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A SMALLSAT CONSTELLATION FOR F10.7 AND F30 CM SOLAR RADIO FLUX MEASUREMENTS

Abstract

The Sun emits radiation across the electromagnetic spectrum from X-rays to radio waves. Solar EUV radiation is a major source of variability in thermospheric density and temperature which change with the altitude and solar cycle phase. This variability leads to a change of atmospheric drag acting on objects in orbit, reducing their lifetime and leading to decay and the following re-entry. In order to specify satellite orbits, perform re-entry services, collision avoidance maneuvers, and other space operations, temperature and density of the atmosphere need to be accurately estimated via atmosphere models. The solar radio flux measurements at F10.7 and F30 cm are required by these models as a proxy for solar input. Currently, F10.7 and F30 indices are available with limited cadence only from ground-based observatories at the Dominion Radio Astrophysical Observatory in Penticton, Canada (F10.7) and the Nobeyama Radio Observatory in Nobeyama, Japan (F30). SmallSats provide cost-effective opportunities to measure space weather data. Additionally, SmallSats can be developed and launched in a relatively short time compared to larger satellites which provides the potential for rapid replaceability. In this study we propose a constellation of 7 SmallSats in a 12-hour Sun-synchronous orbit at an altitude of 850 km with an inter-satellite link to provide 24-hour coverage of F10.7 and F30 measurements. The main payload of each SmallSat is a parabolic antenna and a Software-defined radio (SDR) architecture. We present the mission requirements, Concept of Operations, constellation configuration, and the detailed design of the SmallSats. This study demonstrates how SmallSats can be used to advance science with feasible and relatively incomplex missions.