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A Multi-Technology Analysis of the 2017 North Korean Nuclear Test

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On September 3rd 2017 the Democratic People's Republic of Korea announced the successful test of a thermonuclear weapon. Only seconds to minutes after the alleged nuclear explosion at the Punggye-ri military test site in the mountainous northeast of the country at 03:30:01 (UTC) hundreds of seismic stations all around the globe were able to pick up strong seismic signals from that particular event. Only shortly after different seismic agencies estimated body wave magnitudes of well above 6.0 for the event. Clearly the test appears to be the strongest of all North Korean nuclear tests and can be estimated to be as more as ten times more powerful than the last two nuclear explosions in January and September 2016.
This study aims to provide a comprehensive overview of the 2017 North Korean nuclear test using a wide array of geophysical techniques including seismological, infrasound, geodetic and radionuclide monitoring investigations. The event is located in the area of the North Korean test site with its hypocenter at 41.3° N, 129.1° E and a depth of around 1.3 km. The body wave magnitude calculated from array measurements at the IMS station PS19 in Germany results in a body wave magnitude of around 6.2, which puts the yield of the explosion in a range of several hundred kT TNT-equivalent. Moment tensor inversions of the seismic event reveal a dominant isotropic component accompanied by a positive compensated linear vector dipole term and small double-couple terms. Multi-spectral optical and radar data obtained by geodetic satellite measurements revealed a strong subsidence clearly related to the test in the area of the epicenter. The strong surface deformations at the test site generated large acoustic pressure peaks, which were clearly observed as infrasound signals with distinctive waveforms even in distances of 400 km. In the aftermath of the test atmospheric traces of the fission product Xe-133 have been detected at various locations in the region. While for Xe-133 measurements in September the test site could be excluded as source by means of atmospheric transport modeling, while on the other hand detections in October at the International Monitoring System station RN58 are meteorologically consistent and indicate a potential delayed leakage of Xe-133 from the September 2017 nuclear test.