



## Quakes and tsunamis detected by GOCE

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The aerodynamic accelerations measured by GOCE are used to calculate air density variations and air velocity estimates along GOCE orbit track. The detection of infrasonic waves generated by seismic surface waves and gravity waves generated by tsunamis are presented for earthquakes and tsunamis generated by the great Tohoku quake (11/03/2011). For the seismic/infrasonic waves, a wave propagation modelling is presented and synthetic data are compared to GOCE measurements. The travel time and amplitude discrepancies are discussed in terms of lateral velocity variations in the solid Earth and the atmosphere. For the tsunami/gravity waves, a plane wave analysis is performed and relations between vertical velocity, cross-track velocity and density variations are deduced. From theoretical relations between air density, and vertical and horizontal velocities inside the gravity wave, we demonstrate that the measured perturbations are consistent with a gravity wave generated by the tsunami, and provide a way to estimate the propagation azimuth of the gravity wave. By using these relations, an indicator of gravity wave presence is constructed. It will allow to scan the GOCE data set to search for gravity wave crossings. This study demonstrates that very low earth orbit spacecraft with high-resolution accelerometers are able to detect atmospheric waves generated by the tectonic activity. Such spacecraft may supply additional data to tsunami alert systems in order to validate some tsunami alerts.