N O T I C E

THIS DOCUMENT HAS BEEN REPRODUCED FROM MICROFICHE. ALTHOUGH IT IS RECOGNIZED THAT CERTAIN PORTIONS ARE ILLEGIBLE, IT IS BEING RELEASED IN THE INTEREST OF MAKING AVAILABLE AS MUCH INFORMATION AS POSSIBLE

UTD #E0533-01

8 1 - 1 0 1 0 5

CR-164099

QUARTERLY STATUS AND TECHNICAL

PROGRESS REPORT #1

INVESTIGATION OF THE EFFECTS OF EXTERNAL CURRENT SYSTEMS
ON THE MAGSAT DATA UTILIZING GRID CELL MODELING TECHNIQUES

NASA CONTRACT NO. NAS5-26309

prepared by

David M. Klumpar
Center for Space Sciences, F02.2
The University of Texas at Dallas
Box 688, Richardson, Texas 75080

Period Reported: 15 September, 1980 - 31 December, 1980

Date of Submission: 5 January, 1981

submitted to

NASA/Goddard Space Flight Center
Greenbelt, Md. 20771

RECEIVED

JAN 16, 1981

SIS/902.6

M-013

TYPE II

(E81-10105) INVESTIGATION OF THE EFFECTS OF   N81-21421
EXTERNAL CURRENT SYSTEMS ON THE MAGSAT DATA
UTILIZING GRID CELL MODELING TECHNIQUES
Quarterly Status Technical Progress Report,   Unclas
15 Sep. - 31 Dec. (Texas Univ. at Dallas,   G3/43   00105

1. Report No. 1	2. Government Accession No. ―	3. Recipient's Catalog No. ―

4. Title and Subtitle

Investigation of the Effects of External Current Systems on the MAGSAT Data Utilizing Grid Cell Modeling Techniques

5. Report Date

January 5, 1981

6. Performing Organization Code

7. Author(s)

David M. Klumpar

8. Performing Organization Report No.

9. Performing Organization Name and Address

Center for Space Sciences, F02.2
The University of Texas at Dallas
Box 688, Richardson, Texas 75080

10. Work Unit No.

11. Contract or Grant No.

NAS5-26309

13. Type of Report and Period Covered

Quarterly Status
9/15/80 - 12/31/80

12. Sponsoring Agency Name and Address

Harold Oseroff, Code 902
NASA/Goddard Space Flight Center
Greenbelt, Md. 20771

14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

The overall objective of this effort in support of the Magsat project is to study the feasibility of modeling magnetic fields due to certain electrical currents flowing in the earth's ionosphere and magnetosphere. This first quarterly status and technical progress report discusses initial efforts devoted to reading Magsat data tapes in preparation for further analysis of the Magsat data. A second line of effort during the reporting period is described in which a new modeling procedure is being developed to compute the magnetic fields at satellite orbit due to hypothesized current distributions in the ionosphere and magnetosphere. This technique utilizes a linear current element representation of the large-scale space-current system.

17. Key Words (Selected by Author(s))

Magsat
Magnetic Fields
Birkeland Currents

18. Distribution Statement

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages 5	22. Price*

*For sale by the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

I. INTRODUCTION

The overall goal of this investigation is to study the feasibility of modeling magnetic fields due to certain electrical current systems flowing in the earth's ionosphere and magnetosphere. Vector magnetic field measurements from the near-polar orbiting Magsat satellite will contain, in addition to the main geomagnetic field and that due to crustal anomalies, components that arise from these external currents. In meeting the utlimate goals of the Magsat project, it is desirable that the external current effects be identified in the observations, and subsequently separated from the internal field. The objective of this effort will be to determine the capability of a modeling procedure to facilitate the separation of these external and internal components.

The approach of this feasibility study shall be to develop forward modeling procedures in which the magnetic effects of model currents may be derived. It is intended to include, separately, the equatorial electrojet, S_q currents, and the effects due to auroral zone and polar cap currents including the high latitude ionosphere-magnetosphere coupling currents. In each case likely current systems will be devised and resulting "typical" magnetic field signatures calculated for comparison with Magsat observations. The grid-cell modeling procedures developed by J.L. Kisabeth provide one method for calculating certain of these currents. This as well as other techniques will be evaluated.

II. ACCOMPLISHMENTS DURING REPORTING PERIOD

1. Data Reduction

During this initial reporting period, we have made progress in developing software programs to read the Magsat Chronicle format data tapes on a U.T.D. PDP 11/45 computer. At this time the capability exists to read the Chronicle tapes and printout either the orbital data alone or both orbital and magnetic field-values from both scalar and vector magnetometers for any specified time period contained on the source tape. The program computes geodetic longitude and latitude, and altitude of the spacecraft and outputs this information along with inertial and magnetic coordinate positions. The magnetic field observations for each second are scanned with maximum, minimum, and average values for each scalar head and each vector component being printed. This software package will form the basis of additional data reduction software that will store selected portions of Magsat data on disc, subtract a model field, and plot the resultant magnetic component deviations on a high resolution interactive vector graphics terminal.

2. Field Modeling

A technique is being developed to model the magnetic effects at Magsat altitudes due to hypothetical currents in and above the high latitude ionosphere. In this forward modeling technique prototype current systems representing the auroral electrojet and ionospheric polar cap currents as well as the field-aligned currents that link these low altitude currents to the distant magneto-sphere are devised. This current system is then represented for computational purposes as an array of linear current elements having finite length and a finite diameter with a pre-determined cross-sectional current density distribution. For each hypothetical observation point the three vector components of the

resultant magnetic field are to be computed as a superposition of the contribu-
tions due to each current element in the world-space. The resultant magnetic
perturbations for each vector-field component are displayed on a high resolu-
tion vector graphics terminal by means of a computer program designed to allow
the operator to interactively modify the model parameters. Initial develop-
ment of this model has been restricted to a hypothetical satellite orbit at 90°
inclination in the dawn dusk meridian plane and the initial computations have
included only the sunward component of the perturbation field at various
altitudes. A sample plot of the model output is shown in Fig. 1. The main
plot on this figure shows the sunward directed component of the magnetic field
calculated at 94 separate observation points as a function of latitude at
an altitude of 500 km. The input current system is a "classical" large-scale
Birkeland sheet current model with downward directed currents in the high latitude
postmidnight and the low latitude pre-midnight portions and upward directed
currents in the high latitude pre-midnight and low latitude postmidnight sectors.
This current system is represented computationally in this example by 324
linear current elements as described above. The field-aligned currents are
closed by N-S currents in the ionosphere at 110 km altitude. No E-W ionospheric
currents have been included. The center of the current sheets are located
in the figure by the vertical lines at 70.5 and 77.5° latitude. The latitudinal
distribution of current intensity is plotted along the top of the main panel.
The clock dial in the lower right-hand quadrant depicts the satellite orbit.
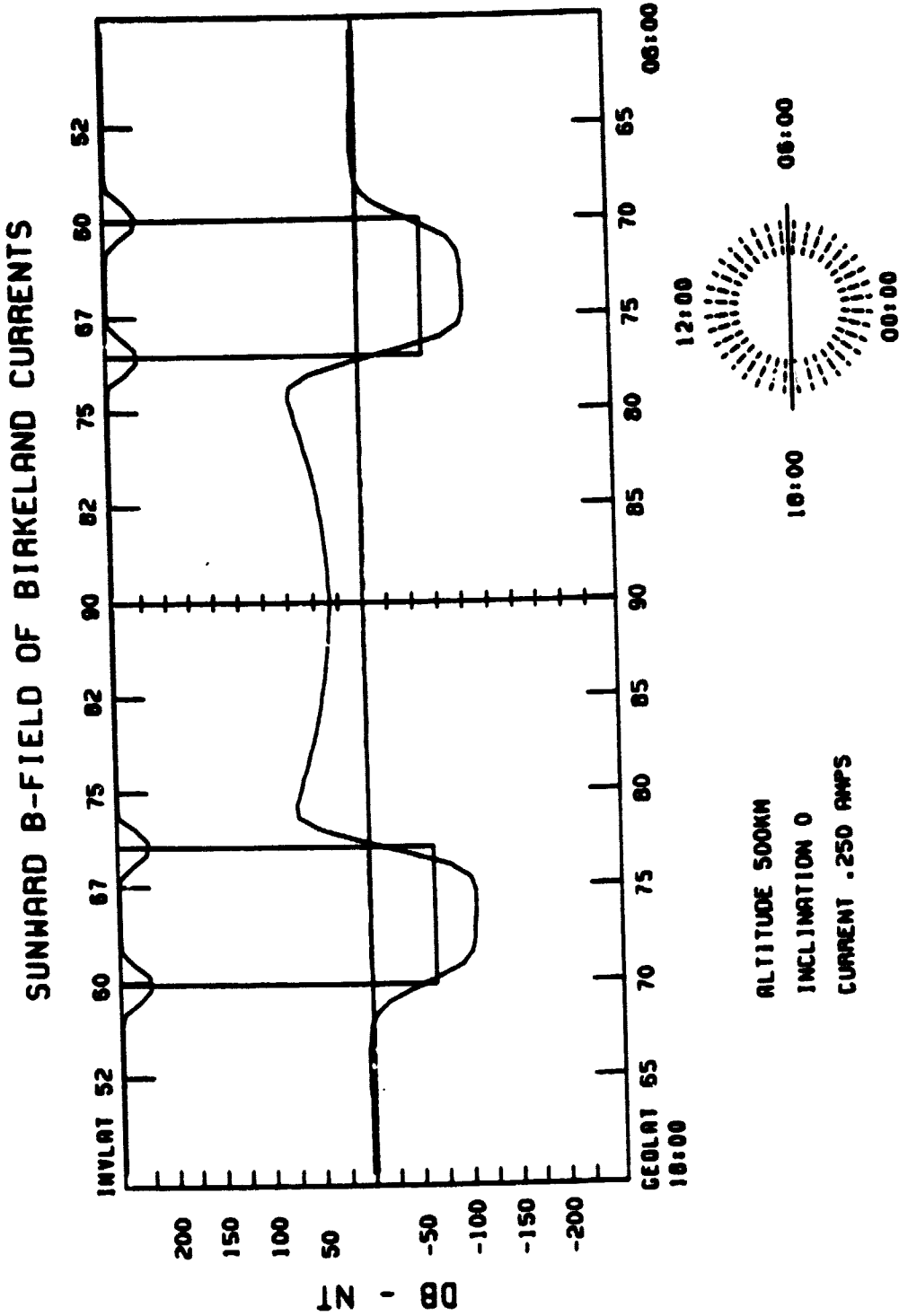
Figure 1

III. **PROBLEMS ENCOUNTERED AND RECOMMENDATIONS**

No major problems have been encountered.

IV. **PLANS FOR NEXT REPORTING INTERVAL**

During the forthcoming quarter the development of data reduction software will continue. Further programs will be developed to store selected portions of Magsat data on disc file for subsequent analysis and plotting. In particular, routines will be developed and integrated into our existing software to compute the geopotential magnetic field at Magsat and to subtract away this model field. The resultant observed perturbations in the scalar magnitude and each of the 3 vector components will then be plotted by interactive graphics routines designed to allow flexibility in plotting format.

Further development of the linear element field modeling procedure will take place during the next reporting period. The emphasis will be placed upon building greater flexibility into the model, allowing all components of the magnetic perturbation to be predicted.

The third major effort during the next quarter will be to obtain and bring into operation the grid cell modeling programs developed by J.L. Kisabeth. In the long term this grid cell modeling technique may be compared and contrasted to the linear elemental current model being developed at U.T.D. and discussed above. Ultimately some combinations of the two techniques utilizing the relative strengths of each might yield the most realistic external field perturbations in the Magsat data.