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TSUNAMI MONITORING IN THE IONOSPHERE

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Abstract. In the last ten years ionospheric anomalies following major tsunamis and earthquakes have been detected. The giant 2004 Sumatra tsunami produced ionospheric anomalies ob- served both from ground-based GPS measurements and space-based satellite altimeters[1,2,3]. More recently the September 2009 Samoa tsunami has produced ionospheric anomalies detected offshore Hawaii[4]. All these anomalies show the signature in the ionosphere of tsunami-generated internal gravity waves (IGW) propagating in the neutral atmosphere overlooking oceanic regions.

Most of these ionospheric anomalies are deterministic and reproducible by numerical modeling via the coupling mechanism through ocean, neutral atmosphere and ionosphere[3,5,6,7]. In addition, the numerical modeling supplies useful helps in the estimation of expected anomalies, as well as to explore and identify new techniques to detect ionospheric tsunami signatures.

Here we present an overview of the physical coupling mechanism and the opportunities given by space-based and ground-based techniques to detect these anomalies. GPS and altimeters are important tools for this purpose, allowing the observation through TEC measurement.

Despite GPS and altimeters strongly highlight the link between tsunami propagation and associated ionospheric perturbations, the tsunami characterization with those instruments is strongly affected by the integrated nature of TEC, the satellites-receivers geometry, as well as the effect of magnetic field[5].

In this work we explore the opportunities given by additional ground-based techniques, nominally the Over-The-Horizon (OTH) radars, for tsunami detection by ionospheric monitoring. OTH radars operate on High Frequency (HF) band and could anticipate the

detection of tsunamigenic IGW sounding the bottomside ionosphere.

To validate this hypothesis, we simulate synthetic radar measurements (by HF numerical ray-tracing) interacting with a 3D tsunamigenic IGW model based on the perturbation theory of empirical atmospheric and ionospheric models. The large coverage of OTH radar and its sensitivity to plasma anomalies open new perspectives in the oceanic monitoring and future tsunami warning system.

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