Space- and Ground-based Measurements of Radiation Belt Precipitation: Extending the Capabilities of CubeSats and Radars

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The overall dynamics of the Earth's radiation belts is governed by the competition between source and sink mechanisms. The purpose of this work is to advance our understanding of loss processes due to energetic particle precipitation in the form of microbursts. We seek to assess and compare in situ measurements of precipitating particles to ground-based remote sensing of their signature in the atmosphere. We use data collected by the Focused Investigations of Relativistic Electron Burst Intensity, Range and Dynamics II (FIREBIRD-II) CubeSat during conjunction times with Poker Flat Incoherent Scatter Radar (PFISR), as well as data collected by PFISR itself. Conjunction experiments were performed for FIREBIRD II's campaign 15 (mid-April to mid-May, 2018), campaign 16 (late June to mid-July, 2018), campaign 17 (late July to late August, 2018), and campaign 18 (mid-September to mid-October). From FIREBIRD II we obtain precipitating particle flux in six different energy channels (~200 keV to ~ 1MeV), to measure the precipitating electron energy spectrum. This information is then used to find the expected D-region electron density through Monte Carlo method and chemistry simulations, which can later be transformed into expected signal-to-noise ratio. On the other hand, PFISR can measure directly the signal-to-noise ratio overhead, which can be translated into electron density and the corresponding particle flux that can lead to such enhancement. We compare measurements made during conjunctions with these two different platforms with the goal of extending data capability from single-point to multi-point scales.