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Seismic Identification of the 2006 North Korean Nuclear Explosion with the IMS Network - Data Analysis and Numerical Modelling

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The International Monitoring System (IMS) of the CTBTO (Comprehensive Nuclear Test Ban Treaty Organization) has been designed for detecting, locating and identifying any nuclear explosion worldwide with a yield of at least 1 kT TNT equivalent. Although the system is not yet completed it was able to successfully detect and accurately locate the North Korean explosion of October 9th 2006. Discrimination parameters are generally provided to the National Data Centres (NDC) which are responsible for identifying the nature of seismic events. In case of the North Korean event the discrimination was based on one parameter and one station only and is therefore not conclusive. We investigate the principal capability of the current and the final configuration of the IMS network to identify an explosion in North Korea without any doubt. The study is based on IMS data and synthetic seismograms. For seismic discrimination, methods such as spectral amplitude ratios are applied to the seismograms. The potential of this criterion for identifying the North Korean event as an explosion is assessed. Moreover, the influence of topography and 3D variations of seismic parameters on the recorded wave field and thus on the identification capability is analyzed. For the modelling the reflectivity method and finite difference codes were used. In order to distinguish an earthquake from an explosion, detailed knowledge about the seismic properties of the region and their influence on the recorded seismograms is essential. For example, lateral heterogeneities are capable of generating S- and surface waves which may lead to false interpretation of the seismograms as being generated by an earthquake. Vice versa, explosion-like seismograms may be obtained by attenuation of shear wave energy. In order to understand such effects, numerical calculations based on existing seismic models were computed. The influence of the 3D structure on the wavefield was quantified by systematically altering the model parameters.