



How do space weather dynamics impact GRACE mission instrumentation?

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Low Earth Orbit (LEO) satellites are often subject to disturbed environment due to space weather dynamics. Perturbations on satellite instrumentation induced by geomagnetic storms have not been fully understood yet. This study assesses the impact of upper ionospheric dynamics on Gravity Recovery and Climate Experiment (GRACE) mission on-board instrumentation during geomagnetically active days. We investigate the impact of various geomagnetic storms along multiple tracks on GRACE accelerometers and examine any coherence with external spacecraft conditions i.e. space weather. For this purpose, we employ Advanced Composition Explorer (ACE) mission interplanetary magnetic field observations and Poynting flux estimates derived from spherical elementary and equivalent ionospheric currents over North America and Greenland. Coherence analysis between GRACE and ACE/Poynting flux estimates is conducted by means of continuous wavelet analysis. Findings suggest that ionospheric dynamics affect directly the GRACE accelerometers in a non-linear sense by SNR of ~ 15 dB in extreme cases. A nearly 100% coherence between ACE and GRACE disturbed signals that peaks in auroral and polar zones is shown. Additionally, GRACE disturbances demonstrate higher magnitude closer to the North Pole as opposed to the South Pole where the disturbances are of lower magnitude. Similar findings using Poynting flux estimates are drawn for other geomagnetic storms. Considering the upcoming GRACE-FO mission, a deeper understanding between space weather dynamics and LEO satellites response can be enlightened.