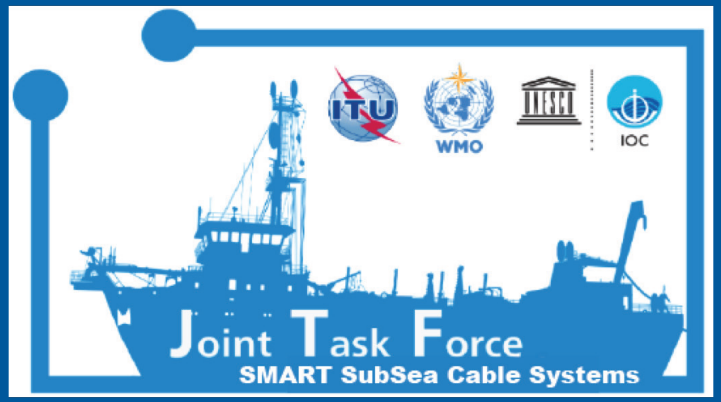
Exploiting commercial submarine cable systems for earthquake and tsunami monitoring – The Science Monitoring and Reliable Telecommunications (=SMART) cable concept

Frederik Tilmann (GFZ) & ITU/WMO/IOC Joint Task Force

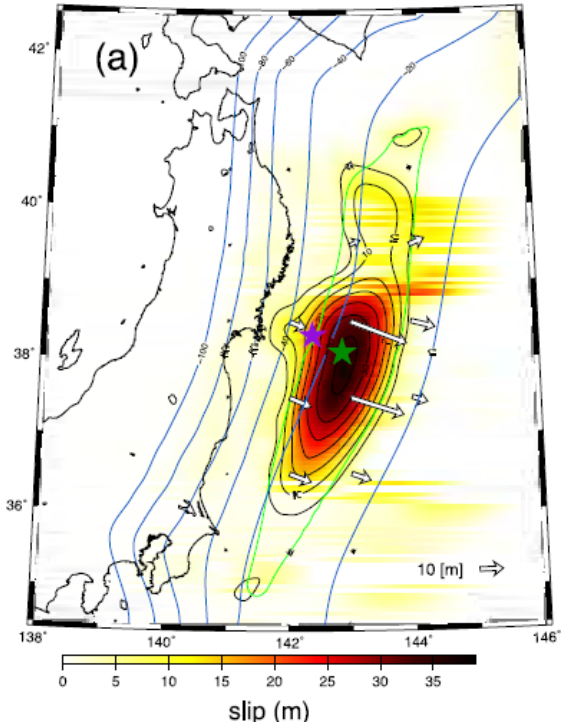


Why?

Deeper slip (~35 m peak)

Shallower slip (~60 m peak)

Miyazaki et al. (EPS 2011), land gedetic only



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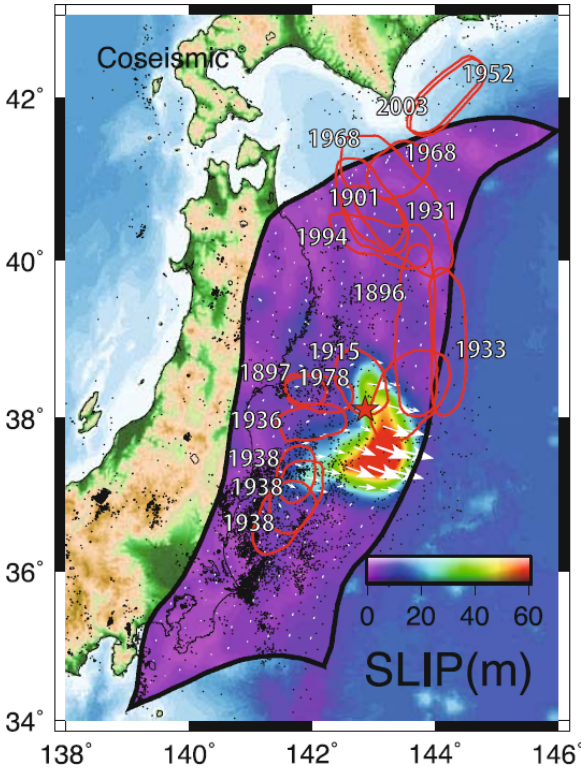

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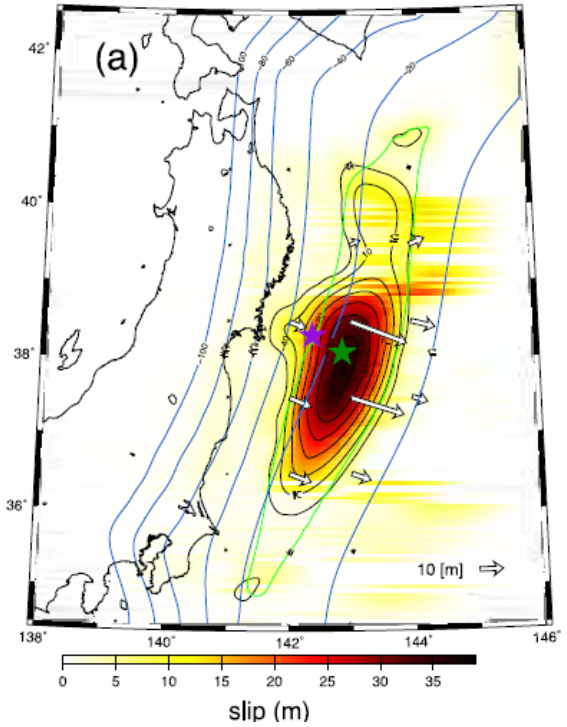

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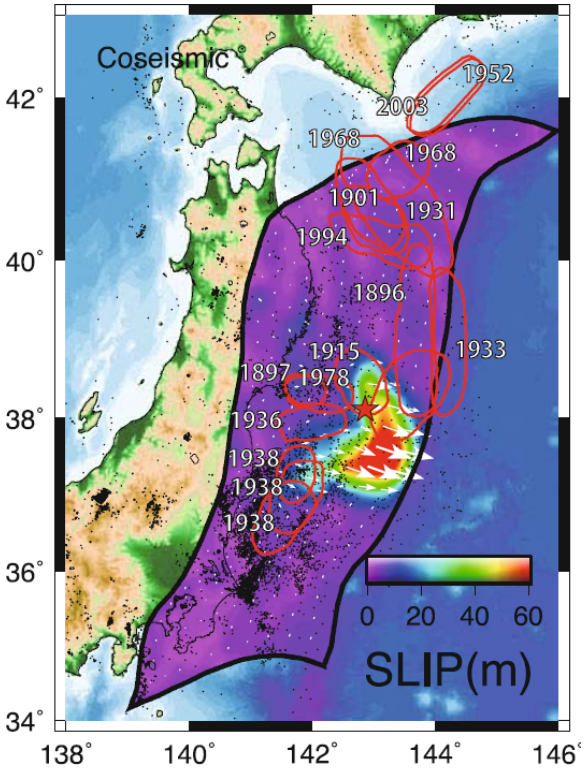

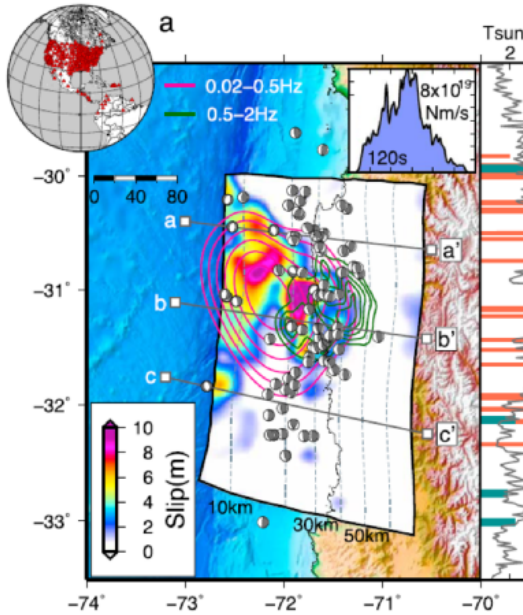

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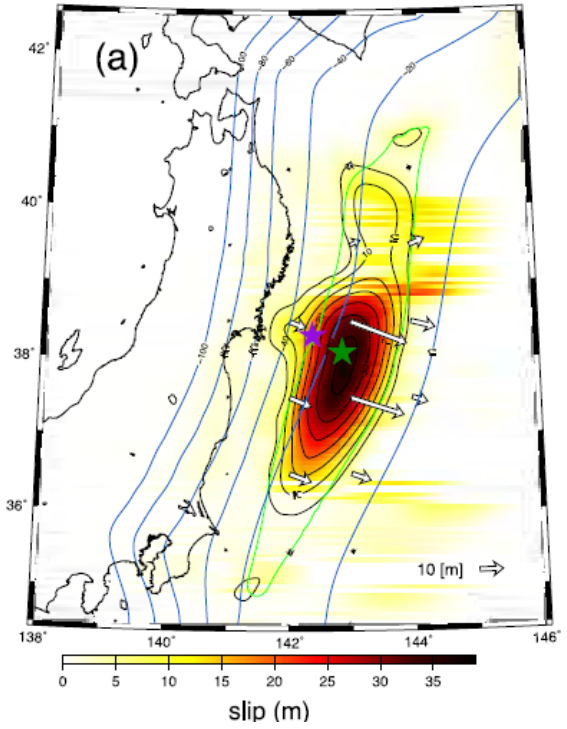

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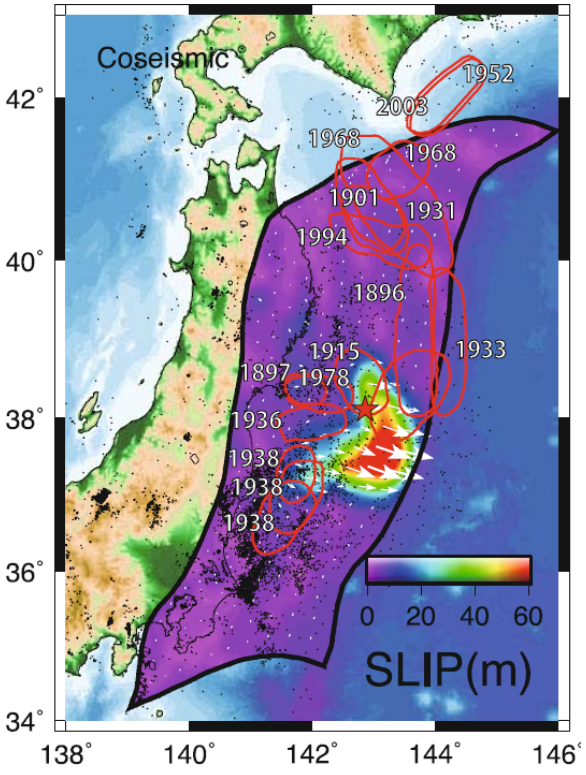
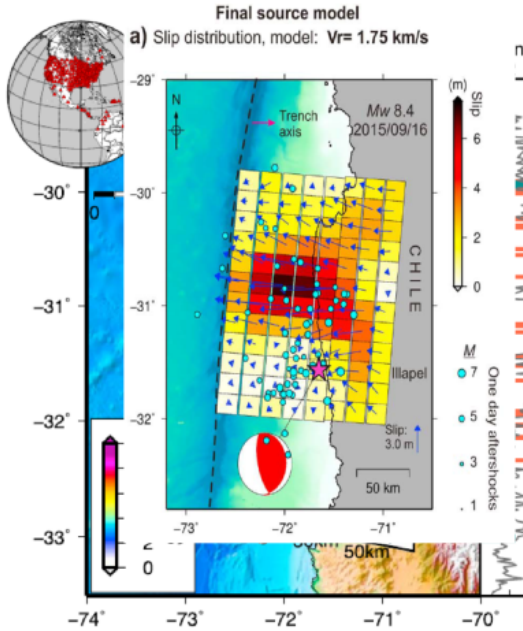


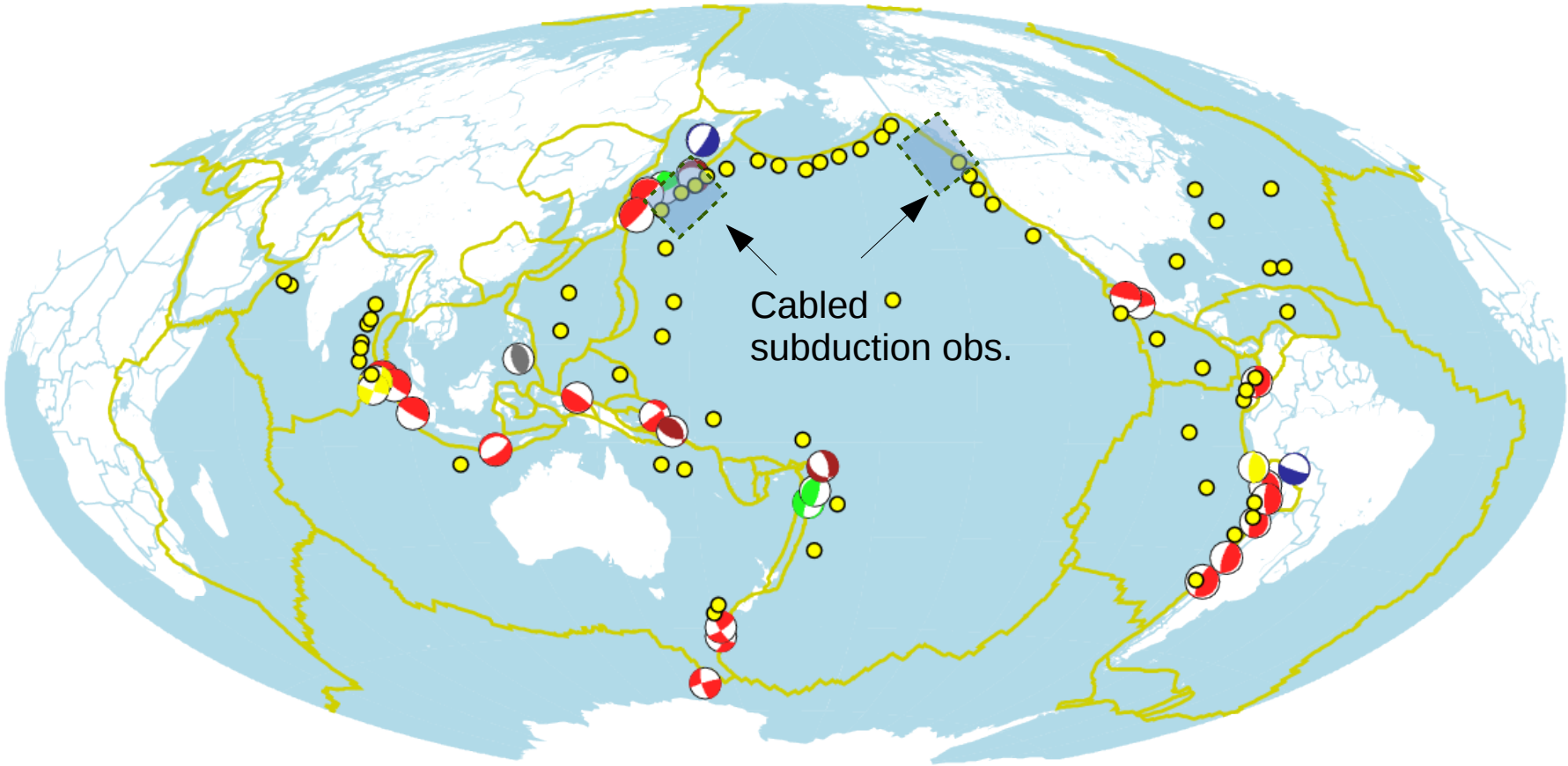


Melgar et al (2016): Shallower (peak >10 m)

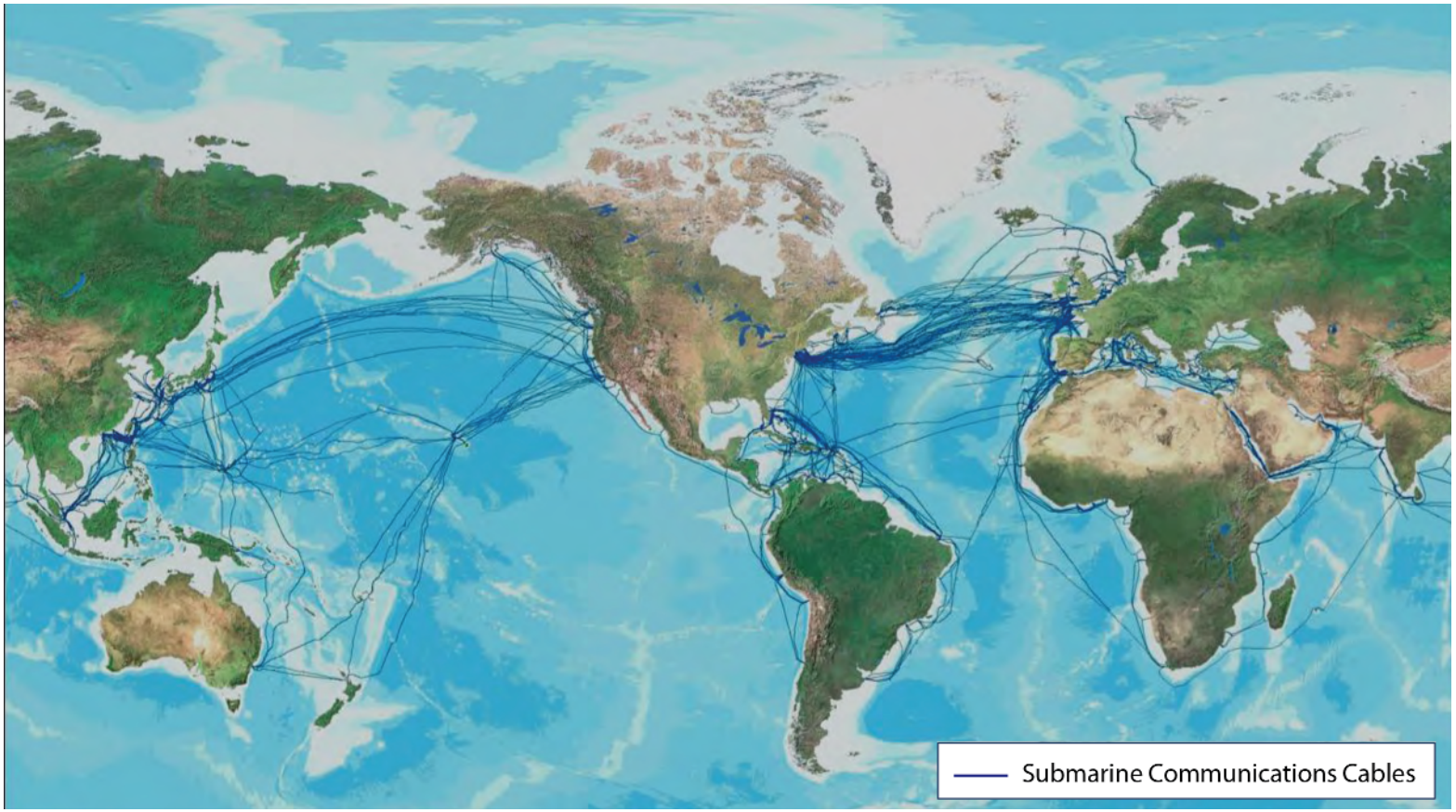
Heidarzadeh et al (2016): Deeper (peak ~6 m)

GFZ Helmholtz Centre Potsdam

Current DART buoys and M8+ eq since 1976



Telecommunications cable: a missed opportunity (so far)

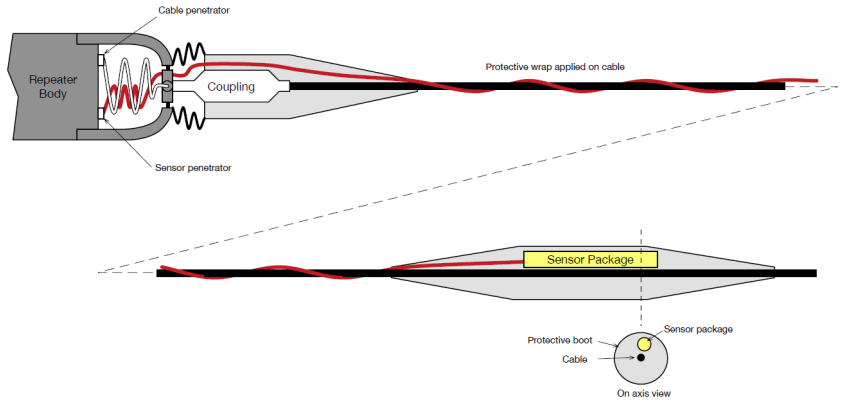


Cables offer power and bandwidth
but: current cables are ‘deaf, dumb and blind’
=> add sensors

What is involved?

Sensors for initial phase:

- Pressure
- Temperature
- Accelerometer



In later phase: extension to other sensor types or plug-in port

Broad community relevance: subduction zone earthquake physics and tsunami triggering; early warning; whole earth tomography; climate science, oceanography, ...

Next steps: Wet Demonstrator

- Objective: Demonstrate viability within a commercial system
- Sea trial with at least 3 repeater elements
- Needs hosting seafloor observatory to 'plug in'

How does this relate to SZO?

- Wet demonstrator will deliver valuable science data if sited properly; could become integral part of an SZO site
- Recommendations for areas to prioritise (consultation)
- Data integration of eventual SMART cable data a necessity

Learn more:

- White paper + poster at this meeting:
- Joint Task Force website: http://www.itu.int/en/ITU-T/climatechange/task-force-sc
- Summary of NASA workshop: http://www.soest.hawaii.edu/NASA_SMART_Cables/

Appendix

Costs (rough estimates!)

Wet Demonstrator

Design US$ 2 Mill
Development US$ +4 Mill
Deployment US$ +4 Mill => US$ 10 Mill

Production system

15% added cost over conventional cable to fit every repeater with sensors
(Base cost for Trans-Pacific cable 10000 km)

Cost per sensor package 260,000 (25 year lifetime) => 10000 / year

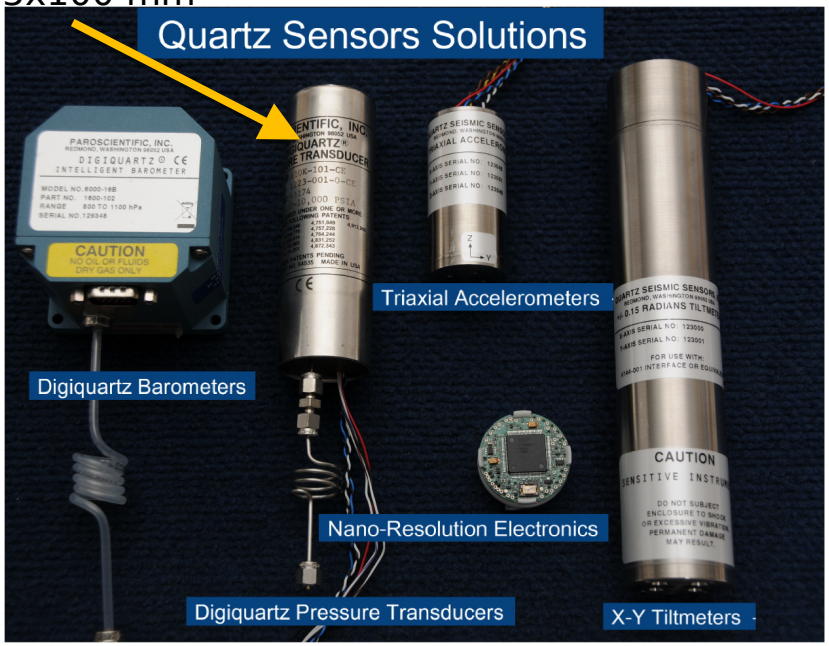
Cf DART Program 27 Mill US$ / year (61 sensors: 435 000 per sensor / year)

Pressure sensor

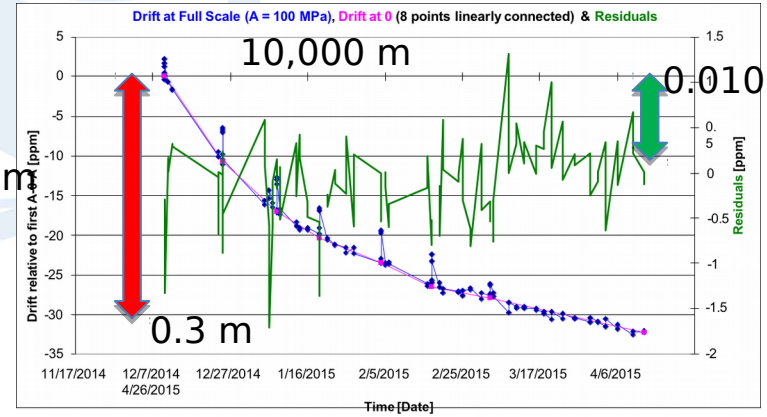
Current Requirements

- Max drift: 0.2 dbar/yr (0.2m / yr)
- Noise floor 0.14 Pa^2/ Hz

~25x100 mm



- Pressure, acceleration, tilt, (Temperature internal)
- Pressure drift solution – wrt internal pressure
- Sampling rate: 20 Hz => ~1kb/s (w. overheads)



Courtesy J. Paros, P. Migliacio

Slide B. Howe

Optical Accelerometers

- Uses optical interferometry
- 3-axis
- 30 mm diameter
- Passband 0.1-1000 Hz
- Noise: 3ng/sqrt(Hz)
- Proposed sampling rate: 200 Hz => with overhead ~18 kb/s

Silicon Audio