The National Geophysical Data Center (NGDC) is a 21st Century Data Center providing scientific stewardship, products, and services which support the research and understanding of space, ocean, and coastal environments. The Data Center continually develops data management programs that reflect the changing world of geophysics. Skilled staff use state of the art technologies and web-based geospatial data services to provide long-term archive, and enable easy discovery of and access to geophysical and environmental data.

NGDC is dedicated to serving the broadest range of user communities with high quality data and products. NGDC manages over 600 types of data ranging from the core of the earth to the surface of the sun.

NGDC operates the World Data Center and supports international data exchange and stewardship.

OUR VISION is to be the world's leading provider of geophysical and environmental data, information and products.

OUR MISSION is to provide long-term scientific data stewardship for the Nation's geophysical data, ensuring quality, integrity, and accessibility.

The Geomagnetism Team at NGDC develops magnetic field models meeting many different requirements. The World Magnetic Model is the standard navigation model representing the Earth's main (core) magnetic field as spherical harmonic coefficients to degree and order 12, or wavelengths of 3200 km. The WMM is updated every 5 years. The Enhanced Magnetic Model represents Earth's crustal and main field to degree and order 720, which equals wavelengths of 56 km. The EMM, also updated every 5 years, supports higher-accuracy navigation requirements. The model best suited for the highest accuracy requirements, such as directional drilling, is the High Definition Geomagnetic Model, a 720 degree elliptical harmonic model updated annually. This model represents the core and crustal magnetic field and includes corrections for external magnetic fields.

NGDC also produces a regular grid of Earth's magnetic field, the EMAG2. This 2-arc minute grid represents Earth's crustal magnetic field in a format easy to use in GIS tools. All of these models and products are described in detail on our web site.

U.S. Department of Commerce
National Oceanic & Atmospheric Administration (NOAA)
National Environmental Satellite, Data & Information Service
National Geophysical Data Center

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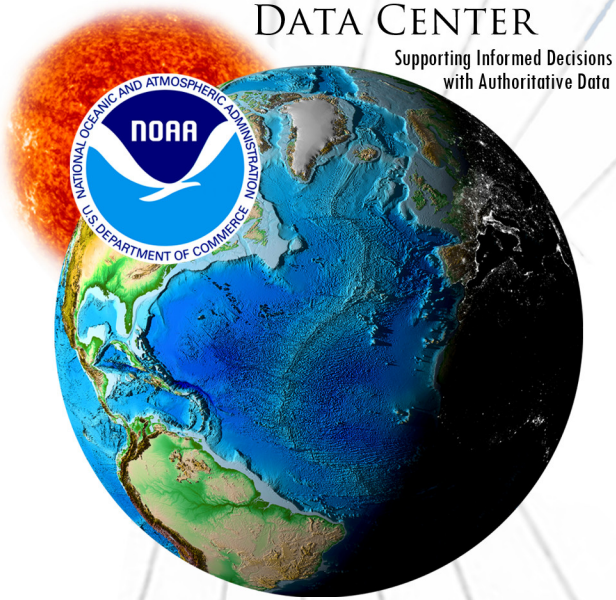
NGDC is located in the David Skaggs Research Center at the base of the Boulder Flatirons.

August 2014

The NOAA National Geophysical Data Center

Supporting Informed Decisions with Authoritative Data



GEOMAGNETISM

Magnetic Modeling & Navigation

NGDC & Geomagnetism

The study of geomagnetism is one of the oldest of the geophysical sciences. Geomagnetic fields have been observed and used from ancient times. Modern uses of geomagnetic data include navigation and mineral exploration. The National Geophysical Data Center develops and distributes models of the geomagnetic field and maintains archives of geomagnetic data to further the understanding of Earth magnetism and the Sun-Earth environment

Integrated databases of surface, ocean, airborne, and satellite measurements are used to create models that depict Earth's magnetic field and its annual change. These data and models are used in many diverse applications, including:

- Navigate on land, sea, and air
- Explore natural resources
- Properly orient satellites in space
- Orient antennas and solar panels
- Survey property boundaries
- Conduct basic research

Magnetism & Migration

Migratory animals are thought to use the geomagnetic field as an important aspect of orienting themselves and navigating to their seasonal homes. Experiments suggest that migratory birds sense subtle changes in the local geomagnetic field and use that to know their location along their route when other landmarks or the sun may be obscured. Some migrating butterflies are known to use the field for a sense of direction. In the ocean, spiny lobsters, dolphins, and whales are also known to use the geomagnetic field to orient themselves for long travels.

Q Does the compass needle point towards the magnetic pole?

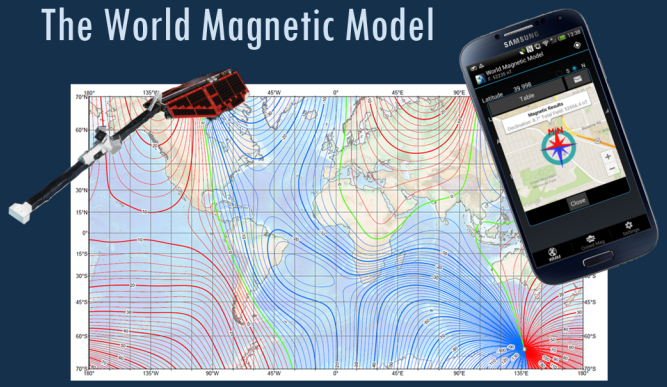
No. The compass points in the direction of the horizontal component of the magnetic field where the compass is located, and not to any single point. Knowing the magnetic declination (the angle between true north and horizontal trace of the magnetic field) for your location allows you to correct your compass for the magnetic field in your area. NGDC has an online magnetic declination calculator where you can enter your location (or zip code for the USA) and get the declination value.

Resource Exploration & Directional Drilling

Directional drillers use the Earth's magnetic Field as a natural reference frame to orient the drill bit kilometers underground. The azimuth of the bottom-hole assembly is inferred by comparing the magnetic field measured while drilling (MWD) with a geomagnetic reference field. Crustal magnetic anomalies constitute a significant source of error in directional drilling if not accounted for in the geomagnetic reference field. To meet increasing demand for accurate geomagnetic referencing, NGDC produces the High Definition Geomagnetic Model (HDGM) which accounts for long-wavelength crustal magnetic anomalies. HDGM significantly reduces geomagnetic referencing errors. Scientists at NGDC use a combination of marine and aeromagetic trackline geophysical data, as well as data from satellites and ground observatories to create an accurate model with global resolution.

Recent surveys about the North Magnetic Pole determined that the Pole is moving approximately north-northwest at 55 km per year.

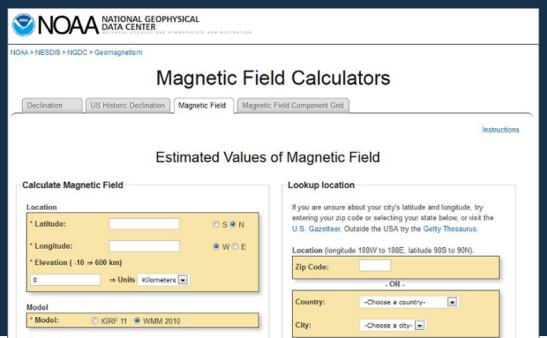
The World Magnetic Model



The World Magnetic Model (WMM) is a joint product of the United States National Geospatial-Intelligence Agency and the United Kingdom's Defense Geographic Centre. The WMM is a data-based, mathematical representation of the Earth's internal magnetic field and its temporal variation down to wavelengths of about 3000km. It is the standard model used by the U.S. Department of Defense, NOAA, the U.K. Ministry of Defense, the North Atlantic Treaty Organization (NATO) and International Hydrographic Organization (IHO), for navigation, orientation, and heading references. It is also widely used throughout the smartphone community by GPS instruments, Web Applications, and heading systems.

Online Calculators + X / ÷

NGDC has created a variety of online calculators that accurately provide a variety of real-time geomagnetic values. These applications include a Declination calculator, Magnetic Field calculator, the U.S. Historic Declination calculator, and CrowdMag (a cell phone app developed at NGDC). All values are calculated from geomagnetic models such as the World Magnetic Model (WMM) or the International Geomagnetic Reference Field (IGRF). The IGRF is derived by an international group of scientists, including NGDC scientists, under the auspices of the International Association of Geomagnetism and Aeronomy (IAGA).



Wandering Geomagnetic poles

The Earth's magnetic field has been slowly changing throughout its existence. When tectonic plates form along oceanic ridges, the magnetic field is imprinted on the rock as it cools below about 700°C. The slowly moving plates act as a kind of tape recorder, marking information about the strength and direction of past magnetic fields. By sampling these rocks and using radiometric dating techniques it as been possible to reconstruct the history of the Earth's magnetic field for the last 160 million years. If one "plays the tape backwards" the record shows the Earth's magnetic field strengthening, weakening, and often changing polarity (reversing North and South magnetic Poles).