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Viscoelastic deformations during a seismic cycle and over cycle around a subduction zone ? Simulation for a realistic SNRVEI earth

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Although there are many previous works to estimate crustal deformations around a subduction zone during one or over many repeated seismic cycles, they are not free from unrealistic assumptions to avoid intrinsic numerical difficulties; some ignore the earth's self-gravitation, some compressibility, and others radial stratification. We develop here a new recipe to compute post-seismic deformation in a realistic, spherically symmetric, non-rotating, visco-elastic, and isotropic (SNRVEI) earth. The calculation is done without the forementioned unrealistic approximations. The essential point of the new algorithm is to perform Laplace inversion integration without evaluating contribution from the innumerable poles.

Using this method, we present a complete set of the Green function , i.e. time variations of displacement, gravity, geoid height on the surface for 4 independent types of point dislocation: strike-slip on a vertical plane, dip-slip on a vertical plane, tensile faulting on a horizontal plane and tensile faulting on a vertical plane. As an earth model, we employ the 1066A together with the standard viscosity profiles. The result shows a diverse spatial pattern due to a viscous structure or a source depth. In particular, ratio of the source depth to the lithosphere thickness governs the evolution of the post-seismic deformation.

Of particular interest is that the far-field deformation (epicentral distance greater than a few hundreds km) clearly reveals transient behavior. This makes a contrast to the near field deformation where coseismic change dominates. It follows that post-seismic gravity change might be detected with satellite missions because the wavelength exceeds 100 km, if a sufficiently large earthquake occurs.

If the back-slip hypothesis holds at a subduction zone, integration of the Green functions over a finte fault plane allows us to compute both transient and secular displacement and gravity change. We shall compare the theoretical result with the observed secular uplift and gravity change at the Tokai region where a larege earthquake is anticipated to occur in a near future.