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YOUTH FOR CTBT

CTBTO PREPARATORY COMMISSION

CTBTO RESEARCH FELLOWSHIP

A Collection of Fellowship Research Papers

2024

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A Collection of
Fellowship Research Papers

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About the CTBTO Research Fellowship

The CTBTO Research Fellowship was launched in 2021 and organized in cooperation with the Center for Energy and Security Studies (CENESS) to help promising young scholars build their professional networks by giving them access to top professionals and experts in the field of nuclear disarmament and nonproliferation. The Fellows were invited to attend a series of webinars lectured by prominent experts and diplomats, conduct research on CTBT, nonproliferation, and disarmament issues, and engage with distinguished scholars and practitioners.

About the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization

The Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) was established in 1996 with its seat in Vienna. Its main tasks are promoting the Comprehensive Nuclear-Test-Ban Treaty and building the verification regime to ensure its operational readiness when the Treaty enters into force. The Commission is headed by the Executive Secretary, Dr. Robert Floyd. The CTBTO Youth Group (CYG), launched in January 2016, is open to students and young professionals dedicated to achieving the entry into force and universalization of the CTBT. By March 2025, the Group had grown to over 1,650 members from over 130 countries.

About the Center for Energy and Security Studies

The Center for Energy and Security Studies (CENESS) is an independent, non-governmental think tank established in 2009. Headquartered in Moscow, CENESS's main goal is to promote independent, unbiased, systematic, and professional analyses on nuclear nonproliferation, arms control, and atomic energy. The flagship project of CENESS is the Moscow Nonproliferation Conference, which includes the New Generation Experts Segment, typically organized every 24 months. The Director of the Center is Anton Khlopkov.

NOTE

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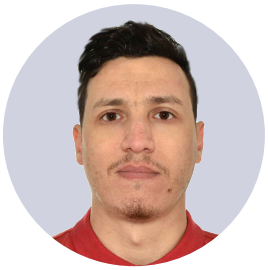

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Science and Technology Conferences: History, Accomplishments, and Role in Supporting CTBT

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ABSTRACT

This paper elaborates on the history, achievements, and impact of the Science and Technology Conferences (SnT) in supporting the Comprehensive Nuclear-Test-Ban Treaty (CTBT). The paper tracks the evolution of this platform from the inaugural "Synergies with Science" Symposium in 2006, the shift to the International Scientific Studies Conference in 2009, and the rebranding to SnT in 2011. These conferences have been instrumental in building the CTBT's verification regime and fostering global scientific collaboration in areas relevant for the CTBT. While challenges persist, the conferences have contributed greatly to advancing the CTBT's objectives. This paper also suggests future directions to maintain innovation and collaborative efforts.

INTRODUCTION

The primary goal of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) is to outlaw and ensure non-reoccurrence of nuclear weapon tests, thus aiding nuclear disarmament and non-proliferation. However, the Treaty faces challenges in achieving universal acceptance; geopolitical tensions and various perceived national interests impede the progress towards the treaty's entry into force.

The Article II.B, paragraph 26(f) of the CTBT provides that the Conference of the States Parties shall "consider and review scientific and technological developments that could affect the operation of this Treaty". For that purpose, a special body composed of independent experts, the Scientific Advisory Board may be established after the entry into force. However, since the Treaty has not yet entered into force and since significant advances in science and technology relevant to the CTBT operation have taken place, the need for an interim mechanism became evident. With this aim, the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO/PC) holds the Science and Technology (SnT) Conferences biennially. Initially known as the "Synergies with Science" Symposium in 2006, these conferences changed their name to the International Scientific Studies Conference in 2009 and adopted the SnT moniker in 2011. They bring together a wide range of technical specialists, scientists and decision-makers from around the world and offer a forum for information exchange, technological demonstration and cooperation. By guaranteeing that the advancements in scientific research on data processing, sensor technology, and other relevant areas are identified and considered, the conferences enhance the CTBT verification regime.

Based on the analysis of available data, this paper provides an overview of the history, key achievements, and prospects of the SnT conferences. It further demonstrates their important role in advancing the CTBT's goals and fostering a global culture of scientific collaboration and innovation for a more secure world.

SYMPOSIUM "SYNERGIES WITH SCIENCE, 1996-2006 AND BEYOND" (2006)

The first attempt of the CTBTO/PC to conduct a systematic review of advances in science and technology took the form of a scientific symposium, titled "Synergies with Science, 1996-2006 and Beyond" that was held in Vienna, Austria from 31 August to 1 September 2006. The symposium marked the 10th anniversary of the adoption of the CTBT, the purpose of the event was to celebrate the CTBTO/PC's achievements and to explore synergies with science that could be valuable for verification activities under the CTBT.[1] The agenda covered three broad subjects: 1) methods and procedures for imaging the solid earth and oceans; 2) methods and procedures for imaging the atmosphere, and 3) modern data analysis techniques. Discussions also touched upon issues directly related to the CTBTO organizational development, namely, the influence of scientific advancements on the CTBTO/PC cost effectiveness and future work of its Provisional Technical Secretariat. As stated in the press releases, the event was attended by several hundred participants including scientists, diplomats and representatives of international organizations. The conference was open for media coverage with the possibility to arrange for interviews with participants. The live-stream on the public web site was organized to engage with a wider audience. The symposium was opened with addresses by high-level officials, including the IAEA Director General and the UN Under-Secretary-General for Disarmament Affairs. While the full list of participants is not publicly available, it is possible to make several conclusions about the speaker lineup. Being the first conference of its type, it hosted only 12 participants as speakers and moderators from 9 countries: Austria, Canada, China, England, France, Italy, Japan, the Netherlands and the USA. Only one woman had the role of a speaker, the youth was not represented. Key participants were affiliated with either universities and research institutions or relevant national agencies. While the NGOs as an interest group were not represented, at least two speakers from business were involved as stakeholders in the field of relevant technologies (Yahoo! and Google Earth).

INTERNATIONAL SCIENTIFIC STUDIES (ISS) CONFERENCE, 2009

In 2006, only a month after the symposium, on 9 October, the Democratic People's Republic of Korea (DPRK) announced that it had conducted a nuclear test. At the time, the International Monitoring System (IMS), being the technical core of the CTBTO's verification regime, was being established and operated in test mode; still, it proved capable of detecting a nuclear event and providing reliable data. Politically, the test underlined the need for an effective CTBT verification regime and for ensuring its technological and scientific capacity. An additional argument was another nuclear test conducted by the same state on 25 May 2009, less than a month before the International Scientific Studies Conference (ISS09), where it was discussed along with the planned topics.

The Conference was organized within the framework of the International Scientific Studies Project launched in 2008.[2] The aim of the ISS project was twofold: 1) to evaluate the readiness and capability of the CTBT verification system to detect nuclear explosions worldwide, thus,

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[1] CTBTO Preparatory Commission, "CTBTO Preparatory Commission holds two-day scientific symposium", CTBTO Preparatory Commission, 2006, <https://www.ctbto.org/news-and-events/news/ctbto-preparatory-commission-holds-two-day-scientific-symposium/, accessed 10 February 2025>.

[2] CTBTO Preparatory Commission, "International Scientific Studies Conference, Vienna, 10-12 June 2009", CTBTO Preparatory Commission, 2009, <https://www.ctbto.org/sites/default/files/2022-08/issafc2_web.pdf/, accessed 10 February 2025>.

assessing the current state of affairs, and 2) to strengthen CTBTO/PC's cooperation with the global scientific community, thus, allowing the organization to keep pace with scientific and technological progress in the long term. The Conference took place from 10 to 12 June 2009 and, according to official publications, attracted around 600 participants from 99 countries, including Annex 2 States that had not ratified the Treaty (China, Egypt, Iran, Israel, USA) and two Non-signatory States (India and Pakistan).[3] As for the speaker lineup, among 55 speakers and moderators from around 24 countries (including the USA, China, India and Israel), only 6 were women (as shown in Graph II), the youth demographic group was not represented. In terms of key participants' affiliations, the overall situation did not change significantly: universities, scientific institutions and national governmental bodies (including defense agencies) remained prevalent. However, the positive dynamics in the diversity can be noted, since representatives of international organizations (UN World Meteorological Organization), NGOs (Center for the Promotion of Disarmament and Non-Proliferation — CPDNP, International Seismological Centre); even speakers from the press (Yomiuri Shimbun) took part.

The agenda covered 8 topic areas: seismology, infrasound, hydroacoustics, radionuclide monitoring, atmospheric transport modeling, system performance, on-site inspection and data mining. Apart from oral presentations, more than 200 posters were presented with seismology (53), on-site inspection (34) and radionuclide monitoring (31) being the most popular thematic fields. The panel on on-site inspection involved valuable contributions that provided comparisons between monitoring processes that exist in the functioning arms control and disarmament regimes, i.e. those of the OPCW,[4] IAEA and the US–Russia bilateral treaties. While the conference did not issue formal conclusions or recommendations, its materials were published in the Book of abstracts, followed by the report titled "Science for Security: Verifying the Comprehensive Nuclear-Test-Ban Treaty," in which topic coordinators summarized their thoughts on the scientific contributions to their fields made by participants. Later, a publication titled "Possible Projects for the CTBTO arising from the 2009 International Scientific Studies Conference, 10-12 June 2009" was issued. Its authors pointed out that many research contributions presented at the ISS09 were driven by the experts' individual scientific interests, and with that report, the authors attempted to tailor the conference outcomes to the future CTBTO's verification regime needs.

SCIENCE AND TECHNOLOGY CONFERENCE 2011

The first scientific event under the title "Science and Technology Conference" was held from 8 to 10 June 2011. The agenda was partly influenced by the Fukushima nuclear power station disaster that demonstrated the importance of CTBTO technological capacity for the global nuclear emergency response framework. A special session was devoted to the event and its aftermath. The contributions not only demonstrated the usefulness of data provided by the IMS in identifying and defining events of that kind (e.g. in discriminating between reactor accidents and possible nuclear explosions), but they also described the impact of such events on the CTBT verification system (e.g. the impact on the sensitivity of the IMS radionuclide network). Other thematic sessions (in total 350 scientific submissions and posters) covered the following topics: 1) "The earth as a complex system" aimed at discussing issues related to monitoring issues caused by various earth's complexities, 2) "Understanding the nuclear

[3] As of September 2009, 181 countries had signed the Treaty and 150 had ratified it. China, Egypt, Indonesia, Iran, Israel, the US, as well as the DPRK, India and Pakistan had yet to ratify the Treaty.

[4] Organisation for the Prohibition of Chemical Weapons.

explosion source", devoted to issues of identification of and distinguishing among nuclear events, 3) "Advances in sensors, networks and observational technologies" and 4) "Advances in computing, processing and visualization for verification application," discussing technological capabilities needed for observational verification activities, and 5) "Creating knowledge through partnerships, training and information/communication technology", where an overview of transnational cooperation mechanisms promoting transparency and openness in science and policy was presented.

The SnT 2011 attracted around 800 participants. In the promotional brochure, it was mentioned that financial support could be provided to a limited number of participants, but it was strongly recommended to first seek funds from non-CTBTO sources. According to the program, among 148 speakers, only 26 were women (as shown in Graph II), and the youth demographic group was not represented. Geographically, around 35 states were represented by speakers and moderators, with the USA (~30), Russia (~13) and Germany (~13) having the largest numbers of participants. Speakers from Egypt, India and Iran (Annex 2 States)[5] took part. In general, more than 60 organizations were represented by participants in the speaker lineup with no prominent changes in the character of organizations in comparison to the previous conference. As a result of the SnT 2011 Conference, a Book of abstracts was published, followed by a report titled "Scientific Advances in CTBT Monitoring and Verification" reviewing the materials presented. Even though no separate publication reflecting on the outcomes of the conference for the CTBT was issued, the mentioned report identified certain gaps in the range of scientific contributions presented at the SnT 2011 that paved the way for research to be presented at future conferences.

SCIENCE AND TECHNOLOGY CONFERENCE 2013

The SnT 2013, held in Vienna from June 17 to 21, brought together over 750 participants from around 100 countries to promote CTBT verification and strengthen ties with the scientific community. Keynote speeches by figures like Hans Blix and Ellen Tauscher highlighted the role of science and technology in global nuclear disarmament efforts. The agenda featured themes such as "The Earth as a Complex System", "Events and Their Characterization", and "Advances in Sensors, Networks, and Processing", reflecting the broad scope of scientific exploration central to CTBT monitoring and verification. Special sessions addressed the DPRK's February 2013 nuclear test,[6] detected by CTBTO stations. The issue of reducing radioxenon emissions from radiopharmaceutical facilities was also discussed.[7]

More than 300 presentations explored non-verification uses of CTBTO data, such as monitoring climate change via whale vocalizations and improving seismic detection with WWII ordnance. A session examined the 2013 meteor explosion in Russia, detected globally by CTBTO infrasound stations. The conference also introduced initiatives like the Young Scientists Evening and a prize for the best young scientist presentation. The media coverage was minimal, with only CTBTO PrepCom covering some aspects of the event.

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[5] As of 2011, the CTBT was signed by 182 and ratified by 153 states, it needed ratification by 6 signatories, and adherence and ratification by India, Pakistan, and the DPRK to enter into force.

[6] CTBTO News Article, "2013 DPRK Announced Nuclear Test", CTBTO Preparatory Commission, 2013, <https// www.ctbto.org/our-work/detecting- nuclear-tests/2013-dprk-nuclear-test/, accessed 10 February 2025>.

[7] CTBTO News Article, "The Science and Technology Conference 2013", CTBTO Preparatory Commission, 2013, <https://www.ctbto.org/ news-and-events/ news/science-and-technology-conference-2013/, accessed 10 February 2025>.

SCIENCE AND TECHNOLOGY CONFERENCE 2015

The SnT 2015 was held from June 22 to June 26. The conference drew more than 1,000 participants from over 70 nations, featuring 550 abstracts and poster presentations, making it the largest event in this series to date. The conference was inaugurated by Mr. Lassina Zerbo, former CTBTO/PC Executive Secretary, who emphasized the critical role of science in fostering peace and highlighted achievements from past conferences, including advancements in machine learning, self-calibrating infrasound sensors, and high-resolution beta-gamma spectrometry. Keynote speakers stressed the importance of scientific innovation in CTBT verification and the need for global collaboration in nuclear disarmament and non-proliferation.[8] Special sessions and panel discussions covered a range of topics, including the application of new and emerging technologies in nuclear security, the role of citizen networks in monitoring efforts, and the ongoing societal benefits derived from CTBT data. The conference also introduced the theme of "Performance Optimization", which encompassed discussions on network performance, trends in information technology, and logistics and lifecycle management.

Additionally, the conference underscored the need to engage young scientists and encourage partnerships through initiatives such as the Young Scientists' Evening and research grants provided by the European Union. In the closing session, the focus was placed on achieving quality in the SnT conferences and motivating attendees to utilize the CTBTO's online resources, such as e-learning modules and the virtual Data Exploitation Centre (vDEC). There was a lack of information regarding youth and women's participation due to the limited media coverage, resulting in no reports or summaries being available online.

SCIENCE AND TECHNOLOGY CONFERENCE 2017

The SnT 2017 occurred from June 26 to 30. This conference drew nearly 1,000 participants from over 120 nations, featuring 650 submitted abstracts, close to 400 posters, and more than 100 oral presentations. For the first time, both women and men were prominently featured as speakers throughout the week, and the conference was co-led by a man and a woman.[9] The high-level opening session included keynote addresses from former CTBTO Executive Secretary Mr. Lassina Zerbo, Princess Sumaya of Jordan, and other distinguished representatives. The event also incorporated a strong youth presence, with over 70 members of the CTBTO Youth Group from more than 50 nations participating.

A theme "Monitoring for Nuclear Explosions in a Global Context" was included in the programme for the first time. A special session and panel discussions explored a variety of subjects, such as the challenges and progress in the IMS, the role of academia in facilitating the Treaty's entry into force, and the CTBT's relevance in a rapidly changing global environment. The conference showcased innovative presentations concerning the use of mobile phones for seismic monitoring and best practices for using social media for advocacy. The CTBTO Youth Group was notably involved, with members presenting their own research, taking part in workshops, and engaging in the "Youth Newsroom" initiative, which aimed to share the conference experience with broader audiences through diverse media formats. The

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[8] CTBTO News Article, "SnT2015 kicks off", CTBTO Preparatory Commission , 2015, <https://www.ctbto.org/news-and-events/news/snt2015-kicks/, accessed 10 February 2025>.

[9] Lassina Zerbo, Former CTBTO Executive Secretary's Article on SnT2017, LinkedIn, 2017, <https://www.linkedin.com/pulse/ctbt-science-technology-conference-2017-peace-lassina-zerbo/, accessed 10 February 2025>.

conference emphasized the intersection of science and policy, underlining the necessity of simplifying complex scientific information for diplomats and policymakers. Three creative projects from the Youth Group were presented to raise public awareness of the CTBT.[10] The conference brought attention to the concept of "science diplomacy" as a pathway to promote the CTBT,[11] with suggestions for establishing summer schools and scholarship schemes focused on nonproliferation. The speakers stressed the necessity for collaboration between scientific and political realms, youth participation, and maintaining optimism in addressing global challenges. The conference highlighted the vital role that scientific and technological advancements play in verifying compliance with the CTBT and emphasized the significance of international cooperation in furthering nuclear disarmament and non-proliferation. The SnT2017 wrapped up with a call for cooperative scientific efforts in pursuit of peace and development, stressing the need for scientific progress and diplomatic initiatives to attain a nuclear threat-free world.

Media coverage increased compared to past events, with the Arms Control Association providing a separate daily summary of the conference proceedings and the CTBTO offering recorded videos on their YouTube channel.

SCIENCE AND TECHNOLOGY CONFERENCE 2019

The primary agenda of the 2019 SnT conference was to advance the verification science of CTBT. In 2019, there were 184 signatory states, and 164 ratifications completed after Zimbabwe's ratification. The Conference not only focused on bolstering verification, but also supported civil applications of the international monitoring system within the treaty.

As the geopolitical landscape in 2019 was in a flux, the timing of this conference was crucial. It is so because global nuclear arms control was faced with several challenges, such as the collapse of the INF Treaty in 2019 or the US withdrawal from the JCPOA in 2018. The Non-Proliferation Treaty (NPT) Preparatory Committee Meeting for 2020 Review Conference mentioned the lack of progress regarding disarmament. In such circumstances, the NPT PrepCom referred to an important role CTBT Preparatory Commission was playing regarding disarmament and non-proliferation education.[12]

The conference showcased geographic diversity with nearly a hundred states participating in the conference. It was also the first time that the issue of gender within science and technology was given a special spotlight in the SnT conference, with the female representation reaching just below 50 percent[13] (See Graph II).

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[10] Arms Control Association, "The CTBTO 2017 Science and Technology Conference: Day 4", Arms Control Association, 2017, <https://www.armscontrol.org/blog/2017-06-29/ctbto-2017-science-technology-conference-day-4/, accessed 10 February 2025>.

[11] Arms Control Association, "The CTBTO 2017 Science and Technology Conference: Day 5", Arms Control Association, 2017 <https://www.armscontrol.org/blog/2017-06-30/ctbto-2017-science-technology-conference-day-5/, accessed 10 February 2025>.

[12] Robert Einhorn, "The 2020 NPT Review Conference: Prepare for Plan B", UNIDIR, 2020, <https://unidir.org/wp-content/uploads/2023/05/The-2020-NPT-Review-Conference-Prepare-for-Plan-B.pdf#:~:text=Third%20Session%20of%20the%20Preparatory%20Committee%20for,the%20Non%2DProliferation%20of%20Nuclear%20Weapons%2C%2010%20May/, accessed 10 February 2025>.

[13] Ilya Kursenko, "Passion and Diversity at the 2019 CTBTO Science and Technology Conference", Arms Control, 2020, <https://www.armscontrol.org/blog/2019-06-30/passion-diversity-2019-ctbto-science-technology-conference/, accessed 10 February 2025>.

Moreover, there was notable youth representation, comprising at least 25 percent of all participants. The Forum on Global Citizenship and Youth Inclusion and Ban Ki-moon Centre co-organized panels for young leaders to discuss the role youth can play to fulfil CTBT objectives as well as other UN goals. The idea was to foster discussions on nuclear non-proliferation, diplomacy, and international law. Key topics in which youth participated included the CTBT's role in combating nuclear threats, enhancing youth awareness, and supporting gender diversity in scientific and diplomatic efforts. The conference also projected that the career preferences among male/female CTBTO youth group members were leaning towards international monitoring system, policy making, on-sight inspections and outreach activities.[14]

SCIENCE AND TECHNOLOGY CONFERENCE 2021

The SnT 2021 conference coincided with the 25th anniversary of the CTBT. The primary focus of the agenda was on further development of verification through technical and scientific capabilities, including AI applications and enhanced sensor networks. Due to COVID-19 pandemic, the conference followed a hybrid format of participation. Over 1600 participants took part in the conference. Although the virtual attendance allowed broader participation, the media coverage was low — unlike during the 2019 conference. The 2021 conference achieved impressive geographic diversity; however, a lion's share of participants came from North America and Western Europe, with significantly less — from Asia. The 2021 conference also saw a decrease in women participation to approx. 32 percent. Participants belonging to the "youth segment" were primarily attracted to non-proliferation issues. They were also involved in On-Site Inspection (OSI) educational initiative for young professionals with technical backgrounds, advanced verification technologies and media coverage hands-on training via Citizen Journalism Academy.

In 2021, the geopolitical landscape saw many important developments including postponement of the Review Conference for the NPT; the extension of the New START Treaty and DPRK's continued development of nuclear and ballistic missile capabilities. Moreover, throughout 2021, there were continuous, though unsuccessful, efforts to revive the JCPOA. Amidst such growing uncertainties, the importance of CTBT's verification framework to prevent nuclear testing was often referred to as crucial in promoting international security.

SCIENCE AND TECHNOLOGY CONFERENCE 2023

Despite further deterioration of global political situation and exacerbation of several conflicts, including around Ukraine, SnT 2023 saw a record increase in participation, surpassing the number of 2000 people from 148 countries. 80 percent of the participants were in-person attendees and 20 percent attended online, as virtual components were added by the organizers for global inclusivity. The major theme of the conference was to highlight innovation as a key to verification science and technical advancements and importance of universalization of the CTBT.

Women included at least 35 percent of the total attendees. The "NextGen for the CTBT" initiative helped to further engage the youth in discussions related to CTBT implementation,

[14] S. Bukhalina and M. Zadorozhnaia, "T5.3-O3 Integration women technicians in CTBTO", 2019 SnT Conference, 2019, < https://ctnw.ctbto.org/ctnw/abstract/30191/, accessed 10 February 2025>.

innovation in monitoring technologies and nuclear security. The 2023 conference successfully made the youth voices heard in the support of CTBT. The themes that included youth were gender parity in nuclear disarmament, youth's contributions to CTBT's progress, awareness building among young students regarding nuclear issues, empowering the youth as torch bearers for science and security, engage youth in shaping a nuclear free world for generations to come. Regarding geographic representation of women, the representation from North America and Western Europe remained high. Nevertheless, there was a notable increase in African participants.

A welcome event, with Somalia ratifying the CTBT, added the momentum to the universalization of the CTBT. Regarding media coverage, despite 11 journalists sponsored to attend the conference, not much media coverage of the conference was seen. Nevertheless, the hashtag Snt2023 was posted on twitter by CTBTO official twitter page Russian Mission in Vienna, National Nuclear Security Administration (NNSA) and participants.

CONCLUSION

At the time when the CTBT has yet not entered into force and in the resulting absence of Scientific Advisory Board, SnT Conferences can be considered as a "precursor" for the CTBT's science and technology review mechanism. At the same time, SnT conferences turned out to be an instrument of much wider outreach to various communities highlighting the importance of the CTBT in terms of global security, arms control, non-proliferation and development — something the Scientific Advisory Board was not supposed to have as a function. Usually lasting for 2–5 days, the SnT conferences feature panel discussions, technical sessions, and keynote speeches. They address topics as data processing, new sensor technologies, and the scientific and civil uses of CTBT data. Key priorities include fostering international scientific collaboration to keep the CTBT's verification system effective.

In terms of participants diversity and agenda scope, SnT conferences saw significant growth: from only 3 panel sessions with 12 speakers and "several hundred participants" in 2006 to the intense programme encompassing 24 scientific topics distributed amongst the five vast themes covered in 101 oral presentations and 455 e-poster presentations with the record attendance of over 2000 participants in 2023. It is pertinent to note that the agenda currently includes relevant topics belonging not only to the natural sciences (physics, chemistry, geology, etc.), but also to political science, thus incorporating knowledge on security, non-proliferation and disarmament issues. The general dynamic in the conferences' geographical scope can also be considered positive: participants from 99 states took part in 2009, and, even though only 70 states were represented in 2015, by 2023 the number increased and participants from 148 states were present. Among the participants, Annex 2 States are represented quite significantly, especially, the USA, followed by Russia, China, France, Germany, as well as Egypt, Iran, Israel and even CTBT Non-signatory states – India and Pakistan. It is also important to note that Iran—Israel relations are conflictual in nature, nevertheless, representatives from both states attended the SnT conferences. This reflects that SnT Conferences can also provide a platform for dialogue necessary to ease regional tensions, thereby, acting as confidence building measure (CBM) tools.

Youth and women engagement is also on the rise: in the period 2006–2011, the percentage of women among speakers did not exceed 17,5%, and the youth as a demographic group was not represented. However, in 2013, there were modest advancements in recognizing youth, highlighted by introducing a special event called Young Scientists Evening and a prize awarded for the best presentation by a young scientist. This event continued in 2015, and in 2017, the conference experienced a noteworthy rise in participation from both the youth and

women. For the first time, the conference included two "Conference Leaders" (a man and a woman). Both men and women were prominently featured as speakers, with more than 70 members from the 200 CTBTO Youth Group participating in the conference, along with six special events dedicated to youth. In the last SnT conference of 2023, inclusion of women was at 35 percent which was lower in comparison to 49 percent in 2019, but the last conference successfully made the youth voices heard on the issues pertinent to the CTBT. Overall, the outreach effect of the SnT conferences also increased with the introduction of the hybrid format of participation.

These SnT conferences are significant in the long term, as they help to preserve and improve the CTBT's verification capabilities. They contribute to the credibility and dependability of the global verification system by consistently incorporating new scientific and technological developments, building and preserving international trust, ensuring compliance with the Treaty, and contributing to global peace and security.

RECOMMENDATIONS

In order to strengthen global advocacy for the ban on nuclear testing and for the entry into force of the CTBT, there is a need to keep the positive dynamics through diverse audience engagement, especially, of such social groups as the youth and women. All-encompassing regional representation, including CTBT Annex 2 and non-signatory states, remains a priority as well. Therefore, it can be recommended to continue the practice of allocating grants providing financial support to prospective candidates from the mentioned groups and underrepresented regions (e.g. South East Asia, the Pacific and the Far East). Specific targeted outreach initiatives for experts and scientists from the Annex 2 and especially non-signatory states can also be beneficial in this regard. Similarly, SnT conferences can also provide an opportunity to organize a panel for young parliamentarians. Continuous connections with the existing initiatives promoting inclusion of women and youth in STEM[15] are necessary. It would also be desirable to invite more international Civil Society Organizations, especially those which focus their efforts on the intersection of science and arms control (especially, but not exclusively, in the nuclear domain) – such as the IPPNW or the Pugwash Conferences on Science and World Affairs (both Nobel Peace Prize recipients).

With the aim of creating a live community of active and interested members, it might be pertinent to consider establishing a collaborative online platform that would enable participants to share research, carry on conversations, and work together on projects. This could increase the intensity of cross-domain collaboration and bring benefit to the CTBTO/PC with innovative and out-of-the-box solutions to pertinent issues related to nuclear disarmament. This recommendation might be in line with the proposition voiced in 2023 by the panelists for the audience to contact them if they had any fresh and innovative ideas. Such a platform might incorporate virtual networking events, webinars, and forums to guarantee continued engagements. The platform could also serve as a feedback mechanism.

It could also be recommended to put virtual and augmented reality (VR/AR) experiences into practice, i.e. to make use of VR/AR technologies to develop immersive experiences that showcase nuclear explosion impact, on-site inspection simulations, and CTBT-related technology. Participants' comprehension and involvement can be improved by these experiences, particularly for those who are beginners in the field.

[15] For example, the IAEA Marie Sklodowska-Curie Fellowship Programme.

Regarding themes for future SnT conferences, it may be desirable to better publicize the civilian/peaceful uses of monitoring systems, in addition to improvement in verification technologies and scientific collaborations. Thus, future themes could focus on climate change and environmental monitoring, disaster risk reduction, space science and planetary monitoring, ethical and social dimensions of sciences, cross disciplinary collaborations to address global challenges in the fields of oceanography, meteorology, and urban resilience and cooperate scientific studies regarding impacts of nuclear testing on ecosystems.

From the point of view of preserving institutional memory, it might be useful to revive the practice of publishing reports reflecting on the results of the conference not only from the purely scientific perspective, but from the one of the CTBTO and identifying gaps in contributions that could be of further interest to the organization. This might become especially important when the time comes to incorporate the achievements of the SnT Conferences into the future Scientific Advisory Board mechanism. Moreover, the graphical representation of participants from countries and the segregation of online and in-person speakers also needs to be added in future reports. Although statistical data in the form of regional distribution and clusters of participants was added in conference reports, there is a need to add a list and/or number of participants individually from countries, especially from Annex 2 States to formulate future strategies for further engagements.

In terms of media coverage of SnT conferences, this area needs significant improvement in communication strategies, since, unfortunately, there was very little social, print and electronic media coverage that did not do justice to the scale at which the conferences were organized, as well as to the important issues these conferences aim to cover. To bring about universal awareness and especially in underrepresented regions and in CTBT Annex 2 and non-signatory states, there should be a solid perception-building strategy that could include spreading press-releases among all prominent international newspapers, electronic media as well as following a collective social media strategy before, during and after the conference.

ANNEX

Scheme I: Timeline and Key Achievements of the SnT Conferences

2006

"Synergies with Science" symposium: the first attempt to conduct a systematic review of advances in science and technology relevant to the CTBT, as well as to actively engage with the global scientific community.

2009

International Scientific Studies Conference was marked by developing a strategic approach via the ISS Project, participation of Annex 2 and Non-signatory States' representatives, inclusion of international organizations, NGOs and press representatives in speakers lineup, incorporating the lessons learned from the DPRK's nuclear tests and the experience of other arms control regimes in terms of inspections, and establishing a mechanism of keeping the record of and developing a critical and reflective approach to the conference's results.

2011

The first Science and Technology Conference provided analysis of the CTBTO technological capacity for the global nuclear emergency response framework based on the lessons learned from the Fukushima accident, and benefited from adding to the agenda a session on creating knowledge through partnerships, training and information / communication technology.

2013

SnT2013 focused on monitoring the Earth's complex systems, analyzing events, and advancing sensor technologies. Highlights included discussions on the DPRK's February 2013 nuclear test. The conference featured the Young Scientists Evening and awards for outstanding presentations, emphasizing the importance of engaging the next generation of researchers.

2015

SnT2015 highlighted advancements in CTBT verification, including machine learning and infrasound sensors. Discussions covered nuclear security, citizen monitoring, and the societal benefits of CTBT data. The "Performance Optimization" theme addressed network performance and IT trends. Initiatives, like the Young Scientists' Evening, were added to encouraging attendees to use e-learning modules and vDEC to expand their expertise.

2017

SnT2017 introduced the new theme "Monitoring for Nuclear Explosions in a Global Context". The event highlighted such advancements as mobile phone seismic monitoring. The CTBTO Youth Group played a significant role, engaging in workshops and creative projects to raise awareness about the CTBT. The conference emphasized science diplomacy, international collaboration, and youth involvement in advancing nuclear disarmament.

2019

SnT2019 continued the positive dynamics in the youth engagement and benefited from adding to the agenda topics seeking to identify how scientific developments and cooperation can support national needs and frame policy objectives in support of the civil applications of the CTBT techniques and data used for test ban verification.

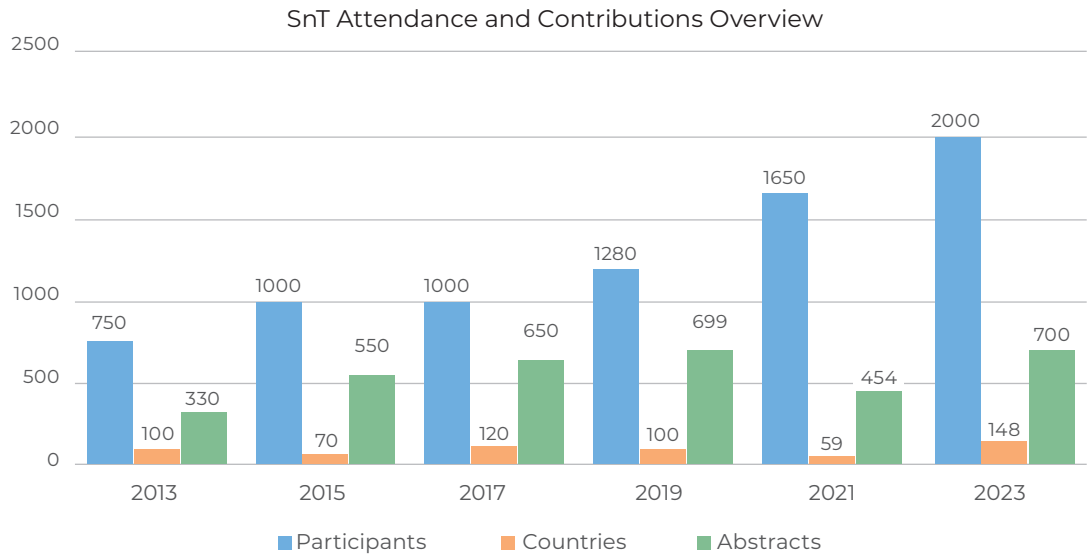
2021

The agenda of the SnT2021 was significantly shaped the COVID-19 pandemic and sought to address the resilience of the CTBT system, especially amid COVID-19 disruptions. The conference marked the 25th anniversary of the opening for signature of the CTBT and allowed for hybrid format of participation (in-person and online).

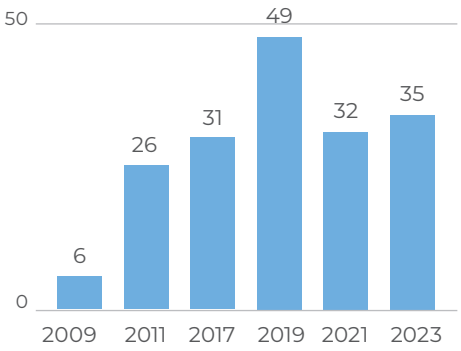
2023

SnT2023 sought to maintain awareness of emerging technologies relevant to CTBT monitoring, 051 preparedness and related areas. The conference brought attention to such pertinent issues as integration of early career scientists, including the CTBTO Youth Group and the Young Professional Network, in the CTBT circuit. Virtual components were added to continue the success of hybrid format of participation at earlier conference.

Graph I: Women Representation in SnT by Region (%)



Graph II: Women Representation in SnT Conferences



Graph III: SnT Attendance and Contributions Overview