

ACCELERATION AND EXTREME DISTORTION WITHIN
THE VAN ALLEN RADIATION BELTS DURING THE "HAL-
LOWEEN" SOLAR STORMS OF 2003

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Sunspot group number 484 appeared on the east limb of the Sun's disk on 18 October 2003. As it and concurrent sunspot groups 486 and 488 rotated across the visible solar surface during the subsequent two to three weeks, the Sun produced spectacular enhancements of solar X-rays ('flares'), solar energetic particles, and, ultimately, some of the largest geomagnetic storms on record. The interplanetary shock waves and coronal mass ejections launched by the Sun reached Earth's vicinity in time periods as short as one day. In striking Earth's outer magnetosphere, these high-speed solar disturbances compressed, distorted, and enhanced the Earth's radiation (Van Allen) belts in ways that have not previously been witnessed by in situ measuring devices. We have continuously observed the Van Allen belts for nearly 12 years with the Solar, Anomalous, and Magnetospheric Particle Explorer (SAMPEX) spacecraft. In the SAMPEX lifetime there has not been such an enhancement and significant distortion of the radiation belts as occurred in late 2003. The center of the outer Van Allen belt is usually about 20000 to 25000 km away from Earth's surface (as measured above the equatorial part of the Earth). During the Halloween Storm, the Van Allen radiation belt electron population was powerfully accelerated and was pushed inward toward Earth's surface to a degree not observed before. From November 1 to November 10, the outer belt had its center only about 10000 km from Earth's equatorial surface. This normally is a place where there are almost no energetic electrons at all. Here we show the observational evidence for the powerful and quite profound changes produced in Earth's radiation belts. We also show - through global imaging data - how such changes were related to the highly distorted Earth's plasmaspheric structure. We discuss why these effects persisted for many weeks and months following the geomagnetic storms themselves. We also note the important practical consequences - the "space weather" effects - of such a remarkable solar-terrestrial sequence of events.

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1. (a)

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2. H - Waves in Plasma

3. (a) Radiation Belts

4. I - Invited Paper, Program
chair: G. Ginet, G. Ganguli,
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5. No special instructions