

## 利用背景噪声互相关研究汶川地震震源区地震波速度变化

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## Temporal changes of seismic velocity around the Wenchuan earthquake from ambient seismic noise correlation

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摘要

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## 摘要

利用2007年3月至2009年3月四川数字地震台网的宽频带连续波形资料, 通过计算地震背景噪声互相关提取台站对间的经验格林函数, 在0.1~0.5 Hz频带下测量每天经验格林函数与参考经验格林函数的走时偏移, 进而得到各台站对在该时段内的相对地震波速度变化。结果表明, 2008年5月12日汶川 $M_s$ 8.0级地震造成了震源区地震波速度的急剧降低, 最大降幅达0.4%; 大致以安县为界, 西南部地区在汶川主震后波速降即达到最大值, 而东北部地区的最大波速降一般出现在主震后的1~4个月, 相对地震波速度的分段特性与地震序列的时空分布特征有较好的对应关系; 在震源区外围的四川盆地也观测到了震后波速降低, 而川西高原有出现显著的波速变化。进一步的分析和计算结果表明主震的静态应力变化和强地面运动引起的地表破坏都不能很好地解释波速的急剧降低, 地震导致的断层区内部结构破坏和周边介质应力状态改变可能是波速变化的主要原因。

 关键词: [地震背景噪声](#) [经验格林函数](#) [地震波速度变化](#) [汶川地震](#)

## Abstract:

We detected the variations of crustal seismic velocity around the  $M_s$ 8.0 Wenchuan earthquake fault zone from March 2007-March 2009 from ambient noise cross-correlation by using continuous seismic data record of broadband stations of Sichuan digital seismic network. The data processing procedure was divided into three phases: (1) single station data preparation including time domain normalization, spectral whitening, empirical Green function estimation and correlation and temporal stacking of 31-day daily cross-correlation functions (CCF), and (3) estimation of seismic velocity change by measuring travel time shifts in frequency 0.1~0.5 Hz between the 31-day stack of reference empirical Green function, which was the stack of 14 months of CCF before the Wenchuan earthquake. The preliminary results revealed a sudden post-seismic velocity drop for the station pairs across the Longmenshan fault, the largest of which was more than 0.4%. The seismic velocity changes with time exhibited a clear spatial difference: in the southwest segment of the Longmenshan fault, the maximum value of velocity reduction occurred at the time immediately after the Wenchuan earthquake, whereas in the northeast segment of the fault, velocity reduction appeared 1~4 months after the main earthquake. Furthermore, the spatial extent of the post-seismic velocity change in the Sichuan Basin exceeded that in the mountainous region west of the fault zone. The static stress change and near-surface physical damage caused by strong ground motion could not entirely explain the measurements in this study. We think the temporal changes of seismic velocity maybe related to the damages from fault ruptures and stress changes around the fault zones.

 Keywords: [Ambient noise correlation](#) [Empirical Green function](#) [Seismic velocity change](#) [Wenchuan earthquake](#)

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