1. Introduction

Title of investigation: Spherical harmonic representation of the main geomagnetic field for world charting and investigations of some fundamental problems of physics and geophysics

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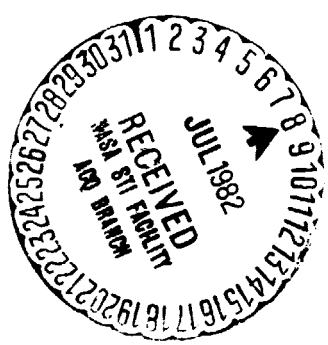

Analyses of the MAGSAT data at Liverpool University Geophysics Department

From the investigator B tapes we have extracted one day's worth of measurements about every seven days from and including 5th November to 10th January. Each of these single-day data sets was subdivided into information on the sunset side of the Earth only, and again on the sunrise side. For any given day we therefore have two data sets which cover the entire surface of the Earth quite well but correspond to one of the two terminators. Our purpose was to do harmonic analyses of the separate data sets for the same day, so as to see whether there were any difference between the two sets of results.

In the event, there is a very clear and consistent difference between the sets of data. g_1^0 for the main field differs systematically and in the same sense by about 5 nanoTesla from one terminator to the other. Since both data sets for any one day cover the entire Earth, it follows that any difference between them must be due to ionospheric currents which differ from the sunset to the sunrise terminator. g_1^0 for the external field shows even greater systematic differences averaging about 10 or 12 nanoTesla, again always with the same sense of difference.

We have analysed for a toroidal field which was the original object of our pursuit, and find that the toroidal field differs from one terminator to the other by about 15 nanoTesla on the average and always with the same sign, with one exception. These data have been "corrected" for a yaw error, which turns out to be mathematically equivalent to the g_1^0 coefficient of a toroidal field. Since the apparent toroidal fields in sunrise and sunset terminators disagree by very significant amounts, it follows that a constant yaw error cannot explain these results. Neither can a toroidal field explain the results. We must be looking at an apparent toroidal field which results from electric currents concentrated in the two terminators. These apparent toroidal fields do not agree with each other because the current systems in the two terminators do not produce apparent east-west fields (toroidal) of the same sign and magnitude.

It follows that the yaw error which has been corrected for is in great doubt, and very likely really corresponds to ionospheric current effects which exist in the two terminators and which do not average to zero when the information from the two terminators is mixed together.

We are continuing to pursue these analyses forward in time.

Our analyses have been carried out several times on each data set so as to progressively eliminate data which deviate from that of a smoothly fitting 14th degree analysis. The final data set in each case contains no data point

which deviates more than 20 nanoTesla from the 14th degree analysis. This turns out empirically to eliminate data from the circular auroral zones in the northern and southern hemispheres, without rejecting data from near the poles arbitrarily. The progressive elimination of these auroral zone data points demonstrates that the information we are presenting in this report does not arise from complications due to Birkeland currents.