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  - Station & Shuttle
  - Solar System
  - Universe
  - Aeronautics
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- Media Resources
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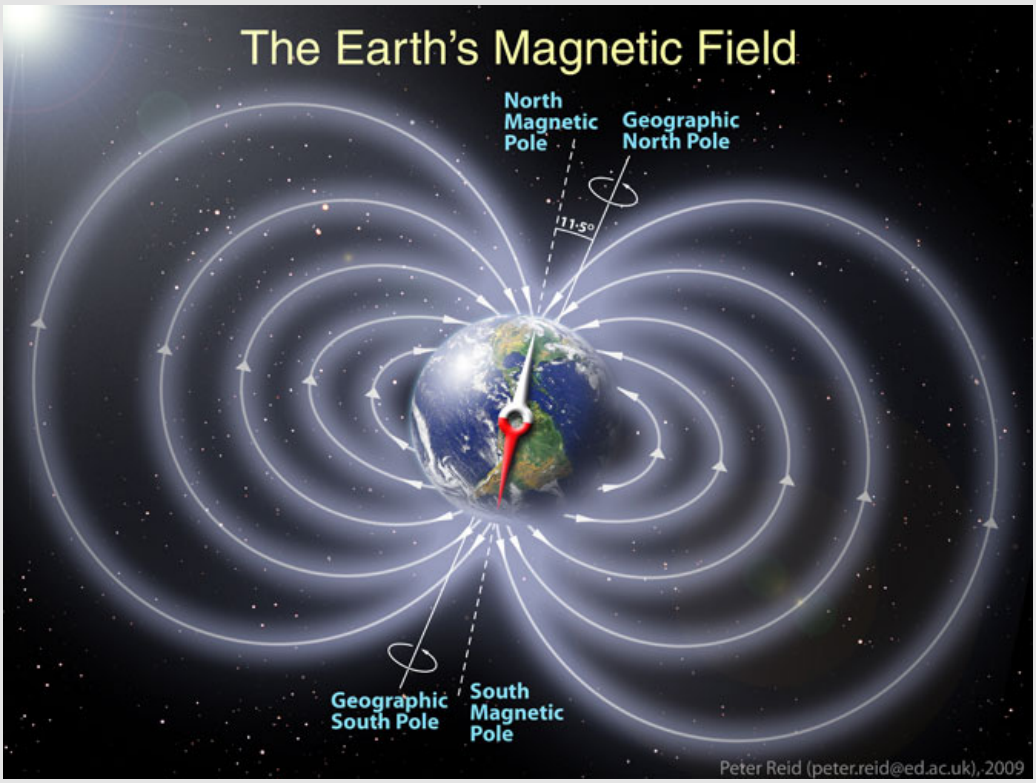
2012: Magnetic Pole Reversal Happens All The (Geologic) Time **11.30.11**



Schematic illustration of Earth's magnetic field. Credit/Copyright: Peter Reid, The University of Edinburgh

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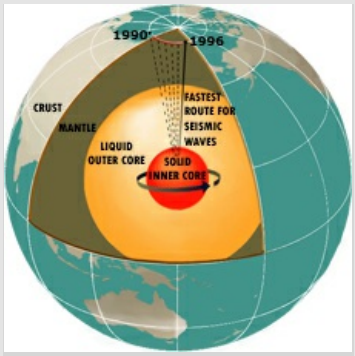
Scientists understand that Earth's magnetic field has flipped its polarity many times over the millennia. In other words, if you were alive about 800,000 years ago, and facing what we call north with a magnetic compass in your hand, the needle would point to 'south.' This is because a magnetic compass is calibrated based on Earth's poles. The N-S markings of a compass would be 180 degrees wrong if the polarity of today's magnetic field were reversed. Many doomsday theorists have tried to take this natural geological occurrence and suggest it could lead to Earth's destruction. But would there be any dramatic effects? The answer, from the geologic and fossil records we have from hundreds of past magnetic polarity reversals, seems to be 'no.'

Reversals are the rule, not the exception. Earth has settled in the last 20 million years into a pattern of a pole reversal about every 200,000 to 300,000 years, although it has been more than twice that long since the last reversal. Areversal happens over hundreds or thousands of years, and it is not exactly a clean back flip. Magnetic fields morph and push and pull at one another, with multiple poles emerging at odd latitudes throughout the process. Scientists estimate reversals have happened at least hundreds of times over the past three billion years. And while reversals have happened more frequently in "recent" years, when dinosaurs walked Earth a reversal was more likely to happen only about every one million years.

Sediment cores taken from deep ocean floors can tell scientists about magnetic polarity shifts, providing a direct link between magnetic field activity and the fossil record. The Earth's magnetic field determines the magnetization of lava as it is laid down on the ocean floor on either side of the Mid-Atlantic Rift where the North American and European continental plates are spreading apart. As the lava solidifies, it creates a record of the orientation of past magnetic fields much like a tape recorder records sound. The last time that Earth's poles flipped in a major reversal was about 780,000 years ago, in what scientists call the Brunhes-Matuyama reversal. The fossil record shows no drastic changes in plant or animal life. Deep ocean sediment cores from this period also indicate no changes in glacial activity, based on the amount of oxygen isotopes in the cores. This is also proof that a polarity reversal would not affect the rotation axis of Earth, as the planet's rotation axis tilt has a significant effect on climate and glaciation and any change would be evident in the glacial record.

Earth's polarity is not a constant. Unlike a classic bar magnet, or the decorative magnets on your refrigerator, the matter governing Earth's magnetic field moves around. Geophysicists are pretty sure that the reason Earth has a magnetic field is because its solid iron core is surrounded by a fluid ocean of hot, liquid metal. This process can also be modeled with supercomputers. Ours is, without hyperbole, a dynamic planet. The flow of liquid iron in Earth's core creates electric currents, which in turn create the magnetic field. So while parts of Earth's outer core are too deep for scientists to measure directly, we can infer movement in the core by observing changes in the magnetic field. The magnetic north pole has been creeping northward – by more than 600 miles (1,100 km) – since the early 19th century, when explorers first located it precisely. It is moving faster now, actually, as scientists estimate the pole is migrating northward about 40 miles per year, as opposed to about 10 miles per year in the early 20th century.



Aschematic diagram of Earth's interior and the movement of magnetic north from 1900 to 1996. The outer core is the source of the geomagnetic field. Graphic Credit: Dixon Rohr
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Another doomsday hypothesis about a geomagnetic flip plays up fears about incoming solar activity. This suggestion mistakenly assumes that a pole reversal would momentarily leave Earth without the magnetic field that protects us from solar flares and coronal mass ejections from the sun. But, while Earth's magnetic field can indeed weaken and strengthen over time, there is no indication that it has ever disappeared completely. A weaker field would certainly lead to a small increase in solar radiation on Earth – as well as a beautiful display of aurora at lower latitudes -- but nothing deadly. Moreover, even with a weakened magnetic field, Earth's thick atmosphere also offers protection against the sun's incoming particles.

The science shows that magnetic pole reversal is – in terms of geologic time scales – a common occurrence that happens gradually over millennia. While the conditions that cause polarity reversals are not entirely predictable – the north pole's movement could subtly change direction, for instance – there is nothing in the millions of years of geologic record to suggest that any of the 2012 doomsday scenarios connected to a pole reversal should be taken seriously. A reversal might, however, be good business for magnetic compass manufacturers.

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Patrick Lynch
NASA's Goddard Space Flight Center

› Back To Top

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- About Langley
- Doing Business With Us
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  - Exploration
  - Science
  - Aeronautics
  - Technical Reports
- Langley History
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Earth and Sun

Thousand-fold Rise in Polar Flights Hikes Radiation Risk

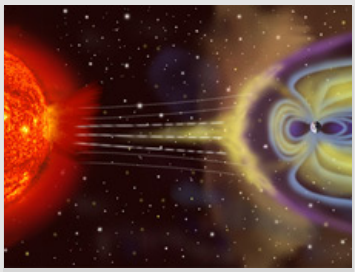
02.18.11

If NASA's Chris Mertens has his way, weather forecasts and airplane cockpits of the future will include measurements of hazardous radiation in the atmosphere.

Mertens, a senior scientist at NASA's Langley Research Center in Hampton, Va., is developing a system to predict radiation entering Earth's atmosphere from space. The goal is to provide high-flying commercial airline passengers and crew with real-time information about the radiation they will be exposed to in flight.

"Aviation occupational radiation exposure currently is not monitored, measured and quantified," says Mertens. "This will be the first model of its type to do that."

Exposure to radiation has been shown to increase health risk, according to numerous studies. Space radiation on the ground is very low, but increases significantly with altitude. At 30,000 to 40,000 feet, the typical altitude of a jetliner, exposure on a typical flight is still considered safe – less than a chest X-ray.



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This artist concept shows the interaction between the sun and Earth's magnetosphere. The magnetosphere deflects most solar and cosmic radiation, but lets more in at the poles. Credit: NASA

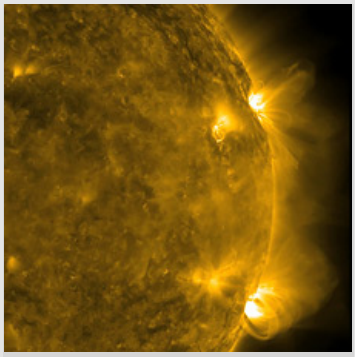
Exposure is considerably higher, however, over the Earth's poles, where the planet's magnetic field no longer provides any shielding. And with a thousand-fold rise in commercial airline flights over the North Pole in the last 10 years, exposure to radiation has become a serious concern.

Radiation constantly bombards the Earth, from the sun and in the form of cosmic background radiation from the universe at large. A magnetic field originating deep within the planet surrounds the Earth, deflecting much of the radiation. At the poles, however, radiation has an opening to the planet's atmosphere. People on the ground are safe from this radiation, but are subject to more hazardous levels at the altitude where jets fly.

A study by Mertens of polar flights during a solar storm in 2003 showed that passengers received about 12 percent of the annual radiation limit recommended by the International Committee on Radiological Protection. The exposures were greater than on typical flights at lower latitudes, and confirmed concerns about commercial flights using polar routes.

While the flights studied appear to have not put passengers in danger of exceeding the safe radiation limit on an individual flight, concerns remain, Mertens said. Many workers whose jobs expose them to consistent radiation sources log that exposure to keep a record over one's career. This is not the case for commercial aircrew, which receive the highest radiation levels of any occupationally exposed group.

People who work on commercial airline flights are technically listed as "radiation workers" by the federal government – a classification that includes nuclear plant workers and X-ray technicians. But unlike some others in that category, flight crews do not quantify the radiation they are exposed to.



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The new solar cycle is ramping up. This image from NASA's Solar Dynamics Observatory shows the sun emitting its first X-class flare in more than four years Feb. 14, 2011. X-class flares are the most powerful of all solar events and can trigger radio blackouts and long-lasting radiation storms. This particular flare comes on the heels of a several other recent flares. Credit: NASA/Goddard Space Flight Center

Polar Routes

Airlines save huge amounts of fuel by flying "over the top" routes because they are the shortest way between certain points, such as North America and Asia. Not only are they shorter, they pass through weaker headwinds, saving even more fuel.

Since 1999, the number of flights over the North Pole from the U.S. has risen from around a handful of demo flights to more than 5,000 a year and growing.

While one or two flights will not exposure passengers and crew to lethal doses of radiation, multiple flights definitely pose an additional health risk, Mertens says.

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Northern Lights above Bear Lake, Alaska. The lights, or aurora borealis

Alaska. The lights, or aurora borealis, are created by solar radiation entering the atmosphere at the magnetic poles. Credit: U.S. Air Force, Senior Airman Joshua Strang

"The average commercial airline pilot receives more radiation exposure than a fuel-cycle worker in a nuclear power plant," he says.

Prediction will be especially critical during solar events that cause large spikes in the amount of radiation entering through the poles. The recommended annual limit can be exceeded in just one high-latitude flight.

"That's the sort of Holy Grail of space weather, to predict these events," Mertens said, "but right now it's not there."

Being able to measure, monitor, and predict that exposure with precision and real-time immediacy is the primary goal of Merten's Nowcast of Atmospheric Ionizing Radiation for Aviation Safety (NAIRAS) project.

Toward that end, Mertens and his colleagues are collaborating with the National Oceanic and Atmospheric Administration (NOAA) and the National Institute of Occupational Safety and Health (NIOSH).

NIOSH is conducting studies to understand radiation effects on pilots and crew. NOAA's Space Weather Prediction Center is working with Mertens to put radiation predictions into National Weather Service forecasts.

"They're the only provider of space weather prediction services, so they're really interested in this," said Mertens.

A prototype is already online at **Cosmic Radiation Monitor**.

Wandering poles

Earth's drifting magnetic poles are another cause for concern. Contrary to popular belief, magnetic north is not at the North Pole - that's true north. Currently, magnetic north is hundreds of miles south, in the Canadian Arctic, moving toward Siberia at about 40 miles per year.

"The more it drops southward, the more radiation exposure we're going to have, especially during solar radiation storms events," says Mertens.

For More Information:

- Cosmic Radiation Monitor
- Advanced Satellite Aviation Weather Products

If magnetic north winds up in an area with lots of air traffic, health risks due to radiation exposure will be significantly higher, and likely will require additional monitoring of flight schedules to keep individual exposure within recommended limits.

Finally, says Mertens, we are emerging from a period of low solar activity, and as solar activity increases - and it recently has – the probability for high level solar radiation storms will rise.

Michael Finneran
NASA Langley Research Center

› Back To Top

Comments

Name: Guest

Comment:

Keep comments relevant. Inappropriate or offensive comments may be edited and/or deleted. Line breaks and paragraphs are automatically converted - no need to use <p> or
. Quotes, apostrophes, and double-dashes are automatically converted to smart punctuation. Be careful when copying and pasting portions of entries or other comments.

> We Got Rules, People

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On Mar 10, 2012 4:17 PM **Antonio Neumann** wrote: +1

As a Airline Captain for many years I realize that crew are not treated as the rest of the human race perhaps due to a lobby buy industries of airplanes which do not want to tell airlines about the dangers of polar routes. The airlines as well save money on the polar routes and are not interested on the effects of radiation on the crew and say there is little or none radiation effect to crew so a group of people who transport the world is used as a part that can be disposed after being sick due radiation.
Civil aviation authorities around the world with little exceptions,
impose the need for regular measuring of radiation exposure, they acknowledge the need for regulations but do not impose the airlines to do so. It is a petty that a class that works so hard for the benefit of the world is so neglected by governments that discriminate against them.
As a cry in the dark this is a captain that has been flying for 43 years and has never been measured for radiation.

On Nov 6, 2011 6:00 PM **Guest** wrote: 0

What is the probability of the flight crew being exposed to so much radiation, that their thinking gets muddled ? What are the current airline pilot checks on this, if any ?

From:

http://www.nasa.gov/topics/earth/features/2012-poleReversal.html

and

http://www.nasa.gov/centers/langley/science/polar-radiation.html