WG2 TT Network
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Nuku'alofa, Tonga

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WG2 Task Team Integrated PTWS Sensor Networks for Tsunami Detection and Characterisation

Co-Chairs:
Tim Melbourne
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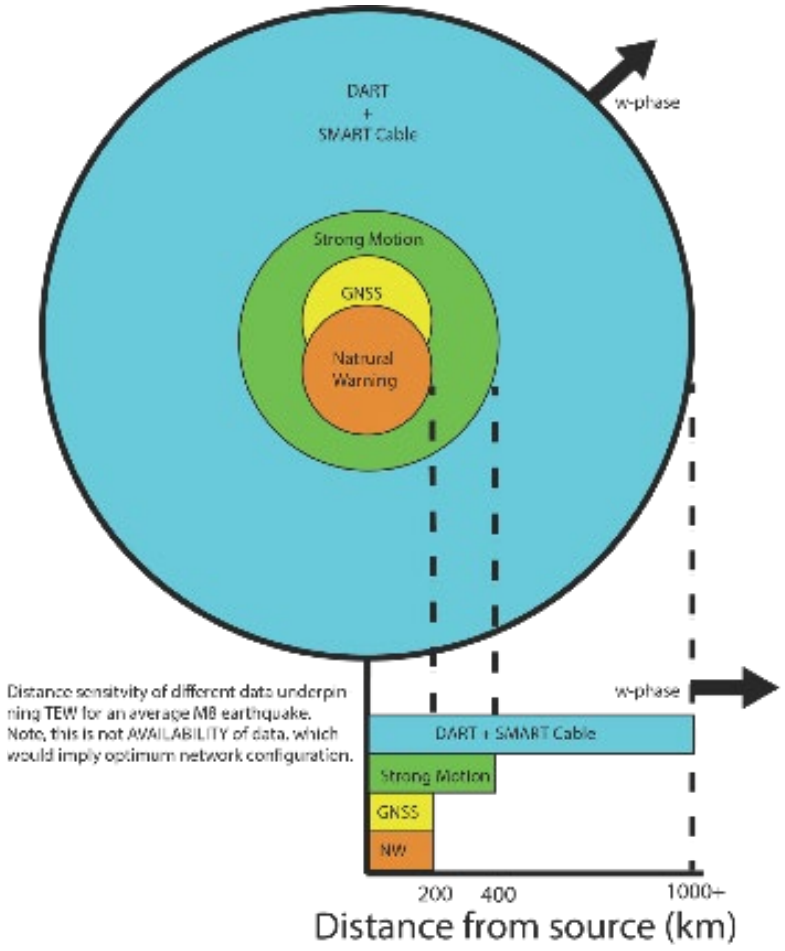
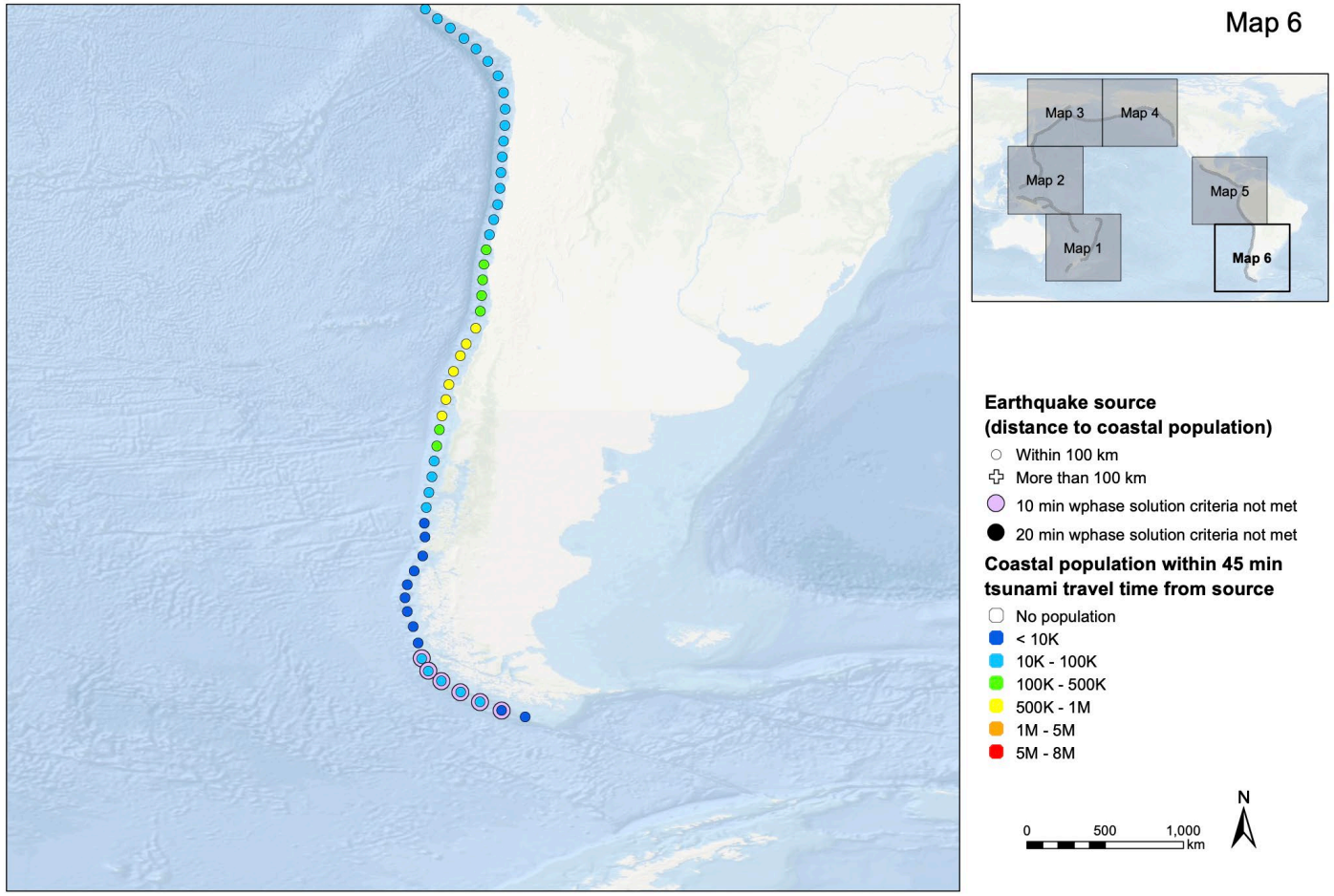
Task Team Terms of Reference



This expert Task Team will establish and document a methodology to test the sensitivity of the PTWS sensing networks, integrating new and emerging techniques and technologies by:

1. Developing a methodology for gap and sensitivity analysis that combines multiple sensing technologies for tsunami detection and characterisation.
2. Integrating emerging techniques and sensor technologies (e.g. better use of tide gauges; GNSS technology and processing; sensors on telecom cables) with the existing sensing network to meet tsunami warning service requirements.
3. Where possible, include cost-benefit analysis of the potential technologies being considered.

Gap and sensitivity analysis for multisensor network 10 and 20 minute wphase solution



- Hypothetical events centred on prop unit sources
- Population based on # of people living within 10 km of coast at an elevation <50m
- 10 stations (calculating travel time through a PREM reference earth model)
- maximum 200 degree azimuthal gap
- For stations within 100km of coast, we assume an M7.5 will generate natural warning for the closest coastlines – also possible to invoke strong motion seismic approaches

Gap and sensitivity analysis for multisensor network
Detour: strong motion seismology and local source tsunamis

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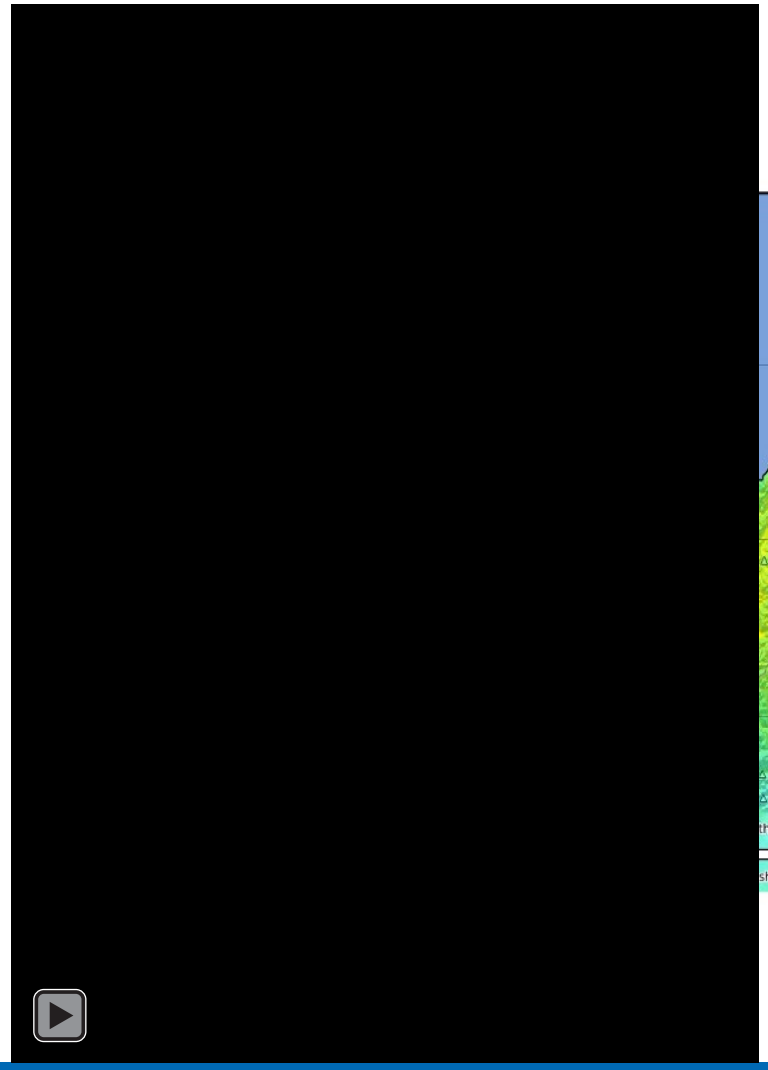
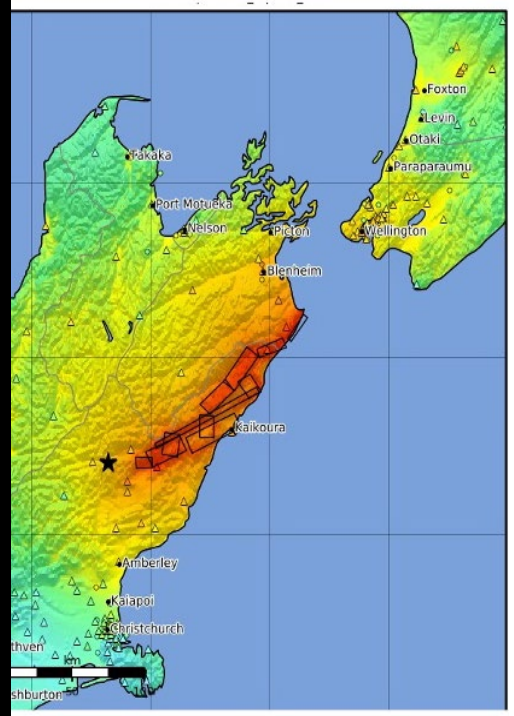
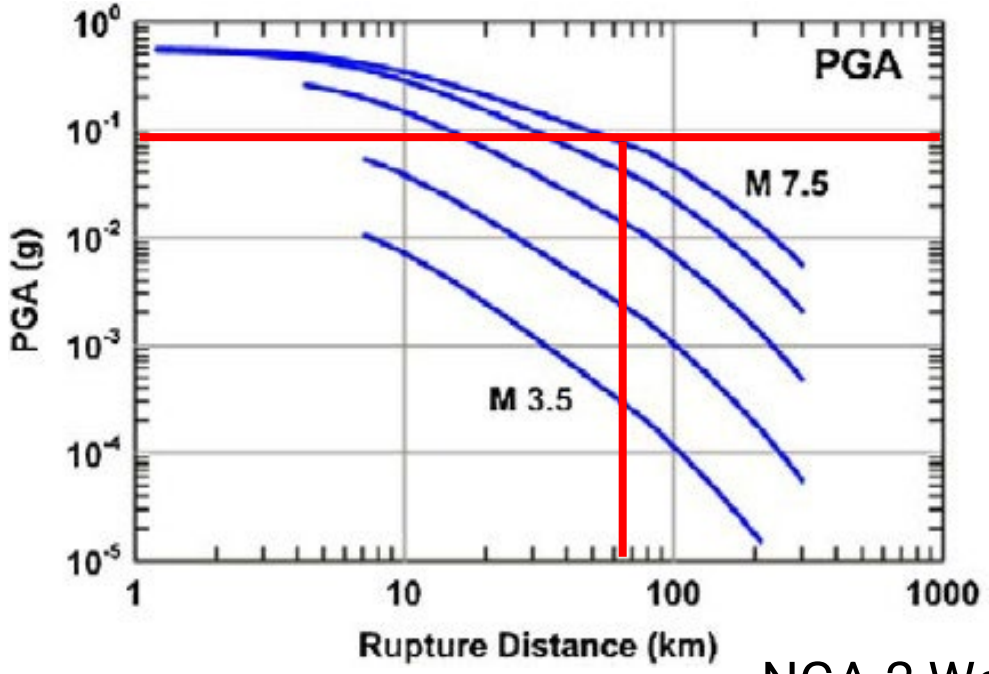




We assume an M7.5 will generate natural warning for the closest coastlines – also possible to invoke strong motion seismic approaches and ABE equations of tsunami prediction



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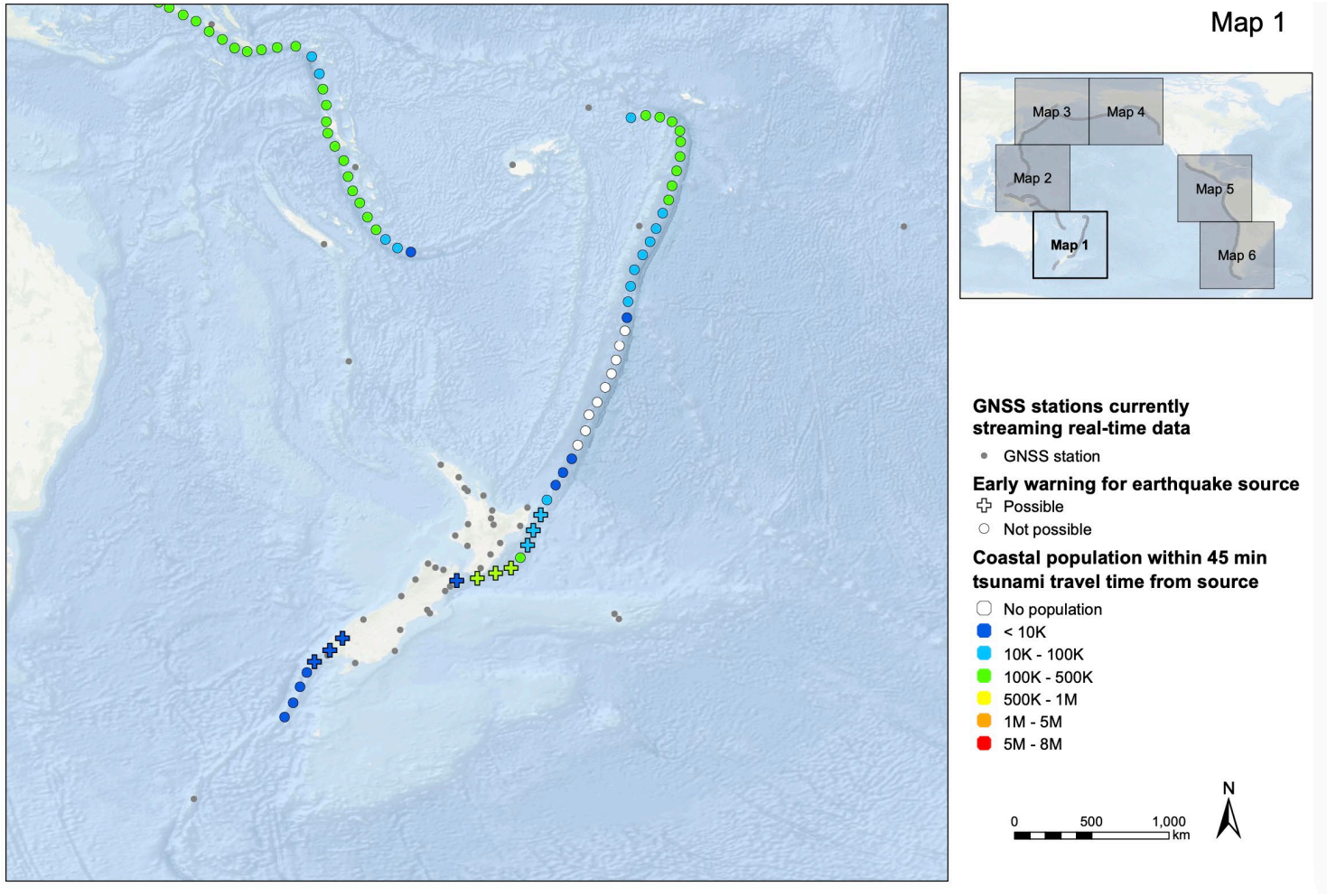
Gap and sensitivity analysis for multisensor network GNSS inversion for earthquake source (finite fault)



GNSS inversion for finite fault (e.g. GFAST) on propDB unit source

- Based on list of “active” stations, we have done the same for “all” possible
- 5 GNSS stations within 200 km of fault (edges of unit source)
- Maximum distance between 2 GNSS stations at least 100 km (minimum aperture)
- Population based on # of people living within 10 km of coast at an elevation <50m.

Integrating emerging techniques and sensor technologies: SMART Cables

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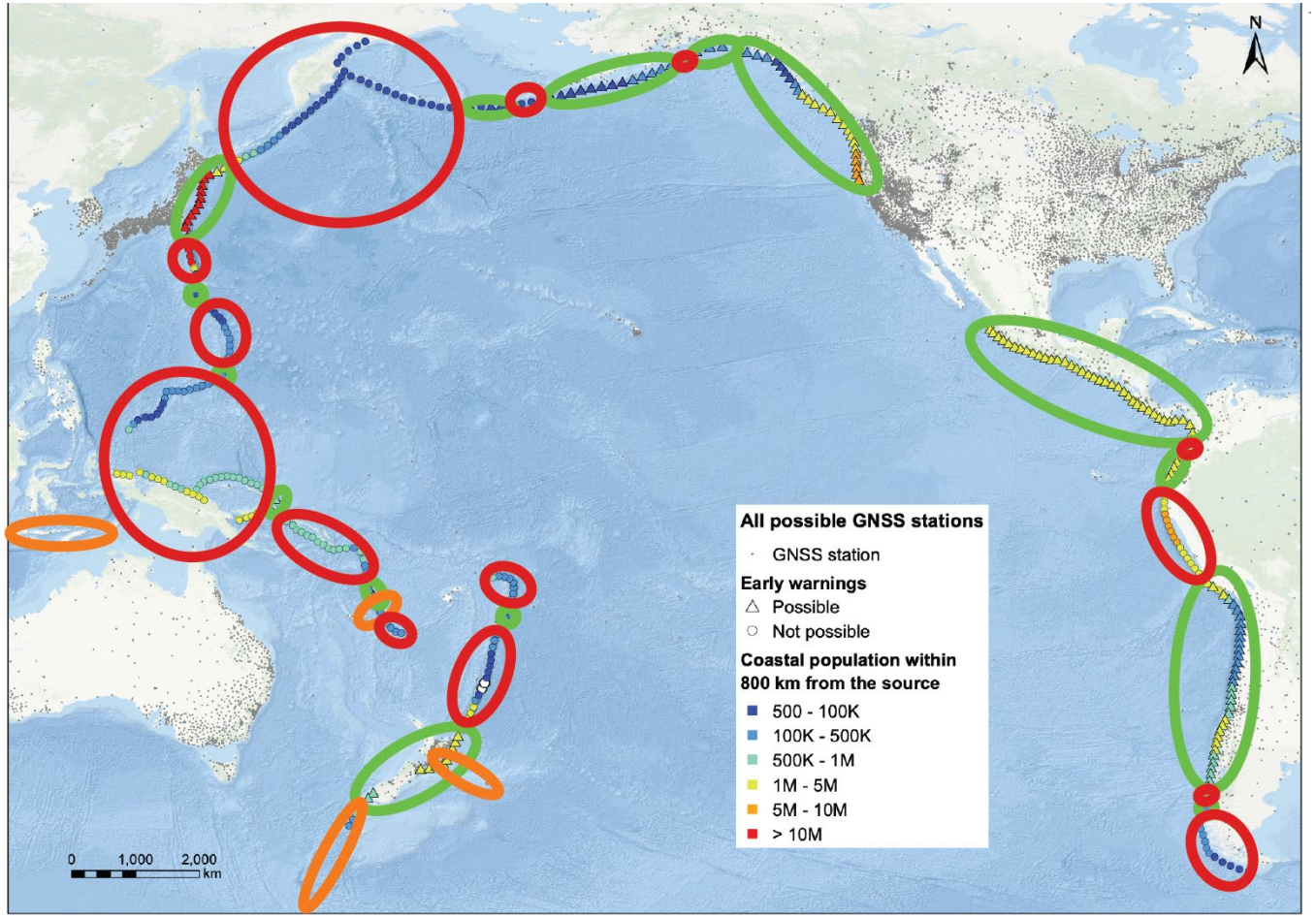


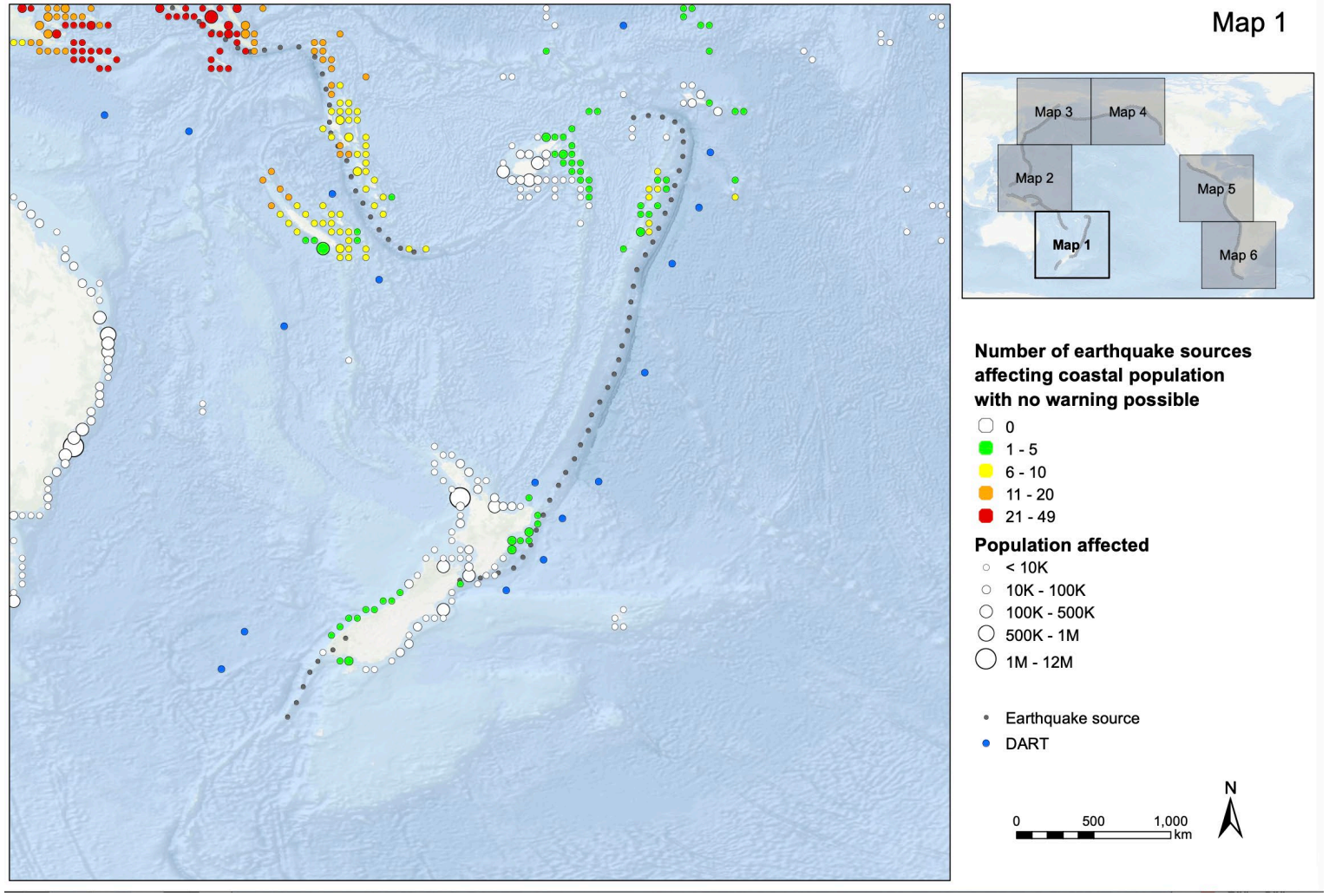
GNSS coverage assumes that every GNSS station that has ever streamed publicly available data were still functional

TEW targets not possible with data currently available to PTWS

TEW targets possible with data currently available to PTWS

In progress SMART Cable initiatives that would support TEW targets

“Where possible, include cost-benefit analysis of the potential technologies being considered.”



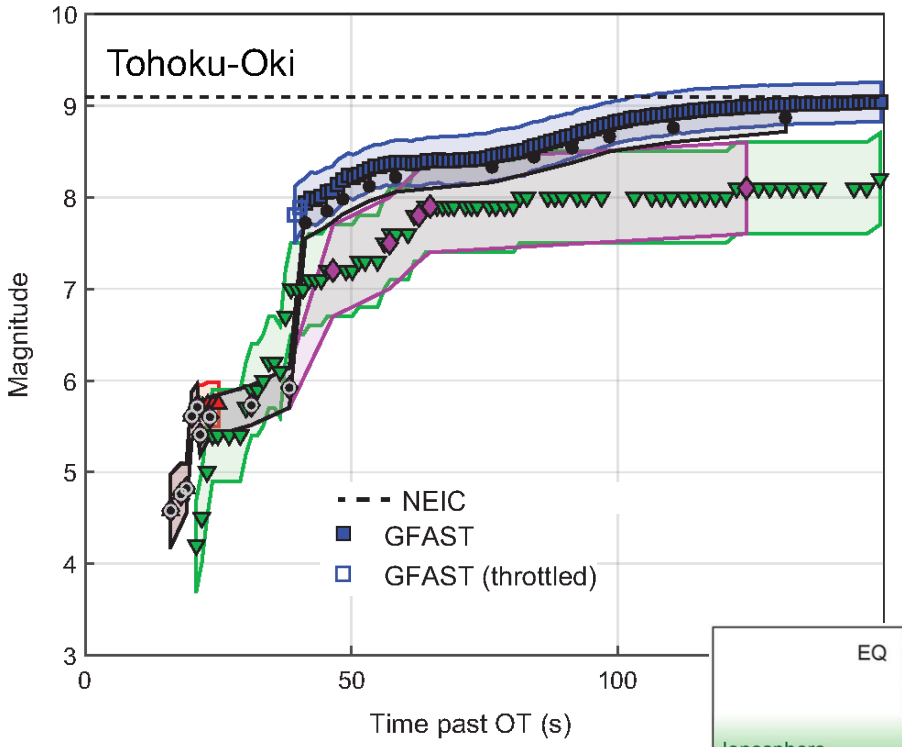
We have developed a risk-based approach

- Exposed population = live within 10km of coast at elevation < 50m (conservative)
- Pre-impact warning time of 20 minutes considered
- WarnTime=Tcoast-max(D1,D2)
- Population based on # of people living within 10 km of coast at an elevation <50m.

A Note on GNSS

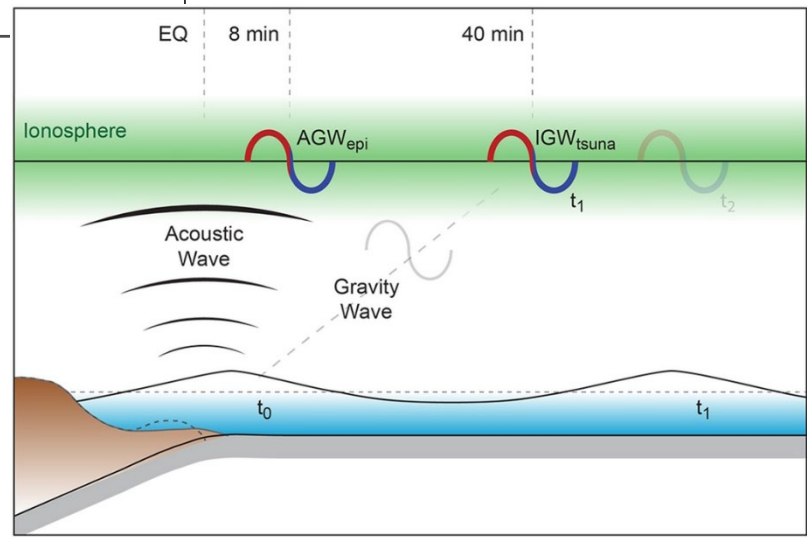
- PPP: Real time GNSS Precise Point Positioning can improve characterisation of large local/regional earthquakes, providing rapid estimates of magnitude and fault geometry/slip distribution. Currently used by USGS-ShakeAlert, NOAA, Japan-REGARD, etc)

- Iono: source agnostic application that infers impact of gravitational waves caused by tsunamis on the ionosphere from GNSS data: several examples in literature, currently operational at Nasa-JPL (Guardian)



Initial Indicator

[Murray et al., BSSA 2023]



Tsunami measurement

[Manta et al., SciRep 2020]

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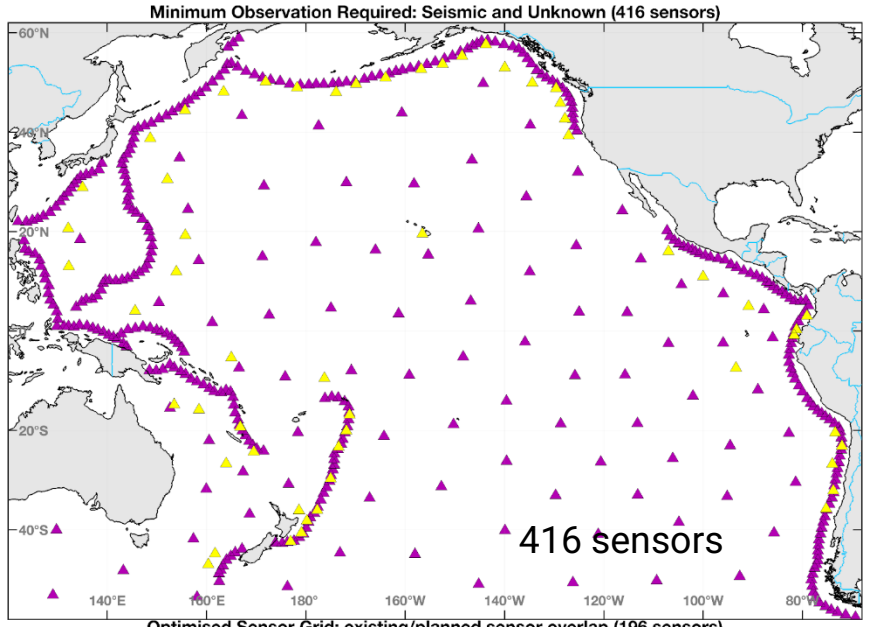
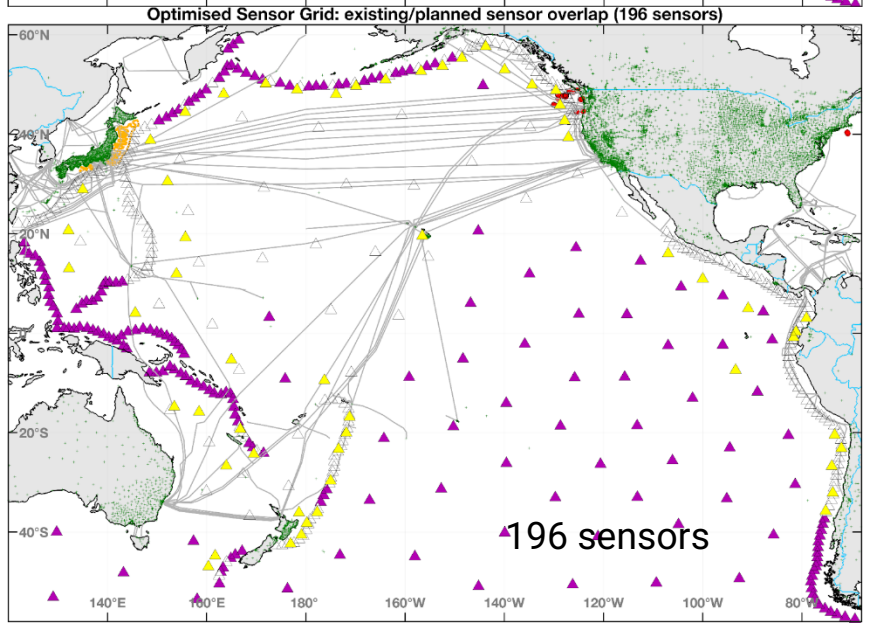
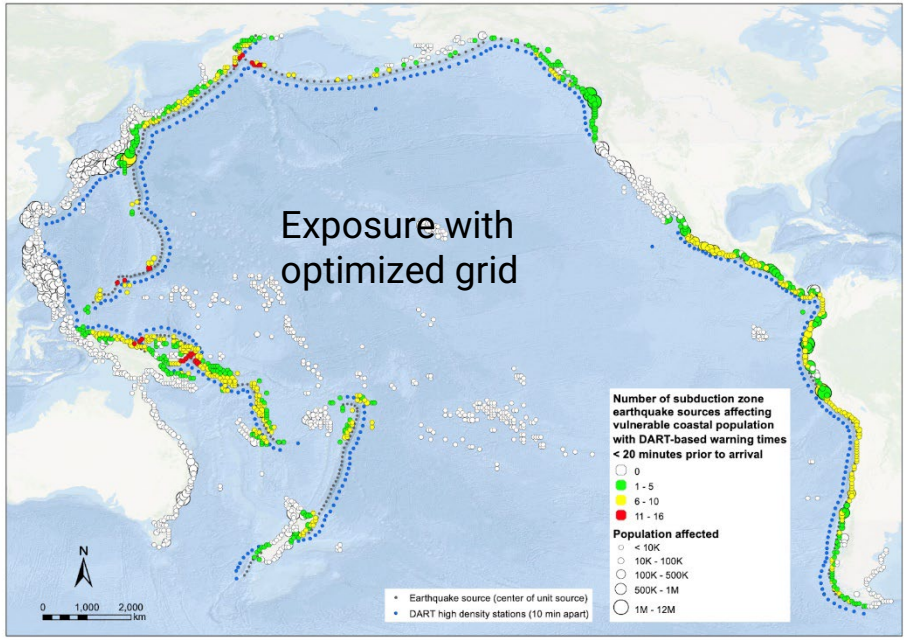
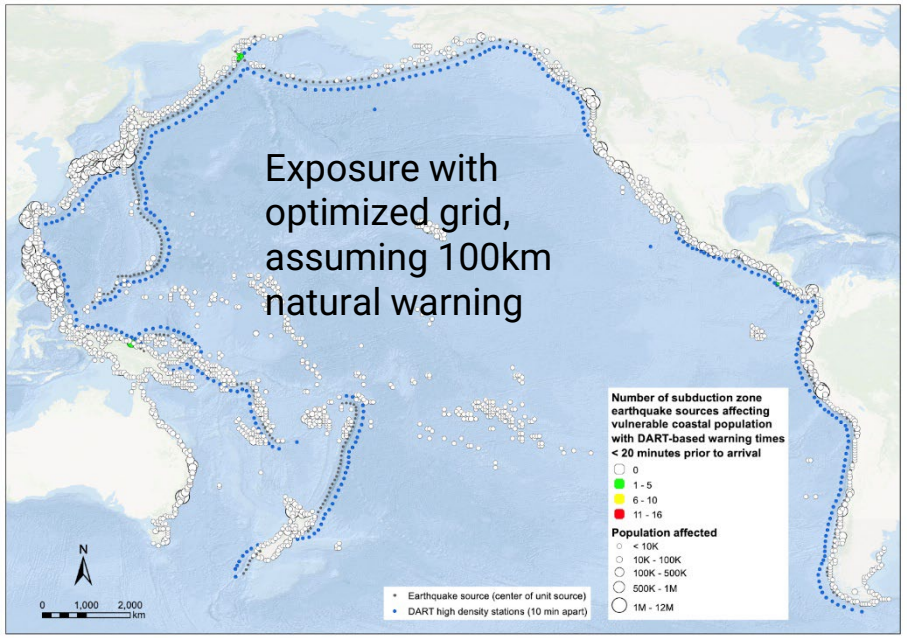
10-minute detection at SZ









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A thought experiment on optimised sensor grids for source agnostic TEW

Figure courtesy C. Moore

Recommendations

- WG2 **recommends** the ICG/PTWS continue to work closely with the JTF for SMART Cables and the IUGG GeTEWS project to utilise monitoring data from these efforts when they are available.
- WG2 **recommends** the TT on Integrated networks develop a framework based on the Research, Development and Implementation Plan for the Ocean Decade Tsunami Programme by which member states can contribute instruments/data/telemetry, etc in order to achieve ODTP tsunami detection, measurement and forecasting goals within PTWS.
- WG2 **recommends** that ICG/PTWS continue the Task Team on Integrated PTWS Sensor Networks.

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Thank you very much for your kind attention.