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二次余震を含んだ摩擦構成則モデリングに基づく余震活動シミュレーション
A numerical simulation of an aftershock activity with the rate-and-state friction model and secondary aftershock effect

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The model of seismicity rate with rate- and state-dependent constitutive law suggested by Dieterich [1994, JGR] (hereafter referred to as Dieterich model) successfully explains the decay rate of an aftershock activity following an inverse power law (Omori-Utsu law [Utsu, 1961, Geophys. Mag.]). The temporal decay of an earthquake sequence derived from the Dieterich model is asymptotically the same as the particular case of the Omori-Utsu law with the p-value equal to 1, but real aftershock sequences has a variety of the p-value. Some studies have already attempted to resolve this consistency, but it is difficult to reproduce the case of $p > 1$. For this issue, Dieterich [1994] suggests his model including secondary aftershock effect. In this framework, Marsan [2006, JGR] shows the variation on the decay of an aftershock activity with his numerical simulation, but did not discuss how the p-value changes.

This study clarifies the effect of secondary aftershocks on the variety of aftershock decay through a numerical simulation. The approach used in this study is similar to that of Marsan [2006]. Probability distributions of stress changes caused by a mainshock and each aftershock are assumed, and random stress changes which follow the assumed probability distributions are given to a huge number of subfaults. Then, on the basis of the Dieterich model, we compute the seismicity rate with the given stress changes. While Marsan [2006] shows the expected decay of a seismicity rate, in this study earthquake sequences are generated from the computed seismicity rate and the p-values are estimated by fitting the Omori-Utsu formula to each of the generated sequences. The numerical simulation reveals that the p-value depends on the assumed probability distributions of stress changes and that in particular p-value is greater than 1 if the mean of the stress changes caused by aftershocks is positive.

キーワード: 余震活動, 大森・宇津公式, p 値, 速度および状態依存摩擦構成則, 点過程解析, 統計地震学
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