Integrated study of the transient slow slip events beneath the Boso peninsula, Japan

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Abstract

The Boso Peninsula (Japan) is close to the triple junction between the North America plate (NA), the Pacific plate (PAC) and the PhilippineSea plate (PHS). The PHS is subducting beneath the NA plate, while the PAC subducts beneath the NA along the Japan trench and beneath the PAC at the Bonin trench. These movements cause a strong seismicity in Boso area with an accelerating seismicity rate from 1990 to 2014 [*Reverso et al., 2016*]. This area also hosted eight $6.4 \leq Mw \leq 6.6$ Slow Slip Events (SSEs) between 1983 and 2014 (in 1983, 1990, 1996, 2002, 2007, March 2011, October 2011 and 2014) [*Hirose et al., 2012; Ozawa, 2014*]. The recurrence interval between those SSEs has progressively decreased from 6.4 years in the 90's to 2.2 years after the occurrence of the Mw 9.0 2011 Tohoku earthquake [*Ozawa, 2014*]. Finally, the existence of smaller SSEs in 2005 and 2010 has been hypothesized from repeating earthquake analyses [*Gardonio et al., 2018*].
The goal of this study is double. First, we wish to investigate whether the decadal acceleration of seismicity rate is reflected in the surface displacement time series measured by GPS. Secondly, we want explore if additional undescribed lower Mw SSEs can be detected and characterized using the same GPS time series.

GPS time series are post-processed following a trajectory model *[Bevis and Brown, 2014]* accounting for antenna jumps, co-seismic steps for $Mw \geq 6.4$ earthquakes and SSEs, post-seismic relaxation for $Mw \geq 7.5$ earthquakes, seasonal variations and a secular term. We then tried to model the residuals with a quadratic term. To assess if models with a quadratic term better explain the time series than models with a linear term only, we used the Akaike information criterion, that accounts for the number of model parameters. A quadratic term is usually required to better explain the residual time series.
To detect potential small SSEs in residual time series, we use the geodetic matched filter developed by *Rousset et al.* [*2017*], based on cross-correlations between the residual GPS time series and physical dislocation slip models. Synthetic tests have been performed and show that SSEs as low as Mw 5.5 can potentially be detected with the dense GPS network in this area. Applying this method to the real dataset will provide a better understanding of the SSEs cycle in the Boso area and should confirm the occurrence of small SSEs of 2005 and 2010.

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