**Benefits and requirements for ocean bottom measurements for tsunami early warning and earthquake science**

In this presentation I will give a short overview over some of the unsolved issues in tsunami warning and earthquake physics, which can be addressed with SMART cable systems.

Although tsunami warnings can be issued fairly reliably in the far field, i.e. for coasts other than those at which the triggering earthquake has occurred, based on a combination of seismological evidence and recordings from deep ocean DART buoys.

For the near field, i.e. adjacent coasts the problem of reliable tsunami warnings is much more difficult to achieve. The potential warning time is small (30-45 min, even less in some cases), meaning that generally no DART measurements are available, and the seismological data are still incomplete, often resulting in underestimated magnitudes for the very largest earthquakes and large uncertainties in the rupture dimensions. Dense onshore GPS networks can constrain the along-strike extent of ruptures, but are nearly blind to the amount of slip in the shallowest part of the megathrust close to the trench, which is most critical for determining the size of a triggered tsunami.

Even where DART type pressure sensors are available close to the earthquake-source, it is impossible to separate the sealevel pressure signal from the signal induced by seismic waves due to the severe temporal undersampling imposed by the DART technology (samples only every 15 s). Pressure sensors in coast-parallel SMART-cable systems would thus be expected to result in a huge improvement in the accuracy of predicted tsunami run-ups for nearby coasts from the much denser sampling not achievable with DART systems, and from the fact that they can be sampled at much higher frequencies allowing a separation of the seismic and sealevel contributions to the pressure signal.

Accelerometers on the updip side of major subduction earthquakes would provide a much better view of the kinematics of the rupture and the occurrence of shallow slip, thereby also contributing to tsunami warning, but also advancing our understanding of earthquake physics.

A similar coast-parallel configuration would allow reliable monitoring of the depths of moderate offshore seismicity from both pressure sensors and accelerometers, which is very difficult to achieve with land-based instrumentation. This would help in particular with identification of structures in the upper crust. For example splay faults can get activated in great earthquakes and enhance vertical displacement of the seafloor, and their activity levels could be monitored. A future inclusion of wideband seismic sensors would expand the reach of this to smaller earthquakes and source studies for moderate size earthquakes.

Globally, the oceans are severely undersampled, meaning that there are many questions about the oceanic lithosphere and asthenosphere as well as the deep Earth, which cannot be answered. Pressure, and as a perspective broadband sensors, in trans-oceanic cables could fill this gap.

Finally, passive seismic interferometry has been shown on land to be able to detect minute (~0.1%) changes in the seismic properties of materials, and for example have detected softening of near-surface layers after large earthquakes. Potentially these techniques could be used for probing the geotechnical properties of the environment of the repeater units on the seafloor.

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