One year comparison of lighting activity and variations in electron fluxes of the inner radiation belt

*Claudia Martinez Calderon[1,2], Jacob Bortnik[2], Wen Li[3,2], Harlan Spence[4], Emma Douma[5], Craig Rodger[5]

1. Department of Geophysics, Tohoku University, Sendai, Japan, 2. University of California Los Angeles, California, USA , 3. Boston University, Massachusetts, USA, 4. University of New Hampshire, New Hampshire, USA, 5. University of Otago, Dunedin, New Zealand

In the radiation belts, energetic electrons with energies above 100 keV undergo cyclotron resonant interactions with whistler-mode plasma waves. These wave-particle interactions lead to either acceleration or loss of particles by energy diffusion or pitch angle scattering. Lightning discharges are known to radiate electromagnetic energy over a wide range of latitudes around their source. Part of this energy propagates in the whistler-mode through the ionospheric plasma and can then interact with electrons in the radiation belts causing whistler-induced electron precipitation. There have been several studies that focus on the effects of these whistler-induced precipitation and their immediate relationship to lightning strikes [Rodger et al. (2004), Clilverd et al. (2004)]. However, there is little research that concentrates on the long-term effects of these electron losses on the population of the inner radiation belts. In this study, we use data from the World Wide Lightning Location Network (WWLLN), continuously monitoring global lightning since 2004, to examine one year of lightning data (January to December 2013) and locate the L-shells with strong lighting activity. Then we use the Energetic Particle, Composition, and Thermal Plasma Suite (ECT) from both Van Allen Probes (RBSP–A and –B) to measure electron fluxes in the inner radiation belt at the L-shells of strong lightning activity. We examine the influence that lightning activity has on long-term electron precipitation using RBSP trapped omnidirectional fluxes, as well as pitch angle distributions, dayside/nightside differences and geomagnetic activity. We use several case studies in order to quantify the loss effects to the radiation belts due to lightning activity.

Keywords: Lightning, Inner radiation belt, whistler induced precipitation, electron loss