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Investigating Space Radiation and Atmospheric Climate Impacts with the Canadian RADICALS Mission

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The RADiation Impacts on Climate and Atmospheric Loss Satellite (RADICALS) mission, scheduled for launch in 2027, is a Canadian small satellite mission designed to investigate the impacts of energetic particle precipitation on Earth's atmosphere. Energetic particle precipitation (EPP) plays a critical role in altering atmospheric chemistry, particularly through the production of NOx and HOx, which catalytically destroy ozone in the middle atmosphere. RADICALS will focus on measuring the energy input from precipitating energetic particles into the atmosphere, shedding new light on the connection between space weather and climate. Operating in a polar orbit, the RADICALS payload contains dual High Energy Particle Telescope (HEPT) suites (each comprising high and low energy telescopes, and a high temporal resolution scintillator), and dual X-Ray Imager (XRI) suites. When mounted on the spinning RADICALS spacecraft they will provide pitch angle distributions of trapped radiation belt electrons and solar energetic protons, and the associated Bremsstrahlung X-rays from atmospheric interactions. The mission's unique back-to-back HEPT suite design will measure both down-going and up-going particles simultaneously, while the XRI will remotely sense particle precipitation via X-ray emissions as well as monitoring lower energy electrons as a secondary product. This combination will allow RADICALS to pitch angle resolve the precipitating electron and protons across a wide range of energies on various timescales, including that of electron microbursts which are believed to play a potentially significant role in atmospheric energy input. The RADICALS science payload will also include a pair of boom-mounted fluxgate magnetometers and a 3-axis search coil magnetometer to substantiate particle measurements with the local magnetic wave activity. By resolving the electron loss cone and quantifying the energy flux of precipitating particles, RADICALS will provide essential data for understanding how space radiation influences atmospheric chemistry, particularly during geomagnetic storms. These measurements will be critical inputs for both radiation belt models as well as for coupled whole atmosphere models, and overall for assessing the role of energetic particle precipitation on climate.

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satellite mission

Keyword-3

climate

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