How much information does an observed data set include ? (2): the importance of covariance for source inversion of seismic waves

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The methods of source inversion using seismic waveform have been developed by previous studies. The inversion with ABIC has been applied widely, in order to estimate a detailed and stable solution. In formulation of the observation equations in the source inversion, a covariance matrix of data was assumed as a diagonal matrix. This assumption means that data vector do not include a correlated error in time and space domain, and the information of source model increase with a sampling frequency of waveform. Since the observed seismic wave contains the effect un-elastic attenuation as long as the observation point is not located in a source area, seismic data include a correlated error in time domain. In addition, a procedure of the low pass filtering creates a correlated error in time domain, whish often applied in source inversion. According to the above reasons, the assumption that the covariance matrix can be regarded as a diagonal matrix seems to be unreasonable. In this study, we calculated the covariance matrix that contains the effect of un-elastic attenuation and low pass filter, performed source inversion of a few large earthquakes, and then compared between the results with proper covariance matrix and that with diagonal covariance matrix. To calculate inverse of covariance matrix with stable, we selected a proper re-sampling rate that depends on a characteristic of un-elastic attenuation and low pass filter. We found that slip distributions with the proper covariance matrix are stable, while slip distributions with diagonal covariance matrix sometime became unstable when re-sampling frequency of seismic wave is higher than 2Hz.