Magnetic North is on the Move!! (and why we shouldn't worry)

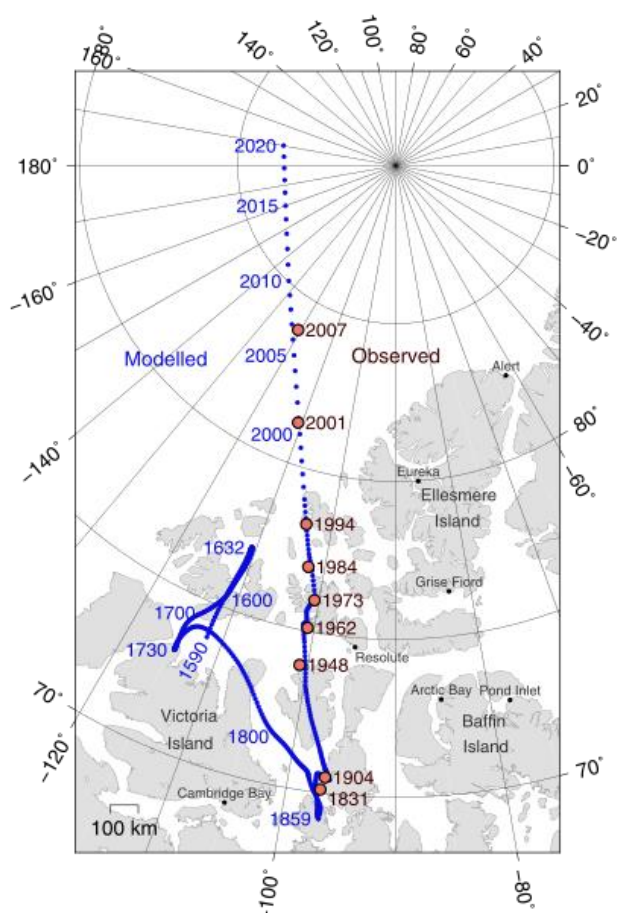
By Kevin Monahan

February 2019

Recently the news media has been full of alarming reports that the Earth's magnetic field is rapidly changing. Some suggest that this is the precursor to a complete reversal of the magnetic poles, during which the Earth's magnetic field will collapse entirely, thus exposing us (or at least our electronics-dependent civilization) to the harmful effects of unfiltered solar radiation. Doomsday rumours are in high gear.

So what do we know for sure?

We know that the Earth's magnetic field is generated by currents in the Earth's liquid iron outer core. This activity takes place at least 1800 miles (2,890 km) beneath our feet, so it is not surprising that our understanding of these processes is poor. But we can observe the effects.



Movement of the north magnetic pole.

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It is true that the magnetic north pole is currently moving faster than at any time since it was first located on the Boothia Peninsula in 1831. At this time the north magnetic pole is moving towards Siberia at a rate of almost 40 miles per year. However it is also true that the north magnetic pole had been wandering significantly before that. NOAA has estimated the position of the north magnetic pole from 1590 to 1831 based on historical measurements of magnetic variation (known as magnetic declination in the US). These measurements reveal a north magnetic pole that is always in motion. To view a map of magnetic declination worldwide visit https://www.ncei.noaa.gov/products/world-magnetic-model

By studying the magnetic signature of ancient rocks, scientists have learned that there have been 183 reversals of the magnetic field in the last 83 million years, separated by periods of stability. Some periods of stability have lasted over 10 million years, while others are much shorter lived. The current stable period has lasted 780-thousand years.

More common than full reversals are geomagnetic excursions, during which the poles may wander up to 45° accompanied by a reduction in the intensity of the field. The frequency and duration of reversal periods, excursions and periods of stability between reversals is completely random.

The most recent excursion, occurred 41,000 years ago and lasted about 440 years. It resulted in a near complete reversal of the magnetic field that lasted about 250 years.

We know that the transition period for a reversal can last hundreds to thousands of years. During this period the magnetic field does not disappear though it may weaken. But we also know that on any day the actual location of the north magnetic pole varies by up to 50 miles (80 km) from its average annual position.

It is also true that the north magnetic pole and the south magnetic pole move independently of each other. They are never at exactly opposite points (antipodal points) on the surface of the Earth. Currently the north magnetic pole is only 4° away from the north geographic pole, whereas the south magnetic pole is more than 25° degrees away from the south pole and has not moved in recent years at anywhere near the speed of the north magnetic pole.

To summarize, we know that the magnetic poles wander regularly and erratically. We have no way of knowing if the current movement is part of the normal wandering of the pole or if we are in the middle of an excursion, or a reversal. In fact some scientists are convinced that there is no reversal in progress and that the magnetic pole will stabilize again fairly soon. However we do know that even if we are in the middle of a major event, these events take hundreds if not thousands of years to complete and in any case, there is nothing new in the movement of the magnetic poles.

The United States and the United Kingdom have teamed up to produce the World Magnetic Model—the standard model used by all NATO countries and the International Hydrographic Organization (IHO) for magnetic compass navigation. Normally the WMM is updated every 5 years, but the rapid changes that are currently taking place have caused the WMM to be updated in early 2019—two years ahead of schedule.

On every government chart, there is a compass rose, showing magnetic and true directions. Printed across the middle of the compass rose will be a notation which reads something like this "Var 19°E 2011 (8'W)" which means that the magnetic variation in 2011 was 19° East, but it is decreasing at an annual rate of 8' annually. After 8 years, the total change would have been 64' or approximately 1°, and therefore the variation in 2019 should be approximately 18° East.

But if the variation is changing at an unpredictable rate, then it would behoove us to ensure that our paper charts are up to date and our electronic charts and navigation equipment is fully updated with the latest software.

Though the impact of these changes is greatest in the Arctic, this is also the area in which our magnetic compasses have always been the most unreliable, because the horizontal component of the Earth's magnetic field is weakest. In layman's terms – compass needles want to point straight down at the north magnetic pole, so there is very little horizontal directional force. Most Arctic navigators use gyrocompasses, which read true north instead of magnetic, though even gyrocompasses can become confused when they are extremely close to the north pole.

In more temperate latitudes, you may not notice any effect on your magnetic or flux-gate compass, especially if you have downloaded all the latest software updates. Most boaters are not able to steer within 1° or 2° with or without an autopilot, and consequently this whole issue may be a tempest in a teapot. But it has made many boaters (and manufacturers) consider other means of providing direction and heading data to their navigation and autopilot systems.

Historically there have been only two ways to provide digital compass data to a navigation system.

Flux-gate compasses contain electronic components which directly read the direction of the Earth’s magnetic field in their vicinity. They appear to be very different from a conventional magnetic compass, being nothing more than a small box with power and data connections, but they are still magnetic compasses and are therefore subject to magnetic declination errors.

Gyrocompasses use a high speed rotating disc which provides the directional stability necessary to find true north, but this is not a practical solution for small vessels due to their high cost.

In the last couple of years a new option has emerged—the satellite compass. These compasses can read the signals from American GPS satellites, Russian GLONASS and European Galileo satellites. They are equipped with two or more separate antennas in a single housing, which allows them to calculate the direction of true north with an accuracy of less than one degree. Since they find true north, magnetic variation is irrelevant to them—and to you. Currently available models cost less than $1,000 US.

A Furuno satellite compass antenna. Courtesy Furuno Electric Company

Whether you choose to replace your flux-gate compass or not, boaters should be aware that magnetic variation may now change rapidly and unpredictably. The best way to protect yourself is to ensure you have the latest charts and software and to check your equipment regularly to make sure it is working efficiently. But don’t waste time and energy worrying about a global magnetic reversal or the collapse of the Earth’s magnetic field.

[2025 World Magnetic Model (map)]