Workshop on SMART Cable Applications in Earthquake and Tsunami Science and Early Warning; Potsdam, Germany, 3–4 November 2016
Short Report

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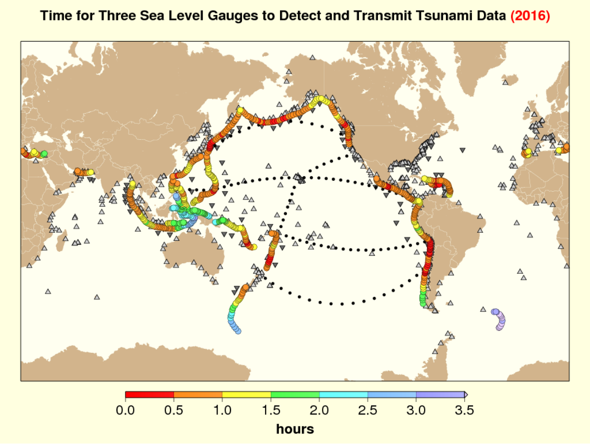
SMART cable workshop Brest November 13

http://www.itu.int/en/ITU-T/Workshops-and-Seminars/201611/Pages/default.aspx

Supported by:

Application: Tsunami early warning

Pacific ring of fire warning times with hypothetical cable routes (S. Weinstein)

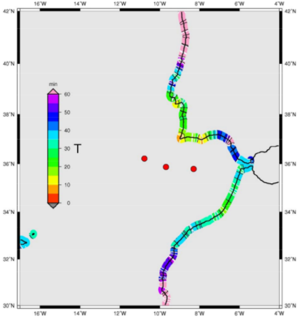


- Trivially, increased number of sensor make it easier to characterise tsunami
- Trench-parallel cables would have even larger impact.

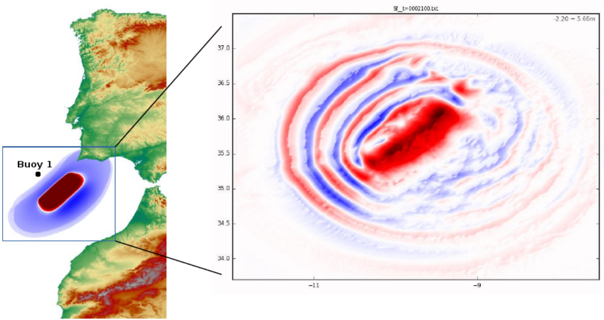
Application: Tsunami early warning

Simulated earthquake in Gulf of Cadiz (M. Nosov, A. Babeyko)

Virtual DART position for optimal warning times



Sea surface evolution at 60 s after nucleation



Application: Tsunami early warning

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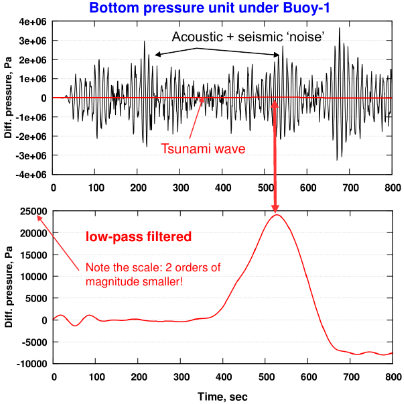
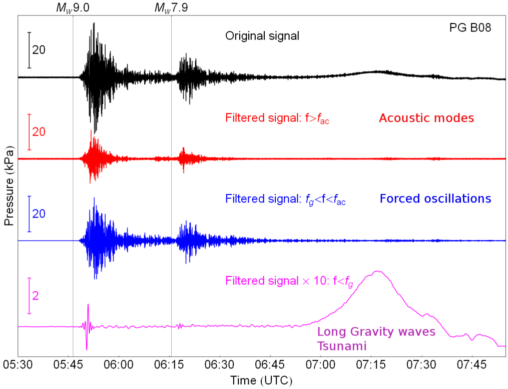
Simulated bottom pressure under Buoy 1



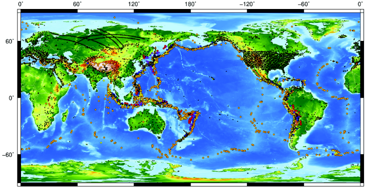
For comparison: actual data from Tohoku earthquake



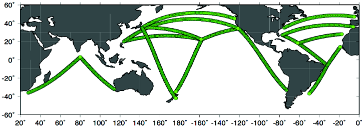
Four regimes dominate depending on freq f and H, depth of seafloor (m):

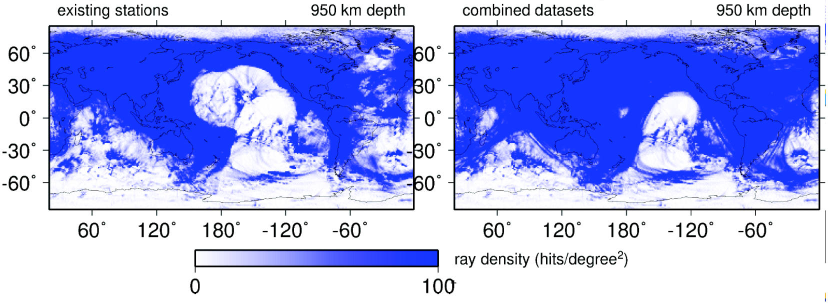
Acoustic waves	$f > c/4H$	$T < 13$ s for H=5000 m
Forced oscillations	$c/4H > f > 0.37\sqrt{g/H}$	13 s< T <61 s
Dispersive gravity waves	$0.37\sqrt{g/H} > f > 0.072\sqrt{g/H}$	61 s< T < 314 s
Long gravity waves	$f < 0.072\sqrt{g/H}$	$T > 314$ s (c. 5 min)

Station and seismicity distribution:



Assumed cable sites:



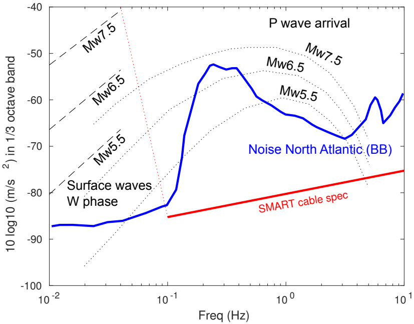


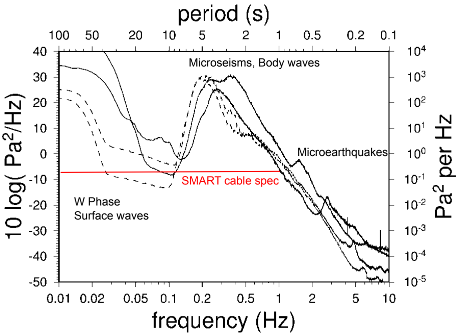
Coverage below the oceans markedly improved even into the lower mantle.

Other applications

- Earthquake early warning (EW)
- Earthquake source modelling for tsunami EW and earthquake physics
- Local earthquake studies
- Surface wave / ambient noise
- Local structure: Monitoring near-sensor elastic properties
- Local structure: Compliance
- Seafloor geodesy: vertical motion of the seafloor from pressure

Acceleration





- Current spec acceleration: PSD (2 ng)^2/Hz=-154 db (m^2/s^2/Hz) for frequencies 0.01-200 Hz
- Current spec acceleration: -8 db (Pa^2/Hz) at $<$10 Hz
- But: many applications in seismology require longer period response
- Pressure can be used for these as well, but acc+pressure allows to improve signal/noise ratio by removing infragravity wave influence at long periods
- Recommendation: extend sensitivity range of accelerometers to longer periods

Recommendations

Applications:

- SMART cables can significantly cut down early warning delays for tsunami early warning and improve the accuracy of forecast. A tangible improvement can also be achieved for earthquake early warning.
- Cable routes parallel to major subduction trenches would be of most interest to tsunami and large earthquake researchers.
- 50 km sensor spacing in the deep ocean would be (marginally) enough to sample details of the tsunami wavefield, allowing analysis of source and propagation effects even for non-seismic sources, such as landslides.

Instrumentation:

- Scientific uses in global tomography and tectonics (local earthquake studies) would benefit strongly from high-sensitivity accelerometers operating at longer periods, beyond the current specifications.
- Long term stability of pressure sensors is of no concern for early warning applications, but is needed for geodetic applications

'Wet demonstrator'

- Wet demonstrator should already return science data in addition to proving concept. In Europe a suitable location could be in Greece due to subduction related high seismicity but no large-scale cabled observatory in place. In North America Ocean Network Canada and Ocean Observatories Initiative have expressed willingness

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