



Revisiting visco-elastic effects on interseismic deformation and locking degree: Case study of Chilean margin

Shaoyang Li, Marcos Moreno, Jonathan Bedford, Matthias Rosenau, and Onno Oncken
Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Potsdam, Germany
(shaoyang.li@gfz-potsdam.de)

Viscoelastic effects are thought to play an important role during all phases of the earthquake cycle in subduction zones. However, models rarely consider the viscoelastic relaxation effects present in the interseismic deformation measurements. Here we use synthetic Finite Element Method (FEM) models to investigate the control of viscoelasticity on interseismic deformation and to present the pitfalls of interpreting the data with elastic models for both the forward and inverse problems. Additionally, we construct a 3-D spherical FEM model of the entire Chilean Subduction Zone constrained by GPS data to estimate along-strike variations of locking degree. Our results confirm that elastic models can overestimate the interseismic locking depth. The application of the viscoelastic model, rather than the elastic model, improves the fit to the interseismic deformation, especially in the inland area. Part of the signals previously interpreted as back-arc shortening in elastic models can be alternatively explained by viscoelastic deformation, which, in turn, refines the interseismic locking pattern in both dip and strike directions. Our viscoelastic locking map exhibits very good correlation with the slips of previous earthquakes and present the transitional limits between wide locked regions to dominantly creeping sections, providing a detailed view of the locking state useful to determine slip deficit. We conclude that incorrect elastic assumptions affect the analysis of interseismic deformation build up mechanism and the calculated slip deficit. Our results thus suggest that it is necessary to thoroughly re-evaluate the elastic locking models, some of which potentially attribute viscoelastic deformation to different sources as e.g. microplate sliver motions