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Solar Wind Effects on South Atlantic Anomaly

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In this research, we investigate solar wind parameters effects on South Atlantic Anomaly (SAA), to estimate the excess charging of Low Earth Orbit (LEO) spacecrafts, in severe space weather conditions, due to their path through the South Atlantic Anomaly zone. Solar winds are considered as a continuous flow of plasma emitted from the Sun, and, the main driver of the space weather. Hence, Van Allen Belts are seriously affected by those solar activities; and because of noncoincidence of the geomagnetic dipole axis and the Earth's rotating axis, radiation belts are very close to the Earth surface, precisely, at south of the Atlantic Ocean, near Brazil, where Earth's magnetic field is weak enough to let the charged particles move into this cavity. Unfortunately, this phenomenon creates harmful effects on LEO satellites: extra-charging may cause damages in its on-board electronic devices.

The two main objectives of this work are: (1) the study of the South Atlantic Anomaly (SAA) parameters: minimum magnetic field value (SAA's center), its movement (longitude and latitude), area, with respect to the altitudes from 200 ~ 1000 km, including solar wind parameters variations, such as dynamic pressure, interplanetary magnetic field components, B_{YIMF} and B_{ZIMF} , Dst index, etc., by adopting Tsyganenko models, T96, T01 and T05, as the external magnetic field contribution, in addition of the main internal magnetic field, the International Geomagnetic Reference Field (IGRF-12); and, (2) charged particles behavior, by performing test particle simulation, to study their penetration level, i.e. the depth they can reach, and their distribution in this zone.

Long-term variations (over 5 years) are investigated, to be suitable for satellite mission lifetime, as well as, the short-term (over one month), to detect the solar storm event, and, the SAA's response.

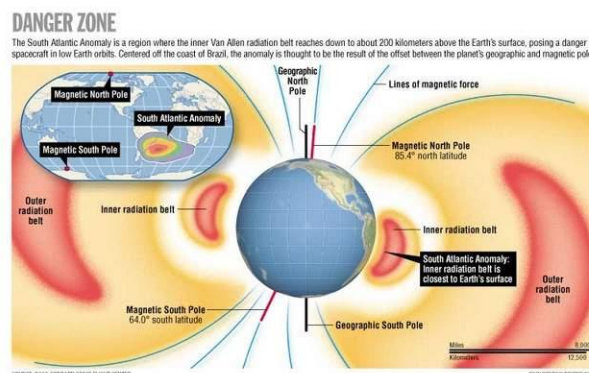


Figure 1: SAA from space

Source: <http://www.ghosttheory.com/wp-content/uploads/2014/05/SAAog.jpeg>

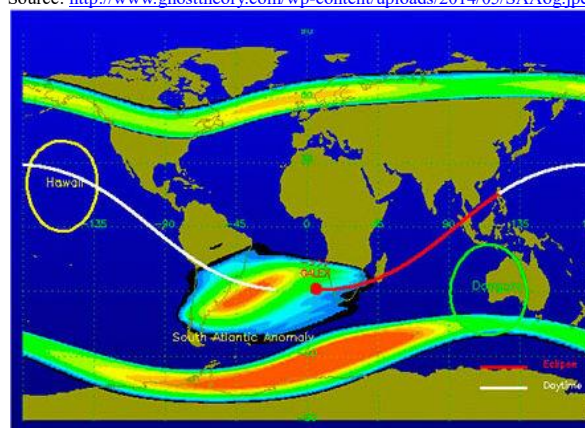


Figure 2: GALEX telescope path through SAA

Source: <https://www.sott.net/image/s3/73868/full/saa.jpg>

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