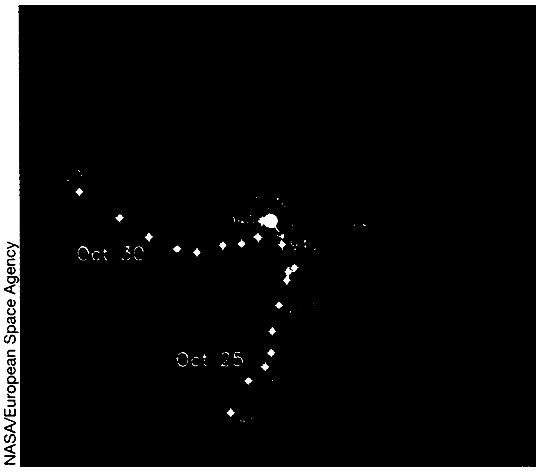
Ulysses pictures the sun's magnetic field



NASA/European Space Agency

Map reveals spiral shape of the sun's interplanetary magnetic field.

Fanning out into interplanetary space like a pinwheel, the magnetic field streaming from the sun's equatorial latitudes has a distinctly spiral pattern. That's the finding of the Ulysses spacecraft, which has taken the first snapshot of this field.

A year ago, from its unique vantage point high above the south pole, Ulysses scanned the sun's equatorial plane as far as Earth's orbit and recorded at radio wavelengths the pinwheel structure predicted by theory. Maryland-based astronomers Michael J. Reiner of the Hughes STX Corp. in Lanham and Joseph Fainberg and Robert G. Stone of NASA's Goddard Space Flight Center in Greenbelt describe the study in the Oct. 20 SCIENCE.

Two properties of the sun conspire to create the pinwheel shape: the billowing solar wind, which carries the sun's magnetic field outward, and the sun's rotation, which winds it up. Other spacecraft had failed to make a full portrait of the interplanetary magnetic field because they took only spot measurements in or near the plane in which Earth orbits the sun.

"What we needed was the equivalent of an aerial photo," says Stone.

Detectors can't image the field directly. But high-speed electrons ejected from the sun's equatorial regions during outbursts trace its structure. These fast electrons move outward along the low-latitude magnetic field lines, causing ionized gas in their path to emit radio waves. Like iron filings sprinkled around a bar magnet, the radio waves reveal the pinwheel pattern of the interplanetary field.

Because the electrons take only about 20 minutes to travel from the sun to Earth's orbit, the radio waves they induce provide a virtually instantaneous snapshot of the field over millions of kilometers.

The interplanetary field doesn't always maintain its spiral shape, Reiner adds. Ulysses found that after particularly violent eruptions, when the sun ejected blobs of gas from its outer atmosphere, the field had a much more distorted, less organized pattern. The ability to detect major solar disturbances by recording the field pattern may ultimately provide a new way for spacecraft to predict geomagnetic storms before they strike Earth, Reiner says.

Ulysses completed its pass over the north pole last summer, and the team plans to use the new data to make additional maps. From its position in the plane of Earth's orbit, another craft, called Wind, provides a simultaneous, though different, perspective on the interplanetary field. Combining the data from each craft, the researchers plan to make the first three-dimensional map of the field.

In related work, scientists reported this week at a Ulysses workshop in Dana Point, Calif., that the interplanetary field appears to be wound more tightly in the sun's southern hemisphere than in the northern. André Balogh of the Imperial College of Science, Technology & Medicine in London and his colleagues base their finding on measurements taken by the craft's magnetometer during the polar passes. *— R. Cowen*

Methyl bromide doesn't stick around

Ozone-depleting chemicals are like strong perfume: The longer they linger in the atmosphere, the more effect they are likely to have.

Methyl bromide, a powerful ozone destroyer, may survive in the atmosphere for less time than previously thought and therefore pose less of a threat to Earth's protective layer, a new study suggests.

Methyl bromide gets into the atmosphere in many ways. Farmers use it as a fumigant to control insects. Marine plants discharge it into the air, as do humans when they burn biomass and leaded gasoline. Once the chemical reaches the stratosphere, sunlight breaks it down, releasing bromine atoms that help destroy stratospheric ozone.

Amendments to the Montreal Protocol, an international ozone-protection treaty, froze methyl bromide production at 1991 levels; the 1990 Clean Air Act amendments require U.S. companies to phase out production by 2001.

Scientists know that chemicals in the troposphere and the ocean break down some methyl bromide, rendering it harmless. They suspect that soil may play the same role.

A new study provides further evidence that bacteria in soil destroy atmospheric methyl bromide—and quickly, at that. Soil's fondness for the chemical reduces methyl bromide's estimated atmospheric lifetime to a little over 9 months, about two-thirds as long as previously thought, report Joanne H. Shorter of Aerodyne Research in Billerica, Mass., and her colleagues in the Oct. 26 NATURE. The Methyl Bromide Global Coalition, a group of agricultural and chemical companies, funded the research.

The new findings also reduce methyl bromide's ozone depletion potential by roughly 30 percent, Shorter and her colleagues assert. That rate of depletion is still high enough to bring it within the scope of regulation by the Montreal Protocol and the Clean Air Act, says coauthor Charles Kolb, also of Aerodyne.

The destruction of methyl bromide by soil throws off some existing calculations of its global atmospheric abundance, says James H. Butler of the National Oceanic and Atmospheric Administration in Boulder, Colo. Previously, global estimates of the emission and absorption of methyl bromide were consistent with measured atmospheric concentrations, he says. But the additional absorption by soil upsets that balance.

The new results, he and the researchers emphasize, are preliminary.

"The problem in this business always is extrapolation," says Butler. The scientists used only a few soil samples to calculate global averages of how much methyl bromide the soil absorbs. However, "the measurements seem reasonably sound," he adds.

The researchers tested in the laboratory and in the field different types of soil from four sites in the United States, Costa Rica, and Canada. They covered the soils with vials, then injected air containing methyl bromide into the vials. All of the surface soils consumed the chemical within minutes; forest soils in the temperate zone acted most rapidly, they report.

By applying antibiotics and fungicides to the soil samples, Shorter and her colleagues concluded that bacteria, not fungi or chemical processes, consumed methyl bromide.

Other researchers tracking the depletion rates of the large quantities of methyl bromide put on fields by farmers had found that soil decomposes the chemical slowly, says Butler. But that's because the fumigant kills the bacteria that would normally eat it, he points out.

Shorter and her colleagues studied lower concentrations of methyl bromide, much closer to typical atmospheric values. *— T. Adler*