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Static corrections for enhanced signal detection at IMS seismic arrays

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Seismic monitoring forms an important part of the International Monitoring System (IMS) for verifying the Comprehensive nuclear Test Ban Treaty (CTBT). Analysis of seismic data can be used to discriminate between nuclear explosions and the tens of thousands of natural earthquakes of similar magnitude that occur every year. This is known as "forensic seismology", and techniques include measuring the P-to-S wave amplitude ratio, the body-to-surface wave magnitude ratio (m_b/M_s), and source depth.

Measurement of these seismic discriminants requires very high signal-to-noise ratio (SNR) data, and this has led to the development and deployment of seismic arrays as part of the IMS. Array processing methodologies such as stacking can be used, but optimum SNR improvement needs an accurate estimate of the arrival time of the particular seismic phase.

To enhance the imaging capability of IMS arrays, we aim to develop site-specific static corrections to the arrival time as a function of frequency, slowness and backazimuth. Here, we present initial results for the IMS TORD array in Niger.

Vespagrams are calculated for various events using the F-statistic to clearly identify seismic phases and measure their arrival times. Observed arrival times are compared with those predicted by 1D and 3D velocity models, and residuals are calculated for a range of backazimuths and slownesses. Finally, we demonstrate the improvement in signal fidelity provided by these corrections.