Elastic-skinned gravity currents

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Most active lava flows exhibit a complex surface structure because of the multitude of
stresses acting upon them. As an idealization of this wrinkling process, we present a
theoretical model describing a viscous fluid flowing down an incline beneath an elastic
skin, and apply it in simple geometries. The model consists of Stokes equations for the
fluid coupled to the non-linear von Kármán–Föppl plate equations for the skin. Using
linear stability theory we show that a variety of buckling instabilities are captured,
which may rationalize how surface wrinkling occurs.