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

The nuclear test-ban verification regime: An untapped source for climate change monitoring

> "Climate knowledge is the foundation for the development of an effective response to the climate change challenge. The UN system plays a central role in this area, bringing together global resources for observation and analysis of climate change trends."
>
> UNITED NATIONS REPORT
> "ACTING ON CLIMATE CHANGE: THE UN DELIVERING AS ONE"

The benefits of a global ban on nuclear testing for international security and for protecting human health and the environment from radioactive fallout are obvious. The relevance of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) for climate change research may not, however, be evident at first glance.

The CTBT bans all nuclear explosions on Earth. To monitor compliance with the Treaty, the CTBTO Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), is establishing a verification regime capable of detecting clandestine nuclear tests.

As the only international body operating its own system of monitoring stations that literally spans the globe, the CTBTO is in a unique position to contribute to the UN's efforts in the area of climate knowledge.

The International Monitoring System (IMS) is a global network comprising 337 facilities that monitor the entire planet. These facilities send monitoring data to the International Data Centre (IDC) in Vienna via an independent global communications infrastructure. At the IDC, the data are analyzed and distributed to over 100 countries.

A ONE BILLION U.S. DOLLAR INVESTMENT AND UNTAPPED RESOURCE FOR CLIMATE CHANGE MONITORING: THE 337 MONITORING FACILITIES OF THE CTBTO

The nuclear test-ban verification regime

Climate change monitoring could profit from the existing global monitoring system

The CTBT's 180 Member States have invested about one billion U.S. dollars over the past decade in this system. This global monitoring network is a valuable asset that could contribute greatly to the UN's knowledge of issues related to climate change.

By the end of 2008, 90% of the IMS network will be installed. The infrastructure of the IMS meets the highest standards for data availability even for facilities in extremely remote and harsh environments. Contractual agreements have been established with local operators. This helps to ensure that utilities, software, and hardware are operating smoothly to support continuous data transmission from sophisticated scientific equipment. Each facility has its own power supply back-up and a communication link to Vienna. Bandwidth capacity at IMS facilities could be made available to transmit additional sensor data for climate change monitoring. The IMS facilities could therefore provide an ideal infrastructure for supporting sensors that are targeted specifically at the global climate problem.

26 gigabytes of IMS data waiting to be used for climate change monitoring

In addition to providing an infrastructure for special climate-change related sensors, the existing IMS technologies for detecting nuclear explosions can also be used for a wide range of climate change monitoring applications. As IMS facilities focus on parameters not monitored by meteorological networks such as infrasound or radionuclide technology, their data would be a useful addition to global climate change research. The facilities produce up to 26 gigabytes of data daily, a veritable treasure for climate change scientists. The use of IMS data to improve the efficiency of tsunami warning centres in the Indian and Pacific Oceans is an example of how the verification regime can be used for other urgent civil purposes.

"What is considered a 'disturbance' or 'noise' in the data when monitoring Treaty [CTBT] compliance may be of relevance to the climate science community. Thus, IMS data could become an important archive for the research of the atmosphere, severe storm systems, mountain waves, etc. – phenomena that can undergo significant changes as a consequence of climate change."

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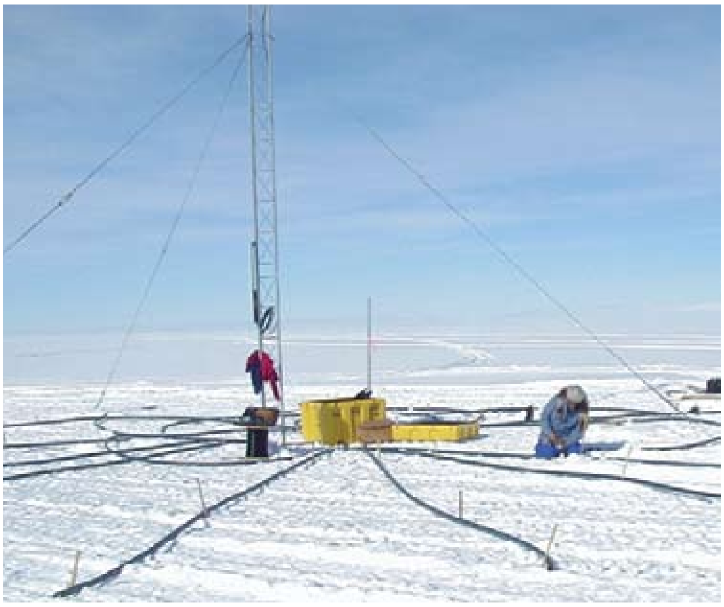

INFRASOUND STATION 55, WINDLESS BIGHT, ANTARCTICA, UNITED STATES

INFRASOUND TECHNOLOGY

Infrasound technology uses microbarographs (acoustic pressure sensors) to detect very low-frequency sound waves in the atmosphere produced by nuclear explosions, which are inaudible to the human ear. The network's 60 stations also register a host of other man-made and natural events on the Earth's surface. Their data could therefore be used for the systematic study of:

- Signals generated by the calving of icebergs and movements of glaciers as indicators of climate change;
- Microbaroms (very low-frequency sound waves generated in marine storms), hurricanes and tornadoes to assess the intensification of storm activity;
- Signals generated by landslides and avalanches as indicators of climate change;
- Specific sources along a fixed source-to-station path to determine seasonal and yearly variations of some atmospheric properties.

Additionally, these stations could contribute to meteorological databases through the meteorological data which they collect on a routine basis (external temperature, absolute pressure, wind speed and direction).

An untapped source for climate change monitoring

RADIONUCLIDE STATION 13, EDEA, CAMEROON

DEPLOYMENT OF HYDROPHONE AT HYDROACOUSTIC STATION 11, WAKE ISLAND, USA

RADIONUCLIDE TECHNOLOGY

The CTBTO's radionuclide network consists of 80 stations which use air samplers to detect radioactive particles or noble gases which could come from nuclear explosions. The network provides global coverage and its high detection sensitivity is unprecedented. The same samplers also measure concentrations of specific natural radionuclides, which could be of particular interest to climate change research as they could help to:

- Increase our understanding of the long-range exchange of pollutants through tracking the transport of air masses or validating atmospheric transport models (used to backtrack the three-dimensional travel path of a radionuclide particle from where it was detected by a monitoring station, to the area where it may have originated):
    - Monitor the stratosphere/troposphere exchange and validate global climate models by using radionuclides as tracers;
    - Monitor seasonal and yearly variations of specific radionuclides which might be connected to climate variations;
- Determine the quantity of dust and pollens present over a certain period of time as well as the evolution of chemical contents in dust, e.g. to analyze the climate impact of megacities or trends in the monsoon circulation;
- Monitor current and re-analyze past solar activity changes.

HYDROACOUSTIC TECHNOLOGY

The network's 11 hydroacoustic stations scan the oceans for sound waves emitted by nuclear explosions. The data generated by these stations are also rich in "background noise" and could be used for:

- Systematic research on the calving of icebergs and ice shelf break-up as indicators of warming at the ice shelves;
- Improving weather prediction and estimates via the inference of ocean temperature;
- Support research on ocean processes and marine life, such as whale populations and migration patterns that might be affected by climate change;
- Measuring water temperature by means of 'acoustic thermometry'; study of the variation of the travel time of signals along a known source-to-station path; the speed of propagation of sound waves is affected by temperature changes.

"The IMS network, the different monitoring technologies and the rich data archive of the CTBTO each constitute unique and unparalleled international assets with the potential to address the global climate change issue."

CTBTO EXECUTIVE SECRETARY TIBOR TÓTH

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SEISMIC TECHNOLOGY

The CTBTO uses 170 seismic stations to monitor the ground for shockwaves that are caused by nuclear explosions. The civil and scientific spin-offs of these stations lie mostly in their ability to help in rapidly acquiring and disseminating data on earthquakes and for research on the Earth's structure. But seismic data could also be useful for certain climate change related applications:

- Serving as an additional source for studying the melting of glaciers, whose size and movements can affect seismic signals;
- Study of the differences in wave travel time (acoustic impedance temporal variations) in the lower atmosphere using co-located seismic and infrasound stations.

Towards a UN-based climate change monitoring system?

The existence of the CTBTO's IMS as an established global monitoring network which is already functioning should be taken into consideration in discussions about future UN-based climate change monitoring responsibilities. While CTBTO Member States would have to approve any possible climate change related mandate, the cost benefits and the significant synergies of using an existing infrastructure would provide strong arguments to this end.