CTBTO PREPARATORY COMMISSION | preparatory commission for the comprehensive nuclear-test-ban treaty organization

Information

Potential civil and scientific applications of the CTBT verification technologies

THE CTBTO GLOBAL NETWORK OF 337 FACILITIES MONITORS THE PLANET FOR POSSIBLE NUCLEAR EXPLOSIONS.

Scientific methods and cutting-edge technology are central features of a global alarm system that is being built to monitor the planet for nuclear explosions. Since its inception, this unique system has therefore sparked considerable interest in the world of science and technology.

The mandate of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) is to develop the tools needed to verify compliance with the Comprehensive Nuclear-Test-Ban Treaty (CTBT). These tools are integrated into the CTBT verification regime to ensure that no nuclear explosion goes unnoticed.

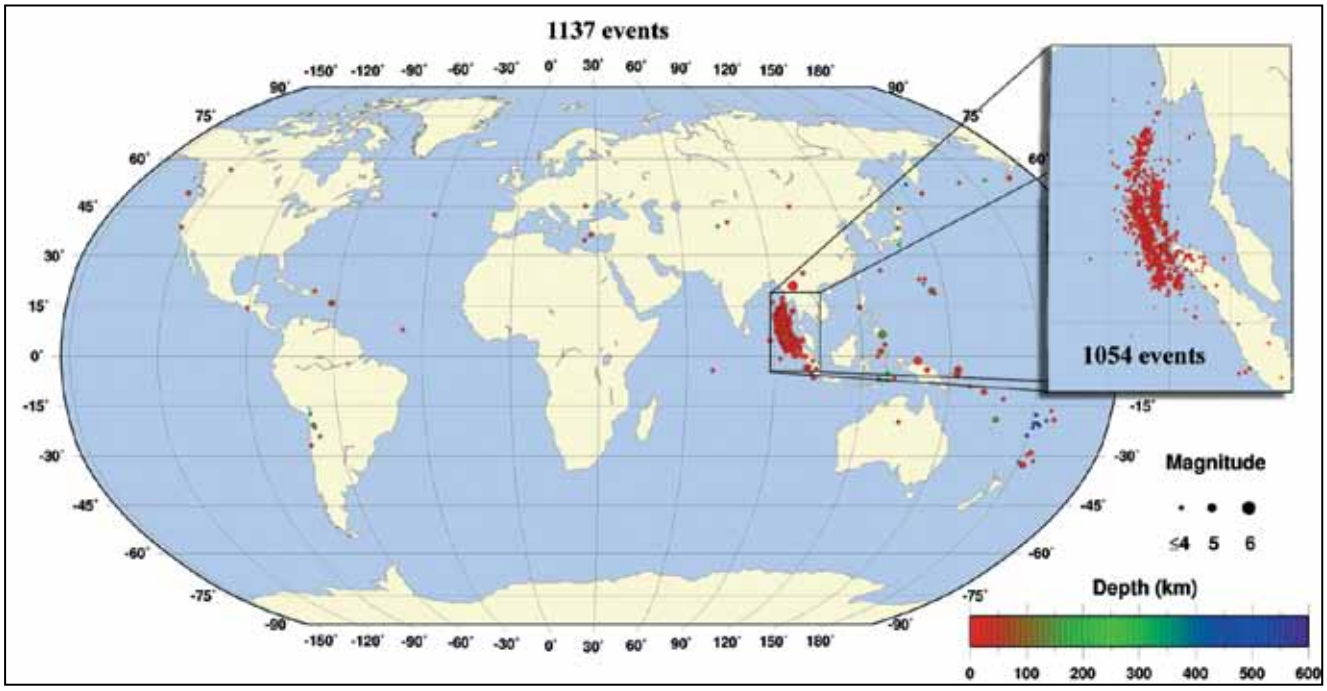
Once the Treaty enters into force, the Earth will be monitored continually by a 337-facility network, the International Monitoring System (IMS), using four technologies – seismic, hydroacoustic, infrasound and radionuclide. While awaiting entry-into-force, the IMS is operating in test mode so that, even now, monitoring data are transmitted for analysis to the International Data Centre in Vienna. All data and their analyses are made available to CTBT Member States for their final assessment. On-site inspections can be invoked as the final verification measure once the Treaty enters into force.

In addition to its actual purpose of detecting nuclear explosions, the CTBTO's global verification regime can offer a wide range of civil and scientific applications. These applications have the potential to contribute significantly to sustainable development, knowledge expansion and human welfare.

Contributing to tsunami warning

Discussions on the potential application of verification data and technologies entered a new phase when a tsunami caused by an earthquake off the coast of Sumatra, Indonesia, on 26 December 2004, damaged coastal regions bordering the Indian Ocean.

DEVASTATION CAUSED BY 2004 TSUNAMI IN THE VILLAGE OF MALACCA, SRI LANKA.



THE CTBTO REGISTERED 1137 EVENTS (MAIN MAP) ON 26 AND 27 DECEMBER 2004, OF WHICH 1054 EVENTS (INSET) WERE ASSOCIATED WITH THE EARTHQUAKE THAT CAUSED THE TSUNAMI.

In March 2005, the CTBTO collaborated with the United Nations Educational, Scientific and Cultural Organization (UNESCO) and started providing real-time and continuous data on a test basis to four tsunami warning centres in Australia, Hawaii, Japan and Malaysia. These data increase the ability of the centres to identify potentially tsunami-generating earthquakes as well as enabling them to provide vulnerable communities with faster warnings.

Based on the success of this test phase, the CTBTO entered into formal tsunami warning arrangements with several Member States in 2008 including Australia, Indonesia, Japan, the Philippines and the United States.

Seismic

- Rapidly acquiring and disseminating data on earthquakes, in particular on potentially tsunami-generating earthquakes, to assist disaster management and response efforts;
- Accurately reporting the location and magnitude of earthquakes to improve the estimation of earthquake hazard;
- Enhancing research on the Earth's structure;
- Assisting in plane crash investigation by providing precise data on timing.

Preventing or mitigating the effects of natural disasters

The versatility of potential applications of CTBT verification technologies in civil and scientific fields is noteworthy. The now fully operational cooperation with tsunami warning centres shows that disaster mitigation remains one of the top priorities.

An example is the potential of CTBT infrasound technology towards making civil aviation safer which has been discussed intensely over the years. Large ash plumes caused by volcanic eruptions can make jet engines malfunction or even stall completely. This has happened four times since 1982, said Hein Haak, Head of the Division of Seismology at the Royal Netherlands Meteorological Institute (see *CTBTO Spectrum, 3, December 2003, p. 10*).

The fact that there are *600* active volcanoes in the world today puts this issue squarely on the disaster mitigation agenda. "Airlines are keenly aware of the danger posed by volcanic ash, and have to be informed of any volcanic activities in the world", Haak added (*CTBTO Spectrum, 3, December 2003, p 10*). CTBT infrasound technology can assist in the detection of volcanic eruptions by registering the very low frequency sound waves they emit.

Targeting new opportunities

Member States clearly recognize that the unique CTBT verification system offers a host of opportunities for applications in everyday life and scientific research. As a logical consequence, representatives of Member States gather at regular intervals to evaluate how best to tap into this vast potential.

VOLCANO ERUPTIONS, SUCH AS THIS ONE ON VANUATU IN 2003/2004, CAN CAUSE DANGEROUS ASH PLUMES.

Hydroacoustic

- Improving research on ocean processes, leading to better weather prediction and climate change estimates;
- Researching marine life, such as whale populations and migration patterns;
- Rapidly acquiring and disseminating data on tsunamis;
- Improving shipping safety through the monitoring of underwater volcanic explosions;
- Monitoring ice shelf break-up and the creation of large icebergs.

The first of these meetings to discuss civil and scientific applications of CTBT verification technologies took place in May 2002 in London. A seminar on the same subject was held in Vienna soon after, in October 2002.

Peter Marshall, a seismology expert from the United Kingdom and a veteran of the CTBT negotiation process, chaired the London meeting. He pointed out that all potential civil and scientific applications of verification technologies depended on the availability of data. As monitoring data and data analyses are made available to all Member States, it would be up to the States to allow access to these data for civil and scientific uses, Marshall said in the very first issue of the CTBTO Spectrum (see *CTBTO Spectrum, 1, December 2002, p 16*).

Further meetings on the same issue took place in Berlin in May 2004 and in Budapest in September 2006. The latter followed the first scientific symposium organized by the CTBTO which took place in Vienna on 31 August and 1 September 2006.

Forging synergies with science

Due to its mandate, i.e. the establishment of a system to verify compliance with the Treaty, the CTBTO is actively involved in science and technology. The symposium 'CTBT: Synergies with Science. 1996-2006 and Beyond' examined ways and means to strengthen the mutually beneficial ties between the organization and scientific institutions worldwide.

EXPERTS MET IN SOPRON, HUNGARY, IN SEPTEMBER 2003 TO DISCUSS POTENTIAL CIVIL AND SCIENTIFIC APPLICATIONS OF CTBT TECHNOLOGIES.

Following on from the symposium, the International Scientific Studies (ISS) project was launched in March 2008 to encourage a broader dialogue with the scientific community. To maintain the credibility of the verification regime, the CTBTO needs to stay attuned to scientific and technological developments and incorporate such developments as appropriate.

This interaction is also crucial to ensure that the CTBTO's knowledge and verification data can be used for civil and scientific purposes. There are numerous examples of ways in which these data could be applied, including: research on the Earth's core; monitoring of seismic activities, earthquakes and volcanoes; research on the oceans, including their biodiversity; studies of climate change; meteorology and research on the atmosphere, in particular research on severe storm systems; monitoring the break-up of ice shelves and the creation of icebergs; and research on worldwide background radiation.

HYDROACOUSTIC DATA CAN HELP RESEARCHING THE OCEANS' BIODIVERSITY.

Using data for climate change research

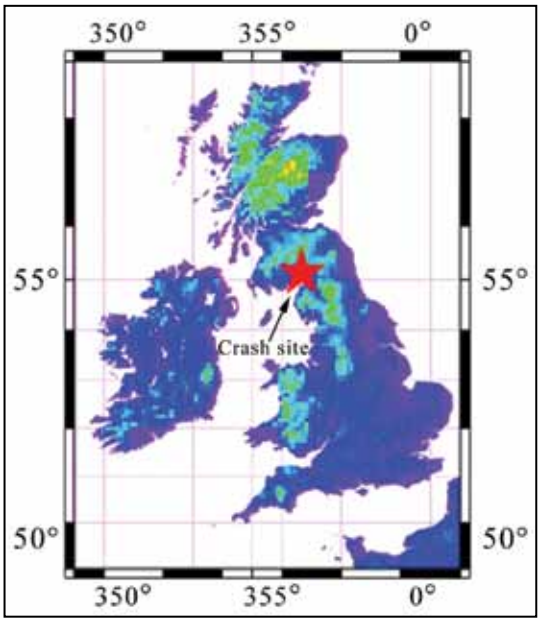
Helga Kromp-Kolb heads the Institute of Meteorology at the University of Natural Resources and Applied Life Sciences in Vienna, Austria. Having introduced the subject matter at the 2006 scientific symposium, Kromp-Kolb continues to support the use of CTBT verification data for research on global climate change.

Citing an example, she said that modern monitoring data, also those originating from CTBTO monitoring stations, facilitate the study of man-made impacts on the atmosphere evidenced when comparing with air trapped in ice cores. "Natural radionuclide data also registered by the monitoring system can be used to validate and calibrate weather prediction and climate models", said Kromp-Kolb (*CTBTO Spectrum*, *10, July 2007, p. 23*).

Infrasound

- Detecting volcanic explosions to assist in aviation safety;
- Detecting a range of man-made and natural events on the Earth's surface including chemical explosions, meteors entering the atmosphere, severe storm systems and aurorae;
- Contributing to climate change research by studying meteorological phenomena;
- Monitoring and tracking storms.

PARTICIPANTS AT THE CTBTO'S SCIENTIFIC SYMPOSIUM IN VIENNA, AUSTRIA, IN AUGUST/SEPTEMBER 2006.



SEISMIC DATA HELPED INVESTIGATING THE PLANE CRASH AT LOCKERBIE IN 1988.

Putting seismic data in the service of forensic work

It is not immediately evident that monitoring data could be used to investigate the cause of plane crashes. Yet, it has been done in the past, as David McCormack of the Geological Survey of Canada described (see *CTBTO Spectrum, 2, July 2003, pp 1 and 15*).

When a Pan Am Boeing 747 crashed near the Scottish town of Lockerbie in 1988, the seismic monitoring station at Eskdalemuir in Scotland, United Kingdom, registered the impact as a seismic event. Ten years later, the exact timing of the crash of a Swiss Air MD11 near Halifax, Canada, could only be accurately verified by using seismic data.

The crash of large, heavy aircraft would cause seismic signals equivalent to small magnitude earthquakes, said McCormack. With more and more seismic stations of the CTBT monitoring network and other networks becoming available, seismic signals emanating from plane crashes will increasingly be available to provide investigators with a useful tool in their investigative forensic work.

Looking ahead

The list of possible civil and scientific applications of CTBT verification technologies is long. To a large extent, these riches still lie dormant. Member States could undertake a number of steps to forward their broader utilization.

Expert discussions need to be continued in order to improve the understanding of potential civil and scientific applications of verification data and technologies. Member States could increase the exchange among countries to spread technological knowledge and ease access to verification technologies.

Radionuclide

- Researching worldwide background radiation levels;
- Contributing to climate change research by providing sample archive for historical studies of pollutants and micro-organisms;
- Using meteorological studies to identify the dispersion of airborne pollutants and global air mass movements;
- Accessing critical information on nuclear accidents, including providing rapid measurement of radioactivity and mapping dispersion of radioactive material.

OSI EXERCISE TESTING RADIATION MEASURING METHODS, CHERNOBYL, UKRAINE, JUNE 2007.

CTBT DATA AND TECHNOLOGIES CAN POTENTIALLY HELP MITIGATING THE EFFECTS OF DAMAGING EARTHQUAKES.

Each Member State has the right to receive all monitoring data and data analyses. National focal points function as the channel for this information. Not all Member States have established these organizational interfaces for CTBTO-related information transfer. Some of them could benefit from assistance in the development of their technical and scientific capabilities.

More efforts need to be aimed at the continuous development and strengthening of mutually beneficial relationships between the CTBTO and the global scientific community. This outreach also applies to a number of international organizations that share common interests in science and technology.

Finally, it is imperative to stay abreast of the latest developments in science and technology with a view to their potential civil and scientific applications in the context of the CTBT's state-of-the-art verification technologies.

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