SEISMIC AND TSUNAMI WAVES IN THE IONOSPHERE

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We present a short review in the detection and modeling of post-seismic signals. We focus on observations performed by GPS networks, TEC measurements onboard TOPEX and JASON and their comparison with Demeter data.

We address three type of ionospheric signals : far field observations associated to the seismic Rayleigh waves, near field observation associated to the acoustic waves generated by the seismic source, and far field observations associated to tsunami see/air coupled waves, especially those recorded after the Sumatra, December 2004 earthquake. We focus on the most recent observations of seismic waves in the ionosphere by dense networks. These network have provided 2D and 3D imaging of the ionospheric waves, leading to a retrieval of the amplitude and propagation speed of the waves. We also compare TEC, Topex/Jason and Demeter data, in order to constraint the amplitude of the signal at different altitudes. All these data provide us with a much better understanding of the post-seismic coupling processes between the solid earth, the ocean, the neutral atmosphere and the ionosphere.

We then present a summary of the theoretical and numerical solid/atmosphere/ionosphere coupled forward problem and use it to compute synthetics for the different events studied. In the case of the Sumatra event, we compute the gravity waves by using tsunami simulation by using a 3D pseudo-spectral code, and then compute the transfer of the neutral atmospheric waves to the ionosphere. Both the density electronic perturbation and the density velocities are computed. In the case of the seismic signals, we use normal mode summation techniques in the neutral wave modeling and then obtain the ionospheric signals with a neutral/plasma coupling modeling. In both cases, we find good agreement between the synthetics and observed TEC waveforms.

These results show that the dream of remote sensing seismology could be a reality in a relatively near future. These exiting perspectives, either in the acquisition of high density seismic data for lithospheric studies, or for future tsunami warning systems are illustrated with a few possible ground based or space based projects.