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Detecting the DPRK nuclear test explosion on 25 May 2009 using array-based waveform correlation

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The Democratic People's Republic of Korea (DPRK) announced on 25 May 2009 that it had conducted its second nuclear test, the first one having taken place on 9 October 2006. As was the case with the first test, the second test was detected and reported by the IDC. We have carried out an experiment taking the 9 October 2006 test as a starting point and running a continuous waveform correlation scheme in order to a) assess the potential for automatically detecting the second nuclear test and b) monitoring the false alarm rate associated with such a detection scheme. Using only data from the Matsushiro array (MJAR), and applying the array-based procedure developed by Gibbons and Ringdal (2006) with a waveform template from the first nuclear test, we found that the second test was readily detected without a single false alarm during the entire three year period. Moreover, by a scaling procedure, we argue that an explosion many times smaller than the second test would have been detected automatically, with no false alarms, had it taken place at the same site as the second test. We note that this remarkable performance is achieved even though the MJAR array is known to be difficult to process using conventional methods, because of signal incoherency. An important element of the detection procedure for the automatic elimination of false alarms is a post-processing system which performs slowness analysis on the single-channel cross-correlation traces. It is well known that successful correlation detection requires the two sources to be closely spaced (i.e. the detector has a narrow "footprint"), but there is evidence that array-based correlation covers a larger footprint than the 1/4 wavelength estimated by Geller and Mueller (1980) for single-station correlation. This could be important for a more general application of the method described here, and needs further study.