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

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Towards a modern and robust quality control tool based on DTK-QUALITY data

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CTBTO PREPARATORY COMMISSION | PUTTING AN END TO NUCLEAR EXPLOSIONS

INTRODUCTION AND MAIN RESULTS

Regular monitoring of noise levels is carried out as part of the quality control process. In an evolving IT world, a modern, robust and user-friendly tool strengthens users' capabilities to assess the data and the performance of the IMS stations and ensures the efficient operation of the Network.

The French NDC Software DTK-QUALITY presents a promising opportunity to overcome existing challenges and to advance the quality control process for the benefit of the IDC, IMS and the authorized users.

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Introduction

Noise Levels at a waveform station can be analyzed by computing Power Spectral Density (PSD), which is an important quality indicator for waveform data recorded by the IMS SHI Network. The continuous monitoring of the PSDs as part of the Quality Control (QC) process ensures that the IMS network is operating efficiently, and that instrument malfunctions or data quality issues can be detected and addressed on a timely matter.

At CTBTO currently, the PSD data is computed by different tools, which are exposed to several challenges such as obsolescence, maintainability, homogenization, reproducibility and usability. CTBTO explores solutions to reduce the number of applications by having one single library that could be used in different applications dedicated to performing station quality control, certification or revalidation of the IMS station, or assess and evaluate the network performance.

CTBTO has evaluated the DTK-QUALITY software (developed and maintained by French NDC), which is a feature-rich and configurable command-line tool.

Objectives

Homogenization

- Do all existing tools that compute and display PSDs have a consistent way of doing it?
- Selection of PSD computation parameters to address the different usages
- Possibility to have a single tool serving IDC operations, IMS field engineers and NDC in a Box

Maintainability

Software development processes and tools are rapidly advancing to make technology accessible and easy to use for one and all. In the other hand, outdated software technology and obsolescence presents challenges to find the expertise to fix some bugs or introduce some improvement to a legacy software or even to port it to newer platform (rocky 8, Rocky 9 migrations). As a result, Software cost might increase, and maintenance comes with a difficulty degree.

Reproducibility

- PSD computation results need to be comparable with other external tools
- Need to transparently expose configuration

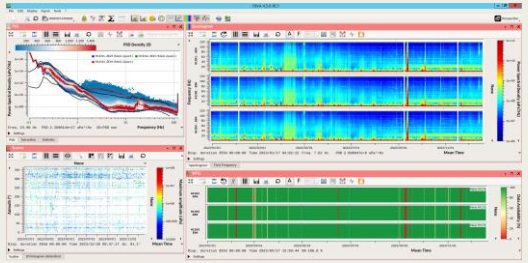
🎯 Reduce the number of applications and have one library → cost and time effective solution as only one library needs to be maintained and results among the applications can be homogenous.

Method

Evaluation of DTK-Quality

IDC and French NDC collaborate to evaluate DTK-QUALITY and compare its PSD results with those produced by QCTool (IDC operational Software)

- Several DTK tools in NDC in a box are already compatible with DTK-Quality



- Configurable and evolutive:
  - All parameters used for calculations are configurable
  - French NDC actively develops and maintains DTK tools
- Notable specifications:
  - Developed in modern language (Qt-C++), relies on shared DTK class library (DTK-Geolib)
  - Support for various metadata and waveform formats (CSS3.0, miniSeed, FDSN…), responses correction for IDC and FDSN station XML
  - Operating Systems: RHEL7 and RHEL9
  - Optimized (parallel computation)
  - Output: Standard netCDF and figure generator

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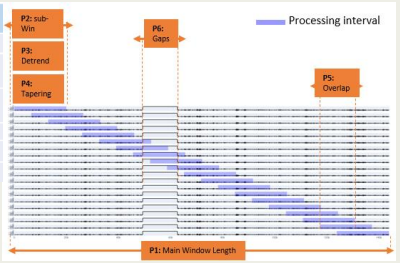
Method / Data

Configuration

IDC configuration as baseline with some exceptions:

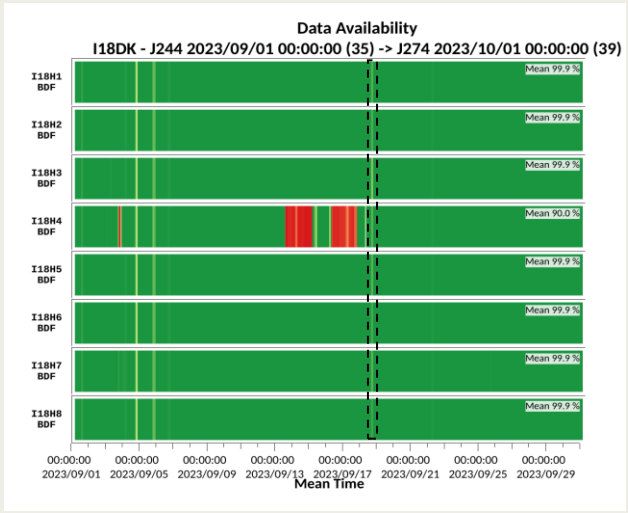
	QCTool	DTK-Quality
P1: Main window length	3600s	3600s
P2: Sub window length	300 for I and H 500 for S	300 for I and H 500 for S
P3: Detrend	Linear detrend on each subwindow	Constant detrend on the main window
P4: Tapering	nutall4a	Hann
P5: Overlap	0.68	0.5
P6: Gaps	fill gaps with 0	Skip windows with gaps



Dataset

The aim is to cover all possible cases:

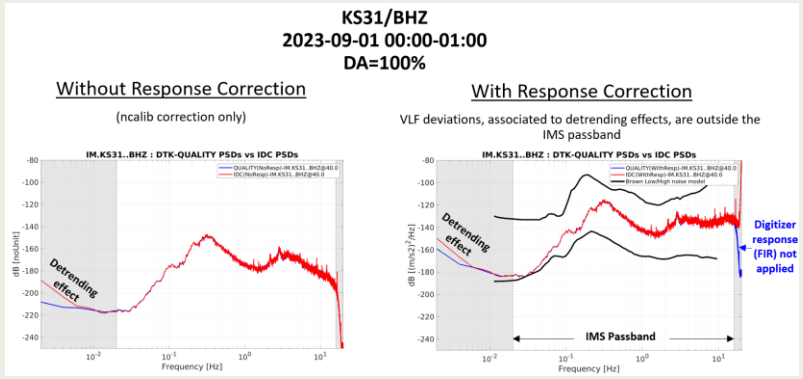
- One station per technology: KSRS (seismic), I18DK (infrasound), H11N (hydroacoustic)
- Period with different quality indicators (gaps, spikes)



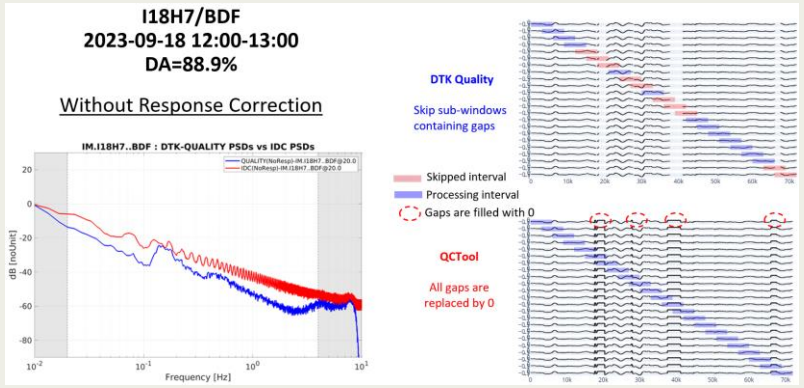
Results

The comparison results are promising, and the slight differences are explainable:

No Gaps – 100% data availability



With Gaps – data availability < 100%



Conclusion

The topic of Quality control is of high interest for both IDC and IMS divisions.

The key objectives for the evaluation of DTK-QUALITY are:

- Reproducibility of the results
- Customization of the configuration parameters
- Possibility of running DTK-QUALITY in IDC environments with regards to system requirements and storage needs
- Possibility to cover all IDC and IMS Use cases and serving DTK-QUALITY results to other tools.

The promising evaluation results opens the horizons to continue collaboration between CEA and IDC/IMS to possibly paving the way for the integration of DTK-QUALITY in NDC in a Box as well as IDC operational environment.