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RESEARCH

Long term drifts in baselines of Ground Magnetic Observatories.

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Abstract

The stability of baseline is the most important criterion for evaluating the data quality of a ground magnetic observatory. Theoretically, a baseline should be a straight line, provided, there are no error factors affecting the absolute instruments, the variometer and the observational procedure. But in practice, we observe that the baselines are affected by some errors in the form of random errors and long term baseline drifts. It is known that temperature, pier tilts, aging of electronic components etc. can affect the long term stability of baselines, but in this paper we discuss a new type of error which affects the baseline in the form of long term drifts due to the variation in the gradient field between the absolute room and the variometer room. Even though, a site is selected with the least magnetic gradient for the establishment of an observatory, in many cases, it is found that the magnetic gradient patterns are not permanent and changes over the time. This slow gradient changes can distort the actual temporal magnetic variations and thus affecting the purity of data recorded at a geomagnetic observatory. We have analytically shown that an ideal baseline has to be a horizontal straight line and the RHS of the fundamental equation of an observatory should be a constant. We have further shown that baseline instabilities are caused by variation in gradient field between the absolute and variometer pillars in addition to the measurement errors from absolute observations and variometer recording. This variation in the gradient field causes long term drifts in baselines. We have derived the correction factor which can filter out the signals arising out of variation in the gradient field. Finally we present how far the data quality can be improved by applying this correction.

Keywords: Long term baseline stability; Magnetic observatory; Gradient field variation; Baseline drift

Background

The primary function of a ground magnetic observatory is to record the temporal variation of the geomagnetic field, whereas the main purpose of a ground magnetic survey is to find the spatial variations of the magnetic field. The temporal variation during the time duration of a magnetic survey has to be corrected to get a clear picture of the spatial variations. In other words the temporal variation distorts the actual picture of the spatial variation of the magnetic component over the surveyed area. Vice versa, in the case of a ground magnetic observatory, the spatial variation component of the magnetic parameter will affect the quality of temporal variation data recorded in a magnetic observatory. In this paper we discuss a new type of error which affects the baseline in the form of long term drifts due to the variation in the gradient field between the absolute room and the variometer room. Even