Block Rotation and Intra-plate Deformation in Java, Indonesia based on GPS observations

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Using the 1998-2013 horizontal velocity field including continuous and campaign Global Positioning System (GPS) phase data, we interpret the kinematics of Sunda Block and the present deformation of Indonesia. Four major earthquakes, the 2006 Java (M7.7, e.g. Ammon et al., 2006), The 2009 West Java (M7), and the 2012 Indian Ocean earthquakes (M8.6 and 8.2) occurred around southern boundary of the Sunda Block that affected the horizontal velocity field within the block. Since we only have the short span of time series for several sites especially in the Java island, we should remove the offsets and the exponential or logarithmic trends in the time series due to the earthquakes. By means of TDEFNODE (McCaffrey, 2009), we invert GPS site velocities simultaneously to estimate the Euler rotation parameter of blocks, earthquake slip vectors, and uniform horizontal strain rate tensor within the blocks. We constructed several block models for the Sunda Block kinematics and deformations. We assume one to four faults extending from the western part off the southern coast of Java and estimate the slip distributions. We also assume the different constraints on the nodes on these faults. From a series of the block models, we determine a preferred model by applying F-distribution tests between two models. The preferred model here is the one consisting of four faults along the java trench with unconstrained nodes without a homogeneous strain rate tensor, and produces the reduced chi-square of 0.754. This model generates the Euler rotation parameters of 48.917 ºN for latitude, 86.876 ºW for longitude, and 0.330 ±0.002 º/Myr for angular velocity with an error elliptic axes of 0.96º and 0.15º for the pole location. The distributions of interseismic locking on the plate boundary along the Java trench demonstrates the low coupling rate of ~30 mm/yr in the western part, the very low rate <10 mm/yr in the middle part, and the very high rate of ~65 mm/yr in the eastern part. The residual velocities derived from this model indicate the effect of the postseismic deformation in the western part of Java and the extensional pattern in the eastern part of Java, which may suggest volcanic deformation.

References:
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