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Finite time singularities in the quasigeostrophic model RICHARD SCOTT, northwest research associates — A finite-time singularity in the evolution of a patch of surface temperature in the quasi-geostrophic equations via two distinct evolution routes is investigated with a grid-free, adaptive numerical scheme. In one case, the singularity proceeds through the formation of a corner, developing infinite curvature in the patch boundary in finite time. The corner is self-similar and the growth of curvature appears to be independent of initial patch shape. In the other case, the singularity proceeds through a self-similar cascade of filament instabilities with geometrically shrinking spatial and temporal scales, and the filament width approaches zero in a finite time. The spatially and temporally adaptive numerical scheme permits the accurate simulation of both corner and cascade singularities over a range of spatial scales spanning ten orders of magnitude. Some aspects of both singularity types exhibit universality, being independent of the initial patch shape and large-scale evolution; however, a simple extension of the initial temperature structure provides evidence that only the instability cascade persists in the case of a continuous initial temperature distribution.

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