Modeling co- and post-seismic deformations in reference frame determination

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Abstract
Current realizations of reference systems, such as the ITRF2008 frame, are based on a piecewise linear model for the time evolution of station coordinates. Continuous improvements in the precision of geodetic techniques impose to realize more accurate and stable reference frames. Is the reference frame model today the most adapted?

1. Co-seismic deformations: from an empirical to a self-acting geophysical search of discontinuities in station position time series

2. Post-seismic deformations: from a linear piecewise to a parametric representation of station coordinates.

Search of seismic discontinuities in time series: discontinuities in GNSS time series due to giant earthquakes are usually detected visually. Based on our geophysical modeling, we develop a method to detect the impact of unexpected co-seismic deformations in GNSS time series. For example:

- Case of giant earthquakes in the far-field
  - Antenna/Receiver changes: Sumatra Earthquake (Mw 9.1)
    - Station velocity change: ± 1.4 mm/yr
  - Station velocity change: ± 0.2 mm/yr

- Case of smaller earthquakes in the near-field
  - HILO East component: Nisqually Earthquake (Mw 6.8)
  - SEAT North component: Nisqually Earthquake (Mw 6.8)

Figures and tables:

- Differences between the classical and the parametric modeling approaches may reach 1 cm.

Acknowledgements: GNSS position time series used in section 1 were computed from IGS combined SINEX files (Rebeschung et al., 2011). Residual position time series used in section 2 were downloaded from NASA/JPL web site (Hein & et al., 2012), we used a Cholesky code developed by F. Bressanelli.

Keywords: Co-seismic deformations, post-seismic deformations, piecewise linear modeling, parametric modeling, station coordinates, earthquake, seismic, deformation, geodesy.