The solar activity can be considered one of the main sources of hazards not only affecting launch operations but also the reliability of Global Navigation Satellite Systems (GNSS), such as Galileo, and Satellite Based Augmentation Systems (SBAS), such as EGNOS. Thus, it could impact critically on GNSS-based services, among other impacts on society. In particular, Solar Energetic Particle (SEP) events pose a serious health risk to humans in space and can result in increased radiation doses for high-altitude aircraft flights and can constitute a serious concern for the microelectronics and other hardware elements of satellites, aircraft and launchers. In addition, severe malfunctions of GNSS and SBAS systems have been reported as well. Then, nowadays, providing GNSS users with predictions and warning alerts on potential disturbances associated to increased solar activity shall be of key relevance. For instance, by taking preventive actions and improving the reliability of GNSS systems to allow significant mitigation of radiation damage.

SEPsFLAREs system

As a result of the European Space Agency (ESA) project “Solar Events Prediction System for Space Launch Risk Assessment” (SEPsFLAREs), a web-based prototype system has been deployed as a provider of early warnings and predictions of solar flares and Solar Energetic Particle (SEP) events. The system covers the pre-flare, post-flare/pre-SEP, and intra-SEP scenarios by means of:

- The prediction of solar flares occurrence from 48- to 6-hour ahead based on Automated Solar Activity Prediction (ASAP) [2].
- The prediction of the SEP onset and occurrence based on UMA Solar energetic proton Event Predictor SEP prediction (UMASEP, [7]) and the so-calledWarning Tool [2].
- The prediction of the SEP peak and duration once there is evidence of a SEP occurrence.
- The near real-time monitoring of solar flares occurrence by means of GNSS-based techniques (GSFLAD and SISTED, [5] and [4], respectively).

Results

SEPsFLAREs system provides as well, from ESA’S MONITOR server, two real-time products developed by authors of this work on solar flares nowcasting based on ionospheric monitoring by Global Navigation Satellite Systems (GNSS) and a worldwide network of GNSS receivers from the International GNSS Service (IGS):

- The GNSS Solar Flare Detector (GSFLAD) [5].
- The Sunlit Ionosphere Sudden TEC Enhancement Detector (SISTED) [4].

Conclusion

SEPsFLAREs is a newly developed web-based prototype system close to be operational at http://sepsflares.esa.int. Its main purpose is the provision of forecasts on solar flares and SEP events. ASPAS has been improved with new functions, also enabling 6, 12, 24, and 48 hours forecast horizons. Also, the latest version of ASPAS includes a new Warning Module which was developed for processing SEPsFLAREs ASPA flares predictions and providing warnings on potential proton flux enhancements. Also, a new SEP Peak and Duration prediction model was developed that uses a new Shock Arrival time prediction Model (SARM; [6]) and a static Parker Spiral. Finally, the system provides nowcasts of solar flares facing the Earth from GNSS-based GSFLAD and SISTED ([4],[5]).

References


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