SnT 2025
8 SEPTEMBER ONLINE DAY
9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

Advancements in quality assurance for the International Monitoring System and calibration challenges for seismic and infrasound technologies

B. Doury, A. Kramer, J.B. Le Blanc, P. Campus

Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO)

INTRODUCTION AND MAIN RESULTS

Maintaining the scientific credibility and trustworthiness of IMS data requires reliable calibration and quality assurance of complete seismic and infrasound measurement systems. This poster highlights recent advances, ongoing challenges, and collaborations with the metrology community to strengthen traceability and ensure long-term sustainment of the IMS network.

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P3.1-727

Introduction

The primary mandate of the IMS is the detection of nuclear explosions. It is therefore designed to provide robust forensic evidence once the Treaty enters into force. Hence, ensuring the technical and scientific credibility of IMS data is critical to the mission of the IMS.

This requires effective management of the full life cycle of deployed measurement systems - from equipment type approval to on-site operations - within a quality assurance framework that is transparent, benchmarked, and peer-reviewed. Quality assurance objectives:

1. Demonstrate quality assurance in IMS measurements to ensure **trustworthiness** and **credibility** of IMS data
2. Ensure **consistency** in IMS measurements and **equivalence** in data produced across the IMS network
3. Ensure **continuity** and transparency of best practices **independent of changes** in instrumentation/service providers, or individual personnel

This e-poster focuses on advancements and challenges for **seismic and infrasound** technologies.

Methods

To achieve its quality assurance objectives, the Provisional Technical Secretariat (PTS) engages with parent network operators, expert laboratories, the metrology community and equipment manufacturers.

- Since 2017, CTBTO's needs are captured in the strategy documents of the Consultative Committee for Acoustics, Ultrasound and Vibrations (CCAUV).
- June 2021: Practical arrangement signed between BIPM and CTBTO.

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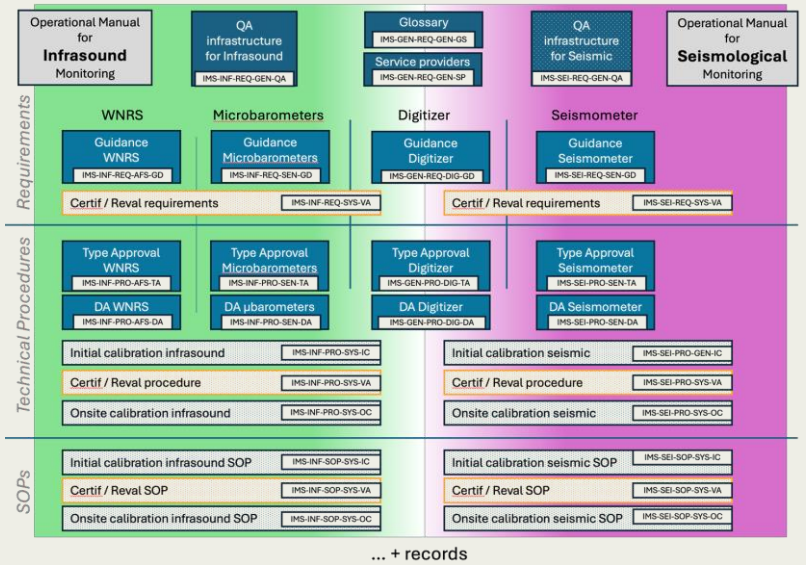
- 2020-2023: EURAMET research project InfraAUV captures CTBTO needs for extended traceable environmental measurements for seismic, hydroacoustic and infrasound.
- CTBTO develops technology specific roadmaps for seismic and infrasound metrology. [O3.1-722]
- CTBTO organizes pilot studies and the first comparison between laboratories for infrasound sensors.
- Collaboration with expert laboratories at formalizing Quality Assurance processes (Type Approval, Device Acceptance, Initial and Scheduled calibration) and documents. [O3.1-722]



Requirements for data quality and calibration of IMS measurement systems are laid out in the IMS Operational Manuals.

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Advances and challenges (infrasound)

Laboratory calibration

- Several calibration concepts developed [Side event SnT2023 by InfraAUV project], [O3.1-761][P3.1-167]
- Equivalence between measurements of expert laboratories demonstrated for majority of IMS frequency range [SnT 2023 - O3.1-676]

cea LNE Pilot PennState Sandia National Laboratories THE UNIVERSITY of MISSISSIPPI

- First accreditation of a laboratory in IMS frequency band of interest [SE01-04]

LNE ISO/IEC 17025 ilac-MRA cofrac ETALONNAGE
IEC TR 61094-10:2022

- Need for further research on environmental susceptibility.

Field Calibration

- Passive calibration (Gabrielson, 2011) is deployed at ~40% of infrasound certified stations [P3.1-708]
- Research continues with new field calibration concepts and propagating uncertainties to IDC products (trace velocity, azimuth). [O3.1-361]

SnT2025 Map for calibration topics

[SE01]: Side event on Metrology at SnT2025

[O3.1-361] Kristoffersen: Infrasound uncertainty propagation: ensuring traceability from the laboratory to the field

[O3.1-722] Barham et al.: A strategy for the development of metrology to enhance the sustainment of the seismic and infrasound component of the IMS network

[O3.1-761] Rodrigues: Exploring the Potential of a Barometer as a Transfer Standard for Infrasound Calibration

[O3.1-814] Ackerley**:** Field Calibration of Weak Motion Seismometers using Strong Motion Accelerometers as Reference

[P3.1-178] Merchant et al.: Challenges in seismometer electrical calibration: A case study preparing for a station recapitalization

[P3.1-182] Bloomquist et al.: Impact of temperature on GS-13 seismometer calibration results

[P3.1-694] Rusanto: In Situ Calibration of CTBTO Seismic Monitoring Stations in Indonesia

[P3.1-708] Le Blanc et al.: From errors to insights: the role of Infrasound Calibration in improving troubleshooting activities and system knowledge

Advances and challenges (seismic)

Laboratory calibration

- Laboratories and NMIs have adapted their workbenches to support large seismometers used for the IMS
- Research by metrology community is ongoing to further develop calibration methods to link seismic measurements to the SI [SE01-05]
- CTBTO calls for pilot studies and interlaboratory comparison to progress towards mutual acceptance between laboratories
- Need for further research on environmental susceptibility.

Field Calibration

On-site calibration for seismometers is a current priority for further development.

- Currently used electrical “self-calibration” comes with operational complexity and limitations. [SE01-01][P3.1-178][P3.1-182]

- CTBTO **calls the community** of laboratories, station operators, parent network operators and manufacturers to identify and evaluate new methods. [O3.1-814][SE01-07]

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