DOWNLOAD PDF IAGA GUIDE FOR MAGNETIC REPEAT STATION SURVEYS

Chapter 1 : IAGA Guides - IAGA

This Guide provides a comprehensive description of the theoretical basis, operational details, and instrumentation for making magnetic repeat station survey measurements. 4. IAGA Guide for Calibrating a Compass Swing Base.

Electrical currents flowing in the slowly moving molten iron generate the magnetic field. The geomagnetic field varies on a range of scales and a description of these variations is now made, in the order low frequency to high frequency variations, in both the space and time domains. First of all, however, methods of observing the magnetic field are described. Declination, inclination and total intensity can be computed from the orthogonal components using the equations where H is given by. The International System of Units SI unit of magnetic field intensity, strictly flux density, most commonly used in geomagnetism is the Tesla. Back to the top of the page 2. The site of the observatory must be magnetically clean and remain so for the foreseeable future. The earliest magnetic observatories where continuous vector observations were made began operation in the s. There are two main categories of instruments at an observatory. The first category comprises variometers which make continuous measurements of elements of the geomagnetic field vector but in arbitrary units, for example millimetres of photographic paper in the case of photographic systems or electrical voltage in the case of fluxgates. A fluxgate sensor comprises a core of easily saturable material with high permeability. Around the core there are two windings: If an alternating current is fed into the excitation coil so that saturation occurs and if there is a component of the external magnetic field along the fluxgate element, the pick-up coil outputs a signal not only with the excitation frequency but also other harmonics related to the intensity of the external field component. Both analogue and digital variometers require temperature-controlled environments and installation on extremely stable platforms though some modern systems are suspended and therefore compensate for platform tilt. Even with these precautions they can still be subject to drift. They operate with minimal manual intervention and the resulting data are not absolute. The second category comprises absolute instruments which can make measurements of the magnetic field in terms of absolute physical basic units or universal physical constants. The most common types of absolute instrument are the fluxgate theodolite for measuring D and I and the proton precession magnetometer for measuring F. In the former the basic unit is an angle. The fluxgate sensor mounted on the telescope of a non-magnetic theodolite is used to detect when it is perpendicular to the magnetic field vector. Collimation errors between the fluxgate sensor and the optical axis of the theodolite and within the theodolite are minimised by taking readings from four telescope positions. With the fluxgate sensor operating in null-field mode the stability and sensitivity of the sensor and its electronics are maximised. True north is determined by reference to a fixed mark of known azimuth. This can be determined astronomically or by using a gyro attachment. In a proton precession magnetometer the universal physical constant is the gyromagnetic ratio of the proton and the basic unit is time frequency. Measurements with a fluxgate theodolite can only be made manually whilst a proton magnetometer can operate automatically. The locations of currently operating magnetic observatories are shown in Figure 1. It can be seen that the spatial distribution of the observatories is rather uneven, with a concentration in Europe and a dearth elsewhere in the world, particularly in the ocean areas. Locations of currently operating geomagnetic observatories Back to the top of the page 2. The first satellites measured only the strength of the magnetic field, sometimes using only a non-absolute instrument, but latterly there have been a number of satellite missions measuring the full field vector, using star cameras to establish the direction of a triaxial fluxgate sensor. An absolute intensity instrument is normally also carried and both magnetic instruments are kept remote from the main body of the satellite by mounting them at the end of a non-magnetic boom. Satellites provide an excellent global distribution of data but generally only last for a short period of time, i. The Swarm mission comprises 3 identical satellites. Two of the Swarm satellites fly side by side at altitudes late of about km and the third is at an altitude of about km. The sampling rate of local times between the lower and upper satellites differs slightly. The upper satellite provides a simultaneous measurement at a different location. This is important for identifying magnetic fields generated by the magnetosphere and ionosphere. These are repeat stations and surveys made on land, from aircraft and ships. Their main purpose is to track changes in the core-generated magnetic field. Most aeromagnetic surveys are designed to map the crustal field. As a result they are flown at altitudes lower than m, they cover small areas, generally once only, with very high spatial resolution. Because of the difficulty in making accurately oriented measurements of the magnetic field on a moving platform, these kinds of aeromagnetic surveys generally comprise total intensity data only. However, between and the Project MAGNET programme collected high-level three-component aeromagnetic data specifically for modelling the core-generated field. The surveys were mainly over the ocean areas of the Earth, at mid to low latitudes. Modern marine magnetic surveys are also invariably designed to map the crustal field but with careful processing it is possible to obtain information about the core-generated field from the data. In a marine magnetic survey a scalar magnetometer is towed some distance behind a ship, usually along with other geophysical equipment, as it makes either a systematic survey of an area or traverses an ocean. Magnetic observations prior to the establishment of observatories and an absolute method of measuring magnetic intensity by Gauss in the s were made, amongst others, by mariners engaged in merchant and naval shipping. These are mainly of declination and extend the global historic dataset back to the beginning of the 17th century. The subject of rock magnetism and palaeomagnetism is outwith the scope of this article. From careful analyses of directions and intensities of rock magnetisation from many sites around the world it has been established that the polarity of the axial dipole has changed many times in the past, with each polarity interval lasting several thousand years. These reversals occur slowly and irregularly, and for a period of about 30 million years around about million years before present, there were no reversals at all. The solid inner metal core is thought to play an important role in inhibiting reversals. Whether this is a sign of an imminent reversal is difficult to say. Back to the top of the page 3. There are internal or external coefficients, modelling the field generated inside or outside the Earth respectively. A separation of the core and crustal fields, both internal, is not perfect. The internal field is often called the main field. The main-field coefficients change with time as the core-generated field changes, and in commonly used spherical harmonic models, for example the International Geomagnetic Reference Field IGRF and the World Magnetic Model, this secular variation is assumed to be constant over 5-year intervals. It has only been possible to accurately determine the small but persistent field generated outside the Earth, largely by the ring current, since satellite data have become available. However, significant deviations from a dipole field exist. Figures show maps of declination, inclination, horizontal intensity, vertical intensity and total intensity at Map of declination degrees East or West of true north at Map of inclination angle in degrees up or down that magnetic field vector is from the horizontal at Map of horizontal intensity at Map of predicted annual rate of change of horizontal intensity for Map of vertical intensity at Map of predicted annual rate of change of vertical intensity for Map of total intensity at Map of predicted annual rate of change of total intensity for This is particularly apparent in the Atlantic hemisphere at mid- and equatorial latitudes. This may be related to the motion of fluid at the core surface slowly westwards, dragging with it the magnetic field. It can be seen from this plot that there have been a number of changes in the general trend of secular variation in the past, in particular at about , , and These sudden changes are known as jerks or impulses and, at the present time, are not well understood and are certainly not predictable. Some researchers have found evidence for a correlation with length-of-day changes. A knowledge of the crustal magnetic field is often very valuable as a geophysical exploration tool for determining the local geology. The anomalies seen at mid-ocean spreading ridges are of particular interest. At these locations molten mantle comes to the surface and solidifies to form new oceanic crust, preserving in it the strength and direction of the contemporary ambient magnetic field. As new material is extruded, the existing crust is pushed away on either side of the ridge, with the direction of the ambient magnetic field at time of formation frozen into it. Marine and aeromagnetic surveys reveal a series of stripes in the total intensity anomalies which run parallel to and symmetrically about the central ridge and these are interpreted as alternating blocks of normal and reversely magnetised oceanic crust. This variation is easiest to observe during periods of low solar activity when large irregular disturbances are less frequent see section 3. For this reason it is often referred to as the Solar quiet or Sq variation. Figure 13 shows the actual variation in declination recorded at Hartland observatory on June 22nd, This graph is typical of the smooth Sq variation seen at this latitude. Below this is the variation in a compass needle at Hartland over the same period. In reality, this type of variation in the geomagnetic field would affect the direction of a compass needle by no more than a few tenths of a degree. Inclination varies by less than a tenth of a degree and the total intensity of the magnetic field is perturbed by only a few tens of nT, which represents about 0. Recorded daily variation in declination over one day at Hartland observatory top and effect of these variations on a compass needle, exaggerated bottom This regular fluctuation is caused by electrical currents high in the ionosphere, a region above about km altitude. All currents, like those in wires, can only flow in materials that conduct. The copper used in wires conducts very well but the air is a poor conductor. These charges allow the air to conduct. At any point on Earth, the Sun is at its most intense around midday and is therefore generating the most charges in the ionosphere overhead, which allows the air to conduct better. After dusk, in the absence of ionising radiation, the charges begin to recombine into neutral molecules again and so the ability for the air to conduct is reduced. This cycle is repeated each day. Effect of solar ultra-violet and X-ray radiation on ionospheric conductivity throughout the day The sunlight not only makes the air conduct, it also heats it causing winds. These winds combine with the tidal winds caused by the gravitational pull of the Sun and Moon and the resulting thermo-tidal winds drive the ionospheric dynamo. These current systems form two closed loops: Because it is solar radiation that produces the charges that in turn let the atmosphere conduct, the currents remain predominantly on the sunlit side of the Earth. It is these currents that produce the daily magnetic field fluctuations as the Earth rotates beneath, which explains why the magnetic field varies throughout the day. The shape, size and location of these vortices also explain why the Sq variation depends on latitude.

DOWNLOAD PDF IAGA GUIDE FOR MAGNETIC REPEAT STATION SURVEYS

Chapter 2 : IAGA Division V | International Union of Geodesy and Geophysics

IAGA Guide for Magnetic Repeat Station Surveys - Read more about magnetic, observations, reference, observatory, variometer and survey.

The WG sets quality standards for measurements and for data processing, and supports observatories in need of modern instrumentation or those in danger of closure. What is an observatory? Globally, geomagnetic observatories form a network of ground-based stations that continually monitor the natural magnetic field over long periods of time. The aim of each observatory is to capture the absolute magnetic field vector at a fixed location, typically for many years, and to publish data to the wider community. Due to the wide amplitude and frequency ranges of the field sources monitored by observatories, highly sensitive and stable instruments are operated in an environment free from artificial magnetic disturbance and measurements are made to documented metrological standards, such as those defined by INTERMAGNET under the V-OBS Working Group. In addition to derived data products e. In order to comply with international standards IAGA adopts the new value to replace the value adopted in for geomagnetic measurements from on. Observatories and instrument manufacturers should implement the new value as soon as possible. The difference between the old and new constants, however, amounts to only 15 pT in 50 nT and thus is within the noise level of most of the present day observatory measurements, therefore it can be safely adopted without problem even if immediate implementation by all observatories at the same time cannot be guaranteed. Vol 80, , DOI: Rasson ed , Publication scientifique et technique No , Proceedings of the IV? Proceedings of the III? List of observatories held as a Google Fusion table. The presence of annual means at a WDC is used to determine observatory status. Observatories marked as "Uncertain" may be variometer stations, or their status is genuinely not known by IAGA. Please send updates to Susan Macmillan. Map of observatories Map of observatories from data held as a Google Fusion table. Click on symbol to get more information. Obtaining an IAGA code Before or soon after the observatory becomes operational, the contact person at the operating institute should suggest a suitable 3-letter code that is not already in use and send a request to WG V-OBS chair and co-chair that it be reserved. See this table for a list of codes already in use. The contact person should also provide full name and location of the observatory. The requirements are sets of hourly and annual means and ideally also a set of filtered 1-minute means that have all been produced from magnetic field measurements which have baseline control by means of regular absolute measurements. When an observatory moves within the same area precedents on what constitutes this are varied the operating institute can opt to keep the existing code provided simultaneous measurements are made at both sites in order to establish jump values. Support for observatories The V-OBS Working Group is concerned with helping to maintain a globally diverse network of geomagnetic observatories that operate and publish data to a common standard. As well as encouraging the establishment of new observatories, the WG welcomes offers of assistance in the form of instrumentation, partnership or training aimed at preserving or improving the operation of geomagnetic observatories. The WG also invites communication from observatories or operating institutes that are facing closure or require assistance in publishing data or meeting modern operational standards. Dourbes Observatory maintains a geomagnetic instrument pool to provide for observatories in need of renewed instrumentation contact: The pool constitutes transformed, reconditioned and calibrated magnetometers donated by third-party Institutions. To replenish the rapidly decreasing available pool, we urge the geomagnetic community to continue supply Dourbes with non-magnetic theodolites, fluxgate sensors, digital variometers and proton magnetometers for which they have no use.

Chapter 3 : IAGA - Division V-MOD Geomagnetic Repeat Stations

iii TABLE OF CONTENTS Foreword .. Acknowledgements Explanation of Terms CHAPTER 1 Introduction Repeat

DOWNLOAD PDF IAGA GUIDE FOR MAGNETIC REPEAT STATION SURVEYS

Stations.

Chapter 4 : IAGA Division V-MOD Geomagnetic Field Modeling: Minutes Uppsala

IAGA Guide for Magnetic Repeat Station Surveys was published by Newitt, Barton, Bitterly. IAGA published with advertisements to offset costs. Free copies were given to people who contributed data.

Chapter 5 : Absolute magnetic measurements, methods and instrumentation

Activities. Maintain a catalog of regional and global magnetic surveys, models and charts. Promote and set standards for magnetic repeat station surveys and reporting.

Chapter 6 : Italian Magnetic Network and magnetic reference fields at | Earth-prints

Enter your mobile number or email address below and we'll send you a link to download the free Kindle App. Then you can start reading Kindle books on your smartphone, tablet, or computer - no Kindle device required.

Chapter 7 : IAGA Working Group V-OBS: Geomagnetic Observation | International Union of Geodesy and

Surveys of the geomagnetic declination, inclination and total field intensity were carried out at eight stations of the Croatian Geomagnetic Repeat Stations Network in and The total field time series at repeat stations and observatories were compared by use of the multi-linear regression.

Chapter 8 : The portfolio of services | EPOS

During the time interval a ground survey of the total magnetic field intensity in the middle-northern part of Croatia was performed, in order to get a detailed insight of the field distribution over the region. A special effort was done to understand the uncertainty and errors in data.

Chapter 9 : An Overview of the Earth's Magnetic Field

APPLICATION NOTE MagH DI used in Absolute Declination and Inclination Measurements the Earth's magnetic field at Guide for Magnetic Repeat Station Surveys.