ABSTRACT:

Over the past decades, extensive research has been made regarding the storm time dynamics. Nevertheless, there are still unanswered questions about the storm time ring current formation and plasmasphere, specifically about the ring current feedback on the energy input.

Using Space Weather Modeling Framework (SWMF) we examined the role the transient spikes in the solar wind parameters play in the development of magnetic storms. We find that changes in the energy input produce a nonlinear response of the inner magnetosphere as opposed to the linear response the empirical models predict. While initial increases in the energy input enhance the magnetospheric response, we observe that as the power transferred to the system is increased, the growth of the ring current is stalled and a saturation limits sets in. A threshold in the energy input is necessary for the ring current to develop, while the short time scale fluctuations in the solar wind parameters did not have a large contribution, implying that the ions drift to the dayside is not the only loss process that contributes to the decay of the ring current but also the existence of an internal feedback mechanism as the magnetosphere acts as a low-pass filter of the interplanetary magnetic field, limiting the energy flow in the magnetosphere.

In addition, theoretical simulations are performed to study the role of IMF Bz fluctuation periodicity in the transfer of solar wind mass and energy to the magnetosphere. We find that the most important characteristic in determining the transfer of periodicity seen in IMF Bz to the inner magnetosphere is the noise to peak ratio in the power spectrum of the input parameter. A peak in the input power spectrum at least twice larger than the background noise is needed in order to trigger a similar periodicity in the magnetosphere response.

Finally, theoretical and numerical modifications to an inner magnetosphere - Hot Electron Ion Drift Integrator (HEIDI)- model are implemented, in order to accommodate for a non-dipolar arbitrary magnetic field. We find that for a non-dipolar configuration, the inner magnetosphere solution can change up to 4%.