Secretariat snapshots

A new platform for exchange with the scientific community

by Dr Andreas Becker and Dr Frank Graeber

values between 22 and 24 October, thus resembling the calculated double peak pattern. Backtracking calculations were evaluated to exclude other known sources of noble gas from facilities closer to the station. Consequently, the ejection of xenon-133 characteristic for a one-kiloton nuclear explosion on the Korean peninsula at the time of the REB event was the most realistic source scenario to explain the observed concentration pattern in Yellowknife.

Conclusion

The Yellowknife detection of the DPRK test demonstrated that noble gas stations are capable of providing evidence of the nuclear character of an event, even though the network is not complete. Once the complete verification system is in place, the fusion of data from the radionuclide and waveform networks in conjunction with state of the art atmospheric modelling will provide an unprecedented system for locating and identifying nuclear events. ■

MSc Paul R.J. Saey is a nuclear physicist working as a PTS Radionuclide Officer, Dr Andreas Becker and Dr Gerhard Wotawa are meteorologists, both working as PTS Atmospheric Sciences Officers. The three were involved in the set-up and operation of the PTS noble gas and atmospheric transport systems utilized for the characterization of the DPRK event.

"The success and efficiency of our verification regime relies on a permanent dialogue with scientific institutions about the latest developments in their areas of expertise and their adaptation to our needs".

These words by the CTBTO Executive Secretary, Tibor Tóth, in his opening address to the CTBTO scientific symposium held in Vienna in 2006 encouraged staff members of the Secretariat to initiate a new scientific session on "Research and Development in Nuclear Explosion Monitoring" at the General Assembly of the European Geosciences Union (EGU). The event, with more than 8000 participants, was held in April 2007 in Vienna.

42 contributions underline importance of meeting

The session was designed to provide a forum for all verification technologies. Forty-two papers were submitted that covered all relevant fields, including seismology, infrasound, hydroacoustics, nuclear physics and atmospheric backtracking. A variety of topics critical for detection, location and characterization of nuclear explosions, including case studies based on natural and man-made events were presented.

PTS contributed 17 papers

By contributing 17 papers, the Provisional Technical Secretariat (PTS) increased the visibility of the CTBTO, thus contributing to enhanced public awareness of the Preparatory Commission's work. Lassina Zerbo, Director of the International Data Centre Division, presented an overview of the CTBTO monitoring system and four other papers described the system in more detail. Many fruitful discussions were initiated among PTS staff members and the Conference participants that may serve as a basis for enhanced activities with the scientific community.

How to detect and localize an event?

Accurate event characterization was one of the main topics of the session as this constitutes a key challenge for each of the CTBT verification technologies. Natural and man made sources, particularly smaller events, may generate signals, which to a certain extent display properties similar to those originating from Treaty-relevant sources. The correct discrimination of such signals poses a significant challenge to the monitoring system and to the automatic and interactive processing software. This requires research and development in quite different fields, depending on the technology in question.

Infrasound

A better understanding of infrasound propagation in a dynamic atmosphere greatly improves the association of signals and the location of events. However, experimental verification of propagation predictions for high altitude infrasound sources recorded at long ranges is difficult to perform due to the rarity of upper air explosion events. Henry Bass, Director of the National Center for Physical Acoustics at the University of Mississippi, presented a paper on an experiment involving moderately sized high altitude explosions. Six other external and two PTS papers presented case studies (e.g. the Buncefield fuel depot explosion in December 2005 near London, United Kingdom) and studies on the capabilities of certain infrasound arrays with regard to event characterization and monitoring of upper atmospheric dynamics.

Hydroacoustic

One of the two hydroacoustic papers presented initial results from a controlled source experiment in the southern ocean, which was designed to study errors in predicted estimates of transmission loss and source location. A PTS paper described a method for identifying seismic waves at IMS hydrophone triads, which represents a good example for positive synergy effects between waveform technologies.

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Recent developments in infrasound monitoring technology: application to CTBT verification

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This has proven to be quite effective and the results are very promising. The technique is based on the use of turbulence-reducing structures constructed from robust screens stretched over a rigid framework. A wide variety of such turbulence-reducing enclosures have been tested and this has led to a highly efficient design consisting of a number of chambers and baffles with excellent noise-reducing performance characteristics. An example of the results obtained using the latest version of the noise-reducing enclosure in typical daytime wind conditions is shown in Fig. 2 for waveform data in the primary monitoring passband. As can be seen from this diagram, wind-generated noise levels are very substantially reduced by the porous enclosure, even in the case where the pipe array is replaced by a single inlet port. It is worth noting that the porous enclosure has virtually no influence on the amplitude of infrasonic signals. The power spectral density plots shown in Fig. 3 provide a better illustration of the high degree of wind noise reduction provided by the turbulence-reducing enclosure at all frequencies. The results presented in this diagram show that the turbulence-reducing enclosure provides a very effective means for reducing wind noise in the primary monitoring passband for CTBT verification. In addition, the results show that a single inlet port system located at the centre of the enclosure is more effective than the distributed six-port pipe array that is also located inside the enclosure.

In summary, recent research at the ANU has shown that turbulence-reducing enclosures can be used to reduce or eliminate wind noise at IMS infrasound stations. These systems can therefore be used to enhance the performance of existing pipe arrays or, in some cases, as effective stand alone noise-reducing systems that do not require a pipe array. ■

Biographical note

Dr Douglas Christie was born in Canada and joined the Australian National University (ANU) in 1975, where he carried out research on nonlinear waves and infrasound. He assisted the Australian Government as an infrasound expert during the CTBT negotiations 1994-96. In 1997 he joined the IMS Division at the CTBTO and helped to establish the global infrasound network. He returned to the ANU in 2003. ■

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Seismic

Eight external and five PTS contributions on seismic data processing dealt with various topics, such as enhancements of the automated processing at the PTS, decoupling experiments in Israel, improvements in local and regional earthquake monitoring, improvements in event discrimination and low magnitude event detection. The October 2006 DPRK event provided seismic data, which was utilized by several studies on the performance of the CTBT verification regime.

Radionuclide, noble gas and atmospheric transport

The DPRK event demonstrated also the crucial role of the radionuclide technology for the nuclear event classification. Moreover, the typical radioactivity release characteristics of underground events have shed a spotlight on the radio-xenon technology and the corresponding atmospheric backtracking methodologies (see also article on page 20). Seven external and six PTS papers elaborated on related topics, such as high-resolution monitoring and atmospheric backtracking studies, enhanced global modelling and data mining to improve global emission inventories, and machine learning algorithms utilizing pattern recognition techniques for radio-xenon event classification.

Conclusion

With this session, a platform of know-how exchange in the much debated field of nuclear explosion monitoring could be established. The 2008 EGU General Assembly will again take place in Vienna offering PTS the opportunity to sustain a scientific dialogue that is tailored to its need to stay abreast of the latest developments in the field and to provide its input to it.

Abstracts of all 42 contributions are available on a CD-ROM (Geophysical Research Abstracts, Volume 9, 2007) and on the 2007 EGU General Assembly web-page[1]. ■

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[1] http://www.cosis.net/members/meetings/sessions/accepted_contributions.php?p_id=251&s_id=4563