

Putting an end to nuclear explosions through sciences

by Pierrick Mialle, International Data Centre (IDC), Comprehensive Nuclear Test-Ban Treaty Organization (CTBTO)

Abstract:

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) that was adopted by the United Nations General Assembly on September 10, 1996, prohibits nuclear explosions. Twenty years later, it enjoys near universality, but the CTBT has not yet entered into force. In the meantime, the Preparatory Commission (PrepCom) for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) is responsible for promoting the CTBT and establishing a verification regime to ensure compliance with the Treaty. The International Data Centre (IDC) of the CTBTO PrepCom receives and processes in near real time data from the International Monitoring System (IMS), a globally distributed network of seismic, hydroacoustic, infrasound and radionuclide stations. Once completed, the IMS network will comprise 60 infrasound stations of which 49 have been installed and certified as of beginning of 2017. The infrasound stations are arrays of measurement systems that are sensitive to acoustic pressure variations in the atmosphere in the IMS frequency band. After reception, storage and referencing in the IDC database, the station data are automatically processed individually. Based on the station processing results the network processing is initiated to form events with all three waveform technologies. The automatic and human reviewed event information are then reported in IDC products (or bulletins) referred to as Standard Event Lists (SELs) and Reviewed Event Bulletin (REB). The REB is the final waveform product of the IDC and currently, during provisional operations, the target timeline for publication is within 10 days of real time. Specialized software has been developed for every processing stage at the IDC in order to improve signal to noise ratio, detect infrasound signals, categorize and identify relevant detections, form automatic events and perform interactive review analysis. For the period 2010 to 2017, thousands of waveform events containing infrasound associations appear in the IDC bulletins, and in particular in the REB. This demonstrates the sensitivity of the IMS infrasound component and the IDC ability to globally monitor the infrasound activity. The unique information gathered by the IMS systems have been widely used for civil and scientific studies and have resulted in numerous publications on meteor impacts such as the largest ever infrasound recorded event that is the Chelyabinsk meteor in February 2013 as well as other observed fireballs and meteors, on powerful volcanic eruptions, on controlled explosions, on announced underground nuclear test or on atmospheric dynamic research, on characterizing the infrasound global wavefield, or on gravity waves study that could lead to deriving a space and time varying gravity wave climatology.