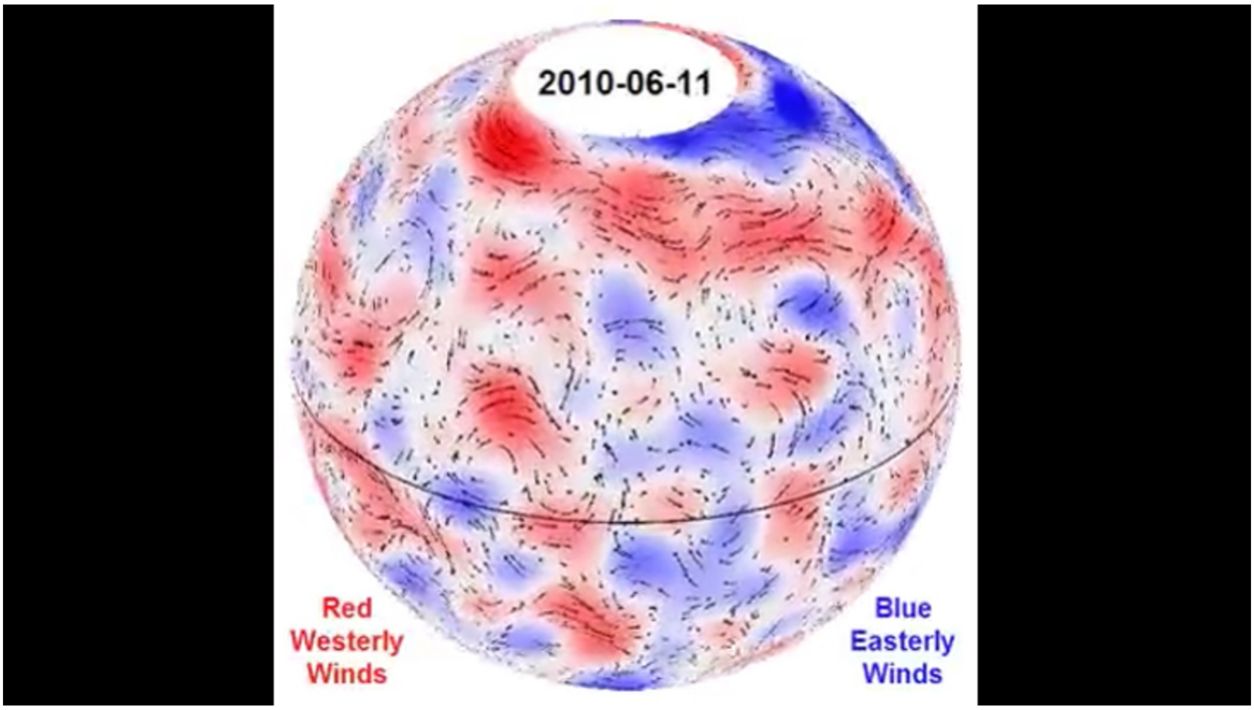
NATURE | NEWS

Probe spots enormous convection currents on the Sun

Slow-moving cells had been hunted for decades.

Alexandra Witze

05 December 2013



Solar physicists are reporting what they call the best evidence yet for long-sought giant 'jet streams' on the Sun's hot surface, some of which would be large enough to span half the distance between the Earth and the Moon. The convection cells are much bigger, and much slower moving, than other structures previously spotted on the Sun.

Data from NASA’s orbiting Solar Dynamics Observatory (SDO) show solar plasma flowing in patterns some 200,000 kilometres across. The giant cells may explain why the Sun rotates about 30% faster near its equator than it does near its poles. Material moving in the direction of rotation tends also to be moving towards the equator, the new study found — helping to transport angular momentum and keeping the Sun spinning more quickly around its midsection.

The flows are likely to be linked to how magnetic fields move within the Sun and how sunspots emerge on its surface, says David Hathaway, a solar physicist at NASA’s Marshall Space Flight Center in Huntsville, Alabama, and a member of the team that observed the new features. That means they could play an important role in solar storms, which can knock out power grids and telecommunications infrastructure on Earth. Hathaway and his colleagues describe the finding today in *Science*[1].

Long predicted

Smaller versions of these cells were first described in 1801 by the astronomer William Herschel. The patterns he saw on the Sun, about 1,000 kilometres across, became known as granules. By the 1960s physicists had discovered ‘supergranules,’ which measure about 30,000 kilometres across. In 1968 researchers predicted the existence of even bigger ‘giant cells,’ roughly 200,000 kilometres across[2].

Several teams have reported finding giant cells before[3], but not definitively. In large part that’s because giant cells move so slowly relative to other solar features. Granules contain solar plasma that races along at 3,000 metres per second, and supergranules move at 300 to 500 metres per second. But in the giant cells, material practically creeps along, at a sluggish 8 metres per second or so.

That slow pace makes it hard to detect giant cells among all the other churning, says team member Lisa Upton, a graduate student at

Vanderbilt University in Nashville, Tennessee.

Hathaway, Upton and summer student Owen Colegrove took advantage of the SDO's constant coverage of the Sun. They tracked the motion of individual supergranules, reasoning these would be carried along on large-scale slow flows. The team spotted long-lived patterns that persisted for as long as six months.

Persisting questions

Mark Miesch, a physicist at the National Center for Atmospheric Research in Boulder, Colorado, says the new study confirms modelling work he and others have done on giant convective cells[4]. There are, however, some differences between what the models suggest and what Hathaway's team observed. For instance, the models indicate that giant cells should align themselves from north to south near the Sun's equator, an arrangement that isn't seen in the new data.

In fact, points out solar physicist Junwei Zhao of Stanford University in California, most of the giant cells were seen at high latitudes, and they need to be spotted at lower latitudes as well. “Whether it will convince the community remains to be seen,” says Zhao.

Nature | doi:10.1038/nature.2013.14312

References

1. Hathaway, D. H., Upton, L. & Colegrove, O. *Science* **342**, 1217–1219 (2013).
2. Simon, G. W. & Weiss, N. O. *Z. Astrophys.* **69**, 435–450 (1968).
3. Beck, J. G., Duvall Jr., T. L. & Scherrer, P. H. *Nature* **394**, 653–655 (1998).
4. Miesch, M. S., Brun, A. S., DeRosa, M. L. & Toomre, J. *Astrophys. J.* **673**, 557–575 (2008).