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E82-10201
CR-168628

M-029
TYPE II

Please Refer to:
TSSD-9336

November 4, 1981

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National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Mr. Locke M. Stuart, MAGSAT Investigation Manager

Subject: Progress Report on "Investigation of MAGSAT and TRIAD Magnetometer Data to Provide Corrective Information on High-Latitude External Fields", for the Period July 1 to September 30, 1981, T. A. Potemra, Principal Investigator

Enclosures: (1) Example of MAGSAT High Latitude Disturbance Catalog

(2) Example of Color Display of MAGSAT High Latitude Disturbances

(3) Abstracts of APL MAGSAT Scientific Presentations

Gentlemen:

Of the $33,000 made available from NASA to this Laboratory on July 1, 1981 to support the subject study of MAGSAT data, $18,000 was spent during the three-month period ending September 30, 1981. This funding was used to support a Post Doctoral Associate and a portion of the time of the Principal Investigator, Dr. T. A. Potemra. The activities of these investigators included the development of computer programs for the correlative analysis of the MAGSAT and TRIAD magnetic field data sets. A catalog of the MAGSAT-observed high latitude disturbances is presently being prepared for the entire data set, an example of which is shown in Enclosure (1). Of particular interest is a display of the MAGSAT orbital tracks in a polar geomagnetic coordinate system with the locations, flow directions, and intensities of field-aligned currents shown in color (Enclosure (2)). This color display is made possible by an interactive color graphics terminal which will be used for future global studies with the MAGSAT data.

The scientific results of the APL studies have been presented in papers presented at the IAGA meeting in Edinburgh (August 3-15, 1981) and scheduled for the Fall AGU meeting in San Francisco (December 7-11, 1981), the abstracts for which are attached as Enclosure (3). Dr. Potemra and his colleagues are preparing two manuscripts for the special Geophysical Research Letters issue on MAGSAT.

The response of the international community to the unique MAGSAT measurements was overwhelming at the IAGA meeting in Edinburgh, and we certainly hope that sufficient support for these important investigations will continue.

If there are any questions concerning this report, please call Dr. Potemra at telephone number (301) 953-7100, extension 3253.

Sincerely yours,

George C. Weiffenbach
Space Department Head

108
GCW:TAP:klb

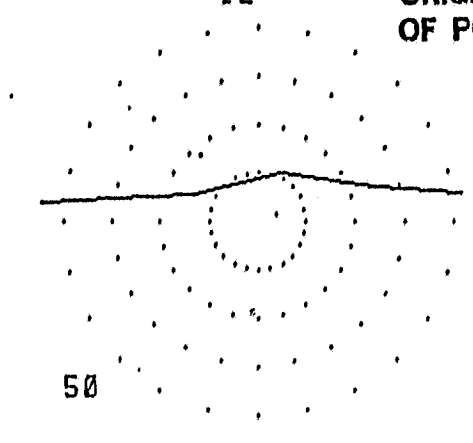
External Distribution:

R. A. Langel, NASA/GSFC
M. Sugiura, NASA/GSFC
M. Settle, NASA Hqs.
E. R. Schmerling, NASA Hqs.

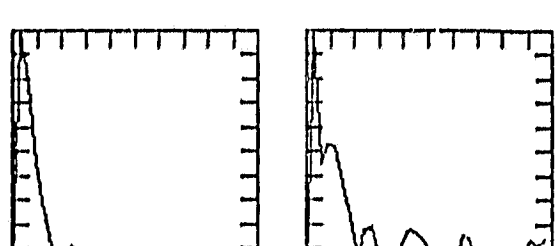
Enclosure (1) to
TSSD-9336

The attached is an example of our MAGSAT catalog of high latitude magnetic activity. The purpose of this study is to investigate Birkeland current signatures which are superimposed upon the main geomagnetic field. A field-aligned current sheet will produce a magnetic field transverse (east and south components) to the main field, as may be seen in the central portion of the plot. These three traces are the MAGSAT data for November 6, 1979 from which the MAGSAT 4/81 magnetic field model (Langel) has been subtracted, versus universal time and associated orbital parameters.

Further studies are being conducted in order to locate the boundaries and higher frequency characteristics of the Birkeland current signatures. The two traces at the bottom are the standard deviations of the data from its average for each 10 seconds. This may enable separation of magnetic signatures due to local current densities from magnetic signatures due to potential fields or in "curl-free" regions. The top left of the graph plots the course of MAGSAT through invariant latitude and magnetic local time. The top right contains the Fourier transform of the Region 1-2 disturbances at dusk (60-80) and at dawn (80-60). These transforms will allow us to determine the scale length, time period and intensity of the large-scale features as well as higher frequency components due to wave activity.

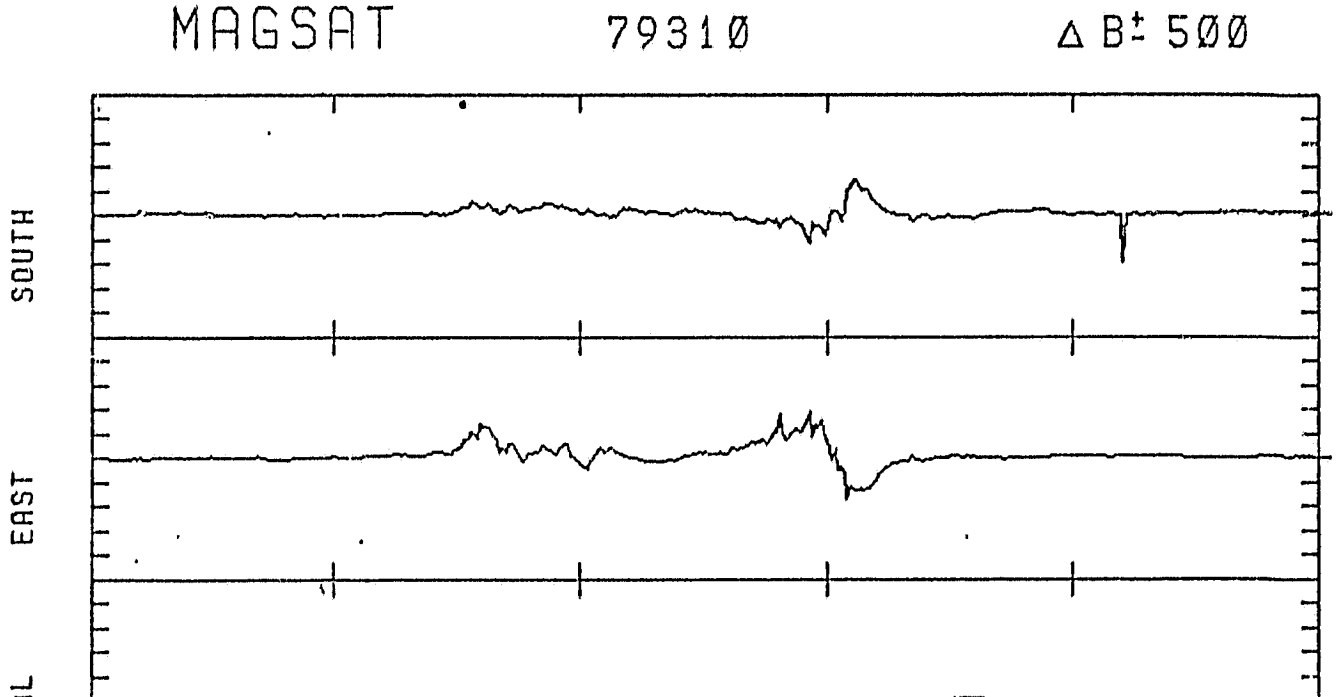


FFT

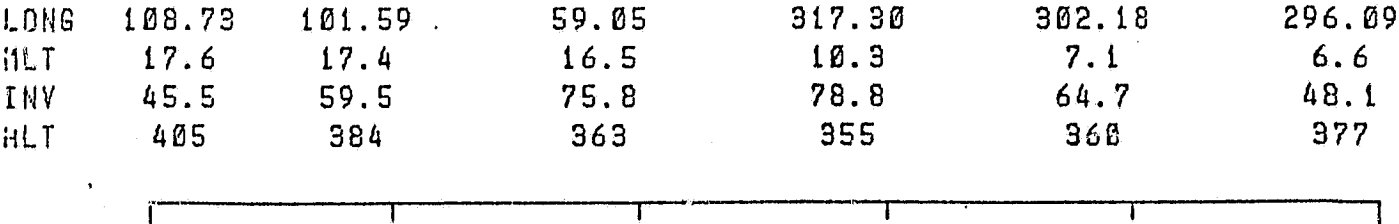


f(mHZ)	0	26	52	78	103	129		26	52	78	103	129
λ(km)		271	135	90	68	54		271	135	90	68	54
max:mhz,geo,km		4.037	248	1734				4.029	248	1738		

MAGSAT 79310 ΔB± 500



UT	10: 7	10:11	10:16	10:21	10:26	10:31
LAT	51.17	64.92	81.82	73.32	54.39	34.77
LONG	108.73	101.59	59.05	317.30	302.18	296.09
MLT	17.6	17.4	16.5	10.3	7.1	6.6
INV	45.5	59.5	75.8	78.8	64.7	48.1
HLT	405	384	363	355	368	377

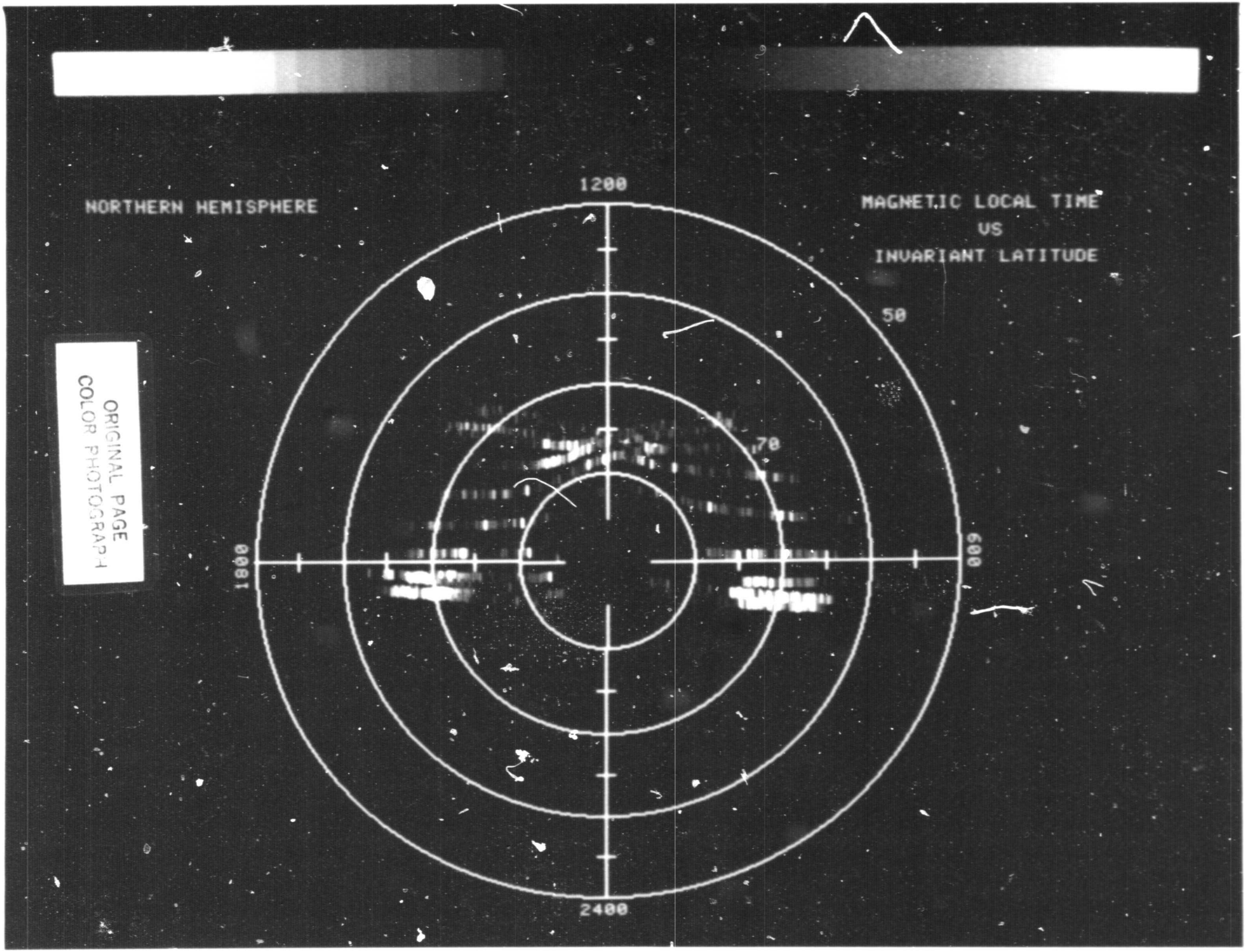


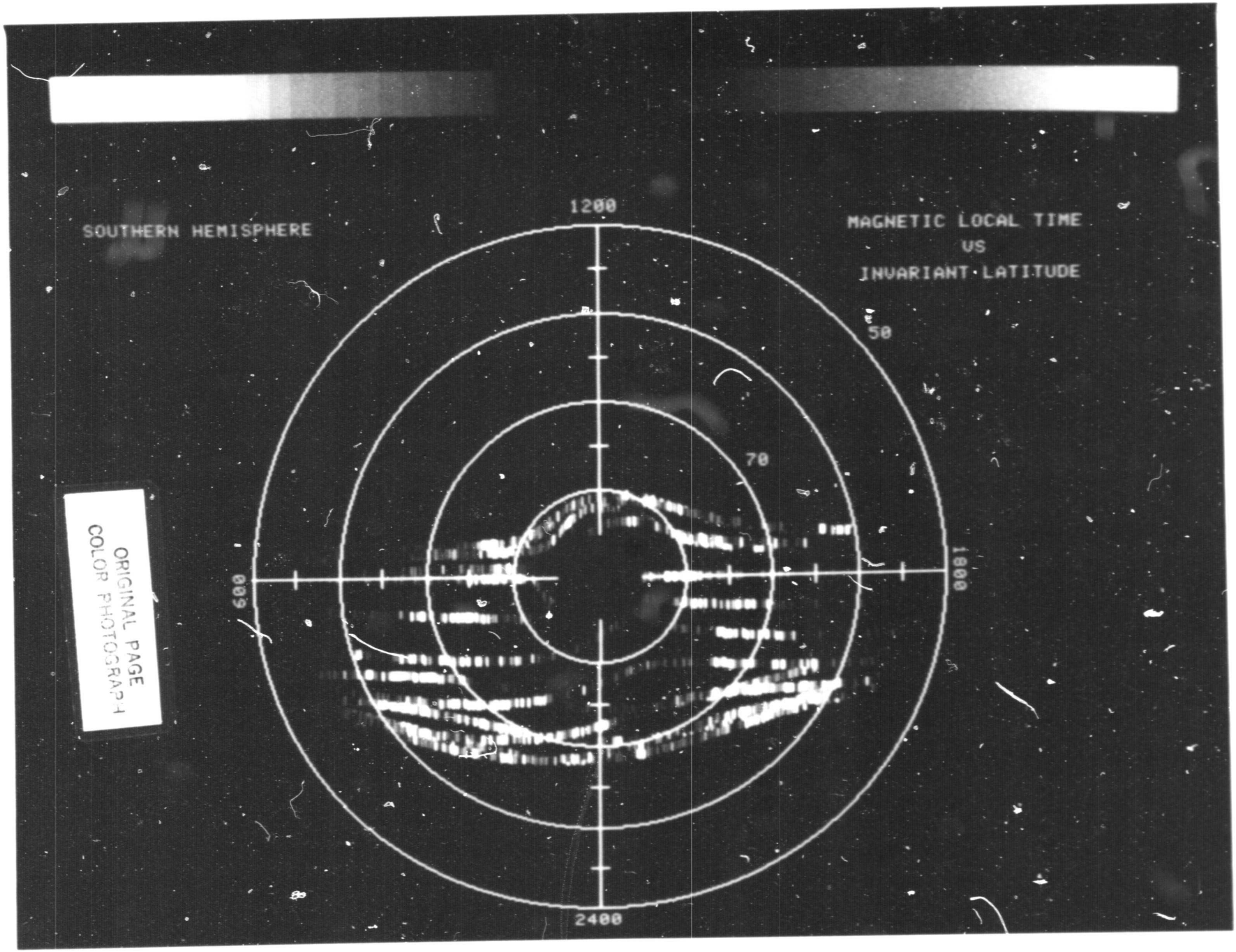
Enclosure (2) to
TSSD 9336

In order to generate a global 24-hr "snapshot" of Birkeland current systems in both the northern and southern hemispheres we have developed a color graphic display of magnetic field data acquired from the MAGSAT vector magnetometer. Because of MAGSAT's unique sun-synchronous orbit its trajectory sweeps back and forth across more than 50% of the auroral oval in either hemisphere during a single day. The resulting data set allows us to map out a composite picture of the location and intensity of field-aligned currents from individual passes across the auroral oval. Figures 1a and b are examples of the composites that can be generated from consecutive orbits. The figures display $J_{\parallel}$ computed from $\nabla \times B$ i.e., $J_{\parallel} = 1/\mu_o \frac{\Delta B}{\Delta X}$ plotted on an MLT (magnetic local time) invariant latitude dial. The color bar extending from left to right is a scale of relative intensity and direction. Zero current is black in the center while maximum inward directed current is blue-white on the right and maximum outward current is yellow-red on the left.

In both the northern and southern hemispheres region 1 and 2 current systems are readily identified near the dawn-dusk meridian. The current intensities and locations exhibit temporal and spatial stability in this vicinity. The confusion of the "cusp" and "Harang" regions is also readily identified near noon and midnight respectively and the variation of the current systems around the oval can also be observed.

This new method of magnetic field data display has the potential to enhance our overall understanding of the spatial and temporal variability of Birkeland current systems and their response to various interplanetary parameters.


NORTHERN HEMISPHERE
MAGNETIC LOCAL TIME
VS
INVARIANT LATITUDE
1200
50
70
1800
600
2400
ORIGINAL PAGE
COLOR PHOTOGRAPH


SOUTHERN HEMISPHERE
MAGNETIC LOCAL TIME
VS
INVARIANT·LATITUDE
1200
50
70
600
1800
2400
ORIGINAL PAGE
COLOR PHOTOGRAPH

Enclosure (3) to
TSSD-9336

Abstracts of APL MAGSAT Presentations
Prepared During Period from July 1, 1981 to September 30, 1981

"Preliminary Evaluation of Distant Magnetic Field Disturbances from Birkeland Currents Using MAGSAT Data", L. J. Zanetti, T. A. Potemra, and M. Sugiura, Presented at the IAGA Meeting in Edinburgh, August 3-15, 1981

"Correlated Birkeland Current Signatures from the TRIAD and MAGSAT Magnetic Field Data", L. J. Zanetti and T. A. Potemra, Scheduled for presentation at the Fall AGU meeting in San Francisco, December 7-11, 1981

PRELIMINARY EVALUATION OF DISTANT MAGNETIC FIELD DISTURBANCES FROM BIRKELAND CURRENTS USING MAGSAT DATA

L. J. Zanetti
T. A. Potemra (both at: Applied Physics Lab., The Johns Hopkins Univ., Laurel, Md. 20810)
M. Sugiura (NASA/GSFC, Greenbelt, Md. 20771)

A major goal of the MAGSAT program is to provide an accurate near-earth magnetic field model. The major contribution to the geomagnetic field is from internal sources, but ionospheric and magnetospheric current systems also provide important contributions. The MAGSAT data acquired during possibly the most quiet two-day period during its lifetime on November 5 and 6, 1979 (with Σ Kp = 4+ and 6-, respectively, and the highest three-hour Kp = 1+) show disturbances up to a few hundred in nT in the auroral region due to field-aligned Birkeland currents. The data from this day within $\pm$ 50° geographic latitude have been used to derive initial MAGSAT geomagnetic field models. The purpose of this study has been to identify and evaluate the magnitude and spatial extent of the curl-free magnetic field disturbances due to Birkeland currents.

1. Applied Physics Laboratory
   The Johns Hopkins University
   Johns Hopkins Road
   Laurel, Maryland 20810

2. I1 Scientific results form the MAGSAT missions: main field

3. N. Fukushima
   R. A. Langel

a) oral presentation only

CORRELATED BIRKELAND CURRENT SIGNATURES FROM THE TRIAD AND MAGSAT MAGNETIC FIELD DATA

L. J. Zanetti (Applied Physics Laboratory, Johns Hopkins University, Laurel, Md., 20707)
T. A. Potemra

On November 1, 1979 the MAGSAT satellite was successfully launched into a 400 km polar orbit from which it could measure the earth's magnetic field. During the first part of MAGSAT's eight month lifetime, the orbit was nearly coplanar with that of the TRIAD satellite at 800 km altitude. This study has concentrated on transverse magnetic disturbances, associated with Birkeland currents, measured by the two spacecraft.

The satellites were nearly coplanar from November through the middle of December 1979. Data were compared when the satellites were over the TRIAD/Chatanika receiving station. Of the approximately 150 comparisons of magnetic disturbances, 75% are very similar in shape and magnitude. Better agreement in the large-scale well defined field-aligned current signatures occur during periods of higher K_p even with time separations as large as 45 minutes. The discrepancies in the remaining cases may be due to temporal, longitudinal and height effects of the Birkeland current system.

1. Fall Meeting
2. ZANETTI947049
3. APL/JHU
   Johns Hopkins Rd.
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4. SPR (Magnetospheric Physics)
5. None
6. None
7. 20% Fall AGU, 1980
8. Dr. Vernon Root
   APL/JHU
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   Laurel, Md. 20707
9. C