engineering, Imperial College London —
We explore the range of behaviour predicted for steady plumes and fountains that undergo an increase or decrease in buoyancy which arise due to phase changes or chemical reactions. We model these changes in the simplest possible way by assuming a quadratic relationship between the density and the temperature of the fluid. We thereby extend the model of Caulfield & Woods ('95) to include the most recent developments in the literature on steady releases of buoyancy emitted vertically from horizontal area sources in unconfined quiescent environments of uniform density based on the plume model of Morton, Taylor & Turner ('56). We provide closed-form solutions and identify four classes of solution: collapsing plumes, resurrecting fountains, plumes with enhanced buoyancy and fountains with enhanced negative buoyancy. We provide criteria for each category of behaviour in terms of the source-value of two non-dimensional quantities: the Richardson number and a temperature parameter.

Caulfield, C. C. P. & Woods, A. W. 1995. Plumes with non-monotonic mixing behaviour. Geophys. Astro. Fluid. **79**, 1-4, 173-199. Morton, B.R., Taylor, G.I. & Turner, J.S. 1956. Turbulent gravitational convection from maintained and instantaneous sources. Proc. Roy. Soc. Lond. A **234**, 1-23.

Ton van den Bremer
Department of Engineering Science, University of Oxford

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