The SPORT Mission: Methodology and Scientific Goals of an International Partnership

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Abstract

The equatorial ionosphere is recognized as a complex region from a scientific point of view because it encompasses a series of phenomena that still need further understanding due to its associations with electromagnetic signal distortions that affect directly some services provided on Earth, such as communications and navigation. These signal distortions are caused by ionospheric instabilities and are known as scintillations. More precisely, plasma structures are created in the lower layers of the ionosphere during the day, and they can reside in these regions most of the time also at night. However, if particular conditions allow the penetration of the structured regions into the highest layer of the ionosphere, called the F layer, then the plasma structures may be of sufficient magnitude to create disturbances in the form of scintillations. Despite being an investigated phenomenon for several decades, there is still no reliable system capable of predicting it. Moreover, the scintillations effect has not yet been resolved due to the complicated interactions of electromagnetic signals and their reflections with the highly irregular and inhomogeneous medium of the equatorial plasma bubbles, which can be briefly defined as being regions of low ionospheric plasma density. Such ionospheric irregularities encouraged the development of the SPORT (Scintillation Prediction Observations Research Task) project. The SPORT is an international collaborative space mission between institutes in Brazil (ITA and INPE) and the United States (NASA Goddard Space Flight Center, NASA Marshall Space Flight Center, Utah State University, the University of Texas at Dallas and Aerospace Corporation) to explore the phenomenon of the equatorial plasma bubbles and their impact on scintillation using a CubeSat equipped with various instruments for diagnosing the ionosphere. More specifically, this project aims to provide the scientific community enhanced data to improve our understanding of the conditions that lead to scintillations, enabling the prediction of these irregularities. Our objective is to talk about the satellite instruments, the mission and scientific methodology, the data distribution policy, and some expected results. The satellite will carry six instruments for the diagnosis of ionospheric plasma: a Langmuir probe, an Ion Velocity Meter, an Impedance probe, an Electric Field probe, a Magnetometer, and one GPS receiver for measurements of scintillation and radio occultation. The proposed instruments will be integrated into an ITA 6U platform that will be launched from the International Space Station (ISS). Remote measurements using ground-based instruments situated at different locations in the Brazilian territory will also be used for ionospheric diagnosis to be integrated later with the satellite instruments.