Interseismic and coseismic deformation on the Philippine Fault (Leyte Island) resolved by InSAR

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Abstract

The 1,200-km long left-lateral strike-slip Philippine Fault is known to display a spectrum of fault slip behavior from large earthquakes to aseismic slip. While the first geodetic surveys have shown that the Philippine Fault exhibits shallow interseismic creep along its central segment in the island of Leyte, and despite the present ubiquity of space geodesy, no systematic analysis has been done to understand the rate and extent of aseismic slip, the heterogeneity of deformation, and the potential for earthquakes in the creeping segment. Furthermore, in July 2017, the largest instrumentally recorded earthquake (Mw 6.5) occurred in the area (with an epicentral depth of 8-10km). We resolve the interseismic deformation with InSAR NSBAS time-series analysis from ALOS-1 PALSAR data (2006-2011) assuming a linear rate. A clear step in the surface line-of-sight velocities across the Philippine Fault can be seen, indicative of surface creep. We infer around 3 cm/yr of interseismic deformation, similar to the slip rate calculated from earlier campaign GPS data (1991-1995). We also observe subsidence related to geothermal energy production adjacent to the fault with additional off-fault deformation. For the Mw 6.5 earthquake (coseismic), we derive the surface displacements from differential interferometry of Sentinel-1 data. The areas of maximum displacement are in accordance with observed displacements in the field. Preliminary results of three-dimensional slip modeling from both the interseismic and coseismic data suggest along-strike variations of shallow interseismic slip rate. Peak coseismic slip along the fault coincides with the fault section where interseismic creep rates are lower.

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