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Icicles: diffusive gravity currents and phase change M.G. WORSTER, J.A. NEUFELD, R.E. GOLDSTEIN, DAMTP, University of Cambridge — The growth and melting of icicles motivates this study of diffusive gravity currents. For example, the growth of an icicle vertically downwards is mediated by convective heat transfer in the surrounding air. The flow of the buoyant air is traditionally viewed as a near-vertical boundary layer and solved using the associated partial differential boundary-layer equations. However, near the tip of the icicle gravity acts in a direction orthogonal to the primary direction of flow. This situation is exemplified by the case of buoyancy-driven flow above a cooled, finite, horizontal plate or below a heated, finite horizontal plate. We find solutions of the corresponding boundary-layer equations in the form of approximate, nonlinear, separable solutions, with the horizontal variation of the boundary-layer thickness being governed by equations similar to those for a gravity current. We exploit the structure of such solutions to compute the steady-state shape and rate of melting of an icicle.

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