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# SPACECRAFT CHARGING OF THE MORAZÁN MRZ-SAT SATELLITE IN LOW EARTH ORBIT: EXAMINING THE INFLUENCE OF ANISOTROPIC ENERGETIC ELECTRONS ON DIFFERENTIAL CHARGING

**Abstract**

The advent of the modular CubeSat satellite architecture has heralded a revolution in satellite missions, drastically lowering the technical and financial barriers to space. As a result, over 600 CubeSat missions are due to launch in 2023 with various scientific and technology-focused applications. Surface charging resulting from energetic electron poses a direct risk to satellites in space, causing electric arcing and breakdowns. This risk is exacerbated for small technology demonstration CubeSats that are less resilient than larger satellites. An upcoming CubeSat launch of significance is the first CubeSat project originating from Honduras, the Morazán satellite (MRZ-SAT), due to launch in 2024. This will carry earth observational payloads to detect natural disasters, such as floods and landslides, which preferentially affect the Central American region and aims to build the first disaster forecasting capabilities for remote Central American region. In this study we conduct simulations using the Electro-Magnetic Spacecraft Environment Simulator code to study absolute and differential charging of the MRZ-SAT cube-sat in Low Earth Orbit (LEO). The MRZ-SAT hosts four antennas extending from four sides of the spacecraft, an architecture which lends itself well to studying and understanding differential charging in LEO. The MRZ-SAT was first simulated in a typical benign ionospheric plasma environment. Here the antenna located in the ambient plasma wake displayed the maximum charging up to –0.9 V, 0.24 V biased to the main cube. An energetic electron population was then included and the wake antenna subsequently charged to greater values of –2.73 V, now 1.56 V biased to the main cube. The anisotropy of the energetic electrons was then varied, and this differential charging trend appeared exacerbated with anisotropies of 0.5 to 0.05 inducing absolute wake antenna voltages of 4.5 V and differential voltage biases 50 and 100 % greater than when an isotropic population was considered. This study highlights the importance of electron anisotropy in LEO to surface charging and identifies this property in the energetic electron distribution functions as inducing potentially greater risks to satellite of electrical arcing and breakdown.