

# SnT 2021

CTBT: SCIENCE AND TECHNOLOGY CONFERENCE



CTBTO  
PREPARATORY COMMISSION

28 JUNE to 2 JULY

HOFBURG PALACE AND ONLINE  
VIENNA, AUSTRIA

## CONFERENCE GOALS

- 1 To identify scientific opportunities and methods for improving nuclear test monitoring and verification;
- 2 To identify how scientific developments and cooperation can support national needs and frame policy objectives in support of the CTBT;
- 3 To broaden and strengthen the engagement of scientific communities working in test ban monitoring, including young scientists, and to enhance geographic and gender representations of these communities;
- 4 To support the exchange of knowledge and ideas between the CTBTO and the broader scientific community;
- 5 To promote the wider civil and scientific applications of techniques and data used for test ban verification;
- 6 To highlight the CTBT's successful model for multilateral science diplomacy and cooperation.

## INVITATION

The Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) relies on innovation to enhance the capabilities of the Treaty's verification regime as well as to help move the Treaty closer to universalization and entry into force. As the sixth conference in the CTBT: Science and Technology series, **SnT2021** is expected to bring together (physically as well as virtually) over 1000 scientists, technologists, academics, students and representatives of the CTBTO's policy making organs. In addition, representatives from the fields of research and development, science diplomacy, science advisory, media and advocacy will be present. The 25th anniversary of the opening for signature of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) presents an opportunity to review the scientific and technological advancements made and to project what developments can be expected in the next 25 years.

It is currently planned for **SnT2021** to be hosted at the Hofburg Palace in Vienna, Austria, featuring a virtual component for active online participation. The structure of the conference will remain flexible to adapt for future changes of COVID-19 restrictions.

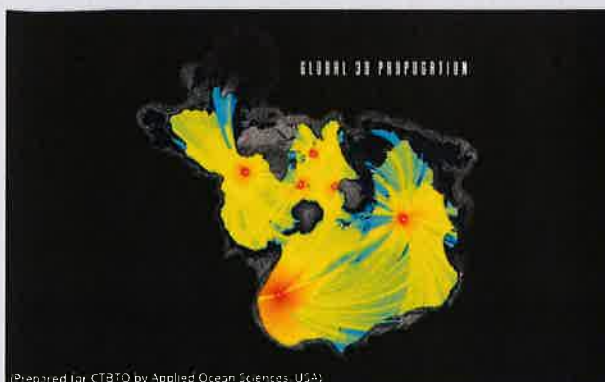
## CALL FOR ABSTRACTS

Deadline for submission of abstracts:  
30 NOVEMBER 2020 AT 23:59 UTC

CTBTO.ORG/SnT2021  
#SnT2021

# THEME 1

## THE EARTH AS A COMPLEX SYSTEM



(Prepared for CTBTO by Applied Ocean Sciences, USA)

3-D underwater sound propagation simulation illustrating the acoustic coverage (red for high and blue for low detection capability) with IMS hydroacoustic hydrophone stations across the world's oceans, in Spilhaus Projection centered on Antarctica.

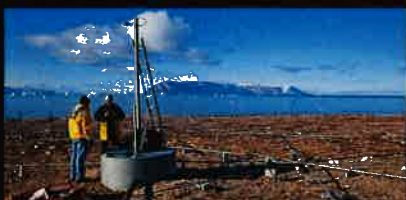
This theme focuses on the dynamic or static properties and processes of the earth whose characterization is necessary for the optimum processing, interpretation and assessment of monitoring data. Scientific and technical advances in monitoring the globe for nuclear explosions require an understanding of the way in which features of the earth influence relevant signals as they travel from their point of origin to points where signals are observed. The signals from monitoring networks, as well as noise recorded by those networks, constitute a massive reservoir of data that can support advances in the earth sciences on a local, regional and global scale. Elements of the monitoring network also need to be able to consider the complexities of the earth as a social system, specifically the interference between anthropogenic aspects and the earth's system processes, as they are connected and may interact with each other.

### TOPICS

- T1.1 The Atmosphere and its Dynamics
- T1.2 The Solid Earth and its Structure
- T1.3 The Oceans and their Properties
- T1.4 Interaction Among the Earth's Subsystems

One focus continues to be seismic and acoustic wave speed and attenuation, which are essential for locating seismoacoustic disturbances in the earth and its atmosphere and oceans. Another area is atmospheric dynamics relevant to the transport of radionuclides and the propagation of atmospheric infrasound. Subsurface properties relevant to the detection of a nuclear explosion by geophysical, radionuclide or other methods during an on-site inspection (OSI) constitute another area of interest. In addition to current monitoring technologies in all these domains, novel methods of monitoring that could potentially be used by National Data Centres (NDCs) might require characterization and understanding of specific properties of the earth's subsystems.

### THE VERIFICATION REGIME



The IMS consists of 337 facilities worldwide which monitor the planet for signs of nuclear explosions. Over 90% of the facilities are already in operation and the IDC in Vienna continuously processes this data stream. Both raw data and analysis results are made available to all 184 States Signatories of the CTBT.

The processing and analysis of data from different sources must ultimately present an integrated picture in order to allow decision makers to determine whether an OSI should be conducted and clarify if there has been a Treaty violation.



# THEME 2

## EVENTS AND NUCLEAR TEST SITES



Snapshot illustrating the plume dispersion 3.5 days after the DPRK event on 3 September 2017. Simulation based on NCEP analysed data.

Events such as earthquakes, explosions and release of radionuclides produce signals and surface features that may be observed locally, regionally, nationally or globally. Such events can be located in time and space and their characteristics can be estimated based on the data collected. This theme covers the characterization of the source, the emitted signals and what these reveal about the event and its environment. Only if the source is well characterized can its associated signals and anomalies be correctly analysed and interpreted. To ensure compliance with the Treaty, it is essential to understand the full extent of signals that may be generated by a nuclear explosion, as well as to be familiar with any other seismic, hydroacoustic, infrasound and radionuclide or other signals that could be confused with those from a nuclear explosion.

The Treaty's provision for OSI depends upon knowledge of the observables that may be expected after a nuclear test and how these could be identified as geophysical, radioactive, temperature or other anomalies or artefacts of testing. While such observations can help distinguish between inactive

### TOPICS

- T2.1** Characterization of Treaty-Relevant Events
- T2.2** Challenges of On-Site Inspection
- T2.3** Seismoacoustic Sources in Theory and Practice
- T2.4** Atmospheric and Subsurface Radionuclide Background and Dispersion
- T2.5** Historical Data from Nuclear Test Monitoring

and active nuclear weapon test sites, the data recorded by International Monitoring System (IMS) stations also make it possible to differentiate nuclear tests from other human made or natural events, thereby serving as a unique reservoir of knowledge for better informed policy making.

One of the challenges facing an inspection team at a historic test site is the need to distinguish and identify observables generated by historic underground nuclear explosions (those conducted before the nuclear testing moratorium) and those resulting from a more recent event. Factors to consider could include recognizing features that may indicate a decommissioned and decontaminated site or those that may suggest an active or reopened site. The types of expertise and capabilities required for these purposes need to be elaborated and could become relevant if any contingency operations that would call upon CTBTO technological capabilities are agreed by the United Nations and the States Signatories.

### ABOUT THE TREATY



The Comprehensive Nuclear-Test-Ban Treaty (CTBT) opened for signature in 1996. It bans all nuclear explosions, everywhere and by everyone. Before the CTBT can enter into force, all of the 44 countries listed in Annex 2 of the Treaty must ratify it. These countries possessed nuclear power or nuclear research reactors when the CTBT

was negotiated. Eight of the Annex 2 States have not yet ratified: China, the Democratic People's Republic of Korea, Egypt, India, the Islamic Republic of Iran, Israel, Pakistan and the United States of America. The 25th anniversary of the opening for signature of the CTBT will be a special highlight of **SnT2021**.

# THEME 3

## VERIFICATION TECHNOLOGIES AND TECHNIQUE APPLICATION



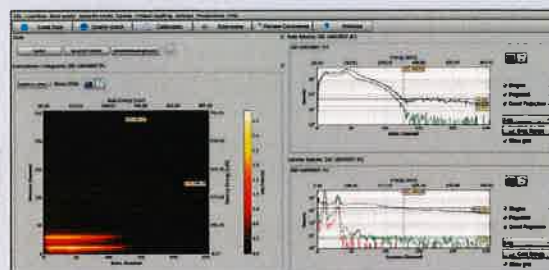
Installation of infrasound station IS03 at Davis Base, Antarctica.

This theme focuses on the systems used for the monitoring of nuclear explosions and the processing of the recorded data. It covers advances in traditional areas such as seismic, hydroacoustic, infrasound and radionuclide instrumentation, sensor networks, processing methodologies, as well as the exploration of novel methods and the adaptation and integration of methods used in other fields. This includes how machine learning or artificial intelligence can assist in large data analysis, for instance, to reduce analyst workload, enhance the quality of automatic products and improve event screening and discrimination in both waveform and radionuclide processing. Diverse sources of remotely sensed data may be useful in nuclear explosion monitoring. OSIs pose special challenges for sensors and associated equipment, which must be capable of detecting observables related to an event that triggered an OSI, especially those related to a nuclear test.

This theme provides an opportunity to review progress made on verification technologies in the last 25 years that the Treaty was open for signature, and consider the possible technological advancements that could be attained in the next 25 years.

### TOPICS

- T3.1** Design of Sensor Systems and Advanced Sensor Technologies
- T3.2** Laboratories Including Mobile and Field Based Facilities
- T3.3** Remote Sensing, Imagery and Data Acquisition Platforms
- T3.4** Augmented Reality and Fusion of Data from Different Monitoring Technologies
- T3.5** Data Analysis Algorithms
- T3.6** Artificial Intelligence and Machine Learning
- T3.7** 25 years of CTBT: progress on verification technologies and looking towards the future 25 years and beyond



INSPIRE (iNTEgrated Software Platform for the Interactive Review): novel IDC software application for radionuclide data analysis

## REGISTRATION AND SUBMISSION OF ABSTRACTS

Online registration and abstract submission is accessible through [ctbto.org/SnT2021](http://ctbto.org/SnT2021). No registration fee will be charged. The working language of the conference is English. Prospective authors are asked to choose the appropriate theme and topic when submitting the abstract (maximum 200 words) of their presentation. Authors can select their preferred format as an oral or a e-poster presentation. While it is hoped that physical attendance at **SnT2021** will be possible, active online participation is offered to ensure the conference remains fully accessible to both presenters and participants in case of COVID-19 restrictions.

In addition, authors are required to submit a short and very simple description (maximum 280 characters) outlining the abstract's

main contribution to the **SnT2021** objectives. The selection of abstracts will be based on quality and relevance to the themes and topics of the conference. The Scientific Programme Group may reassign an abstract to an alternative topic in order to maintain a coherent scientific programme. By submitting an abstract, authors agree to the publication of their abstract and presentation material by the CTBTO. Accepted abstracts will be made available online and through the CTBTO Event mobile app and compiled into a book of abstracts. Short descriptions may be used for advertising presentations during the event and in the final conference report. A peer reviewed collection of publications will be produced from a selection of all abstracts submitted.



# PERFORMANCE EVALUATION AND OPTIMIZATION



New generation OSI Flight Pod serving as housing units for the OSI Field Laboratory – here: the upgraded OSI SAUNA system installed.

The operation and sustainment of a global network of monitoring systems poses substantial challenges. Near real time acquisition and forwarding of continuous and segmented data from the IMS and the subsequent processing and analysis of data at the International Data Centre (IDC) also present great challenges. Strict requirements for operational data availability, quality and timeliness must be met and sustained. The results of processing and analysis raise further issues with regard to quality and timeliness. The handling of OSI data is also subject to specific requirements outlined in the Treaty and the OSI Operational Manual. In addition, the performance of the IMS and IDC depends on enabling technologies such as information technology and power systems.

Beyond the IMS, IDC and OSI, the full Treaty verification system also includes NDCs and the possible use of other data to supplement IMS data for expert technical analysis. NDCs provide advice to their National Authorities that make decisions

## TOPICS

- T4.1** Performance Evaluation and Modelling of the Full Verification System and its Components
- T4.2** Systems Engineering for CTBT Verification
- T4.3** IT, Power Systems and other Enabling Technologies
- T4.4** Network Sustainability
- T4.5** Resilience of the CTBT Monitoring Regime, including Lessons Learned from the COVID-19 Pandemic

within a broader policy context. NDCs may have IMS data and Treaty monitoring functions integrated into national operations and procedures to enhance their performance. NDCs provide feedback to the IDC on its products and services, including the NDC analysis tools, and conduct preparedness exercises jointly with other NDCs.

Evaluation and optimization of the performance of the CTBT verification regime involves other factors such as improvements to efficiency and cost effectiveness, reliability and security. Contributions on improving the performance of the verification regime are encouraged.

2020 brought about unprecedented challenges for the monitoring system with the onset of the COVID-19 pandemic. Facing these challenges, the system demonstrated resilience while remaining functional, thus providing the organization and stakeholders with important lessons that will be useful in the future.

## INVITATION TO ACCESS IMS DATA



CTBT-IMS-2021

CTBTO FOR SCIENCE  
GET INVOLVED NOW!

The virtual Data Exploitation Centre (vDEC) provides scientists with access to IMS data to conduct research and to publish new findings. The strong relationship between the scientific and technological communities and the CTBTO helps to ensure that the IMS remains at the forefront of technological innovation and that no

nuclear explosion goes undetected. Conference participants are encouraged to make use of vDEC to carry out scientific studies and assessments and to present their findings at **SnT2021**. Requests for access to vDEC can easily be completed and submitted online at <https://www.ctbto.org/specials/vdec/>.

CTBT  
IN A GLOBAL CONTEXT

SnT2019 Opening Ceremony, Festsaal, Hofburg Palace, Vienna, Austria

The CTBTO verification system exists within the broader context of international organizations, global policy making, international collaboration, public awareness and safety. This theme explores lessons learned from other arms control agreements and arrangements and from relationships within a broader context as they relate to the CTBT and nuclear explosion monitoring.

Advances in science and technology can bolster evidence-based policy making which in turn can reinforce confidence building. This theme explores applications of verification technologies and identifies innovative solutions within the framework of the CTBT as well as other relevant agreements and arrangements.

Apart from their purpose of monitoring and detecting nuclear test explosions, IMS data and IDC products may be made available for scientific use, under confidentiality agreements, through the virtual

## TOPICS

- T5.1** Science in Policy Discussions and Scientific Lessons Learned from Other Arms Control Agreements and Arrangements
- T5.2** Experience with and Possible Additional Contributions to Issues of Global Concern such as Disaster Risk Mitigation, Climate Change Studies and Sustainable Development Goals
- T5.3** Capacity Building, Education, Communication and Public Awareness

Data Exploitation Centre (vDEC). IMS data may also be used for civil applications, such as nuclear and radiological emergency preparedness and tsunami early warning systems.

Ensuring that countries and institutions have a robust science policy interface requires the wide dissemination and appropriate communication of scientific knowledge to both decision makers and the general public. It is therefore important to raise awareness and understanding through a broad range of outreach initiatives and science communication.

## FINANCIAL SUPPORT

Financial support may be available to a limited number of participants. Such assistance must be requested at the time of registration and **no later than 30 November 2020**.

Financial support will be considered only for participants who have submitted an abstract that is approved by the Scientific Programme Group. Participants are strongly encouraged to first seek travel and participation funds from non-CTBTO sources.

If you do not find the answer to your questions on the [ctbto.org/SnT2021](https://ctbto.org/SnT2021) pages, please email [SnT@ctbto.org](mailto:SnT@ctbto.org).



The CTBTO Youth Group is open to all students and young professionals who are directing their careers towards global peace and security and who wish to actively promote the CTBT and its verification regime. Members share the common goal of achieving the entry into force of the CTBT. For more details, email [youthgroup@ctbto.org](mailto:youthgroup@ctbto.org) or visit <https://youthgroup.ctbto.org/>.