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The viscoplastic Rayleigh-Benard problem

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We study the onset of convection in a fluid confined between two horizontal plates maintained at different temperatures (the Rayleigh-Benard problem). We consider the viscoplastic version of this problem, i.e. convection in fluids in which the viscosity depends on the shear rate and with a yield stress. We use weakly nonlinear methods to explore the effect of a small yield stress, and extend those results to steady convection in fluids with arbitrary yield stress using numerical methods. We demonstrate that the usual onset of linear instability is removed when there is a yield stress, and uncover how the development of finite-amplitude convective patterns is modified. The effect of shear thinning is also discussed, particularly in the context of 'regularized' constitutive models.