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**Macroscopic model of unstable two-phase flow in a Hele-Shaw cell** LUIS CUETO-FELGUEROSO, RUBEN JUANES, Massachusetts Institute of Technology — When a less viscous fluid displaces a more viscous one in the gap between two parallel plates (a Hele-Shaw cell) or in a porous medium, the displacement front is unstable, and the hydrodynamic instability that ensues is referred to as viscous fingering. The emerging pattern is characterized by branching structures, with an intrinsic length scale that depends on the fluid properties, essentially viscosity and surface tension between the fluids, the injection rate and gap size, and the wetting properties of the system. Here we present a continuum model of two-phase flow in Hele-Shaw cells that reproduces the observed displacement patterns. The key feature of our model is that it captures the dynamic distribution of fluids in the gap, in the sense that the thickness of the film of more viscous fluid left attached to the wall depends on the capillary number.

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