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The data analysis of 4-component borehole strainmeters with high sampling rate

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Two sets of 10 Hz YRY 4-component borehole strainmeters and one set of 100 Hz FBS-3B broadband seismometer are adopted to study the 11 April 2012 MW 8.6 earthquake off the west coast of northern Sumatra, and compare the response characteristics during the coseismic stage after preprocessing the data. It is convenient to investigate the spectrum's dynamic process during the coseismic stage with the S transformation method, and analyze on the spectrum's details of different seismic phases. The time series of borehole strain observations display very good consistency between two sets of orthogonal strain sum, and show high signal to noise ratio during the earthquake. The relationship between observations of YRY 4-component borehole strainmeters at different locations disagree with the theoretical prediction, and that may mainly result from local structural complexity, coupling condition and sensitivity diversity. The S transformation results indicate that the components of high frequency in observational records soar immediately after the first arrival of seismic waves and cover a large range of frequency band. After the arrival of some seismic phases of P and S waves, the surface waves with dominant energy emerge in the records characterized by obvious frequency dispersion. The components of the surface waves with low frequency arrive first and then the other high frequency components. The frequency band of record narrows down and all the distinctive signals stay in a stable frequency range after the surface waves leaving. The S transformation results of colocated seismometer and borehole strainmeter show that the evolutions of the two coseismic spectrums have much in common, and so do the results of two borehole strainmeters which is not far from each other. Comparison between them can be helpful for indentifying the origins of specific wave signals. Therefore, it is reliable to observe the data at high frequency using the borehole strainmeters and to bridge the gap of observational frequency band between seismometers and GPS.

Key words: high sampling rate; 4-component; strain; coseismic; time-frequency