Earth's Magnetic Field Is Drifting Westward

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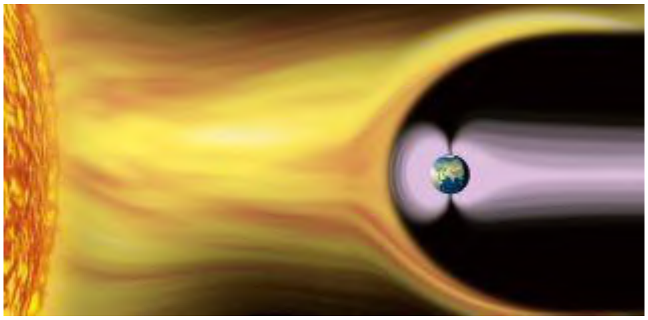

Earth's magnetic field protects us from the solar wind by deflecting the charged particles. And for some reason, the field has been drifting westward. (Image credit: CLAUS LUNAU/Getty)

Over the 400 years or so that humans have been measuring Earth's magnetic field, it has drifted inexorably to the west. Now, a new hypothesis suggests that weird waves in Earth's outer core may cause this drift.

The slow waves, called Rossby waves, arise in rotating fluids. They're also known as "planetary waves," and they're found in many large, rotating bodies, including on Earth in the oceans and atmosphere and on Jupiter and the sun. [6 Visions of Earth's Core]

Earth's outer core is also a rotating fluid, meaning Rossby waves circulate in the core, too. Whereas oceanic and atmospheric Rossby waves have crests that move westward against Earth's eastward rotation, Rossby waves in the core are "a bit like turning atmospheric Rossby waves inside out," said O.P. Bardsley, a doctoral student at the University of Cambridge in England, and the author of a new study on the Rossby wave hypothesis. Their crests always move east.

Rotational forces

The rotation of magnetic iron in Earth's core gives rise to the planet's geomagnetic field. The geomagnetic field, in turn, protects the planet from solar radiation, making it important for life on Earth. Without it, the planet's surface would be bombarded by charged particles streaming from the sun that would ultimately rip away Earth's atmosphere.

While trying to understand the waves that propagate throughout Earth's core, Bardsley realized that some of these waves might explain one of the mysteries of the planet's magnetic field. Over the past four centuries, scientists have made measurements of magnetic declination — the difference between true north and the point where a compass needle points. (Because the magnetic field is chock-full of little local anomalies, the compass needle moves around a little compared to true north depending on where you're standing.)

Throughout those four centuries, the anomalies revealed by these declination measurements have shown a tendency to move westward, Bardsley reported in the new research, which was published today (May 15) in the journal Proceedings of the Royal Society A.

"The westward drift manifests itself primarily as a series of blobs over the Atlantic near the equator," Bardsley told Live Science, and they drift at around 10.5 miles (17 kilometers) per year.

East and west

Theories to explain the drift have typically focused on the dynamics of the outer core. The most popular hypothesis, Bardsley said, is that the outer core contains a gyre similar to the atmosphere's jet stream, which happens to be moving westward and is dragging Earth's magnetic field along with it. The problem, Bardsley said, is that there's no particular reason why this gyre should exist. It might very well exist, he said, but given that there is no direct evidence, other explanations are still possible.

One possibility, Bardsley said, is that Rossby waves explain the weirdness of the magnetic field on Earth's surface. This is a little odd, Bardsley said, because Rossby waves in the core have eastward-moving crests, quite opposite the westward-moving drift. But crests of waves don't always represent their total energy movement.

"It is entirely possible to have a group of waves where the crests themselves are going east but the [bulk of the] energy is going westward," Bardsley said.

Something similar can even happen with water waves. Their crests typically travel in the same direction of the bulk of their energy, Bardsley said, but not necessarily at the same speed.

Surface measurements of the geomagnetic field capture the bulk of energy movement, Bardsley said, but not all the wiggly little details. So Rossby waves with a large-scale tendency to move energy westward could explain the westward drift measured over the Atlantic Ocean. The small-scale details, like those eastward-moving crests, would be impossible to detect.

The westward drift and the Rossby wave hypothesis are largely unrelated to a more famous question regarding the magnetic field: Is it going to flip? Periodically throughout Earth's history, magnetic north and magnetic south have swapped places. This isn't particularly problematic, except that it takes about 10,000 years, Bardsley said, and the process causes an uptick in anomalies and a weakening of the magnetic field in between the poles.

A weakened field can let more solar particles through, which can disrupt electric grids and cause problems with navigational systems. However, scientists aren't certain whether the weakening of the magnetic field over the past century or two is a sign of an impending flip-flop or merely a recoverable wobble.

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