

Enhance data quality control with interactive station monitoring tools in the OPS centre.

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CTBTO Preparatory Commission

INTRODUCTION

The requirement for data availability emphasizes the significance of data quality monitoring. In conjunction with other PTS monitoring tools, the Multi-Technology Integration Portal was developed to support PTS monitor data quality at the station and network levels in a more systematic, timely, reliable, and accurate approach. As well as supporting other technical routine activities to ensure station performance meets the IMS Operational Manual requirements. This assists the OPS Centre, especially when dealing with incidents, in monitoring data quality at the station and network levels..

METHODS/DATA

The method entails integrating/aggregating existing PTS monitoring tools and displaying them on a single portal. The Multi-Technology Integration portal has been developed to provide an informative view of data quality that allows the user to obtain a concise summary of the station status. Data is gathered from the station Information (DOTS), SOH-Grafana, PRTTools, IRS-ITS reporting system, PSD/PDF, residual, calibration (CAMT- CalxPy), station configuration, and other sources.

START

RESULTS

The results show that using these methods led to a significant improvement in data quality monitoring in the OPS Centre. This enhances data accuracy and identifies incident sources, allowing more reliable troubleshooting. This approach supports identifying and informing OPS of potential incidents at an early stage by continuously monitoring station data quality. Efficient in terms of time and operational efficiency when dealing with incidents. Maintain the IMS network's high performance.

CONCLUSION

In dealing with station incidents and monitoring IMS networks, the use of Multi-Technology Integration Portal along with other PTS monitoring tools has resulted in significant enhancements in OPS data quality monitoring. These benefits contribute to the overall reliability of IMS network performance.

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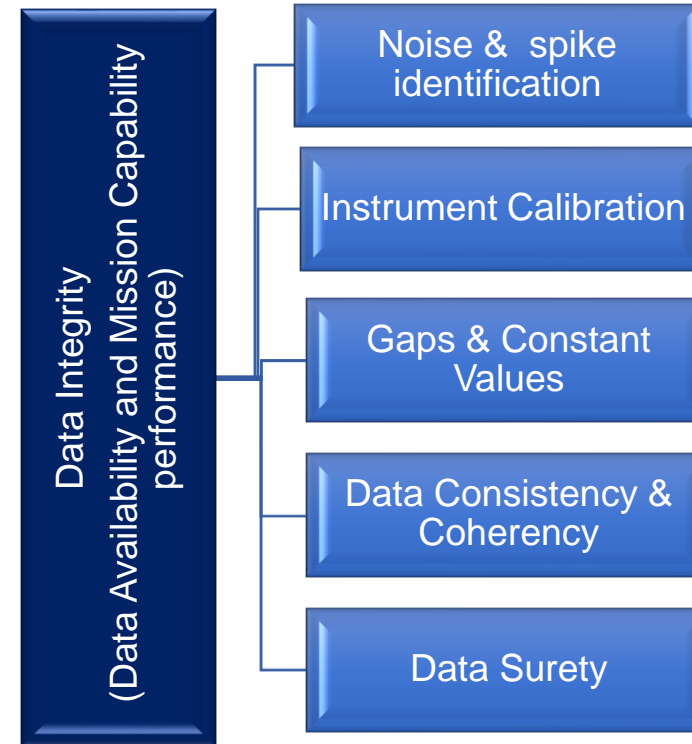
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The International Monitoring System (IMS) is a globally distributed network of monitoring facilities using sensors from seismic, hydroacoustic, infrasound, and radionuclide technologies. **The need for data availability increased the significance of data quality monitoring.** This task is addressed through the creation of a platform for **the fast and easy identification of data acquisition problems, as well as regular activities to ensure that station characteristics meet the requirements of the IMS draft Operational Manuals.**

The Provisional Technical Secretariat (PTS) has developed **a Multi-Technology Integration Portal internal platform with a variety of monitoring tools to facilitate data quality monitoring.** This portal has been developed to support **Internal/PTS** on the daily IMS station – network monitoring.

The **accurate and reliable data** in PTS context facilitates efficient troubleshooting at any level, enables informed decision-making in any type of incidents, supports predictive analysis, and drives continuous improvement on the **station performance.** It provides the necessary **foundation** for Station Operator and PTS to **optimize their operations, improve data transmission quality, and achieve desired outcomes that meet the requirement.** (Data Availability and Mission Capability performance).

In terms of data quality, what does OPS monitor?



Compliance with Standards it involves verifying that the acquired data meets the specified requirements, such as **sampling rate, amplitude range, frequency response, and other relevant parameters.**



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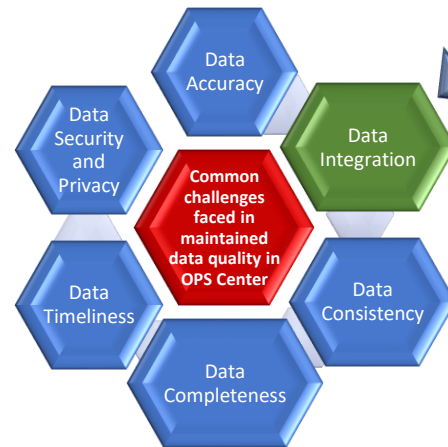
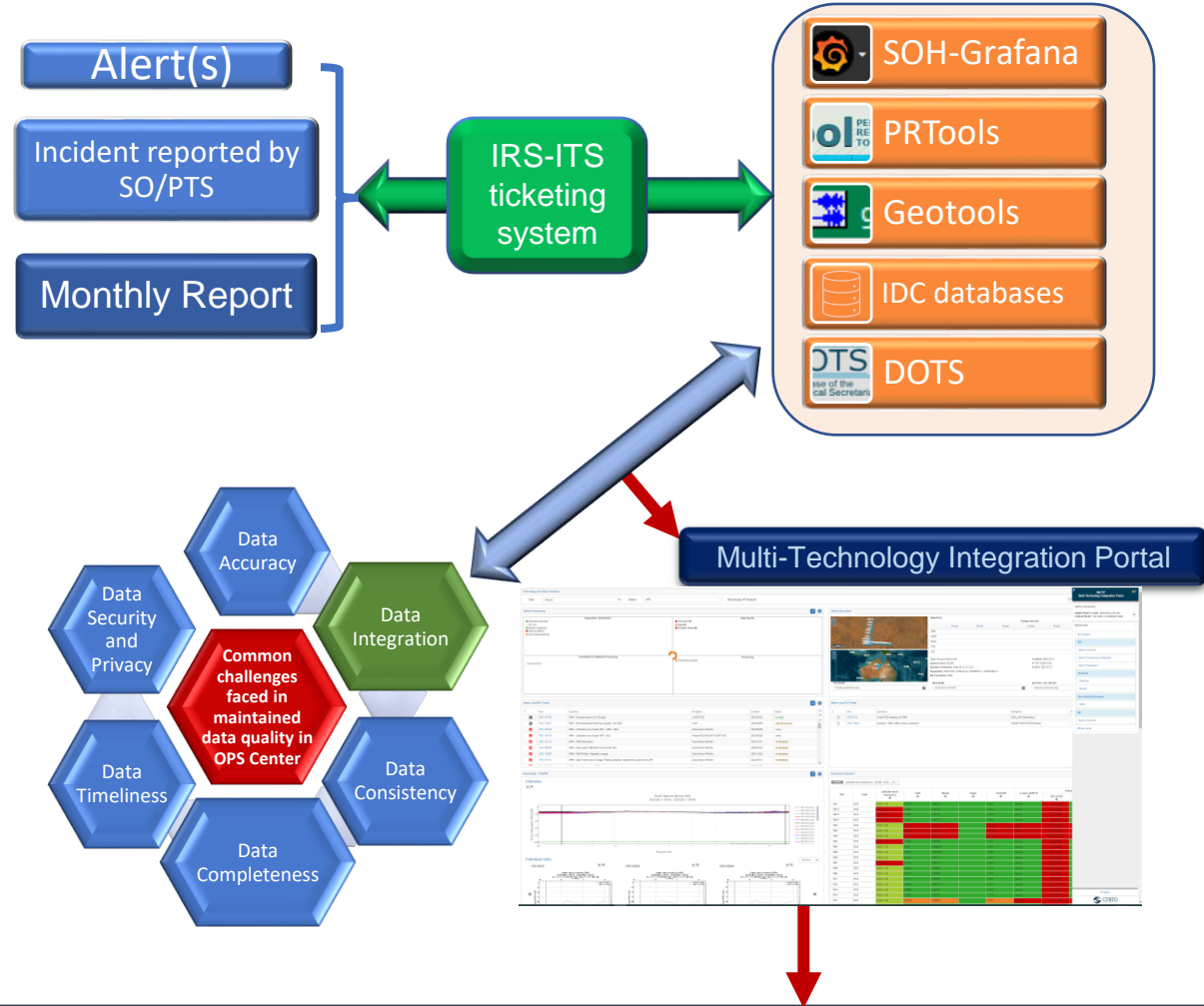
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How OPS improves data quality monitoring ?

OPS's approaches to handling incidents and improving data quality monitoring are as follows:

1. OPS is primarily based on **real-time monitoring** and **alerts** for incident management.
2. OPS **validates** and **verifies** data by utilizing OPS Tools (SOH, PRTools, Geotools, and others) as well as existing databases.
3. **Data quality control** evaluated the overall quality of monitored station data using defined Data Quality Metrics and Indicators as specified in the Station O&M. Multi-Technology Integration Portal **is particularly supported at this stage to ensure OPS can have more reliable data quality monitoring.**
4. Continuously **evaluate** and **improve** on data quality based on the feedback, analysing data quality reports and process.

This approaches is also used to review Station Performance on a monthly (**Monthly Report**) or yearly (**SSR's**) basis.



- **The dedicated portal gathered** information from various OPS tools and database(s) and visualized station data/information on a dedicated page for preliminary/summary/detail analysis.
- Using the **provided indicator**, this tool can detect anomalies, outliers, and inconsistencies in data.

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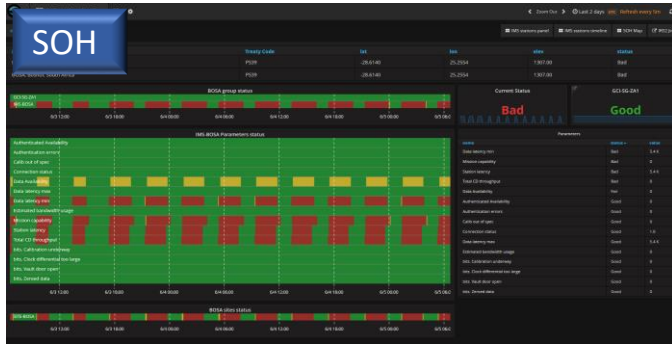
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Handling Incident - Alert

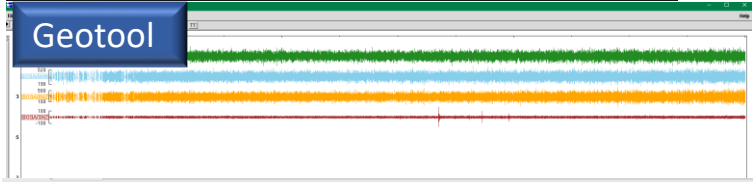
ALRT-229810 BOSA PS PS39 **ACTIVE**

Station Performance

Boshof, South Africa (Air Force Technical Applications Center)



Geotool



PRTools

Data Quality > Gaps
 mtrc-jdq-q-1-5
 to 05 Jun 2023 (day)

Entity	Station	30 May 2023	31 May 2023	01 Jun 2023	02 Jun 2023	03 Jun 2023	04 Jun 2023	05 Jun 2023
1	BOSA_BHE	0.0041	0.00002	0	0	0	0	N/A
2	BOSA_B...	0.0041	0.00005	0	0	0	0	N/A
3	BOSA_BHZ	0.0041	0.00005	0	0	0	0	N/A
4	BOSA_SHZ	0.0041	0.00005	0	0	0	0	N/A

IRS

(S) Tickets

T	Key	Summary	Assignee	Started	Status
PR	IRS-175135	BOSA - Lightning strike; damaged Cisco ASA device	OPS Centre	2023/05/10	IN PROGRESS

- Gaps**
 - [Gaps Status]**
 - BOSA_BHE: 0.006391166022959007
 - BOSA_BHN: 0.006392510837735421
 - BOSA_BHZ: 0.006386576134842002
 - BOSA_SHZ: 0.006385890329599328

- Constant Values**
 - [Constant Values Status]**
 - BOSA_BHE: 0.0013094242463158744
 - BOSA_BHN: 0.0005310843210487116
 - BOSA_BHZ: 0.0003594713249889713
 - BOSA_SHZ: 0

```

BOSA - Property Issues: Station [IC] with channels: [4]
BOSA_BHE BOSA_BHN BOSA_BHZ BOSA_SHZ

Channel Summary (from CQQuality table, only DQC<100 displayed):
Time: 2023/06/05 06:58:17 06:58:17 06:58:17 06:58:17 06:58:17 06:58:17
BOSA_BHE 01:48:27 54:58:17 96.7% 2023/06/05 05:09:50
BOSA_BHN 01:48:27 54:58:17 96.7% 2023/06/05 05:09:50
BOSA_BHZ 01:48:27 54:58:17 96.7% 2023/06/05 05:09:50
BOSA_SHZ 01:48:27 54:58:17 96.7% 2023/06/05 05:09:50

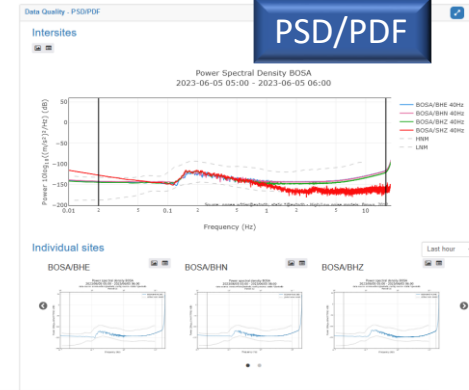
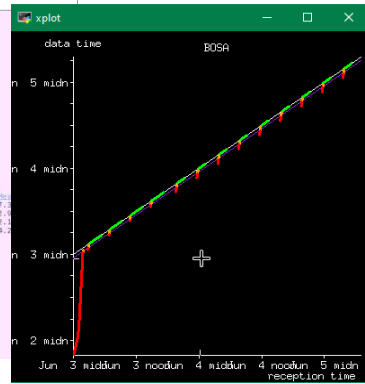
MISSING DATA (from CQQuality table, only 2 components displayed):
Time: 2023/06/05 06:58:17 06:58:17 06:58:17 06:58:17 06:58:17 06:58:17
BOSA_BHE 2023/06/05 05:09:50 - 2023/06/05 06:58:17 01:48:27
BOSA_BHZ 2023/06/05 05:09:50 - 2023/06/05 06:58:17 01:48:27

Channel Status
Report period from 2023/06/05 06:58:17 to 2023/06/05 06:58:17
Time: 2023/06/05 06:58:17 06:58:17 06:58:17 06:58:17 06:58:17 06:58:17
BOSA_SHZ 96.859 96.859 1 7655600 0 87.7
BOSA_BHE 96.859 96.859 1 7655600 25 14852.26
BOSA_BHN 96.859 96.859 1 7655600 10 18312.1
BOSA_BHZ 96.859 96.859 1 7655600 25 13954.2

PING count 3, packet size 51200
Time: 172.32.35.212 (172.32.35.212) 512(540) bytes of data.
520 bytes from 172.32.35.212: icmp_seq=1 ttl=248 time=830 ms
520 bytes from 172.32.35.212: icmp_seq=2 ttl=248 time=790 ms
520 bytes from 172.32.35.212: icmp_seq=3 ttl=248 time=812 ms

--- 172.32.35.212 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 201ms
rtt min/avg/max/ndev = 789.737/812.440/835.548/18.741 ms

PING RESULT:
[Result] Remote Address is up! [172.32.35.212]
  
```



The incident handling procedure in OPS includes an assessment on the data quality.

- Alert is **Active (SOH)** (or Alert has **ended-outage >1 hour**)
- The **Station Performance** indicator confirms that the alert is active due to lost DAU, MCU, gaps and Authentication DA.
- Check the **SOH-Grafana** for more information on the parameter that caused the **BAD** status.
- Geotool** can provide information on waveform data.
- Check **KPI performance** with **PRTools**.
- The **Station Summary** section is used to validate the data quality (PSD/PDF, residuals, and configuration current status).
- Establish communication with the Station Operator/PTS via **IRS-JIRA** for troubleshooting.

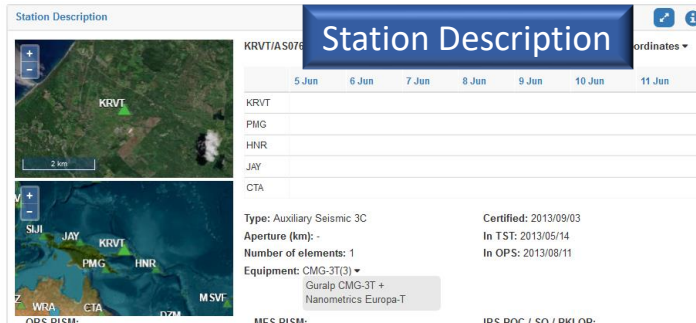
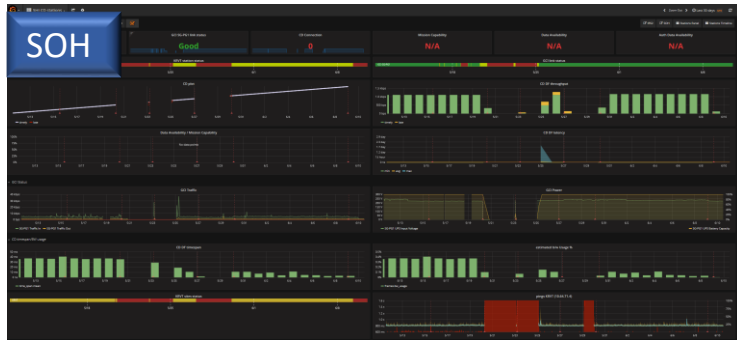
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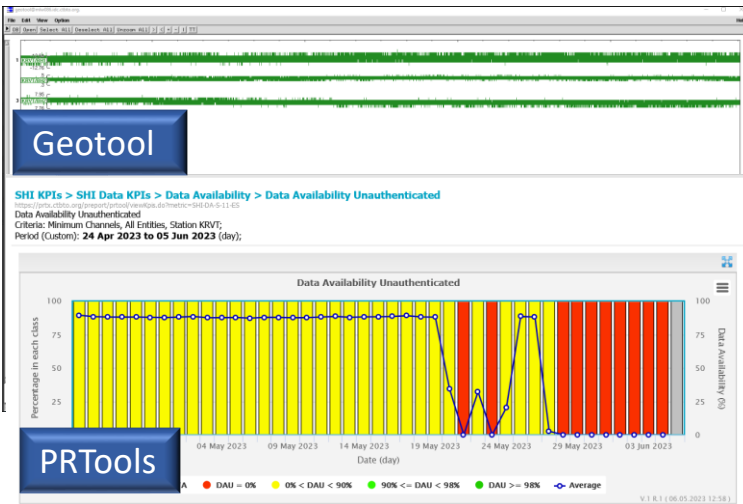
Use Case(s) in the PTS OPS Center

Equipment changed required due data quality deteriorated



Station Jira(IRS) Tickets

T	Key	Summary	Assignee	Created	Status
CCN	IRS-175586	KRVT - Priocomp hotspare installed	LOGISTICS	2023/06/05	OPEN
PR	IRS-175368	KRVT - Change of sensor and Digitizer at KRVT	OPS Centre	2023/05/23	IN PROGRESS
CCR	IRS-174772	KRVT - Station Maintenance - change of sensor and digitiser	CMO	2023/04/25	CMO EVALUATION
PR	IRS-168401	KRVT - VAULT DOOR OPEN alarms set in KRVT CSF affecting MC	Jose Pereira	2022/06/16	OPEN
PR	IRS-162117	KRVT - KRVT sensor failures	Jose Pereira	2021/08/25	IN PROGRESS
PR	IRS-161130	KRVT - Data quality deteriorated - station is non-MC	Jose Pereira	2021/07/06	IN PROGRESS
PR	IRS-160527	KRVT - Pseudo Random calibration not good with ssCalibView	Moctar MOUMOUNI KOUNTCHE	2021/06/07	OPEN



The quality of the data transmission has deteriorated:

- DAU/MCU degraded; **PRTools** was used to assess station KPI performance.
- **Geotool** confirmed that the station is only transmitting digitizer noise.
- More information about the Station Performance can be found on the **SOH-Grafana**.
- The **Station Summary** section is where the data quality issue (PSD/PDF, residuals, and current configuration status) is validated. PSD/PDF and residuals plots provided information on the anomaly that could result in **equipment failure**.
- Verified the existing reports for more information and communicate with the Station Operator/PTS via **IRS-JIRA** for troubleshooting.

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Reviewing the Station Performance

Monthly Report review

IMS Reporting System /
H09N - May 2023

Details
 Type: Monthly Report

Stations: H09N
 Treaty number: HA09
 Technology: HA
 Country: United Kingdom of Great Britain and Northern Ireland
 Other stations affected: H09W
 Period Covered: May 2023
Report Summary:
 ✓ DA (Unauth.) H09N/W = 96.36%/96.29%; MC (Unauth.) H09N/W = 95.66%/95.73%.
 The monthly report for May 2023 is reviewed and accepted.

Summary in May 2023:
 IRS-174696: Calibration 2023, scheduled moved to October 16-18th, 2023.
 IRS-174698: GPS antennas received (CCN).
 IRS-175048: GG - Primary link down - VSAT modem was changed to bring up the link.
 IRS-175288: GG link SG-GB2 down.

Reports are still open or in progress as of June 2nd, 2023:
 IRS-174597: CCR computer - spare required.
 IRS-164060: CCR intrasite communication upgraded.
 IRS-163612: H09N - Discussion on the Full Frequency Response
 IRS-162979: H09W - Problem during calibration H09W (ED)
 IRS-156108: H09W calibration - November 2020 (ED)
 IRS-146929: H09W calibration not working (ED)
 IRS-140804: Authentication, (MFS)
 IRS-171507: Data Transmission Outage (SSI and UPS) (H09N, H09W, and 149GB).
 Attached:
 The station performance, DA (Unauth.), MC (Unauth.), status bit, and authentication status in May 2023.
 O&M table, performed by the Station Operator in May 2023.
 Data quality was verified.

PTS Review:
 ✓ The monthly report for May 2023 is reviewed and accepted.
 DA (Unauth.) H09N/W = 96.36%/96.29%; MC (Unauth.) H09N/W = 95.66%/95.73%.
 Both parameter were lower than minimum channels requirement due to issue on the SG-GB2 link.

DA (Unauth.) %: H09N: 96.36; H09W: 96.29
 DA (Auth.) %: H09N: 96.02; H09W: 96.07
 MC (Unauth.) %: H09N: 95.66; H09W: 95.73
 MC (Auth.) %: H09N: 95.32; H09W: 95.51

Technology and Station Selection
 Type: Hydroacoustic Station: H09N Tristan da Cunha, United Kingdom of Great Britain and Northern Ireland

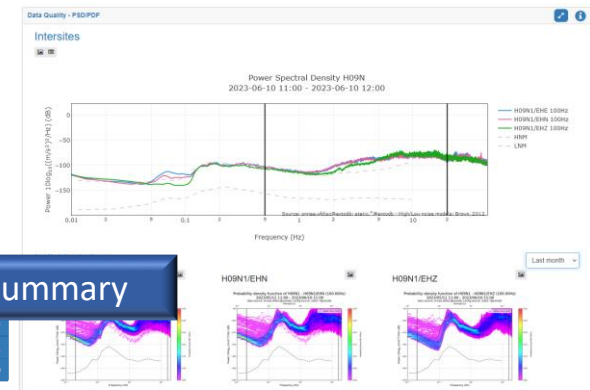
Station Performance
 Acquisition, Distribution Data Quality
 Contribution to Network Processing Processing

Station Description

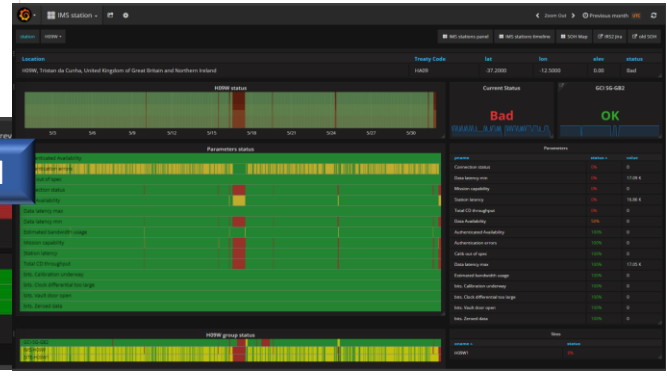
Columns: calibrate result received on, NCalib, Calib, ... (8)

Site	Code	calibrate result received on	Calib	NCalib	Calper	Calib diff	in spec (SO/PTS)	Published	
								CD1.1(CSF)	VOMS
H09N1	EHE	2023-04-25	0.0081802310	0.00835	0.2	-2.03%	yes/yes	updated	true
H09N1	EHN	2023-04-25	0.008187085	0.00835	0.2	-1.95%	yes/yes	updated	true
H09N1	EHZ	2023-04-29	0.008364946	0.00835	0.2	0.18%	yes/yes	updated	true

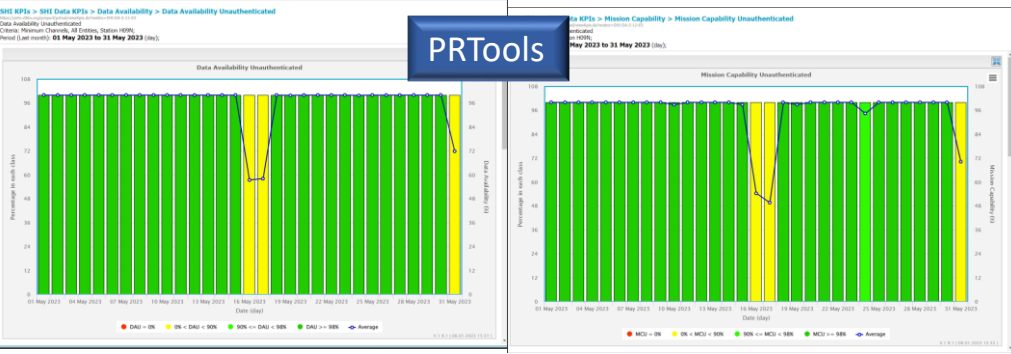
Station Summary



SOH



PRTools



Monthly report review:

- **PRTools** is used to verify KPI station performance.
- Review and verify the station O&M Activity (Status Bit) on the **SOH-grafana**.
- **SOH-grafana** confirmed the station's performance and authenticity.
- **Geotool** to confirmed the data quality of the waveform.
- In the **Station Summary section**, PTS can analyze data quality station performance (PSD/POP, residuals, calibration, and configuration status).

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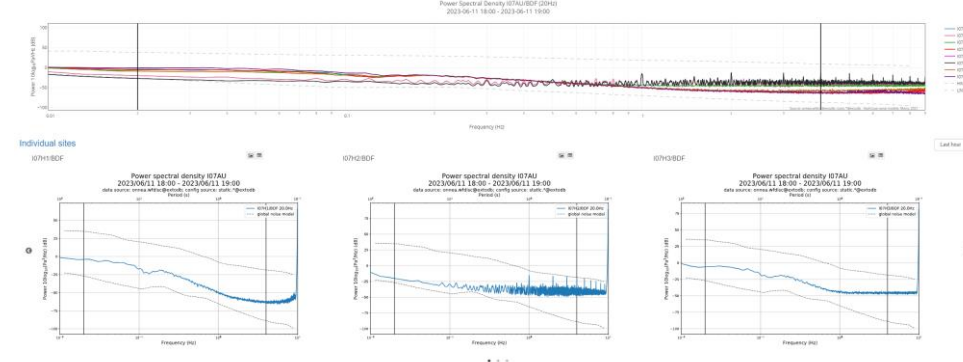
Other use case(s) in OPS Center

- Support on the station Parameter Update process.
- Identify the Orientation Issue at Station.
- Identify the discrepancies among internal database(s).

Station parameter and Response file update

To verified and track changes to station parameters and response file update. MuTIP also provide tools for determining whether the format is correct.

Data quality problem caused by environmental disturbance.



Orientation Issue:



Discrepancies among database(s)

STA	CHAN	PARAM	DOTS	OPS
MMAC	SP1	capacity	1	1
MMAC	SP1	dfs	MMAC_ML_response_20210210	MMAC_ML_response_20210210
MMAC	SP1	rcsbs	0.0017	0.0018
MMAC	SP2	capacity	1	1
MMAC	SP2	dfs	MMAC_ML_response_20210210	MMAC_ML_response_20210210
MMAC	SP2	rcsbs	0.0018	0.0018
MMAC	SP2	capacity	1	1
MMAC	SP2	dfs	MMAC_ML_response_20210210	MMAC_ML_response_20210210
MMAC	SP2	rcsbs	0.0018	0.0018

Database(s): DOTS, OPS, TODB, Devlan

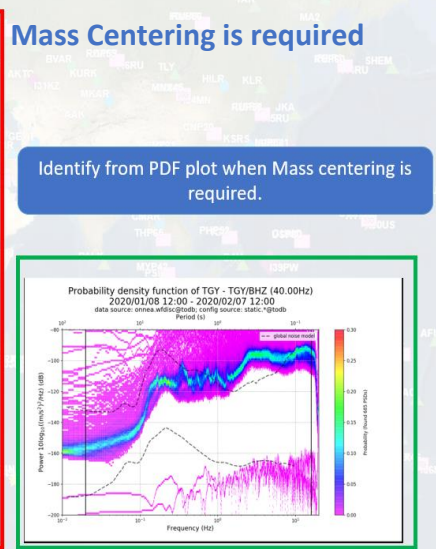
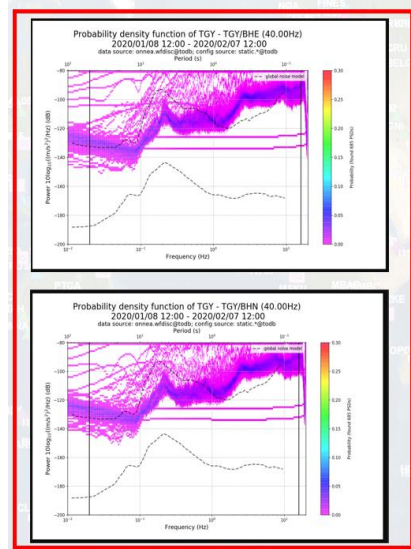
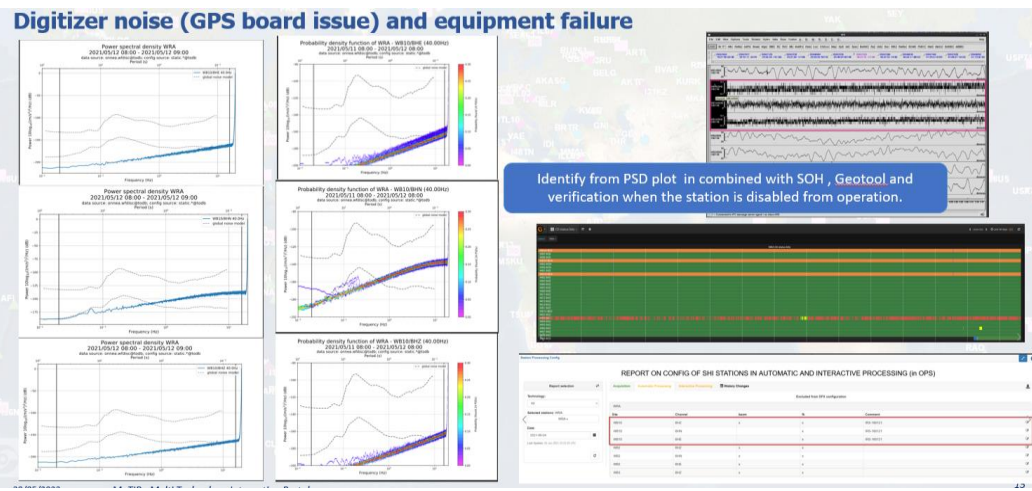
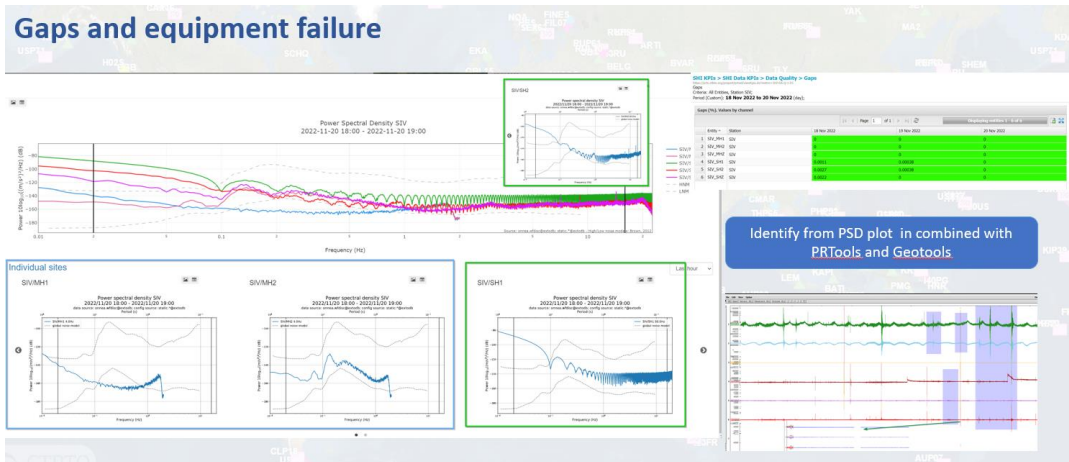
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Other use case(s) in OPS Center

- Identify the equipment failure (ex: the equipment only providing noise/spike).
- Identify Mass Centering is required.
- Identify the gaps and constant value.



Advantages from data quality monitoring with Multi-Technology Integration Portal: Enhances operational processes by providing **real-time visibility**, enabling **proactive issue detection**, improving **decision-making**, fostering **collaboration between Station Operator and PTS**, facilitating **predictive maintenance**, and **driving continuous process improvement**. These benefits contribute to increased efficiency, reduced downtime, an optimized troubleshooting escalation process, and improved overall station operational performance.

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Conclusion

The **objective** of seismic data quality monitoring is to ensure that the acquired seismic data is accurate, reliable, and of high quality. By implementing a **systematic monitoring process and reliable platform/tools**, potential issues can be detected and addressed early on, leading to improved interpretations, better decision-making, and more robust data transmission.

The Multi-Technology Integration Portal was developed as a result of **a cross-divisional project** to support PTS with **data quality monitoring** and other **technical** routine activities to ensure that station performance meets the requirements of the IMS Operational Manual.

Using a Multi-Technology Integration portal in conjunction with other PTS monitoring tools is an excellent way to **enhance data quality monitoring** in the OPS Center.

These benefits contribute to the overall **reliability of IMS network performance**.



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Please visit other interesting posters for other tools that are integrated in the Multi-Technology Integration Portal and future development.



CalxPy: A Software for Calibration Against a Reference
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Evaluation of the International Monitoring System Seismic, Hydroacoustic and Infrasound Network Performance with NetMOD
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- IMS Reporting System (<https://irs.ctbto.org/>)
- SOH-Grafana ([https:// soh.ops.ctbto.org](https://soh.ops.ctbto.org))
- PRTools (<https://prtx.ctbto.org/>)
- Geotools
- Draft Operational Manual for SHI monitoring (CTBT/WGB/TL-11,17/15/Rev.7)
- Internal documentation



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