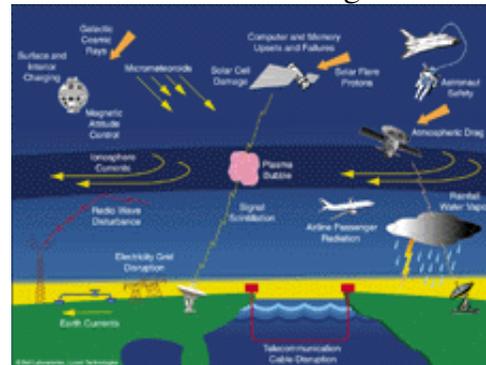


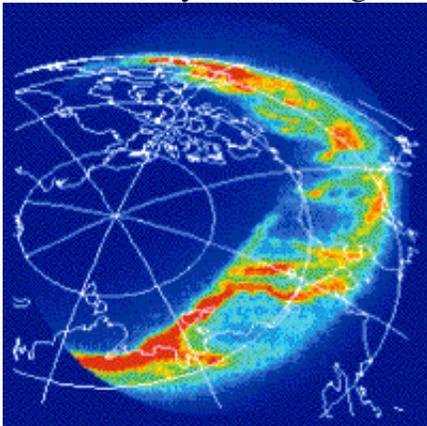
Blackouts, Burnouts, and Bummers

Aside from bright auroras, there are other less benevolent effects of the connection between Sun and Earth. In fact, bright auroras are merely a visible sign that the balance of electrical and magnetic energy in Earth's magnetosphere has been upset. With the average CME dumping about 1500 Gigawatts of electricity into the atmosphere (double the power generating capacity of the entire United States), big changes can occur in our space. Those changes can wreak havoc on a world that has come to depend on satellites, electrical power, and radio communication—all of which are affected by electric and magnetic forces. For the satellites dancing in and out of the radiation belts and the solar wind, CMEs and magnetic storms can be perilous. For instance, a series of flares and coronal mass ejections in March 1989 produced a potent magnetic storm. After the particles and energy from the Sun bombarded the Earth, more than 1500 satellites slowed down or dropped several miles of altitude in their orbits due to increased drag.



[Movie: Formation of Ring Current \(2.4M MPEG\)](#)

But atmospheric drag isn't the only effect CMEs can have on satellites. When excited and accelerated by a storm, high-energy electrons can degrade the solar panels used to power satellites and can upset and even shut off computers on a spacecraft. The increased flow of electricity in Earth's space also can cause electrical charge build up on the surface of a spacecraft. That charge can eventually be released as a damaging spark (a spark not unlike the one you get when you touch metal or a friend after you drag your feet on a carpet). In 1994, two Canadian satellites were shut down when each was electrically shocked during magnetic storms; as a result, telephone service across Canada was disrupted for months. Similarly, in January 1997, an American satellite went dead just hours after a CME struck the magnetosphere. The loss of that satellite disrupted television signals, telephone calls, and part of a U.S. earthquake monitoring network.



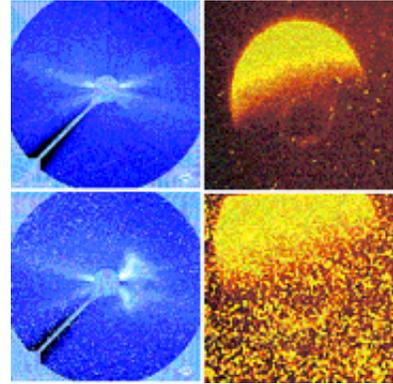
[Movie: UVI Aurora \(2.6M QT\)](#)

Magnetic storms also play havoc with radio signals, which are bounced off Earth's ionosphere (the outermost layer of our atmosphere, made up mostly of plasma) as a sort of natural relay station. In March 1989, listeners in Minnesota reported that they could not hear their local radio stations, but they could hear the broadcasts of the California Highway Patrol. In the extreme, magnetic storms can completely wipe out radio communication around Earth's North and South Poles for hours to days.

On the ground, magnetic storms can affect the strength of Earth's magnetic fields. Changes in magnetic fields can produce surges in power lines and strong electrical currents in gas and oil pipelines. The extra current can cause pipelines to corrode and deteriorate faster than they would naturally; in power lines, the extra electricity can burn out transformers and cause brownouts and blackouts. During the March

1989 storm, a transformer burned up at a power plant in New Jersey, and a whole system was blown out at a power station in Quebec, leaving 6 million people without electricity for hours, some for months. Since so much modern information is relayed by satellites and other advanced technology—from automated teller machines and broadcast signals to the Global Positioning System and disaster warning systems—CMEs pose a natural and technological hazard to life on Earth.

NEXT PANEL: [Make Your Own Sun-Earth Connections](#)



[Movie: Nine Months
of the Corona
\(800K MPEG\)](#)

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