# Estimating rate and state friction parameters from postseismic GPS data

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We model early postseismic deformation of the 2003 Tokachi-oki earthquake using high-rate GPS posititions calculated every twelve minutes for the first 5 hours following the main shock. The data show little or no motion at GPS sites immediately after the earthquake with sudden acceleration at about 1.5 hours after the main shock followed by gradual deceleration. We interpret the GPS signal during this first 5 hours as a response to afterslip on the subduction interface. We model the time series of the postseismic deformation using a spring-slider model that is assumed to obey a rate- and state-dependent friction law. We invert the GPS time series to estimate the posterior probability distribution of the friction parameters in the rate- and state-dependent friction law using a Markov chain Monte Carlo method with standard Metropolis rule. The results show that the friction parameters can be fairly tightly constrained by the data. However, the parameters are strongly correlated, and this makes the algorithm inefficient. We found that the 1.5 hour delay in afterslip places tight constraints on the critical slip distance, $D_c$, which we estimate to be $0.5¥times $10^{-3}$-2.5¥times $10^{-3}$ m. This value is larger than laboratory measurements of $D_c$ which are of order $10^{-6}$ to $10^{-4}$ m. The estimated value of $¥sigma(a-b)$, an indicator of frictional stability, is about 0.105 MPa, consistent with other estimates using postseismic data and rate-dependent friction laws.