

The Balloon Array for Radiation belt Relativistic Electron Losses (BARREL) measures electron loss from Earth's radiation belts by observing the bremsstrahlung X-rays produced by precipitating electrons as they collide with the Earth's atmosphere. To date, four balloon campaigns have been carried out with two long duration balloon campaigns from Antarctic research stations in January-February 2013 and 2014 and two "Turnaround" campaigns from Kiruna Sweden in August 2015 and 2016. During each Antarctic campaign, ~20 small (~20 kg) balloon payloads were launched from two separate sites with an average flight time of ~10 days while the Sweden campaigns consisted of ~7 ~24 hour flights. The balloon floats at an altitude of 30-38 km. Each balloon carried a NaI scintillator to measure the bremsstrahlung X-rays and (for the first three campaigns) a DC magnetometer to explore the nature of Ultra Low Frequency temporal modulations of precipitation. We present several science highlights from BARREL. Precipitation was observed over a range of energies with temporal and spatial structure at a variety of scales. The combination of BARREL with in situ (e.g. Van Allen Probes, THEMIS) and ground-based (e.g. riometer, VLF) measurements provides a unique opportunity to study wave-particle interactions, and to quantify the spatial scale of energetic precipitation. This presentation will give highlights from the first two campaigns as well as first results from the just completed 2nd Sweden campaign. This includes an analysis of duskside precipitation in association with EMIC waves and dawnside precipitation observed in conjunction with whistler chorus waves.