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GNSS contributions to tsunami early warning systems with focus on Europe.

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Geohazards, such as tsunamis, inflict an enormous cost on society and mitigation of disasters through early warnings will save lives and reduce economic losses. Tsunami warning is a race against time on local, regional and distant scales. Tsunami warning systems include several components. Today sensor networks generally consist of seismic sensors and coastal tide gauges to validate the tsunami wave characteristics and inundation. In addition several new signal networks are being incorporated such as ocean buoys, deep ocean pressure recorders and GNSS.

Current operational weaknesses of tsunami warning centers include an inability to detect landslides and volcanic sources, and an inability to provide early-enough warnings for local tsunamis except in a few cases. Europe is prone to local tsunamis and hence rapid estimates of the geophysical parameters will be pivotal for the NEAMTWS, the regional component of UNESCO's ITWS.
The challenge is to provide high quality information at the right time. In the case of local tsunamis that means within less than 5 minutes.

GNSS describes displacements of the Earth's crust and may improve the rapid determination of the magnitude and fault geometry of an earthquake. Particularly for large earthquakes, GNSS can radically reduce the response time and accuracy of tsunami warnings. GNSS contributes to the knowledge about sources of tsunamis pre-, co- and post event which are important input for the warning system. GNSS can also contribute to tsunami warning systems for non-seismic events such caused by landslides, precarious rocks and volcanoes. A description of GNSS products and methods that can be applied in those cases are discussed.

We present an overview and discuss GNSS's existing and potential contributions to tsunami warning systems, including non-seismic sources. For tsunamis caused by earthquakes, real-time GNSS analysis strategies are assessed. An evaluation with suggestions for improvements of the existing geodetic network, including Europe's Euref, is presented. We also reflect on how a local GNSS network can be integrated in global Earth observing systems, and its potential for multipurpose use in accordance with GEO's implementation plan.