

地球动力学★地震学

基于时-空ETAS模型给出的川滇地区背景地震活动和强震潜在危险区

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**摘要** 利用基于时-空传染型余震序列 (Epidemic Type Aftershock Sequence, 简称ETAS) 模型的随机除丛法, 重新审视了2008年5月12日汶川 $M_S$ 8.0地震前可能存在的长期地震活动异常, 研究了川滇地区背景地震活动特征, 并评估了当前的强震危险状态. 对川滇地区1970年以来的  $M_L$ 3.0以上的背景地震和丛集地震活动的研究表明, 该地区地震丛集特征明显、时空分布很不均匀、地震序列常有前震事件. 直接将概率值作为地震计数的权重, 对地震丛集率空间分布图像分析表明, 汶川 $M_S$ 8.0地震前, 龙门山断裂带中南段存在着长期、大范围的地震丛集率低值区, 震前该段处于应力闭锁状态. 对川滇地区地震丛集率低值区内背景地震与全部地震的累积次数、 $b$ 值和新定义的 $\Delta b$ 等统计参量的分析表明, 龙日坝与龙门山断裂带具有地震活动的关联性, 川滇地区当前的强震潜在危险区可能是巧家地区和汶川 $M_S$ 8.0地震破裂尚未穿越的龙门山断裂带南段. 此外, 还发现 $b$ 值倾向于反映局部应力场变化, 而 $\Delta b$ 能较为敏感地给出更大范围应力场的相对变化.

**关键词** [Based on the time-space epidemic-type aftershock sequence \(ETAS\) model and stochastic declustering method, a retrospective study was conducted to investigate whether long-term seismicity anomalies existed before the May 12, 2008, Wenchuan  \$M\_S\$ 8.0 earthquake, and to evaluate the current potential risks of strong earthquakes in the Sichuan-Yunnan region. We analyzed the background and clustering of earthquakes above  \$M\_S\$ 3.0 in the period from 1977 to the day before the Wenchuan  \$M\_S\$ 8.0 earthquake, the results showed that seismic activity in the Sichuan-Yunnan region was significantly clustered, heterogeneously distributed in space and time, and the earthquake sequences were usually preceded by foreshock events. Through the analysis of the spatial variation of the 'clustering seismicity ratio', we found that there existed a long-term and large area of low 'clustering seismicity ratio' in the middle-south section of Longmenshan faults, which implied that this region had been in a state of stress barrier before the Wenchuan  \$M\_S\$ 8.0 earthquake. Statistics of several parameters including cumulative numbers of background and total seismicity,  \$b\$  value and newly defined  \$\Delta b\$  value were conducted to evaluate the current potential risk of strong earthquakes in the areas of low 'clustering seismicity ratio' in the Sichuan-Yunnan region. The results showed that the seismic activity is correlated significantly between the Longriba and Longmenshan faults, and that the Qiaojia region and the southern segment of Longmenshan faults have high potential of strong earthquakes. Moreover, we also found that the  \$b\$  value trends to reflect the local variations of stress field, while  \$\Delta b\$  can reveal sensitively the relative variation of the stress field in a larger spatial range.](#)

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Evaluation of background seismicity and potential source zones of strong earthquakes in the Sichuan-Yunnan region based on the space-time ETAS model

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**Key words** [Long-term seismic hazard evaluation; Potential source zones of strong earthquake; ETAS model; Sichuan-Yunnan region; Wenchuan  \$M\_S 8.0\$  earthquake](#)

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