Potential civil and scientific applications

The International Monitoring System uses seismic, hydroacoustic, infrasound and radionuclide monitoring technologies capable of detecting evidence of nuclear explosions underground, in water and in the atmosphere in order to monitor compliance with the Comprehensive Nuclear-Test-Ban Treaty. These verification technologies, together with the data, technologies and products of the International Data Centre, have potential civil and scientific applications which can provide significant benefits to States and the international scientific community.

Benefits of potential civil and scientific applications of CTBT verification technologies

by Bernard Massinon

What are the benefits of the potential civil and scientific applications of CTBT verification technologies? Scientists from the Provisional Technical Secretariat (PTS) and various National Data Centres (NDCs) addressed this question at a meeting in Berlin on 10 and 11 May 2004, initiated by the Japanese and German Missions to the International Organizations in Vienna.

With more than 50% of the International Monitoring System (IMS) stations now operational, the International Data Centre (IDC) is providing NDCs with timely, high quality data and products. Recently, various NDCs have conducted extensive research in collaboration with the PTS to improve the characterization and understanding of source and propagation phenomena.

In the oceans, for example, highly sensitive hydrophone arrays and seismic T-phase stations have observed an increasing number of icebergs breaking off the Antarctic ice shelves and sliding on icy or rocky surfaces, a phenomenon probably linked to global warming. Submarine volcanoes, earthquakes and underwater explosions are also identified and located, contributing to a better understanding of hydroacoustic wave propagation.

In seismology, the Reviewed Event Bulletin (REB), which the PTS has been providing to the International Seismological Centre (ISC) since 2000, has contributed significantly to evaluations of earthquake magnitudes. This may have an impact on seismic hazard assessments in some areas of the globe. The ISC also provides the IDC with access to its collection of data from 2000 stations worldwide, making the collaboration between the PTS and ISC of clear mutual benefit. Furthermore, the increased access to waveforms and phases readings made possible by the IMS network will certainly help to improve 3-dimensional tomographies of the globe computed by national and international scientific institutions, allowing a better understanding of the internal structure of the earth's core.

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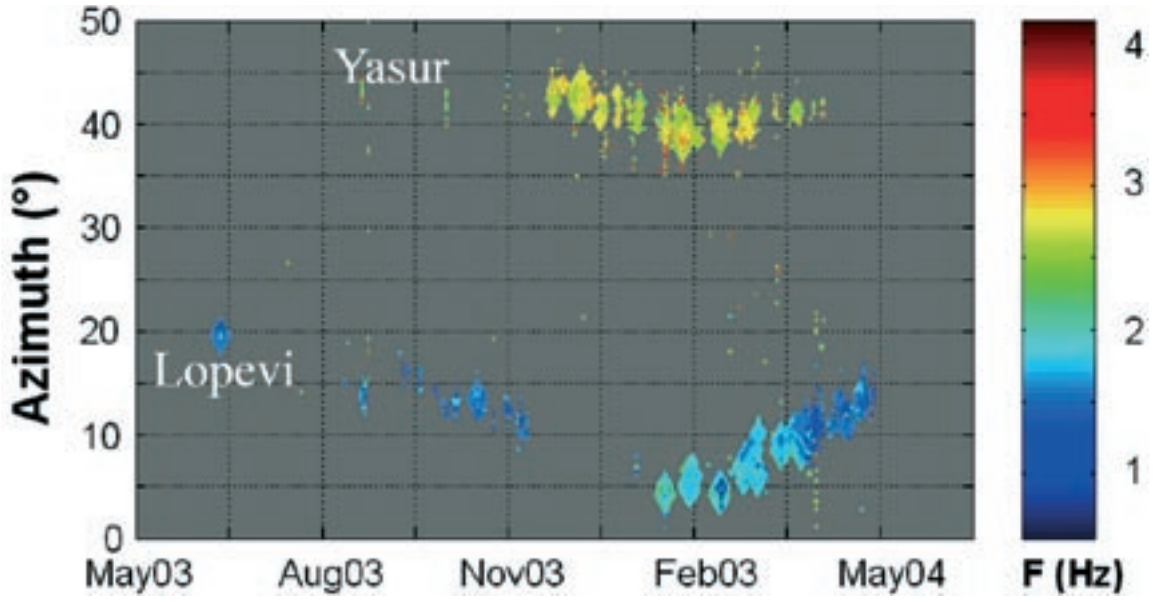

INFRASOUND WAVES PROPAGATING FROM TWO SIMULTANEOUS VOLCANIC ERUPTIONS ON VANUATU (YASUR AND LOPEVI), AS RECORDED BY IMS IS22 STATION IN NEW CALEDONIA. THE AZIMUTH DEVIATIONS ARE STRONGLY DEPENDENT ON SEASONAL WIND VARIATIONS. SUCH OBSERVATIONS SHOULD PROVIDE MORE REALISTIC REGIONAL ATMOSPHERIC PROPAGATION MODELS, WHICH CONTRIBUTE TO BETTER EVENT LOCATION AND MAY ALSO BE USEFUL FOR AIRCRAFT SAFETY.

Benefits of potential civil and scientific applications ...

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ERUPTION OF VOLCANO LOPEVI, VANUATU

The synergy between the verification technologies has also improved analysis of other phenomena. A combination of IMS seismic and infrasound data, for example, pointed out the solid earth and atmospheric response to the large earthquake in Southwest China in 2003.

ERUPTION OF VOLCANO YASUR, VANUATU

In infrasound technology, the sensitive IMS infrasound arrays and the adapted processing system developed at the IDC and various NDCs have provided a unique tool which detects, locates and characterizes natural atmospheric phenomena on a global scale, and refines atmospheric transport models.

The IMS radionuclide network also provides a new level of sensitivity and coverage through the worldwide, quasi-continuous, low level data it can deliver on levels of natural or artificial radioisotopes. For example, natural radioisotopes originating from the crust and from the upper atmospheric layers may provide clues on the vertical mixing and interaction of air masses on a global scale, of possible interest to global warming investigations. Continuous radionuclide monitoring at very low detection thresholds will allow detection and tracking of accidental releases. This will help emergency preparedness efforts in detection, modelling and decision support by providing predicted deposition rates.

In conclusion, although the CTBT verification system is not yet fully complete, and the issue of access to IMS data and IDC products for scientific and hazard monitoring organizations has not yet been resolved, workshops and meetings on the possible civil and scientific applications of the verification technologies clearly demonstrate that impressive developments in scientific research are taking place. This development is likely to increase as collaboration between NDCs grows. It is important to consider the issue of expanding this collaboration to the scientific society, and of contributing to human welfare and safety through cooperation programmes with other international organizations. ■

Biographical note

Bernard Massinon studied at the Ecole Supérieure d'Electricité and holds a doctoral degree in Geophysics from the University of Paris (1964). He has worked as a research geophysicist with the French Commissariat à l'Energie Atomique (CEA) and has served as Head of the Data Processing and Geophysics Group at the Laboratoire de Détection et Géophysique (CEA/LDG).

From 1994 to 1997, Mr Massinon served as a member of the French Delegation in the Group of Scientific Experts at the Conference on Disarmament in Geneva. He also served as Scientific Assistant Head, Département Analyse, Surveillance, Environnement (CEA/DASE) from 1996 to 1999.

Since 1997, Mr Massinon has been a member of the French Delegation and Task Leader to Working Group B, while also serving as a Scientific Adviser at the Commissariat à l'Energie Atomique (CEA) since 2000. He recently received the 'Prix Science et Defense 2003' from the French Ministry of Defense. ■