GRACE-FO and Swarm integrated data analysis reveals ionospheric disturbances on the accelerometer measurements

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Low Earth Orbit (LEO) satellites are subject to numerous disturbances related to the Earth's upper ionosphere. Perturbations induced by the activity of the electromagnetic field (EM) at the upper ionospheric layers have not been fully understood yet. This study focuses on the disturbances shown on GRACE-FO accelerometer measurements when the EM field was disturbed by an intense geomagnetic storm occurred on August 2018. A thorough analysis of the accelerometer measurements of GRACE-C as well as the magnetic and electric field measurements from Swarm constellation is conducted, to enlighten their impulse-response relationship. We derive the temporal variations of the magnetic field by removing the main static field and we calculate the Poynting vector employing the Swarm magnetic field measurements and electric field data, by implementing rigorous data analyses to analyze the spatiotemporal characteristics of the energy flow of the electromagnetic field. Results show that GRACE-C accelerometer measurements are highly disturbed in the higher latitudes especially near the auroral regions. The signature of the spatial temporal variations of the magnetic field and the Poynting vector demonstrates very similar behaviour with GRACE-C disturbances. Cross wavelet analysis between Poynting vector and GRACE-C accelerometer disturbances shows a very strong coherence. With the two LEO missions, i.e. GRACE-FO and Swarm, orbiting the Earth in very similar orbits, further analysis towards integrating their measurements will enhance our understanding of the interaction of LEO satellites with the space environment and how this interaction is depicted in their measurements.