The International Data Centre (IDC) of the Comprehensive Nuclear Test Ban Treaty Organization (CTBTO) automatically processes infrasound data later reviewed by interactive analysis; the detected and located events are being systematically included in IDC products.

The IDC works on enhancing the automatic system for the identification of valid signals and the optimization of the network detection threshold by identifying ways to refine signal characterization methodology and association criteria. The objective of this study is to reduce the number of associated infrasound arrivals that are rejected from the automatic bulletins when generating the reviewed bulletins. The study is twofold; the first part consists of improving the detection accuracy at the station processing stage by enhancing the infrasound signal detector DFX-PMCC (Detection and Feature Extraction – Progressive Multi-Channel Correlation). The second part separates infrasound data from other waveform technologies at the automatic network processing stage. Infrasound rules in Global Association (GA) are tuned to pursue a lower ratio of false alarms. Once modifications are tested and validated, the updated algorithms will be implemented in the development area of the IDC for further assessment of their performances in fusion with other waveform technologies.

The study is based on SEL3 results from IDC Operations, solely taking into account SEL3 detections on infrasound stations. The objective is to primarily focus on infrasound seed events.

Figure 1. Status of the IMS infrasound network in November 2012 (red triangle: certified and operational, black: in reconstruction, blue: out of operation or under maintenance).

Figure 2. Top: Configuration being tested in the vDEC (red part) for development; Bottom: Current configuration of the automatic SH system in IDC Operations, until the production of reviewed bulletins.

Current configuration in IDC Operations:
- Data processed in single association pass
- Very difficult to integrate technology-specific rules
- Most events are either primarily infrasonic or seismic (+ hydro-acoustic)

Proposed configuration:
- **Infrasonic-only pipeline** allows for simpler integration of infrasound-specific processing flow.

Implementation of infrasonic only pipeline on vDEC

The study is based on SEL3 results from IDC Operations, solely taking into account SEL3 detections on infrasound stations. The objective is to primarily focus on infrasound seed events.

4 weeks of SEL3 are reprocessed using SEL3 infrasound detections corresponding to 4 different seasons:
- \(01 – 08\) May 2010
- \(01 – 08\) November 2010
- \(01 – 08\) August 2010
- \(24 – 30\) January 2011

The first step results for this infrasound pipeline SELI gives:
- SELI contains 18% less infra-seed events than SEL3
- Slightly improved performances: –17% of valid SEL3 vs. –20% for SELI
- Still large proportion of missed events: 39% SEL3 vs. 41% SELI
- Still ~80% of false alarm rate

**Revisiting the associations with atmospheric ducting**

**Objective**: Improving association procedure for infrasound detections by validating associations with climatology.

**Proposed solution**: the association creation remains unchanged (with 3 regimes for celerity model) and is then being validated at the conflict step with atmospheric specifications

- The association are reviewed one by one and validated based on the presence of a stratospheric waveguide along the path.
- The presence of the waveguide is estimated, using ECMWF specifications, by calculating the ratio of effective celerity: \(c_{eff}\) ratio along the propagation path
- Each events with less than 2 valid association is rejected

**Way forward** [under implementation]:
- Presence of tropospheric waveguides and integration of range dependency
- The detections from rejected association become available for creation of other events seeds
- Implementation of ray tracing to validate the association

**Concluding remarks**:
- Ongoing efforts to reduce the false alarm rate and improve the miss-event rate of infrasound events of the IDC automatic system at the Network Processing level:
  - SEL-Infra (SEL3) pipeline implemented on vDEC, allows for enhancements
  - Need to integrate climatology in automatic processing (in GA)
  - Several potential solutions with pros and cons (complexity, computing time, ...)
- Work ongoing at the IDC on:
  - Expanding the method to tropospheric ducting, incorporating phase celerity verification for upwind propagation (thermospheric returns) separation of celerity regime vs. range
  - Implementation of the prototype in GA and in IDC development pipeline
  - Test and validation on a larger dataset (more than 2.5 years of reviewed data available)
  - Implementing ray tracing for phase identification (providing travel-times and azimuth deviations)

**References**

**Disclaimer**: The views expressed on this poster are those of the authors and do not necessarily reflect the view of CTBTO Preparatory Commission.

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**Figure 3.** Proposed approach to revisit IDC association of infrasound phases with climatology.

**Figure 4.** Example: Top: Situation map with the source (orange star), the station (red triangle) and location along the trajectory (blue points); Right: Corresponding effective celerity profiles (matching colors with map) obtained with ECMWF specifications. The 2 boxes corresponds to the ground effective celerity for each point along the path and (resp.) to the maximums in the stratosphere

**Figure 5.**
Top: SEL3 reviewed manually (accepted: green dots, rejected: magenta stars) vs. LEB (blue dots). Bottom (2 figures with and without tracks) - SELI verified automatically (rejected: magenta stars, validated: green dots) vs. LEB (blue dots).

**Table 1.** Comparison of SEL3 before and after first pass analysis and SELI before and after automatic verification of the associations (validity based on association review).