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Co- and post-seismic slips of the 2011 Tohoku-oki Earthquake sequence from EOF analysis of GPS kinematic time series

MUNEKANE, Hiroshi[1*]

[1]GSI of Japan

GPS kinematic time series are analyzed to estimate slip distributions for the M 9.0 2011 off the Pacific coast of Tohoku Earthquake sequence. Empirical orthogonal function (EOF) analysis is employed to enhance the signal-to-noise ratio of the original time series. The coseismic and subsequent postseismic deformations of the foreshock can be described by a single mode, suggesting that the extent of the source for both events must be similar. The total moment magnitude of the afterslip following the foreshock is estimated to be M 7.1 with a decay time of 0.63 days. The magnitude of the afterslip was larger for the duration than was anticipated by the scaling law for a typical slow earthquake, although two previous earthquakes in the adjacent regions showed the same tendency as that in the present case. No acceleration of quasistatic slip that may hint at the occurrence of a future mainshock was detected. The pattern of slips of the mainshock and the subsequent afterslips and aftershocks indicates that each slip occurs in a region adjacent to that of the previous slips in a complementary manner. Finally, in the course of the EOF analysis, the modes representing the thermal expansion of the GPS pillars are clearly identified.

Keywords: Kinematic GPS, Empirical Orthogonal Function, Coseismic slip, Afterslip