Geophysical Research Abstracts
Vol. 14, EGU2012-160, 2012
EGU General Assembly 2012

The Seismic Coupling of Subduction Zones Revisited

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The nature of seismic coupling for many of the world's subduction zones has been reevaluated. Geodetic estimates of seismic coupling obtained from GPS measurements of upper plate deformation during the interseismic period are summarized. We compared those with new estimates of seismic coupling obtained from seismological data. The results show that with a few notable exceptions the results using the two methods agree to within about 10%. The seismological estimates have been greatly improved over those made 20-30 years ago because of an abundance of paleoseismological data that greatly extend the temporal record of great subduction earthquakes and by the occurrence, in the intervening years, of an unusual number of great and giant earthquakes that have filled in some of the most critical holes in the seismic record. The data also, again with a few notable exceptions, support the frictional instability theory of seismic coupling, and in particular, the test of that theory made by Scholz and Campos [1995]. Overall, the results support their prediction that high coupling occurs for subduction zones subjected to high normal forces with a switch to low coupling occurring fairly abruptly as the normal force decreases below a critical value. There is also considerable variation of coupling within individual subduction zones. Earthquake asperities correlate with areas of high coupling and hence have a semblance of permanence, but the rupture zones and asperity distributions of great earthquakes may differ greatly between seismic cycles because of differences in the phase of seismic flux accumulation.