This reprint is intentionally incomplete.

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Astrophysics Noise: A Space Weather Signal

Imagine the accuracy of terrestrial weather forecasts if society relied on only a handful of isolated weather stations to supply all the input to meteorological models. Yet that is precisely the daunting situation faced by space weather forecasters, who seek to predict when and how ejections of plasma from the Sun will interact with the Earth's magnetosphere. These interactions can damage spacecraft electronics, produce spurious global positioning and navigation readings, interfere with radio communications, and disrupt electrical power line grids on the ground. Though modern society increasingly relies on satellite technology and electrical conveniences, only a handful of operating heliophysics missions supply the bulk of space weather model inputs.

Tremendous advances in the ability to anticipate and mitigate treacherous conditions at geosynchronous orbit and other

heavy ions such as carbon (C), oxygen (O), and iron (Fe) in charge states like C^{6+}, O^{7+}, and Fe^{13+}. Ionized close to the Sun, these species maintain their charge states as they flow outward with the solar wind through the solar system. When they encounter high densities of neutral atoms close to comets, the heavy ions undergo charge exchange, basically "stealing" an electron from the cometary neutral atoms. The resulting heavy ions, which now have a charge state lower by one, end up not in the ground state but rather in an excited state. This excited state quickly relaxes, causing the ions to emit soft X-ray photons. Since the original comet Hyakutake observations, scientists have learned that all comets are soft X-ray sources.

With the insight provided by the cometary soft X-ray observations, it is not much of a jump to realize that the same charge exchange process operating at comets must

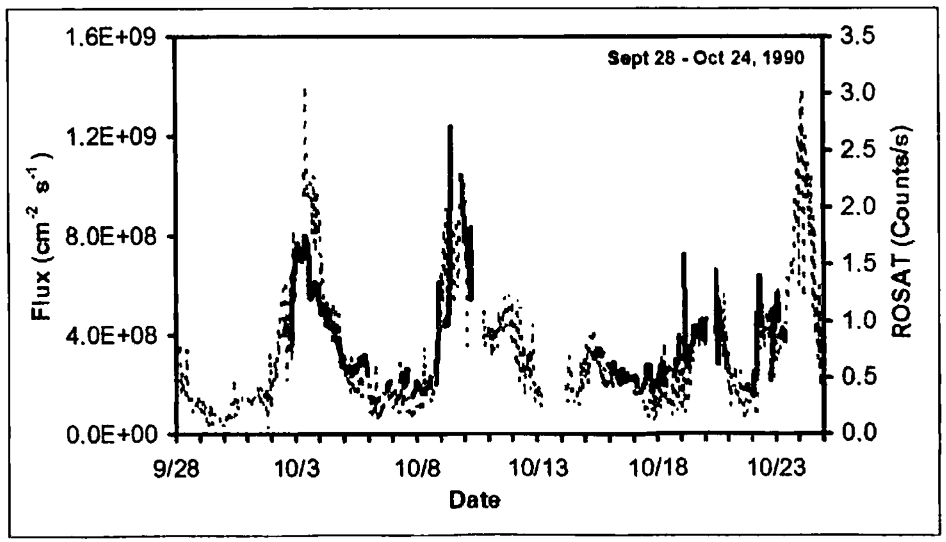

Fig. 1. The correlation between soft X-ray intensities (red dashed curve) and solar wind particle fluxes (blue solid curve) shows that soft X-ray emissions near Earth respond strongly and quickly to changes in the solar wind.