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Seismological analysis of the fourth North Korean nuclear test

Gernot Hartmann, Nicolai Gestermann, and Lars Ceranna
Federal Institute for Geosciences and Natural Resources, Hannover, Germany (gernot.hartmann@bgr.de)

The Democratic People's Republic of Korea has conducted its fourth underground nuclear explosions on 06.01.2016 at 01:30 (UTC). The explosion was clearly detected and located by the seismic network of the International Monitoring System (IMS) of the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Additional seismic stations of international earthquake monitoring networks at regional distances, which are not part of the IMS, are used to precisely estimate the epicenter of the event in the North Hamgyong province (41.38°N / 129.05°E). It is located in the area of the North Korean Punggye-ri nuclear test site, where the verified nuclear tests from 2006, 2009, and 2013 were conducted as well.
The analysis of the recorded seismic signals provides the evidence, that the event was originated by an explosive source. The amplitudes as well as the spectral characteristics of the signals were examined. Furthermore, the similarity of the signals with those from the three former nuclear tests suggests very similar source type. The seismograms at the 8,200 km distant IMS station GERES in Germany, for example, show the same P phase signal for all four explosions, differing in the amplitude only.
The comparison of the measured amplitudes results in the increasing magnitude with the chronology of the explosions from 2006 (mb 4.2), 2009 (mb 4.8) until 2013 (mb 5.1), whereas the explosion in 2016 had approximately the same magnitude as that one three years before. Derived from the magnitude, a yield of 14 kt TNT equivalents was estimated for both explosions in 2013 and 2016; in 2006 and 2009 yields were 0.7 kt and 5.4 kt, respectively. However, a large inherent uncertainty for these values has to be taken into account. The estimation of the absolute yield of the explosions depends very much on the local geological situation and the degree of decoupling of the explosive from the surrounding rock. Due to the missing corresponding information, reliable magnitude-yield estimation for the North Korean test site is proved to be difficult.
The direct evidence for the nuclear character of the explosion can only be found, if radioactive fission products of the explosion get released into the atmosphere and detected. The corresponding analysis by Atmospheric Transport Modelling is presented on the poster by O. Ross and L. Ceranna assessing the detection chances of IMS radionuclide stations.