Life Without a Particle Flux Monitor

Predicting IUE Radiation Without Using 1-900 Numbers

Andrew Groebner and Richard Arquilla

Astronomy Programs, Computer Sciences Corporation

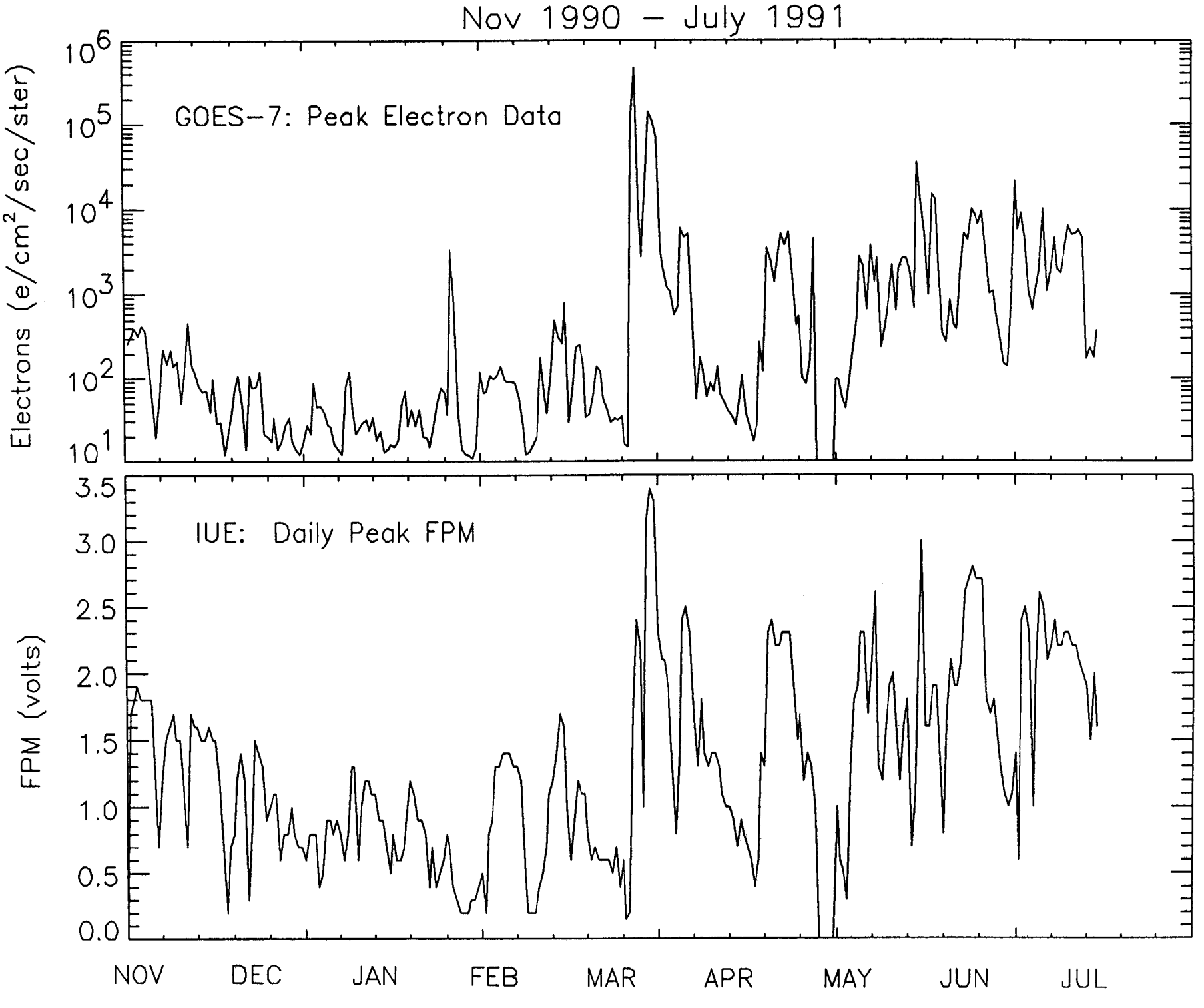
When it reaches perigee, the International Ultraviolet Explorer approaches the outer Van Allen radiation belts. During this passage, the particles trapped in the belts effect normal operations by fogging any exposing camera on board IUE. Since the failure in 1991 of IUE's particle flux monitor(FPM), users have had no real-time knowledge of the level of this radiation. The fogging rate of the cameras can now only be determined after the camera has been read and analyzed. This rate, in DNs per hour, is known to be: $constant \times 10^{FPM}$ where the constant is 1.0 for the SWP and 1.3 for the LWP (high dispersion). Fortunately, today we have a method of forecasting the level of radiation to expect during the US2 shift, when IUE experiences its peak radiation levels.

The Geostationary Orbiting Environmental Satellites (GOES) collect a wide range of particle information, which is available to us through the Space Environment Laboratory Data Acquisition and Display System (SELDADS). This system is operated by the National Oceanic and Atmospheric Administration. The electron fluence data of the GOES-7 satellite has been shown to be a good predictor of IUE's peak radiation.

The GOES-7 electron fluence represents electrons with energies of 2 MeV or greater. The FPM had a threshold of about 960 KeV for electrons. Examination of the electron fluence data readily shows a diurnal pattern, with a peak at about 17:00 UT when the satellite passes between the sun and the earth. Because of IUE's orbit the time of its perigee, and thus its peak radiation, varies throughout the year. But the high radiation values of both satellites are correlated rather well. Data from November 1990 through July of 1991 show the relationship (see attached figure). These are the only months for which both GOES and IUE data are available.

Although the GOES-7 data will provide this valuable information, it does not replace the particle flux monitor. It does not provide information in real-time, as the FPM did. Also, it gives little information on the radiation levels during VILSPA or US1 shifts, when IUE normally experiences little or no radiation. Lastly, even though it gives us a good idea of the peak US2 radiation levels, it is imprecise and doesn't tell us how fast the radiation rises and falls. Even with these shortfalls, its value has been demonstrated many times. When the GOES data is used in combination with FPM radiation charts from previous years and careful daily monitoring of the radiation, we have an effective method of predicting IUE's radiation.

The GOES-7 is primarily used as a weather satellite serving North America. It's images are seen daily as we view our local television weather forecast, and are so crucial for accurate hurricane forecasting as well. In order to better meet these demands, its orbit may soon be changed. A position west of its current orbit would provide better coverage of the Pacific Ocean. It is unknown how this new orbit will affect our ability to use GOES-7 electron flux data as a tool in predicting IUE's radiation.


Nov 1990 – July 1991
GOES–7: Peak Electron Data
Electrons (e/cm²/sec/ster)
10⁶
10⁵
10⁴
10³
10²
10¹
IUE: Daily Peak FPM
FPM (volts)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL