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Sustainment of the International Monitoring System: The Value Beyond the Strategy

Xyoli Pérez Campos

Director, IMS Division, CTBTO

CTBTO PREPARATORY COMMISSION | PUTTING AN END TO NUCLEAR EXPLOSIONS

Presentation Date: 10 September 2025

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Development of the IMS Sustainment Strategy

Nuclear Tests

> 2000 tests	6 tests
> 60 sites	1 site

1996

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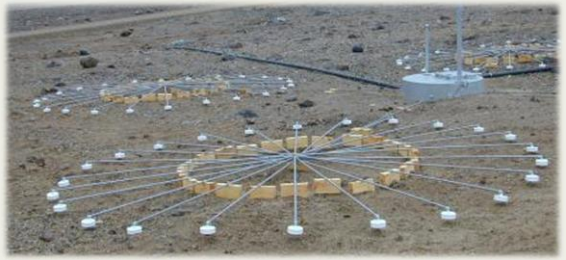
International Monitoring System

- ✓ Collect
- ✓ Analyse
- ✓ Store
- ✓ Distribute

} Data



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The International Monitoring System

	Certificadas 307	TOTAL 337
AS	110	120
HA	11	11
IS	54	60
PS	45	50
RN	73	80
RL	14	16
RN NG	26	40

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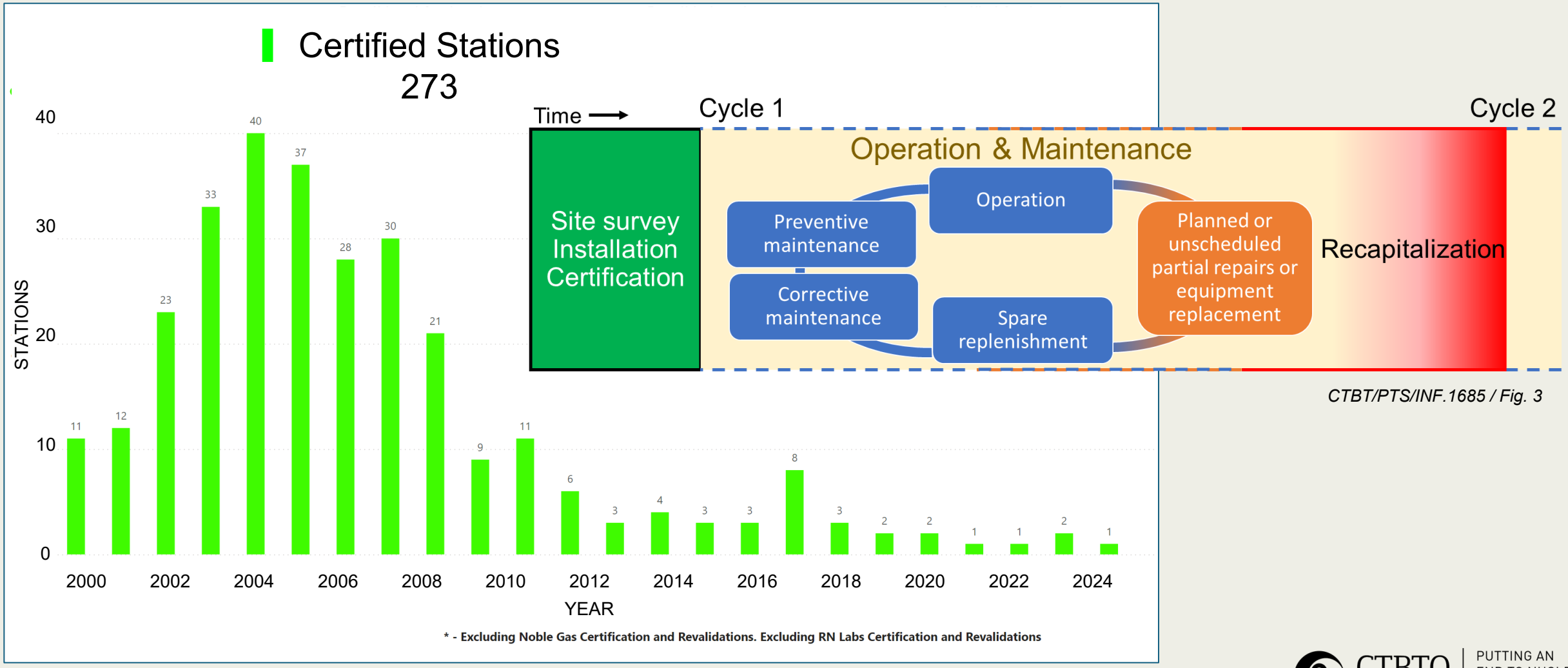
Life Cycle of the IMS Network



CTBT/PTS/INF.1685 / Fig. 3

Modified from CTBT/PTS/INF.1651 / Fig. 1

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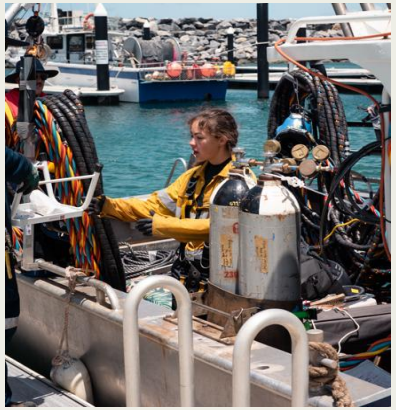
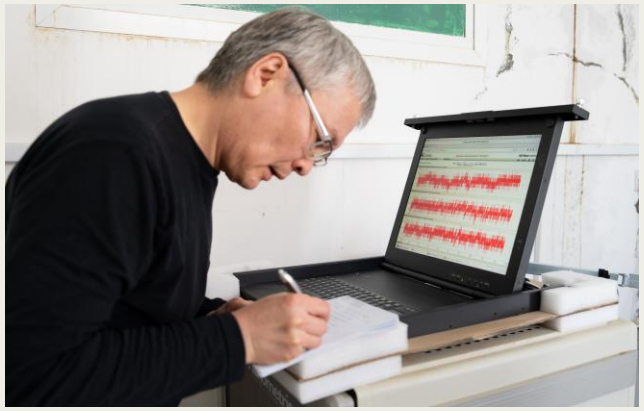
Sustainment of the IMS Network

Updating infrasound equipment
IS44, Petropavlovsk-Kamchatskiy, Russia



Underwater maintenance
HA01, Cape Leeuwin, Australia



Digitizer inspection
AS074, Wadi Sarin, Oman

Seismometer installation
AS118, Puerto la Cruz, Venezuela

Station maintenance
RN49, Spitsbergen, Norway

Updating borehole seismometer
AS097, Babate, Senegal

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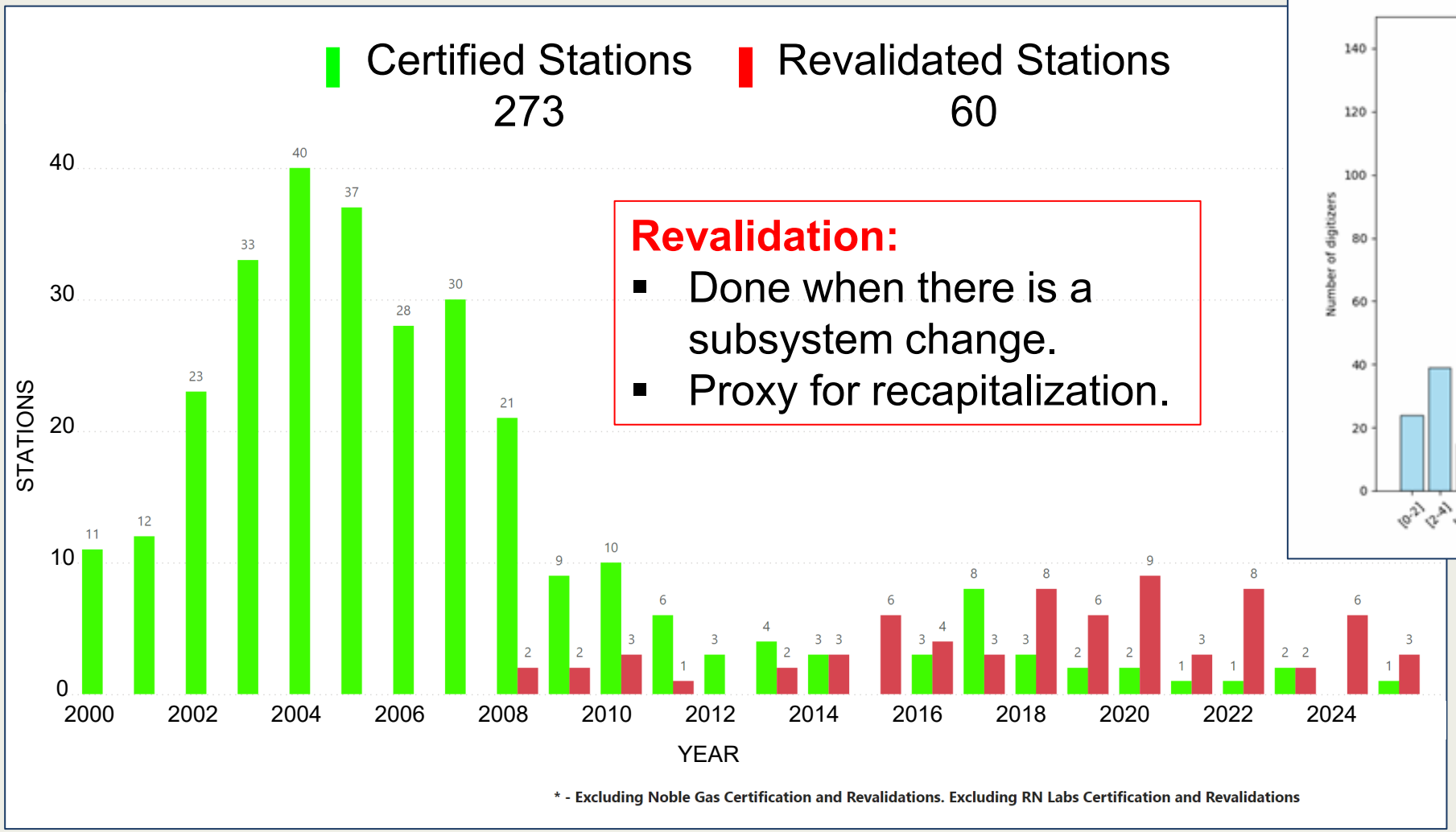
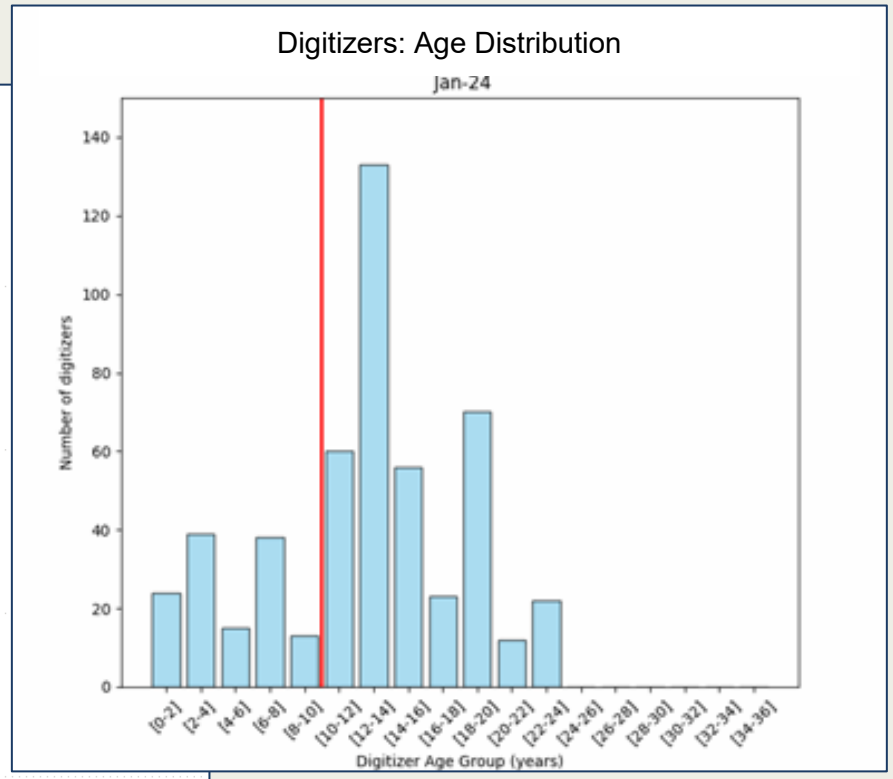
Subsystems age



Revalidation:

- Done when there is a subsystem change.
- Proxy for recapitalization.



Modified from CTBT/PTS/INF.1685 / Fig. 1

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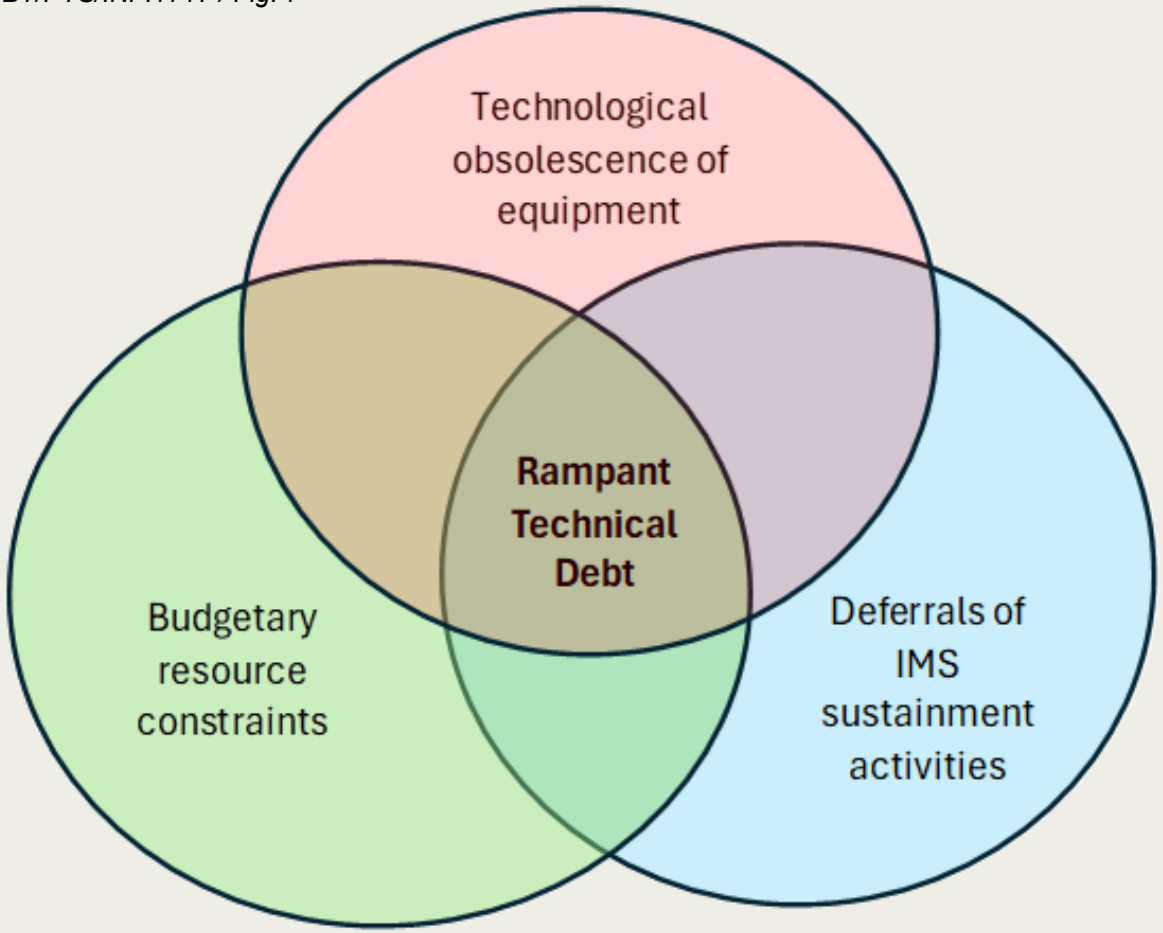
Technical Debt

Technical Debt – Sustainment Strategy

CTBT/PTS/INF.1717 / Fig. 7



Objective

Protect the Network

- ✓ Financial investment
- ✓ Data availability/quality

Strategy

Long term sustainment

- 90% of the network installed
- Transition from installation to sustainment
- Transition from reactive to proactive

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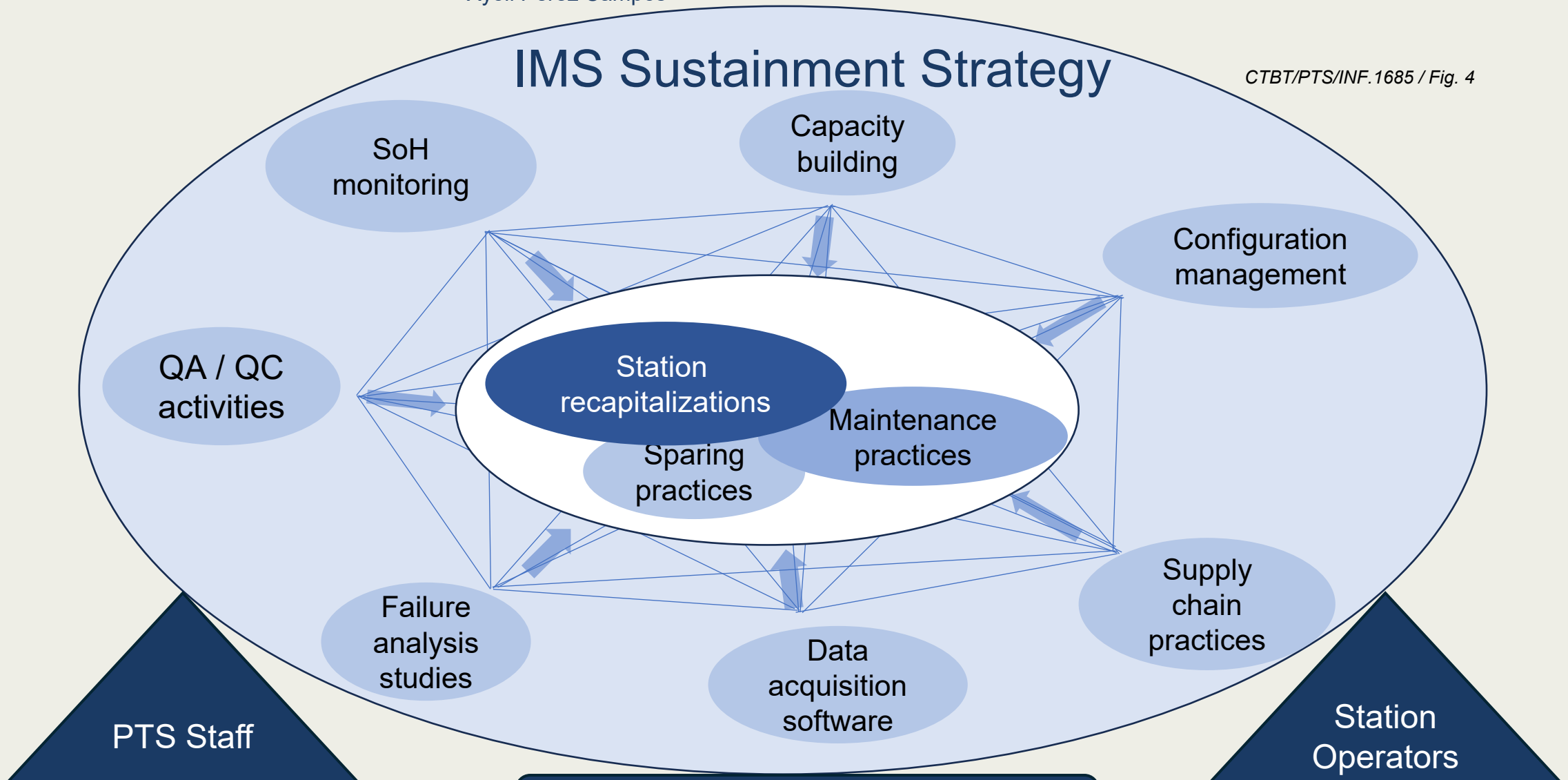

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Development of the IMS Sustainment Strategy

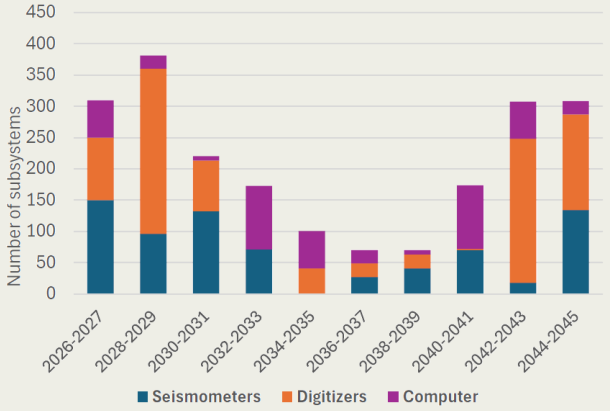
Technology specific:

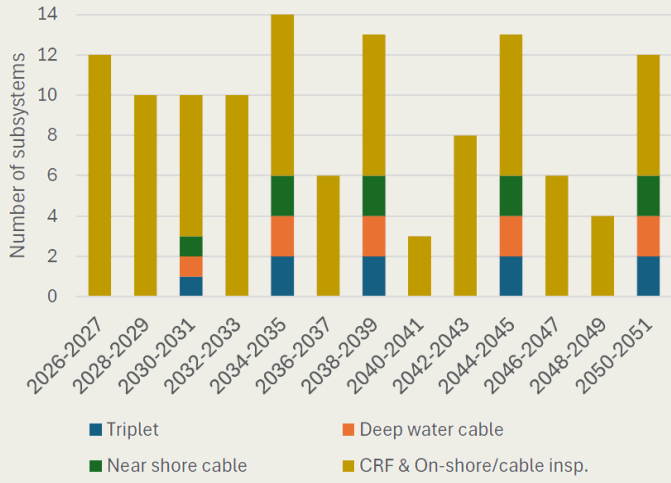
Identification of **functional components**

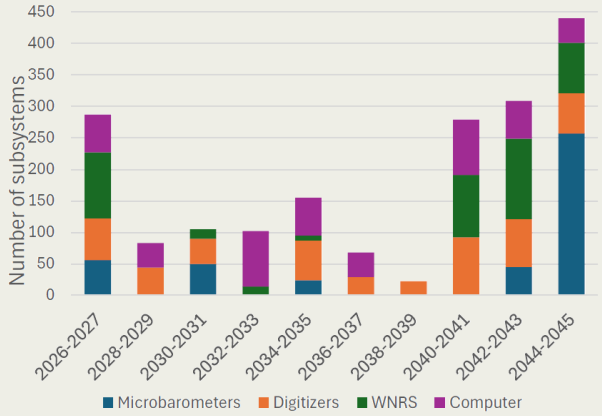
Comprehensive **estimates of lifespans** of station subsystems

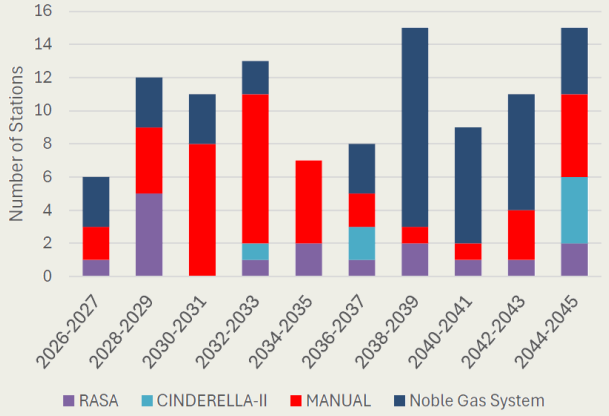
- Manufacturers
- Obsolescence
- Foresight Technology
- Feedback from Station Operators
- Capability of equipment repair
- Maintenance vs replacement

Estimates of lifespans of station subsystems









CTBT/PTS/ INF.1712/Figs 4-7

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Development of the IMS Sustainment Strategy

Technology specific:

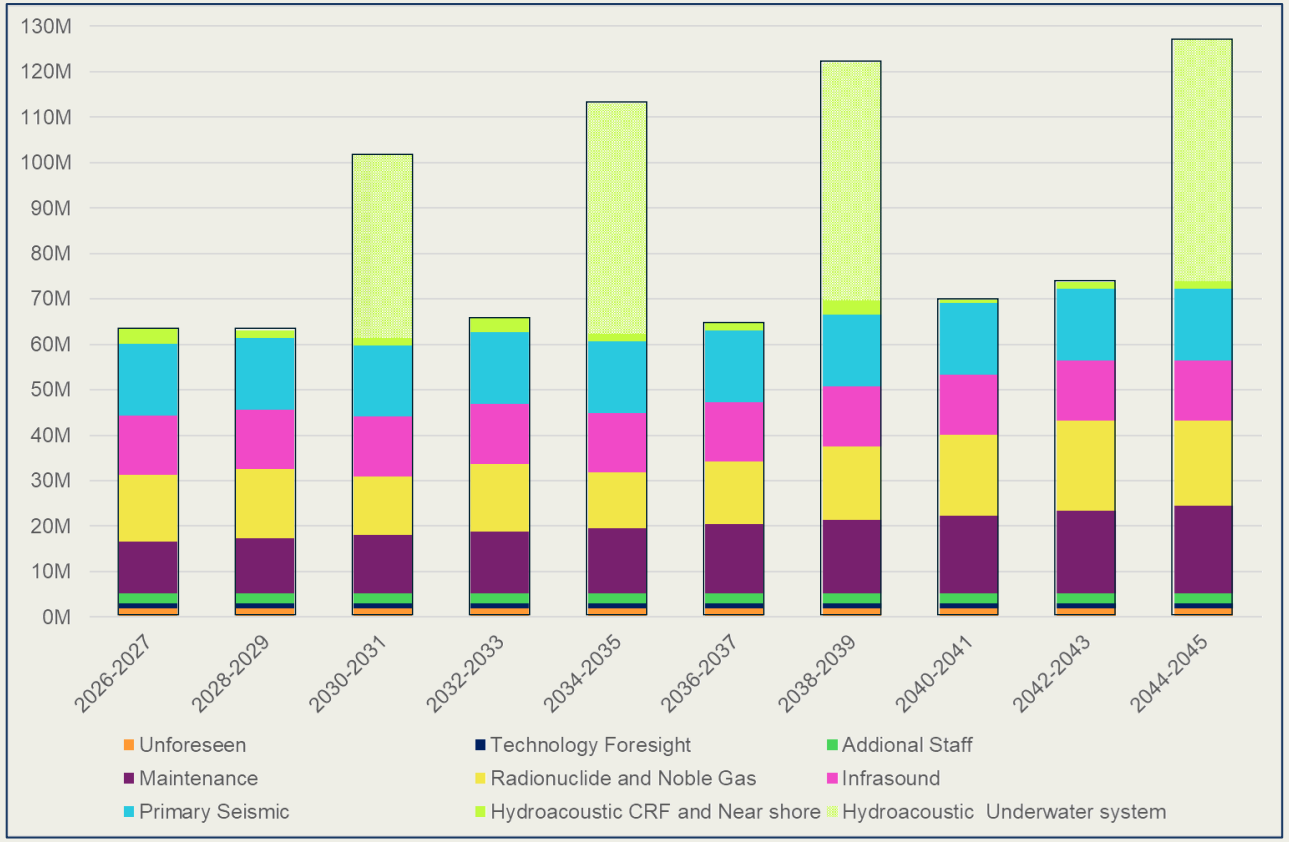
Identification of **functional components**

Comprehensive **estimates of lifespans** of station subsystems

- Manufacturers
- Obsolescence
- Foresight Technology
- Feedback from Station Operators
- Capability of equipment repair
- Maintenance vs replacement

Average cost

Distributed financial needs over 20 year period



Modified from CTBT/PTS/ INF.1717/Fig. 13

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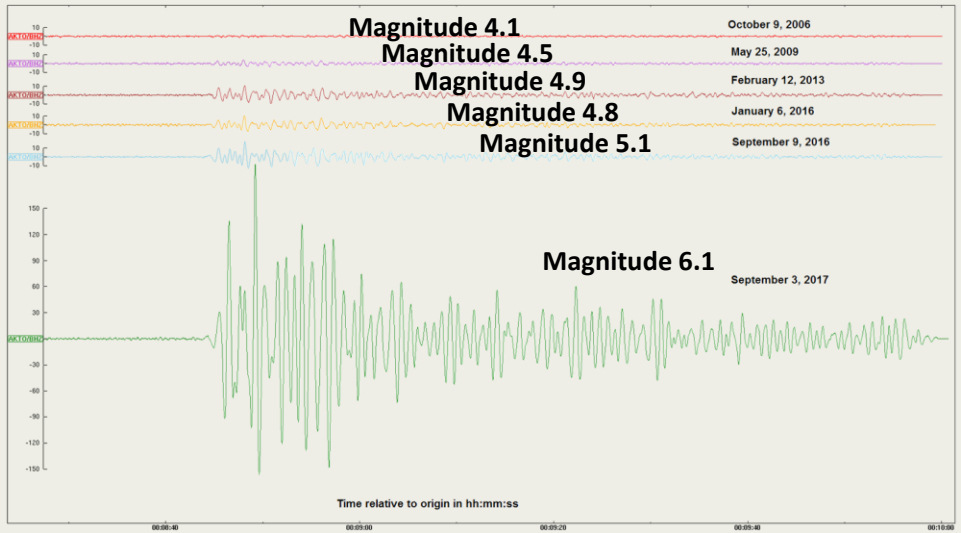
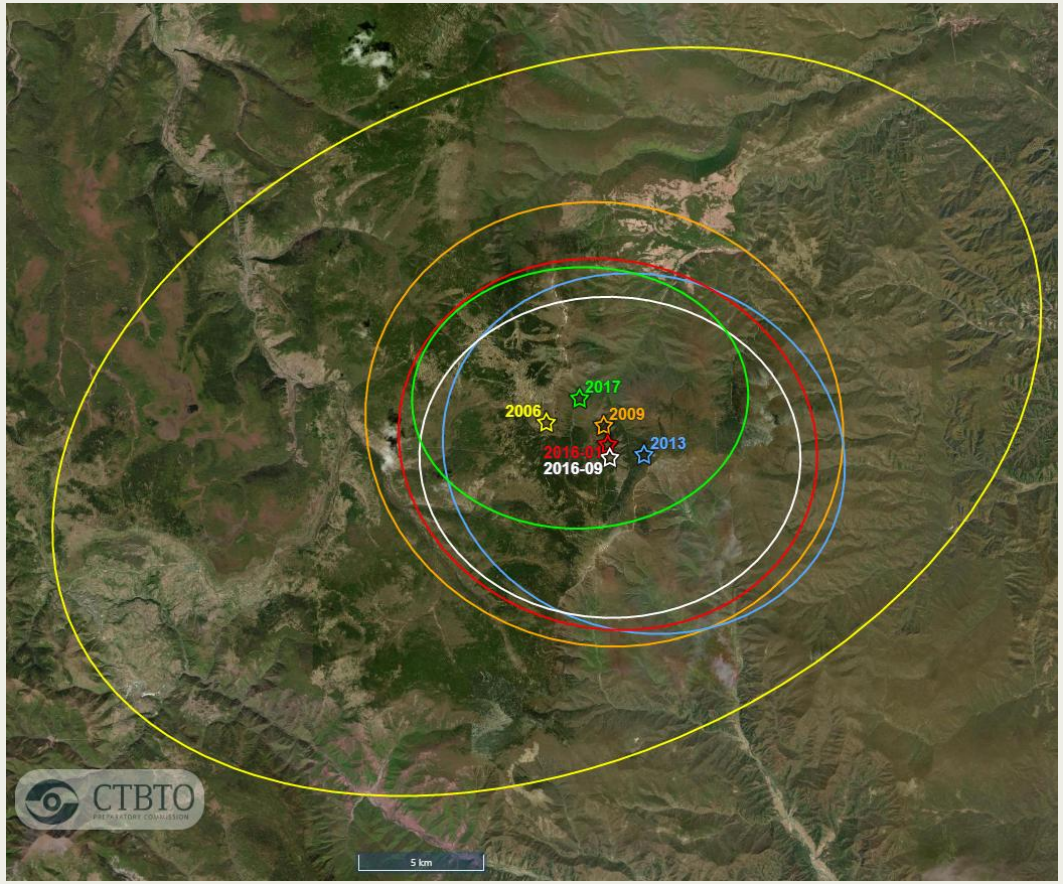
Detecting Events





Date	m_b Final (Preliminar)	IMS Stations Installed	Stations that Detect the Event (Used in Location)	Confidence Area s_{max} x s_{min} (Area)
09 Oct 2006	4.08 (4.04)	180 (53%)	22 (22)	20.6 km x 13.6 km (880 km^2)
25 May 2009	4.51 (4.53)	252 (75%)	61 (59)	9.6 km x 8.8 km (265 km^2)
12 Feb 2013	4.92 (4.96)	286 (85%)	96 (88)	8.1 km x 7.1 km (181 km^2)
06 Jan 2016	4.82 (4.88)	301 (89%)	102 (83)	8.4 km x 7.3 km (193 km^2)
09 Sep 2016	5.10 (4.90)	302 (90%)	108 (97)	7.6 km x 6.4 km (153 km^2)
03 Sep 2017	6.07 (5.90)	304 (90%)	134 (125)	6.7 km x 5.2 km (109 km^2)

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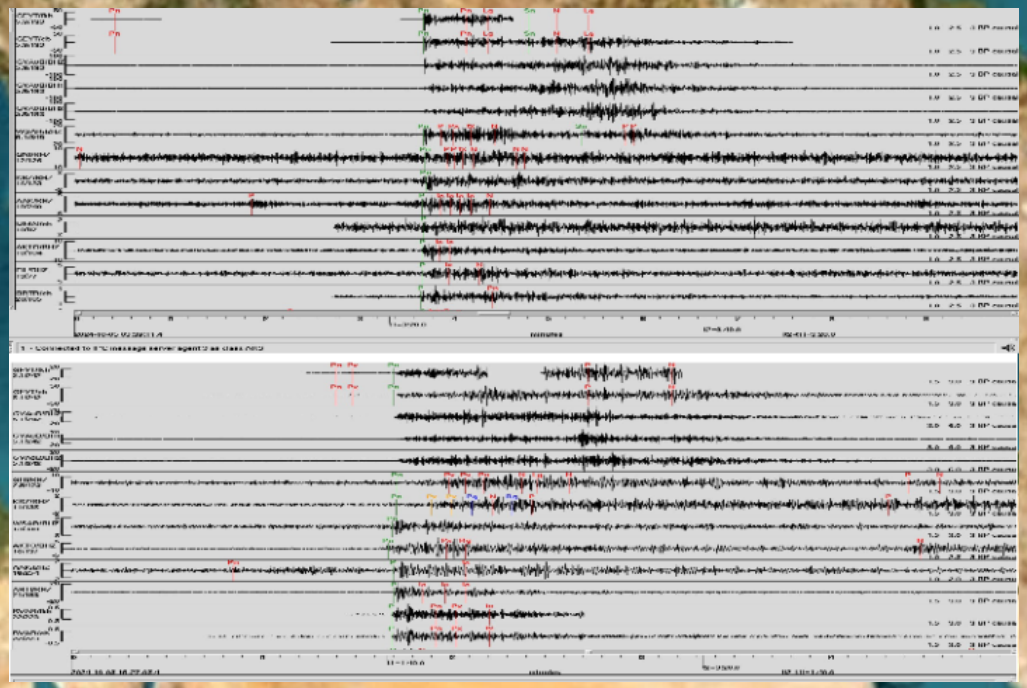
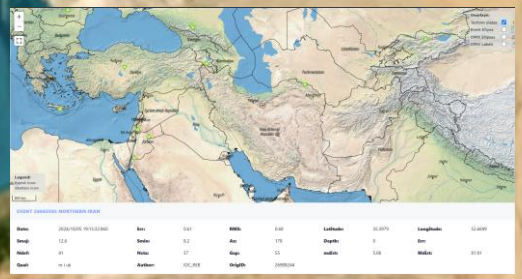
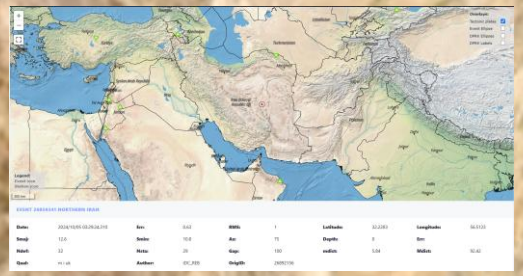
Discrimination Events





19:15, 2024/10/05 Mb4.2

03:29, 2024/10/05 Mb4.0



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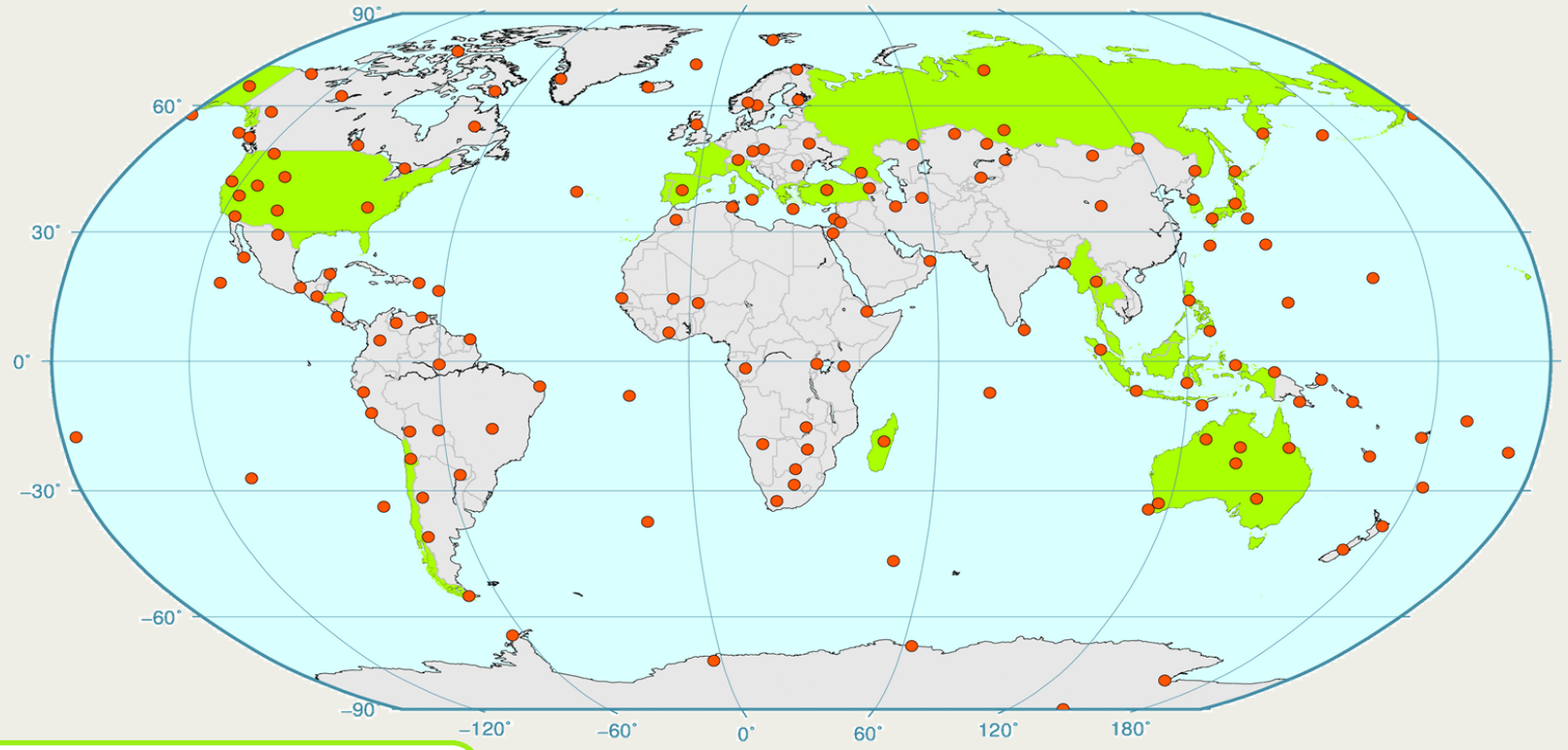
Tsunami Early Warning Agreements



- Australia
- Chile
- Francia
- Grece
- Honduras
- Indonesia
- Italia
- Japan
- Korea
- Madagascar
- Malaysia
- Myanmar
- Philippines
- Portugal
- Rusa Federation
- Spain
- Thailand
- Türkiye
- United States of América

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Volcanic Eruption Hunga Tonga-Hunga Ha'apai 15 January 2022

Geophysical Journal International

Geophys. J. Int. (2023) **235,** 48–73
https://doi.org/10.1093/gji/ggad204
Advance Access publication 2023 May 18
GJI Heat Flow and Volcanology

The January 2022 Hunga Volcano explosive eruption from the multitechnological perspective of CTBT monitoring

S. Donner,[1] A. Steinberg,[1] J. Lehr,[1] C. Pilger,[1] P. Hupe,[1] P. Gaebler,[1] J.O. Ross,[1] E.P.S. Eibl,[2] S. Heimann,[2] D. Rebscher,[1] T. Plenefisch[1] and L. Ceranna[1]

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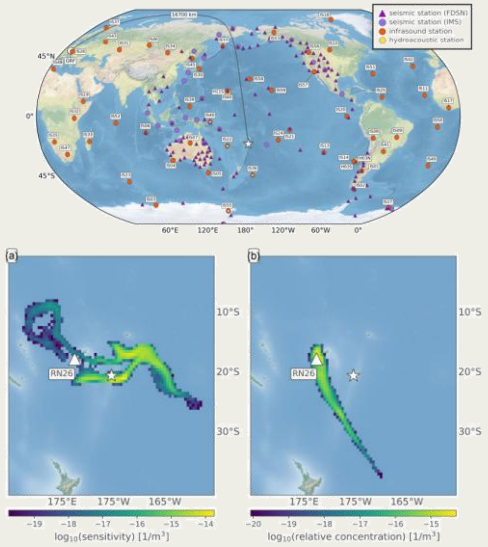
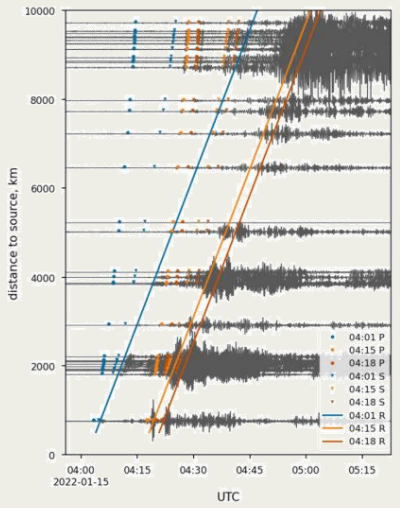
[2]*Institute for Geosciences, University of Potsdam,* 14469 *Potsdam, Germany*





DISCLAIMER: The views expressed in this presentation are those of the author and do not necessarily reflect the view of the CTBTO

Some Usages of the Hydroacoustic Data

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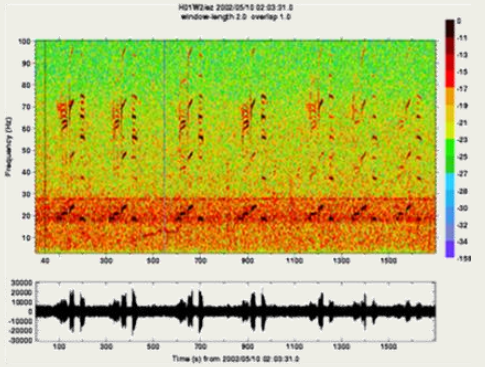
Marine Mammals
HA01 Cape Leeuwin
Blue Pigmen Whale

10 May 2002



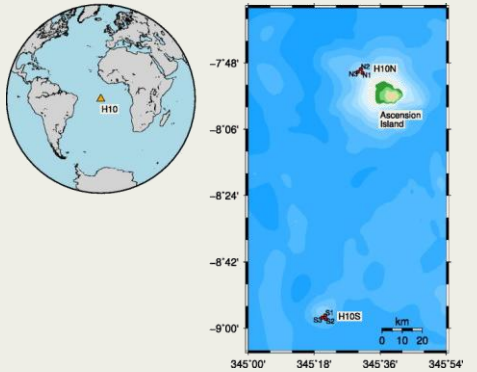
Sounds played x16 speed

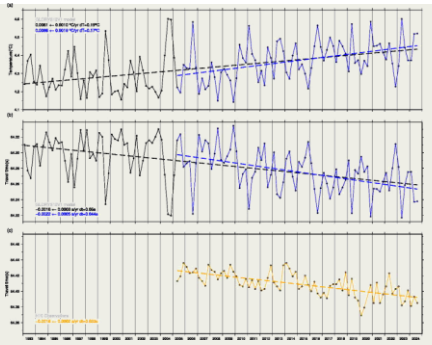
JASA EXPRESS LETTERS ARTICLE asa.scitation.org/journal/jel

Decadal observations of deep ocean temperature change passively probed with acoustic waves

Läslo G. Evers[1,2]

[1]*Research and Development Department of Seismology and Acoustics, Royal Netherlands Meteorological Institute (KNMI), De Bilt, the Netherlands*
[2]*Department of Geoscience and Engineering, Faculty of Civil Engineering and Geosciences, Delft University of Technology, Delft, the Netherlands*
evers@knmi.nl





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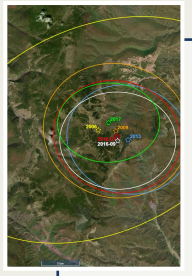
Final Remarks

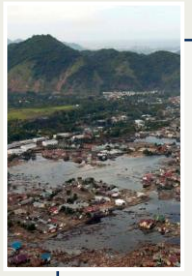
Sustainment of the IMS Network

- Protect the investment
- Data availability and data quality



No event goes undetected

- Detection of events
- Discrimination



Global multi-technology network

- Civil applications; e.g. tsunami early warning
- Scientific advancement