Geophysical Research Abstracts
Vol. 13, EGU2011-948, 2011
EGU General Assembly 2011


# The systematic study of the stability of forecasts in the rate- and state-dependent model

Denise De Gaetano (1), John McCloskey (2), and Suleyman Nalbant (2)

(1) School of Environmental Sciences, University of Ulster, Coleraine, Northern Ireland, UK (de_gaetano-d@email.ulster.ac.uk), (2) School of Environmental Sciences, University of Ulster, Coleraine, Northern Ireland, UK

Numerous observations have shown a general spatial correlation between positive Coulomb failure stress changes due to the main shock and the locations of aftershocks. However, this correlation does not give any indication of the rate from which we can infer the magnitude.

*Dieterich's* rate- and state-dependent model can be used to obtain a forecast of the observed aftershock rate for the space and time evolution of seismicity caused by stress changes applied to an infinite population of nucleating patches. The seismicity rate changes in this model depend on 6 parameters: the stressing rate, the amplitude of stress perturbation, the physical constitutive properties of faults (represented by the parameter $A\sigma$), the background seismicity rate, the spatial parameters (location and radii of the cells) as well as the start and duration of each of the temporal windows. We will use the 1992 Landers earthquake as a case study, using the Southern California Earthquake Data Centre (SCEDC) catalogue, to examine if *Dieterich's* rate- and state-dependent model can forecast the aftershock seismicity rate. We perform a systematic study on a range of values on all the parameters to test the forecasting ability of this model. The results obtained are a comparison between the calculated aftershock seismicity rate and the observed aftershock seismicity rate, by taking the logarithm of the ratio between the two. These results suggest variable success in forecasting, when varying the values for the parameters, with the spatial and temporal parameters being the most sensitive.

The *Omori* law is another forecasting model where the aftershocks follow a power law. This law uses less parameters (the aftershock productivity, the elapsed time since the main shock and the constant time shift). We examine which one of the two techniques, between *Dieterich's* rate- and state-dependent model and *Omori's* law is more accurate in forecasting the aftershock seismicity rate, taking into account the number of parameters being used. The same data set, using the same spatial and temporal criteria is taken into account for both models. An initial time window just after the main shock occurs is set, starting with a day and increasing at equal time intervals. Then the best fit value for the parameter in that time window is calculated using the downhill simplex method. These values for the parameters are then used to forecast the remainder of the aftershock sequence. The success of *Dieterich's* model against *Omori's* law can only be evaluated if the number of free parameters being used are penalised by taking the *Akaike* information criterion. The model having the lowest *Akaike* information criterion is considered the best.