Gravitational effects and stress in subduction zones

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In order to extend subduction zone force-balance studies to more detailed variations of the stress field in subduction zones (e.g., to study the effects of variations in dip angle and subduction obliquity within an individual subduction zone), we consider the inclusion of gravitational effects into FEM modeling of subduction deformation. To do this we perform calculations of a pre-stress field to balance the gravitational forces arising from density variations in our model. The pre-stress is calculated iteratively until the displacement calculated after applying gravity is acceptably small. Our present work involves 2D calculations, but work is in progress to extend this to 3 dimensions

Knowledge of the state of stress in subduction zones is essential for understanding subduction zone dynamics and seismicity, and in particular is important for assessing the seismic risk associated with the occurrence of great earthquakes there. One of the most important factors in determining the state of stress in a subduction zone is the effect of gravity on density variations, especially that associated with the subducting slab - i.e., 'slab pull'. For this reason slab pull features prominently in force balance studies which have been used to explain how seismic coupling and intra-slab seismicity varies for different subduction zones.

In order to extend such studies to more detailed variations of the stress field in subduction zones (e.g., to study the effects of variations in dip angle and subduction obliquity within an individual subduction zone), a more numerical approach which can systematically deal with variations in shape and density structure seems warranted.

In this presentation we will present work on incorporating gravitational affects in finite element modeling of subduction zone deformation, with particular regard to the stress field. To do this we perform calculations of a pre-stress field to balance the gravitational forces arising from density variations in our model. The pre-stress is calculated iteratively until the displacement calculated after applying gravity is acceptably small. Our present work involves 2D calculations, but work is in progress to extend this to 3 dimensions.