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

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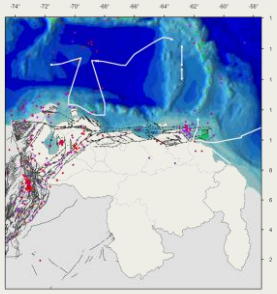
Empowering Venezuelan Seismological Service for scientific and civil applications: Integrating IMS Technologies and Capacity-Building for Enhanced Regional Monitoring.

A. Pérez[1], R. López [1], G. Romero [1].

Venezuelan Foundation for Seismological Research (Funvisis) [1]

INTRODUCTION AND MAIN RESULTS



Venezuela is a seismic country and has the longest coastline in the Caribbean region, which significantly increases its exposure to tsunami related hazards. This work shows how the capacity-building program and the use of products and data generated by the different IMS waveform technologies reinforcing local and regional capacities for monitoring of regional seismic and tsunamigenic activity and to the development of forensic seismology research.

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Introduction

National Data Centres (NDCs) are crucial national technical organizations responsible for advising their authorities on verifying the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Standardizing processes and providing essential hardware, software resources, technologies and techniques for monitoring, acquisition, processing, and data analysis are vital for optimizing the use and interpretation of data generated by the IMS.

The capacity-building program empowers more countries to actively participate in nuclear-test-ban verification through intensive technical training courses for experts. This program equips NDCs with the necessary knowledge and tools for capacity strengthening while promoting international cooperation through meeting spaces and scientific-technical exchanges. Combined with the NDC4All initiative, this enhances the verification regime's effectiveness and aligns with global efforts to improve monitoring through scientific development and cooperation.

This work presents the results of strengthening NDC Venezuela through the capacity-building program. It details how the acquired skills and tools from this program, along with regional NDC cooperation, have optimized NDC Venezuela and empowered the Venezuelan Seismological Service for scientific and civil applications. This showcases the integration of IMS waveform technologies for monitoring regional seismic and tsunamigenic activity, and developing forensic seismology, thereby reinforcing local and regional capacities to address national and international needs.

Metodology

Venezuela, as a State Signatory to the Comprehensive Nuclear-Test-Ban Treaty (CTBT)—signed on October 3, 1996, and ratified on May 13, 2002—designated the Venezuelan Foundation for Seismological Research (Funvisis) as its National Data Centre (NDC). Funvisis also oversees the Venezuelan Seismological and Tsunami Alert Service, which operates two auxiliary seismic stations of the International Monitoring System (IMS), located in Puerto la Cruz (AS118) and Santo Domingo (AS117).

Figure 1. NDC Venezuela.

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Nearly three decades of sustained activities

Since the signing of the Treaty, nearly three decades of sustained activity have contributed to the progressive strengthening of National Data Center (NDCs), guided by a methodological approach grounded in:

- ❑ Technical training and capacity building.
- ❑ Technology transfer and system integration of IMS waveform technologies.
- ❑ Regional collaboration and knowledge exchange
- ❑ Continuous improvement.

Results

Through technical training and capacity building activities, staff from Venezuela's National Data Centre (NDC) have actively participated in intensive training courses, workshops, and conferences organized by the CTBTO, addressing topics such as seismic data acquisition, waveform analysis, and event characterization. These sessions aimed to enhance technical competencies and promote standardized practices aligned with CTBT verification protocols. As of June 2024, a total of 105 professionals have participated in training activities across 68 events, as illustrated in the bar chart in Figure 1.

Participation in these technical-scientific and training exchange events has enabled, among other benefits, the following:

- ❑ Facilitating access to cutting-edge technologies and enhancing the availability of data generated by the International Monitoring System (IMS), thereby expanding monitoring coverage in areas exposed to seismic and tsunami-related threats (Figures 3, 4, and 5).
- ❑ Acquiring the necessary skills and expertise for processing and utilizing IMS-generated data and products through the tools provided in the "NDC in a Box" package. This has allowed for the integration of IMS technologies into seismic event detection, as well as the incorporation of automated calculation tools included in the package. These advancements have significantly strengthened the capabilities for tsunami event detection and have contributed to the development of research in the field of forensic seismology within the SSV (Figure 6).

Figure 2. Number of Participations by Event Type (January 1997 – June 2024)

Figure 3. CBS Installation (March, 2022).

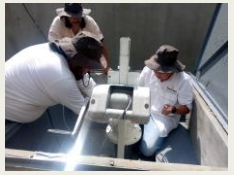

Figure 4. Upgrade PCRV Seismic Auxiliay Station (November, 2023).

Figure 5. Signing of the Tsunami Agreement (February 21, 2024).

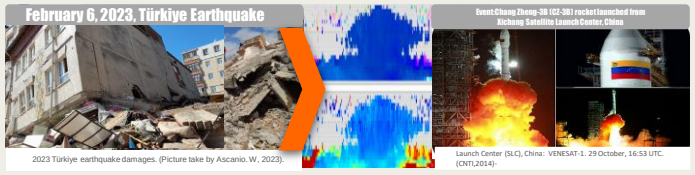

Figure 6. Incorporation of infrasound technology into Venezuelan Seismological Service (SSV) for seismic event detection activity and to the development of forensic seismology research, 2024.

Conclusions

Over three decades of sustained engagement in the CTBTO Capacity Building Programme have fostered notable institutional and technical improvements within the Venezuelan Seismological Service (SSV). This long-term collaboration has enabled the development of specialized competencies in waveform technologies, data analysis, and verification methodologies aligned with IMS and IDC standards. The adoption of tools such as NDC-in-a-Box has enhanced automation, multilingual reporting, and interoperability. Expanded access to IMS stations, through the signing of the tsunami agreement, has improved spatial resolution, reduced reporting latency, and strengthened event characterization. In this context, capacity-building efforts have reinforced regional cooperation and operational readiness, contributing to the IMS performance validation process and bolstering NCD Venezuela role in supporting the CTBT verification regime.

This enables development of local and regional capacities for monitoring seismic and tsunami events in the region, based on international cooperation and the IMS performance validation process, strengthening mission capability to detect any nuclear weapons test, any time, any place.

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