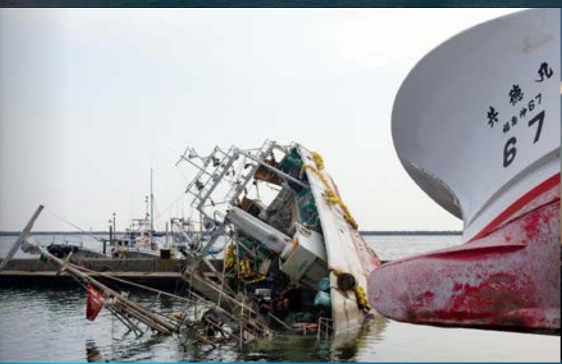
CTBTO
PREPARATORY COMMISSION

COMPREHENSIVE
NUCLEAR-TEST-BAN
TREATY ORGANIZATION





THE CIVIL AND SCIENTIFIC USES OF CTBTO DATA

Disaster warning and promoting human welfare

"Even before entering into force, the CTBT is saving lives."

Ban Ki-moon
FORMER UNITED NATIONS SECRETARY-GENERAL

The aftermath of the earthquake and tsunami that triggered a nuclear accident at the Fukushima Daiichi Nuclear Power Plant in Japan on 11 March 2011. CTBTO's data enabled national authorities to assess the dispersal of radioactive emissions after the accident.

EXAMPLES OF CIVIL AND SCIENTIFIC USES

DETECTION AND REAL TIME WARNING OF

- Earthquakes and tsunamis
- Radiation dispersal from nuclear accidents
- Volcanic eruptions
- Meteors

RESEARCH ON

- The Earth's core
- Climate change
- Meteorology
- Break-up of ice shelves and the creation of icebergs
- Oceans and marine life
- Worldwide background radiation

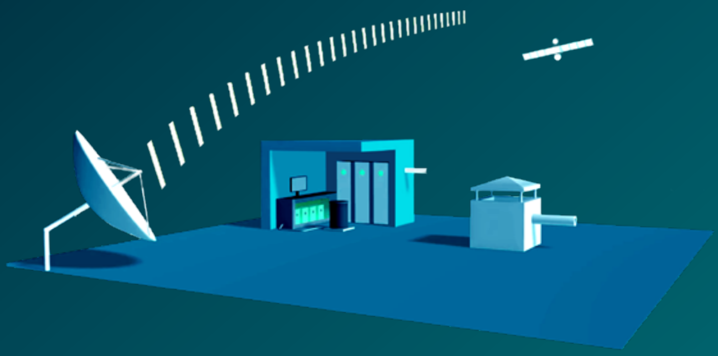
THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY (CTBT) BANS ALL NUCLEAR EXPLOSIONS. ITS VERIFICATION WILL BE ASSURED BY THE GLOBAL ALARM SYSTEM CURRENTLY BEING ESTABLISHED BY THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION (CTBTO).

The 337 facilities of the International Monitoring System (IMS), which span the entire globe, ensure that no nuclear explosion escapes detection. The IMS uses four technologies – radionuclide, seismic, infrasound and hydroacoustics. Over 90% of this system has already been established.

Apart from detecting nuclear explosions, this one-billion dollar investment by over 185 CTBTO Member States can be put to a wide range of civil and scientific uses, thereby contributing to sustainable development, knowledge expansion and saving lives.

The data recorded by the International Monitoring System (IMS) are widely considered to be unique and a treasure trove of knowledge with a broad range of civil and scientific applications.

RADIONUCLIDE TECHNOLOGY



- Providing critical information on nuclear accidents, including measurements of radioactivity and the prediction of the dispersion of radioactive material
- Using meteorological studies to identify the dispersion of airborne pollutants and global air mass movements
- Contributing to climate change research by providing sample archives for historical studies of pollutants and microorganisms
- Researching worldwide background radiation levels

Just one day after the 11 March 2011 Japan disaster, the IMS started detecting radioactive particles, such as iodine-131 and caesium-137, emitted by the damaged Fukushima power plant. The Takasaki station (Tokyo, Japan) – located around 250 km from Fukushima – was the first to pick up the radionuclides. The radioactive cloud was then detected by an increasing number of IMS stations as it travelled first to Russia and the United States before dispersing across the northern hemisphere and later around the entire globe.

While the levels detected were far below those that would impact human health, the IMS demonstrated its ability to track radiation from nuclear accidents quickly and accurately. Furthermore, dispersion was predicted correctly using atmospheric transport modelling, the method by which the travel path of a given radionuclide is calculated either forwards or backwards, using meteorological data.

On the basis of these data, CTBTO Member States were able to provide reliable information to concerned populations. The Fukushima accident also led to intensified cooperation between the CTBTO and other relevant international organizations such as the International Atomic Energy Agency (IAEA), the World Health Organization (WHO) and the World Meteorological Organization (WMO).

NUMBER OF FACILITIES

80 stations (half of them detecting noble-gases) + 16 laboratories

VERIFICATION FUNCTION

Detects radioactive particles and radioactive noble gases from nuclear explosions

Radionuclide Station RN49, Spitsbergen, Norway

SEISMIC TECHNOLOGY

TSUNAMI WARNING

Following the catastrophic earthquake and tsunami off the coast of Sumatra, Indonesia, in December 2004, the CTBTO was mandated to provide monitoring data from its seismic and hydroacoustic stations directly to tsunami warning centres. During a test period, these centres received real-time continuous data which they confirmed improved their ability to identify potentially tsunami-generating earthquakes and to issue timely warnings. The CTBTO has concluded formal tsunami arrangements with 18 countries.

During the signing ceremony of the tsunami warning arrangement with Japan in August 2008, former Ambassador Yukiya Amano, who signed on behalf of his government, expressed his confidence that the CTBT's verification data "… will help save many lives in the case of a tsunami." This was confirmed by Japanese authorities who stated that during the March 2011 earthquake and tsunami, IMS data helped them issue timely warnings, allowing many people to escape to higher ground.

DETERMINING THE TIME OF PLANE CRASHES

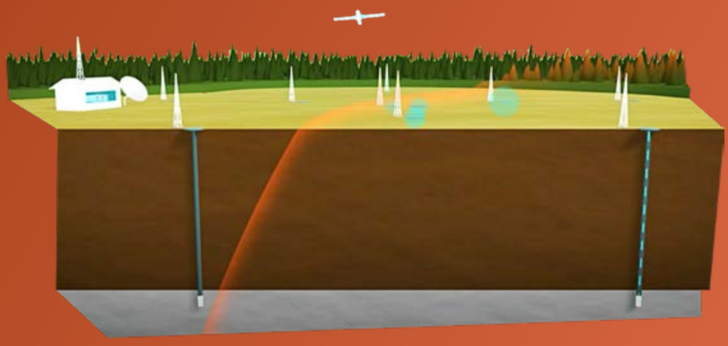
If a large, heavy aircraft crashes, it causes seismic signals equivalent to small magnitude earthquakes that can be picked up by IMS seismic stations. The exact time of the impact of the Pan Am Boeing 747 near the Scottish town of Lockerbie in 1988 or the crash of a Swiss Air MD11 near Halifax, Canada in 1998 could only be verified accurately by using seismic data.

NUMBER OF FACILITIES

170 stations

VERIFICATION FUNCTION

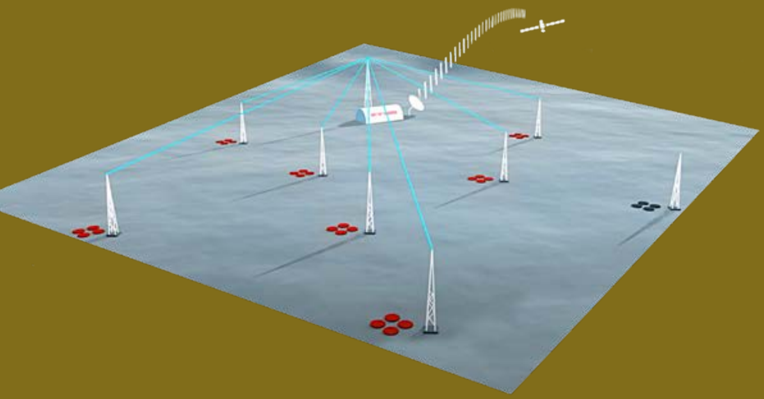
Detects shock waves from nuclear explosions travelling through the Earth



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

Primary Seismic Station PS21, Tehran, Iran

INFRASOUND TECHNOLOGY



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

Infrasound technology has the potential to make civil aviation safer. Large ash plumes caused by volcanic eruptions can make jet engines malfunction or even stall completely.

In spring 2010, the airspace over many parts of Europe was closed due to the eruption of the Icelandic volcano Eyjafjallajokull. Many of the world's 600 active volcanoes are in the direct vicinity of much-frequented air routes and can render the airspace hazardous in a matter of minutes. IMS infrasound stations can detect the ultra-low frequency sound waves emitted by volcano eruptions and help provide warnings in real-time.

When a meteor exploded over Russia's Ural mountains on 15 February 2013, the blast was detected by 20 IMS infrasound stations, one of them 15,000 km away in Antarctica. The infrasound data can help scientists learn more about the altitude, energy released and how the meteor broke up.

NUMBER OF FACILITIES

60 stations

VERIFICATION FUNCTION

Detects low-frequency sound waves in the atmosphere generated by nuclear explosions

Infrasound station IS55, Windless Bight, Antarctica

HYDROACCOUSTIC TECHNOLOGY

Hydroacoustic stations also play a role in tsunami warnings. Depending on a tsunami's amplitude and origin, they may detect its pressure wave and help tsunami warning centres – together with the seismic data – to issue timely warnings. In the case of the 11 March 2011 tsunami in Japan, the hydroacoustic station on Wake Island (USA) helped track the wave as it progressed across the Pacific Ocean.

By warning of underwater volcanic eruptions, hydroacoustic stations could further bring the same security benefits to maritime traffic as infrasound stations to air traffic.

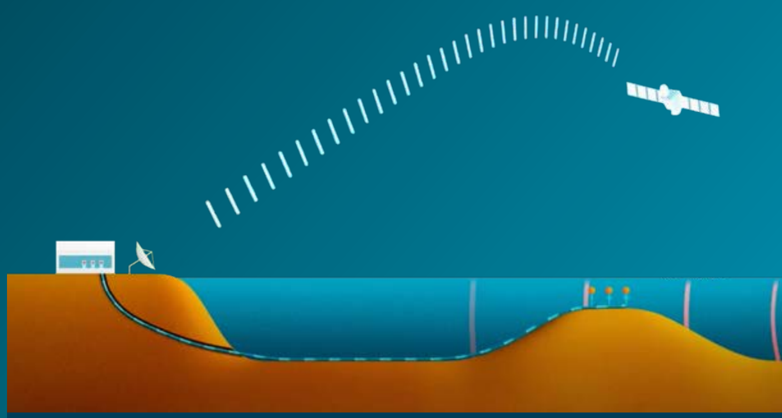
In addition, the hydroacoustic network has a number of climate-related applications, such as improving weather prediction and estimates based on ocean temperatures or helping to analyze the migration patterns of whale populations. In fact in 2021, CTBTO's technology in the Indian Ocean led to the discovery of a new colony of pygmy blue whales, which have eluded discovery for decades despite their massive size.

NUMBER OF FACILITIES

11 stations

VERIFICATION FUNCTION

Detects acoustic energy generated by an underwater nuclear explosion



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

Hydrophone nodes are used at every CTBTO hydroacoustic station and can detect underwater explosions anywhere and at any time

SYNERGIES WITH SCIENCE

A series of scientific conferences have been held in Vienna since 2006 designed to foster closer cooperation between the CTBTO and the scientific community. Over 1200 participants have attended recent conferences, including scientists from around 100 countries. Apart from seeking innovations in nuclear test-ban verification, all of the meetings have explored the civil and scientific applications of the CTBT's verification regime.

The wealth of IMS data – around 35 gigabytes of raw data per day – have helped Earth scientists to better understand the complexities of our planet. This, in turn, enables experts at the CTBTO to hone their skills in detecting nuclear explosions. It's a veritable cross-fertilization: a deepened understanding of the Earth's crust, for example, helps scientists analyze the propagation of seismic waves from a nuclear explosion. Similarly, insights into atmospheric and meteorological phenomena can enhance knowledge on the propagation of infrasound waves or the travel paths of radionuclide particles and noble gases. The same applies to the hydroacoustic technology deployed in the oceans.

"The CTBTO is helping to save lives by providing data from the International Monitoring System for tsunami early warning and other natural disaster mitigation and prevention efforts."

Robert Floyd
EXECUTIVE SECRETARY OF THE CTBTO

The opening ceremony of the CTBT: Science and Technology 2021 conference, Vienna, Austria. The Conference provides a forum for scientists from around the world to exchange knowledge and share advances in monitoring and verification technologies of relevance to the Treaty in support of its global verification regime.

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