3D numerical instantaneous flow models induced by subduction

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We conduct simple 3D subduction experiments using a numerical, finite element approach (Zhong et al. [2000]) to compare the predicted velocity fields with those recorded using Feature Tracking for laboratory analogue models. We prescribe slab temperature and shape based on an intermediate stage of an analogue self-consistent subduction experiment, and study the instantaneous flow field solution for a free slab. We explore the resulting flow patterns, particular the toroidal vs. poloidal component of upper mantle circulation, as a function of box size, plate width, and, importantly, viscosity contrast between slab and mantle. We show that slab rheology determines the strength of toroidal flow, an important consideration when trying to relate subduction processes with observations such as shear wave splitting.

References:

Zhong, S., M.T. Zuber, L.N. Moresi, and M. Gurnis, Role of temperature-dependent viscosity and surface plates in spherical shell models of mantle convection, J. Geophys. Res., 105, 11,063-11,082, 2000.