Temporal Variation of Interplate Coupling in Java Subduction Zone Based on 2008-2012 GPS Observations

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In the southern Java, the Australian plate subducts beneath Sunda Block at almost perpendicular direction on the western part of Java trench and more oblique along the rest of Java trench. There have been several earthquakes, the 2009 West Java (M7.0), the 2010 West Java (M5.9), the 2011 East Java (M5.7) and the 2011 Bali (M6.1) that occurred as a result of interplate coupling along the Java subduction zone. Since they caused coseismic offsets in the coordinate time series at several GPS sites near the epicenter, we divided them into some specific time periods and estimated the temporal variations of the slip deficit rates along Java subduction zone. We carry out the geodetic inversion analyses of the GPS site velocities from 2008 to 2012 located in Java, Bali, Madura, and Lombok (54 national network sites) and 10 IGS stations, together with the azimuth of slip vector from some earthquakes in Java subduction zone using TDEFNODE software (McCaffrey, 2009). We use the Euler pole parameter from previous result (Longitude: 86.876ºW, Latitude: 48.917ºN, and Angular velocity: -0.330º/Myr) in the inversion. We do several checkerboard tests to examine how well the artificial distributions of coupling ratio with 100% and 0% slip deficits can be restored. The results show that TDEFNODE can recover well the most part of fault surfaces in Java subduction zone except for the plate boundary near the trench.

The locking map before and after the 2009 West Java earthquake demonstrates the low coupling rate of ~30 mm/yr and ~10 mm/yr, respectively, near the hypocenter. The inversion result before the 2010 West Java earthquake cannot detect the significant coupling rate near the hypocenter because the lack of the data but after that earthquake the coupling rate became ~10 mm/yr. The locking map before and after the 2011 East Java earthquake and the 2011 Bali earthquake show the unrealistic result since low ability to resolve the coupling rate in the easternmost of Java Subduction zone. Overall the inversion of the GPS data before the 2012 Sumatra earthquake shows the low coupling rate of ~30 mm/yr in the western part, the coupling rate of ~40 mm/yr in the middle part, and the very high rate of ~70 mm/yr in the eastern part.

References:
McCaffrey, R. (2009), “Time-dependent inversion of three-component continuous GPS for steady and transient sources in northern Cascadia”, Geophysical Research Letters, 36, L07304, doi:10.1029/2008GL036784

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