Introduction to Space Weather Program

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Adverse space weather is one of the principal threats to modern human technology. Solar coronal mass ejections, large solar flares, and high-speed solar wind streams often lead to sequences of damaging disturbances within the Earth's magnetosphere, in the atmosphere, and even on the Earth's surface. Powerful and long-lasting geomagnetic storms can develop following solar disturbances and enhancements of the highly relativistic electron populations throughout the outer terrestrial radiation zone can also result. High-energy protons and heavier ions arriving in near-Earth space?or trapped in the magnetosphere and having clearest effect in the South Atlantic Anomaly (SAA)--can damage satellite solar power panels, confuse optical trackers, and deposit harmful charges into sensitive electronic components. Recent international space science programs have made a concerted effort to study activity on the Sun, the propagation of energy bursts from the Sun to near-Earth space, energy coupling into the magnetosphere, and its redistribution and deposition in the upper and middle atmosphere. Extreme solar, geomagnetic and solar wind conditions can be observed by a large array of international satellites and ground-based sensors. Many of types of space weather-related problems have been identified in recent years. This lecture presents examples of space weather-induced spacecraft (and ground-based) anomalies and failures. It also discusses efforts to consolidate and integrate results from many international programs and campaigns. An important component of this community effort is to propose technical and operational solutions to space weather problems and we discuss this aspect of space weather in this lecture.