

Solar Storm Effects on Humans

The radiation from the Sun provides the Earth with life sustaining energy, which along with other factors, helps to maintain a sensitive balance between the atmosphere, oceans, and land. The Sun also produces a solar wind, an outward flow of charged particles, which can interact with the Earth's magnetic field environment. Events such as Coronal Mass Ejections (CMEs), which occur at the Sun, release significant bursts of charged particles in various directions. When these solar storms are Earthward directed, the incoming flurry of charged particles, which enter the Earth's magnetosphere, can cause a variety of effects on humans.

Communication with Earth orbiting satellites can be disrupted, as charged particles induce deep dielectric charging in unprotected parts of the satellite, or produce bit flips in the satellite's data system. Astronauts, working outside of the protective environments of their spacecraft, are in much greater danger, of being exposed to dangerous doses of radiation during solar storms. These incoming charged particles set up circulating currents above the Earth's poles, and will interact with atoms and molecules high up in the atmosphere producing beautiful aurora displays in the high latitude regions. The auroras can extend to lower latitudes when the solar storms are especially strong. The charged particles will also heat up the Earth's atmosphere causing it to expand, and this will cause increased drag on orbiting satellites, making those in low-earth orbit especially susceptible. The induced currents high up in the atmosphere will in turn set up magnetic fields which interact with the Earth's magnetic field. The resulting magnetic field variations can extend down to the Earth's surface and produce Geomagnetic Induced Currents (GICs) into the Earth (land and oceans). These currents will preferentially flow in structures of high conductivity such as power lines, oil pipelines, and underwater cables. These GICs can significantly effect power grids causing disruption of power to large populated areas, as a consequence of resulting transformer failures or voltage surges. Such currents flowing in pipelines can cause enhanced corrosion over time.

This seminar will cover the above topics as well as providing a background discussion on the Sun itself. This talk will be supplemented with spectacular images of the Sun captured by instruments on board spacecraft such as SOHO, as well as photographs of beautiful aurora displays taken from the Earth's surface and from the Space Shuttle.

David D. Morabito

David D. Morabito was born in Los Angeles, California. He did his undergraduate and graduate work in Electrical Engineering at the University of Southern California between 1970 and 1979. Since 1973, he has worked at Caltech's Jet Propulsion Laboratory in Pasadena, California, on several engineering and scientific research projects. Among the areas he has worked on are spacecraft navigation, Very Long Baseline Interferometry (VLBI), Radio Science experiments for the Voyager 2, Ulysses, and Galileo spacecraft, antenna performance characterization of beam-waveguide antennas, atmospheric noise effects on spacecraft telecommunication links, and design work on telecommunications systems for future space missions. His most recent project is studying the use of Ka-band (32 GHz) as a telecommunications link frequency for spacecraft communications. He has over seventy publications in several professional journals, and conference proceedings. He is a member of the IEEE, the American Astronomical Society, and the American Geophysical Union.