NOTES ON GEOMAGNETIC REPEAT MEASUREMENTS AT GRYTVIKEN, APRIL 1987

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Abstract. Geomagnetic repeat measurements were made at Grytviken, South Georgia, in April 1987 in order to provide an update of the absolute field values. The results, reproduced in this report, confirm the trend of the drift in declination to have reversed at the site since the late 1970s. They also indicate a decrease in the secular change of the horizontal component since that time. The annual rate of decrease of the vertical component is seen to be comparable to that of recent years, but will require further measurements in the future to determine how this is changing.

Introduction

In order to maintain a continuing record of the geomagnetic field at South Georgia, a programme of repeat measurements was started at Grytviken in November 1984 (Simmons, 1986). The following notes detail the results of a second set of such measurements which were made at the same site in April 1987.

The latest observations give the absolute values of the three components of the Earth's field and the deduced secular change for the period until 1987. They are also able to confirm a change in sign of the secular change in declination first suggested by the 1984 repeat measurements.

Observations

A series of twenty-five absolute observations of H, D and F were carried out by Jonathan Buckingham and Martin Dowson, covering a 48-hour period from 1100 UT on 8 April to 1100 UT on 10 April 1987. The observations were made every one to two hours during the day, and less frequently during the night, when field changes were predicted to be less rapid.

The equipment and techniques used were the same as those employed in 1984 with the exception that three sets of three readings were made with the proton precession magnetometer (PPM) rather than two, and that an EDA fluxgate magnetometer was used in the nearby 'workshop' to produce a continuous chart record of the three components over the same period.

Apart from a 40 nT bay in H and D from 0220 UT to 0320 UT on 10 April, there were no disturbances greater than 10 nT during the 48-hour period. None of the five international quiet days in the month fell within this period.

Results

The absolute observations were plotted against time for the 2-day period, and the daily variation completed with reference to the fluxgate record so that hourly means could be obtained from the graph. The mean values calculated for H, D and Z over the observing period were:

$$H,\ 17652 \pm 2\ \text{nT};\quad D,\ 351^\circ\ 26.5' \pm 0.4';\quad Z,\ 24021 \pm 2\ \text{nT}.$$

The mean observatory values (Simmons, 1985) for each of the years 1975–81, together with the results of the repeat measurements made in 1984 and 1987, are listed in Table I and are also plotted in Fig. 1. Table II lists the deduced secular changes as annual rates. The values given for 1975–81 are obtained by linear regression, whilst those for 1981–84 and 1984–87 are calculated from the differences between the two

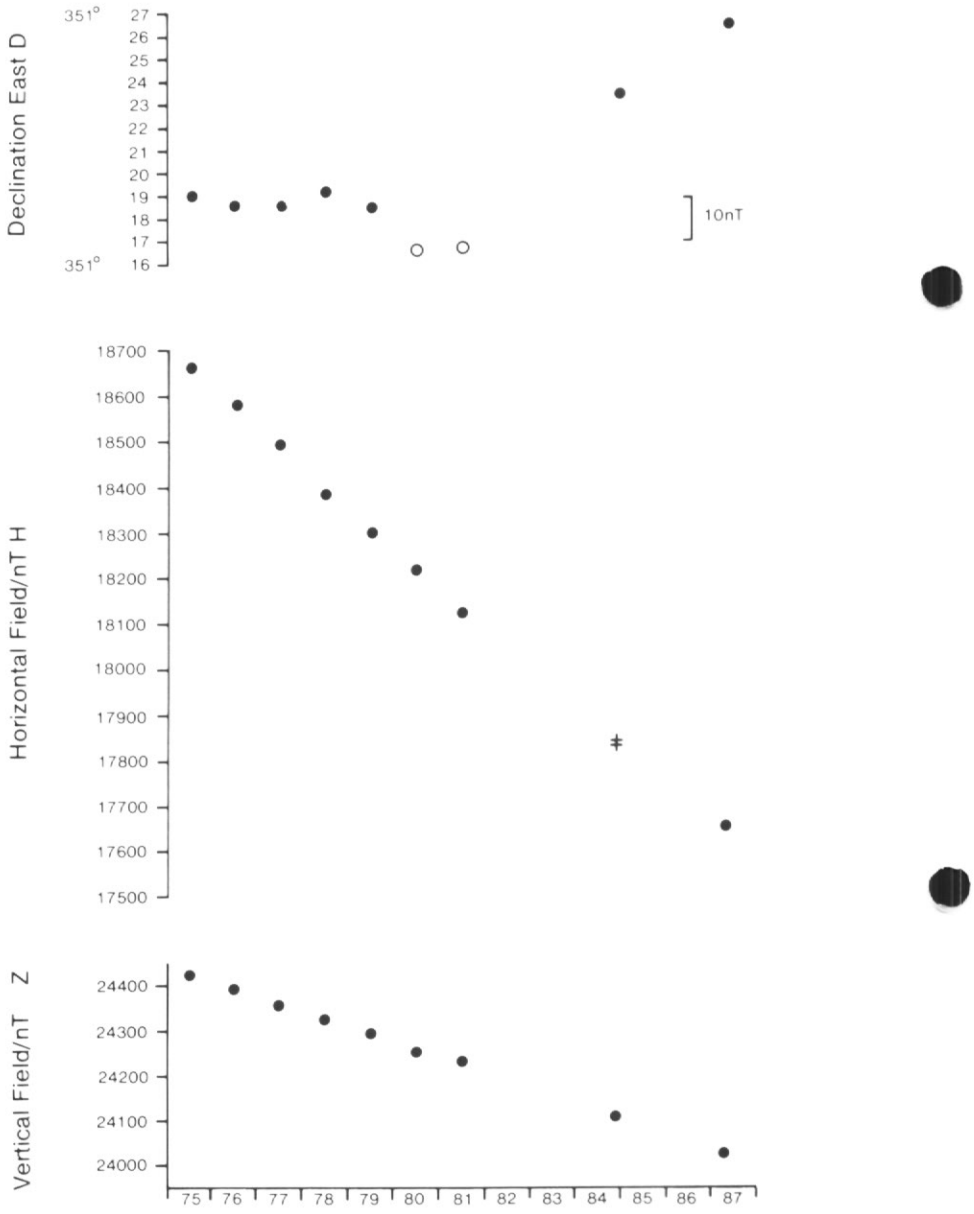

Fig. 1. Mean values of the field for all days, 1975–81, and mean values for the periods of the repeat measurements, 26–27 November 1984 and 8–10 April 1987. ○, unreliable data; +, values of field uncorrected (top) and corrected (bottom) for geomagnetic activity.

Table I. Mean absolute values of the geomagnetic field at Grytviken, 1975–1987

Year (decimal)	*H (nT)*	*Z (nT)*	*D (deg min)*
1975.5	18663	24426	351° 19.0′
1976.5	18584	24393	351° 18.6′
1977.5	18492	24358	351° 18.6′
1978.5	18389	24329	351° 19.2′
1979.5	18302	24294	351° 19.5′
1980.5	18221	24255	351° 16.6′
1981.5	18122	24231	351° 16.7′
1984.9	17842	24110	351° 23.4′*
1987.3	17652	24021	351° 26.5′

Values used are annual means, except the 1984 and 1987 data which are obtained from the repeat measurements.

* Value corrected since 1984 after recalibration of QHM.

Table II. Observed secular changes at Grytviken, South Georgia

Secular change per year	*H (nT)*	*Z (nT)*	*D (min)*
1975.5–1981.5	−91	−33	—
1981.5–1984.9	−82 (−84)	−35	—
1984.9–1987.3	−80 (−77)	−38	1.3
IGRF 1985	−83	−32	~ 0

Values are calculated from the data shown in Table I. Values in parentheses denote the secular change when the 1984 data are corrected for geomagnetic activity. They are only noted, however, when the resulting value is found to be significantly different from the 'uncorrected' value. See Discussion.

values. The effect of geomagnetic disturbance on the field values, and therefore the values for secular change, may to some extent be corrected for, (see Discussion for details) and the effects on the secular change are shown where different. The 'uncorrected' values nevertheless give a good indication of the trends.

Discussion

In Table I, the 1975–81 values shown are the observatory means for all days. The 1984 value, however, is for two particularly quiet 'quiet' days and that for 1987 is for two days intermediate between quiet and disturbed. To allow for the difference in magnetic activity when the observations were made, a simple correction may be applied. The effect of this is commented upon for each component.

Horizontal component, H

The observatory data for the years 1975–81 show 'all day' means to be 7 ± 3 nT lower than 'quiet day' means. The 1984 value can therefore be reduced to 17835 nT to represent an 'all day' value. The three values of the secular change then become: −91, −84 and −77 nT per year. A similar result is obtained if the quiet day values are used for 1975–81 and the 1987 value is increased to represent a 'quiet day' value.

The secular change, whether from corrected or uncorrected data, is seen to be decreasing over the observed period and is close to the 1985 IGRF value.

Vertical component, Z

The difference between 'all day' and 'quiet day' means for the Z component is found to be of the order of 1 nT. However, with an uncertainty of up to 3 nT, the values for secular change are left uncorrected. The level of uncertainty due to disturbance and seasonal effects is also similar to the apparent increase in the magnitude of the secular change over the period. We can thus only conclude that the field is continuing to decrease at approximately 35 nT per year. We also note that the IGRF value now agrees with the observed value.

Declination, D

Some doubt was expressed about the reliability of the 1984 D value (Simmons, 1986, p. 72). The 1987 result supports the view that the 1984 value was real and that the easterly declination is now increasing.

Long-term records of the declination at South Georgia (Simmons, 1987) show a decrease in easterly declination from 22° E in 1700 to 9° W in the 1970s. If the suggestion that there is an error in the 1980 and 1981 D values (Simmons, 1985, p. 20) is accepted, then the picture is of the declination decreasing to an easterly minimum of 351° 19′ before starting to rise again, with a secular change to date of approximately 1′ per annum (equivalent to 5 nT/a).

The difference between 'all day' and 'quiet day' means is close to zero, and thus again has negligible effect on the secular change calculations.

Future Work

A continuation of the programme of geomagnetic repeat measurements will provide useful updates to the South Georgia data.

Received and accepted 21 September 1987

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