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GPS 時系列データの逐次インバージョンによるプレート間カップリング変化の推定
Sequential inversion of GPS time series data to estimate spatiotemporal change in interplate coupling

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To estimate steady increase rates of slip deficits at plate interfaces, first, we obtain linear trends of the time series of GPS daily coordinate data by removing seasonal variations and coseismic and postseismic changes due to episodic events. Then, we invert the linear trends (surface displacement rates at GPS stations) into steady slip-deficit rate distribution on a plate interface with completely relaxed slip-response functions for an elastic-viscoelastic layered half-space model under gravity (Noda et al., 2013, GJI). Noda et al. (SSJ 2012 Annual Meeting) demonstrated that this method is applicable to GPS time series data in northeast Japan for the interseismic period (March 1997-February 2008) before the 2008 Ibaraki-oki (Mw6.8) and Fukushima-oki (Mw6.9) earthquakes. After these events, the trends of GPS time series data gradually change with time (Suito et al., 2011, EPS), indicating spatiotemporal change in interplate coupling preceding the 2011 Tohoku-oki mega-thrust earthquake.

The change in slip-deficit rate distribution disturbs a steady stress state in the asthenosphere, and so we need to use the viscoelastic transient slip-response functions for the analysis of GPS time series data after the 2008 events (Noda et al., 2013, GJI). An exact treatment of the viscoelastic inverse problem to estimate cyclic slip processes at a plate interface has been given by Fukahata et al. (2004, GJI), but it is not applicable to the present problem because the change in slip-deficit rate distribution is not a cyclic but transient process. So, we propose a simple inversion technique, called sequential inversion of GPS time series data, to estimate spatiotemporal changes in slip-deficit rates at plate interfaces. A similar sequential inversion technique has been used by Lubis et al. (2013, GJI) for the analysis of afterslip distribution following the 2007 southern Sumatra earthquake (Mw8.5) on the assumption that the asthenosphere has been in a steady stress state until the 2007 event.

In the present study, we estimate the spatiotemporal change in interplate coupling by applying the sequential inversion technique to GPS time series data for March 2008-February 2011, and reveal the slip history at the North American-Pacific plate interface off Tohoku during the 14 years before the 2011 Tohoku-oki mega-thrust earthquake.

キーワード: GPS 時系列データ, 逐次インバージョン, 過渡的な粘弾性応答, プレート間カップリング変化, 2011 年東北沖地震
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