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Simulation of space-borne tsunami detection using GNSS-Reflectometry applied to tsunamis in the Indian Ocean

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Abstract. Within the German-Indonesian Tsunami Early Warning Sy
project GITEWS (Rudloff et al., 2009), a feasibility study on a future
tsunami detection system from space has been carried out. The Gl
Navigation Satellite System Reflectometry (GNSS-R) is an innovativ
using reflected GNSS signals for remote sensing, e.g. sea surface a
In contrast to conventional satellite radar altimetry, multiple heigh
measurements within a wide field of view can be made simultaneo
With a dedicated Low Earth Orbit (LEO) constellation of satellites e
with GNSS-R, densely spaced sea surface height measurements co
established to detect tsunamis. This simulation study compares th
and the meshed comb constellation with respect to their global ref
point distribution. The detection performance of various LEO const
scenarios with GPS, GLONASS and Galileo as signal sources is inve
The study concentrates on the detection performance for six histor
tsunami events in the Indian Ocean generated by earthquakes of
magnitudes, as well as on different constellation types and orbit
parameters. The GNSS-R carrier phase is compared with the PARIS
altimetry approach. The study shows that Walker constellations ha
much better reflection point distribution compared to the meshed c
constellation. Considering simulation assumptions and assuming te
feasibility it can be demonstrated that strong tsunamis with magni
(M) ≥8.5 can be detected with certainty from any orbit altitude witl
25 min by a 48/8 or 81/9 Walker constellation if tsunami waves of
higher can be detected by space-borne GNSS-R. The carrier phase
approach outperforms the PARIS altimetry approach especially at l
altitudes and for a low number of LEO satellites.

Full Article (PDF, 729 KB)

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