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The North Korean nuclear test in 2016 – release of shear energy determined by 3D moment tensor inversion

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On January 6, 2016 the Democratic People's Republic of Korea (DPRK) carried out an announced nuclear test, which was the fourth after tests conducted in 2006, 2009, and 2013. An important task in discriminating a man-made explosion and a natural tectonic earthquake is the analysis of seismic waveforms. To determine the isotropic and non-isotropic characteristics of the detonation source, I invert long-period seismic data for the full seismic moment tensor to match the observed seismic signals by synthetic waveforms based on a 3D earth model.
Here, I show that the inversion of long-period seismic data of the 2016 test reveals a clear explosive (isotropic) component combined with a significant release of shear energy by the double-couple part of the moment tensor. The short- and long-period waveforms of the recent test are very similar to the previous ones. First data show that the energy release of the recent event on long periods greater than 10 s is enlarged by 20-30% compared to the nuclear test in 2013. As shown previously, the double-couple part of the 2009 event was lower by a factor of 0.55 compared to the explosion in 2013, while the isotropic parts of the nuclear tests in 2009 and 2013 were similar (Barth, 2014). However, the recent test again shows a rather small double-couple part, indicating a lower amount of shear-energy radiation than in 2013. This highlights the importance of considering the release of shear energy in understanding near source damaging effects and the containment of nuclear explosions.