

30th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Space Science Missions (2)

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AN ESA NANOSATELLITE CONSTELLATION TO MONITOR SPACE WEATHER EFFECTS

Abstract

Major space weather events have the potential to cause significant damage and disruption to critical terrestrial and space-based infrastructure, including radio communication networks, Global Navigation Satellite Systems (GNSS) and the electricity grid. The continuous monitoring of space weather is therefore crucial for providing advanced warning of potentially destructive events. The European Space Agency (ESA) is in the process of developing the Enhanced Space Weather Monitoring System, which will utilise spacecraft to monitor space weather on and away from the Sun-Earth line (e.g. the ESA Vigil mission).

The Distributed Space Weather Sensor System (D3S) will form part of this Enhanced Space Weather Monitoring System and focus on making measurements in the vicinity of the Earth. In early 2021, SSTL was selected to lead an ESA-funded Phase 0/A study titled “SSA P3-SWE-LIII Nanosatellites for D3S”. The aim of the study was to establish the role that nanosatellites can play as part of the D3S space weather monitoring system. Nanosatellite technologies have seen significant performance and capability improvements in recent years, and this was one of the reasons that nanosatellites were of particular interest for this study, along with the benefit of their small size and lower costs. The objective of the Phase 0 study was to analyse the space weather measurement requirements for the mission and identify potential space weather instruments that could be accommodated on a nanosatellite mission. A trade-off of a range of different mission architecture concepts was conducted, and the two most promising concepts were selected for more detailed analysis in the latter half of the Phase 0 study. At the end of the Phase 0, ESA selected a concept comprising 6x 16U SSTL CubeSats in a 500-600km Sun-Synchronous Orbit to take forward into Phase A for further definition. The Phase A study focussed on the more detailed design of a precursor demonstration mission comprised of 1-2 16U SSTL CubeSats, and the necessary development work and critical technologies for the mission were identified. The objective of the demonstration mission is to allow for the de-risking of the fully operational 6x satellite constellation, and for the testing of the payloads and key technologies such as a BGAN Inter-Satellite Link. This paper will provide an overview of the work that was carried out during the Phase 0 and Phase A studies.