REPORT UAG - 56

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for
Solar-Terrestrial Physics

ISO-INTENSITY CONTOURS OF GROUND MAGNETIC H PERTURBATIONS FOR THE DECEMBER 16-18,1971 GEOMAGNETIC STORM

April 1976

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Y. Kamide
Cooperative Institute for Research in Environmental Sciences
University of Colorado, Boulder, Colorado 80302 U.S.A.
and
Geophysical Institute, University of Alaska,
Fairbanks, Alaska 99701 U.S.A.

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FOR THE DECEMBER 16 - 18, 1971 GEOMAGNETIC STORM

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Y. Kamide*
Cooperative Institute for Research in Environmental Sciences
University of Colorado, Boulder, Colorado 80302

and

Geophysical Institute
University of Alaska
Fairbanks, Alaska 99701

PART I

1. Introduction

The geomagnetic storm is one of the dramatic signatures of the solar-terrestrial phenomena which are observable on and near the earth. Many storms seem to follow by a day or so the large solar flares or other flurries of solar activity. Among the various kinds of space and ground manifestations of the storm, the storm's growth and decay can be most typically recognized in the H-component magnetic depression at middle and low latitudes which is attributable to the ring current in the magnetosphere. For this reason the initial, main and recovery phases of the magnetic storm have conventionally been identified from the mid-latitude magnetic records.

A dramatic magnetic storm which began at 1904 UT on December 16, 1971 has been very interesting to study in detail because of the large amount of ground-based and satellite data available. The particular sequence of processes characterizing this storm is commonly observed in many other large storms. Some works on the interpretation of specific storm features and their physical processes have already been published for this storm, and other studies are still being made.

To examine the progressive change of the storm in terms of ground magnetic signatures, we prepared consecutive iso-intensity contours of the H-component ground magnetic perturbations at middle and low latitudes. From these we estimated the intensity and the location of the symmetric and asymmetric storm-time ring current. A total of 720 contour maps, one every 5 minutes, was produced using 52 northern hemisphere magnetic observatories for the 2½ day or 60-hour interval 1200 UT December 16 to 2400 UT December 18, 1971. Then, an interpolation technique was used to obtain 30 second contours from which a movie film was produced. This report provides exerpts from the movie film, giving the maps and the corresponding geomagnetic activity indices for every 10 minutes.

The author provides these data as a tool for use with satellite observations to improve the understanding of solar-terrestrial processes.

2. The December 16 - 18, 1971 Storm

Solar activity, solar radiation, ionospheric disturbances, cosmic rays, and geomagnetic and radio propagation indices during the December 16 - 18, 1971, storm are given in *SGD*, Number 330, Part I [1972].

Figure 1 shows some of the conventional representations of the time-varying characteristics of the storm. From top to bottom it gives the auroral electrojet indices AU and AL [Allen *et al.* 1975], the superposed H-component records from ten mid-latitude observatories, and the Dst index for the interval from 1200 UT December 16 to 2400 UT December 18, 1971. Two kinds of the equatorial Dst indices are plotted: a 5-min Dst calculated from the ten observatories' data (for the method of the calculation see the next section), and an hourly Dst [Sugiura and Poros, 1972] which was calculated by using data from four observatories (Hermanus, Kakioka, Honolulu, and San Juan). There is a general agreement between these two curves, except during the main phase of the storm (1700 - 2200 UT, December 17, 1971); the maximum depression in the 5-min Dst was -202γ, but only -157γ in the hourly Dst.

During the interval, there occurred two major storm sudden commencements (ssc) at 1904 UT December 16 and at 1418 UT December 17, which are identified by dashed lines in Figure 1. This we conveniently call a double magnetic storm [Cahill, 1973]. The two periods of world magnetic disturbance following these two sudden commencements are quite different in appearance. Following the first

* Guestworker at Data Studies Division, NOAA/EDS/NGSDC, Boulder, Colorado 80302.

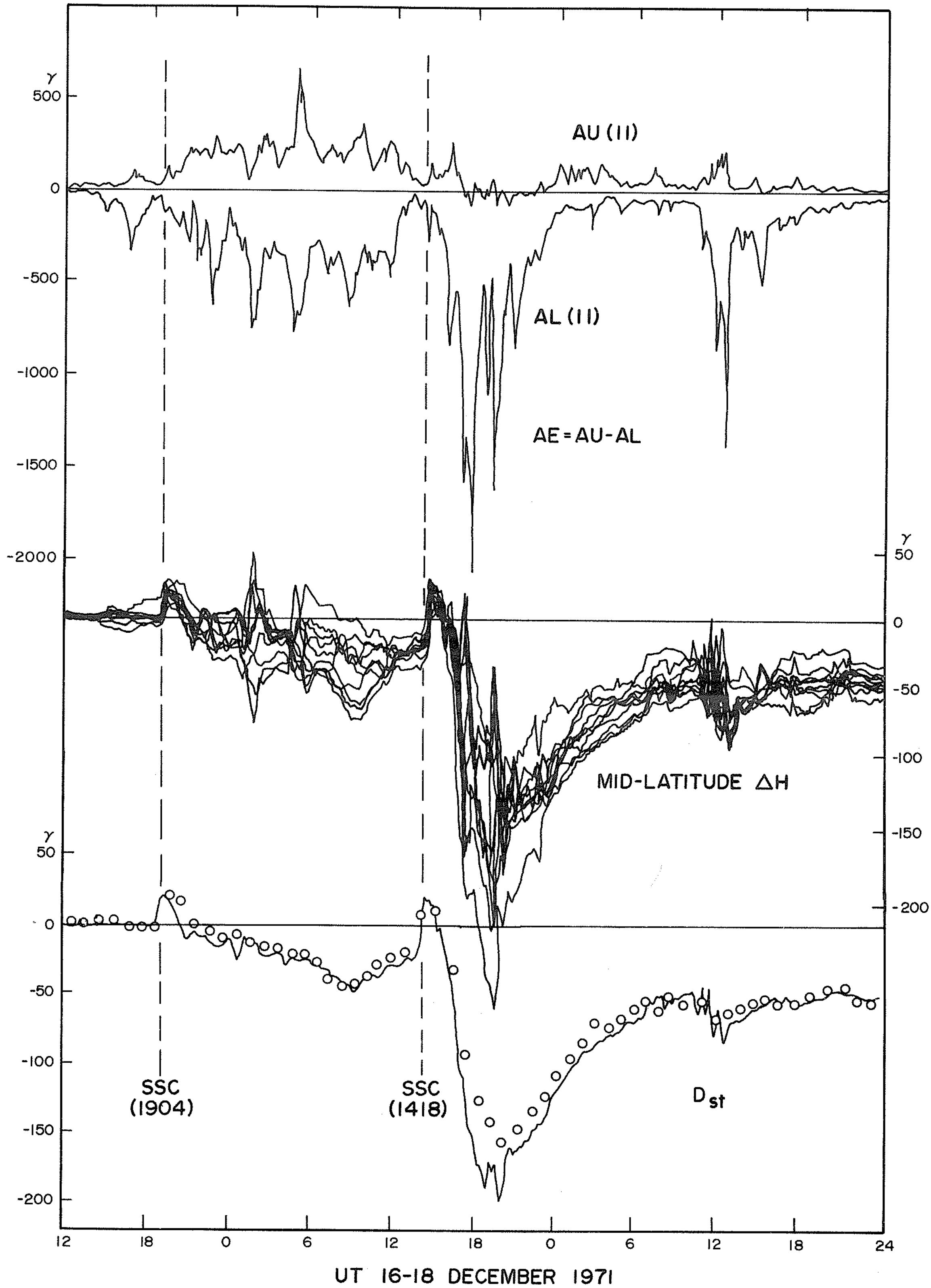

Fig. 1. The auroral electrojet indices, the superposed H-component records from ten mid-latitude observatories, and the Dst index. The 5-min Dst (solid line) are calculated from data at ten mid-latitude observatories. The hourly Dst (circles) are from data at four observatories [Sugiura and Poros, 1972].

sudden commencement, the ground records in auroral latitudes show successive substorm activity; the maximum AE index (AE = AU - AL) was greater than 1400γ (at about 0445 UT on December 17). However, the corresponding worldwide depression at middle and low latitudes was not very large; the minimum Dst was only -50γ. On the other hand, a rapidly growing main phase (the minimum Dst was -202γ) followed the second sudden commencement. During the early main phase AL reached -2000γ, although the simultaneous AU was quite small. This is one of the characteristics of the auroral electrojet activity during the maximum phase of a great magnetic storm. Throughout the two periods, the main phase decrease in the H component at mid and low latitudes was asymmetric, as indicated by the large differences in value among the observatories plotted.

By 0000 UT December 18, the electrojet activity ceased, and there was no appreciable substorm activity until an intense substorm took place at about 1030 UT. During the interval from the main phase (1900 UT December 17) to the onset of the substorm during the recovery phase (1030 UT December 18), the world depression showed a rapid recovery from about -200γ to -50γ in the Dst index. After 1200 UT December 18, all mid- and low-latitude observatories showed a slowly decreasing ring current effect. Not until the end of December 21 (not shown in Figure 1) did the depression recover completely.

All these ground magnetic signatures are commonly observed in many other large storms, e.g., April 1965, February 1967, March 1970, and August 1972. There have been a number of published works on these magnetic storms. Some unsolved topics of interest are:

1. Why are there two sudden commencements?
2. Why does a large main-phase depression occur only after the second sudden commencement?
3. Why is there no AU activity during the main phase?
4. What is the main constituent of the storm-time ring current?
5. Why does the main-phase depression show an asymmetric growth with respect to local time?
6. Why is the recovery of the main-phase depression two-fold (rapid recovery and subsequent slow recovery)?

2. Practical Procedure and Examples

To examine the growth and decay of the storm-time magnetic disturbances in these dimensions (time and geographical locations), we made iso-intensity contours of the ground magnetic perturbations at middle and low latitudes for a 2½ day period of the magnetic storm 1200 UT December 16 - 2400 UT December 18, 1971. The quiet interval, which was used as the baseline, was 1200 UT December 15 - 1200 UT December 16, 1971, when $\Sigma Kp = 4+$.

The first step was digitizing the H-component traces from 52 northern hemisphere magnetic observatories (see Table 1) for both disturbed and quiet intervals. These 52 observatories were all the data available through the World Data Center A for Solar-Terrestrial Physics at the time of the study. Figure 2 shows the location of these observatories in geomagnetic "latitude - local time" coordinates for 1200 UT. Observatories are identified by observatory numbers which are also given in Table 1. A value was taken every 5 minutes during the storm period and every one hour during the quiet periods. The 5-min disturbed values were then subtracted from 5-min quiet-time values, interpolated linearly from the hourly values, to obtain H-perturbation values at each observatory.

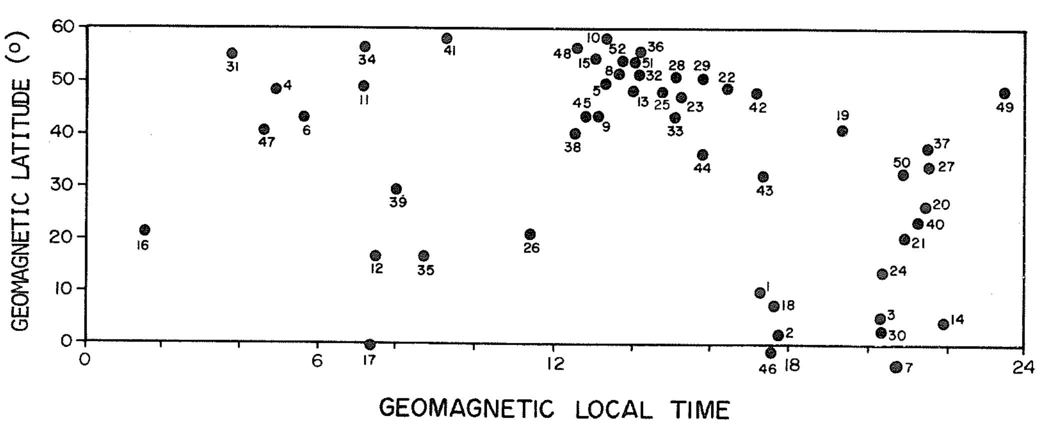

Fig. 2. Distribution of the 52 magnetic observatories whose data are used in this report (see Table 1).

Table 1.

Observatories used for the plot of the iso-intensity contours of ground magnetic H perturbations					
No.	Observatory	Geographic Latitude (north)	Geographic Longitude (east)	Geomagnetic* Latitude (north)	Geomagnetic* Longitude (east)
1	ALIBAG	18.63°	72.87°	9.43°	144.34°
2	ANNAMALAINAGAR	11.40	79.68	1.51	150.10
3	BAGUIO	16.42	120.60	5.16	189.98
4	BOULDER	40.13	254.77	49.04	317.40
5	CHAMBON-LA-FORET	48.02	2.27	50.31	85.07
6	DALLAS	32.98	263.25	42.98	328.64
7	DAVAO	7.08	125.58	-3.95	195.26
8	DOURBES	50.10	4.60	51.83	88.39
9	EBRO	40.82	0.50	43.74	86.37
10	ESKDALEMUIR	55.32	356.80	58.31	83.57
11	FREDERICKSBURG	38.20	282.63	49.51	350.78
12	FUQUENE	5.47	286.27	16.88	355.87
13	FURSTENFELDBRUCK	48.17	11.28	48.67	93.99
14	GUAM	13.58	144.87	4.10	213.63
15	HARTLAND	50.98	355.52	54.48	79.70
16	HONOLULU	21.32	202.00	21.23	267.29
17	HUANCAYO	-12.05	284.67	-0.67	354.55
18	HYDERABAD	17.42	78.55	7.61	149.62
19	IRKUTSK	52.17	104.45	40.78	175.31
20	KAKIOKA	36.23	140.18	26.15	206.65
21	KANOYA	31.42	130.88	20.65	198.75
22	KAZAN	55.83	48.85	49.26	130.94
23	KIEV	50.72	30.30	47.46	112.79
24	LUNPING	25.00	121.17	13.76	190.19
25	LVOV	49.90	23.75	47.89	106.49
26	M'BOUR	14.40	343.02	21.07	55.77
27	MEMAMBETSU	43.90	144.20	34.14	209.10
28	MINSK	54.10	26.52	51.37	110.98
29	MOSCOW	55.48	37.32	50.77	121.08
30	MUNTINLUPA	14.37	121.02	3.13	190.46
31	NEWPORT	48.26	243.01	55.18	301.13
32	NIEMEGK	52.07	12.68	52.10	97.21
33	ODESSA	46.78	30.88	43.57	111.74
34	OTTAWA	45.40	284.40	56.76	352.51
35	PARAMARIBO	5.82	304.78	16.88	15.13
36	RUDE SKOV	55.85	12.45	55.74	99.16
37	SAKHALINSK	46.95	142.72	37.02	207.33
38	SAN FERNANDO	36.47	353.80	40.81	72.06
39	SAN JUAN	18.12	293.85	29.79	3.98
40	SIMOSATO	33.57	135.93	23.15	203.13
41	ST. JOHN'S	47.60	307.30	58.39	22.17
42	SVERDLOVSK	56.73	61.07	48.45	141.26
43	TASHKENT	41.33	69.62	32.30	144.07
44	TBILISI	42.08	44.70	36.58	122.72
45	TOLEDO	39.88	355.93	43.71	75.39
46	TRIVANDRUM	8.48	76.95	-1.11	147.11
47	TUCSON	32.25	249.17	40.50	313.06
48	VALENTIA	51.93	349.75	56.48	74.18
49	VICTORIA	48.52	236.58	54.27	293.51
50	VLADIVOSTOK	43.68	132.17	32.38	198.60
51	WINGST	53.75	9.07	54.27	95.32
52	WITTEVEEN	52.82	6.67	54.00	91.85

* These coordinates based on different model than that used in Report UAG-38.

As a by-product, we calculated the equatorial Dst index for every 5 minutes from ten mid-latitude observatories' H perturbation values (denoted by ΔH). The observatories used are Dallas, Ebro, Honolulu, M'Bour, Memambetsu, Odessa, Sakhalinsk, San Juan, Tashkent, Vladivostok. The equatorial Dst is given by

$$\text{Dst} = \frac{1}{10} \sum_{i=1}^{10} \Delta H_i \sec \phi_{mi} ,$$

where ϕ_{mi} is the geomagnetic latitude of the i-th observatory. These are the Dst values given by the solid curve in Figure 1.

The iso-intensity contour is drawn in geomagnetic "latitude - local time" coordinates. Figure 3 shows a schematic illustration. The letter H or L in the center of each vortex expresses high or low intensity, respectively, of the magnetic H-component perturbation as compared with the values surrounding the region. Iso-intensity contour lines are drawn for every 20γ intervals. In the actual diagram, contour lines are labelled at every 40γ interval.

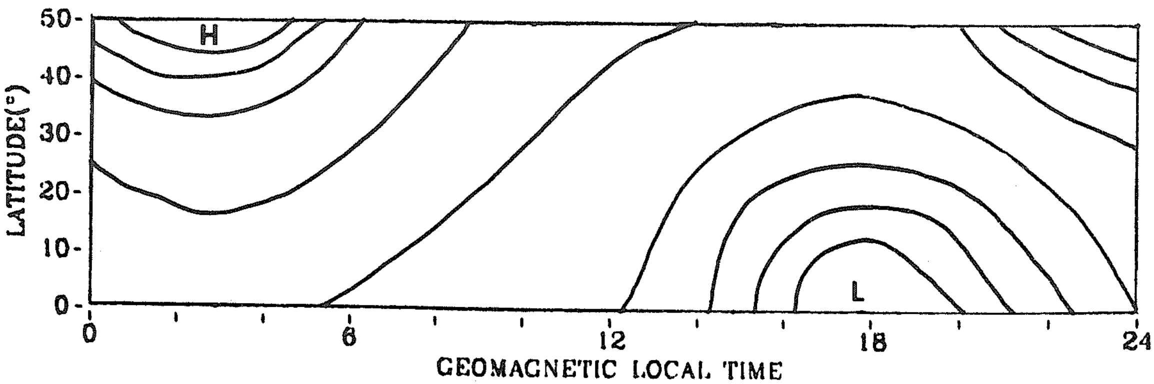

Fig. 3. Schematic iso-intensity contour plot of ground magnetic H perturbations which appear during magnetic substorms and storms.

Because features similar to Figure 3 appear repeatedly in the consecutive patterns of the contour maps, we will briefly discuss some aspects of the currents which produce such characteristic features. There are essentially two different vortices, H and L: H in the early morning and L in the evening sectors. The high vortex is centered in high latitudes, whereas the low vortex is in low latitudes, suggesting that the current sources are different for these two disturbances. If the magnetic disturbances are larger in higher latitudes, field-aligned currents or return currents from the auroral electrojet or a combination of the two could be the source currents. That is, either the field-aligned currents flowing into the morning part and out from the evening part of the ionosphere or eastward ionospheric currents will produce the same kind of distributions of the positive H perturbations on the earth's surface. If the magnetic disturbances are largest in the equatorial region and decrease with an increase of the latitude, the ring current in the magnetosphere may be responsible for such a magnetic signature. In this way, the negative H perturbations could be explained by the partial (westward) ring current in the evening sector. Note, however, that actual patterns observed during the storm period are not as simple as this, but there often appear several complicated vortices which require detailed examination for each pattern of these cases.

In Figure 4, we show an actual example of the obtained iso-intensity contours, the one for 1705 UT on December 17, 1971. This particular example was taken from the early main phase of the magnetic storm when auroral electrojet activity reached nearly its maximum value. The AU(11) and AL(11) indices and the Dst indices are plotted for every 5 minutes for the entire 60-hr interval. Time is identified along the bottom of the index plots, 3 hours per tick mark. The time, for which the iso-intensity contour is illustrated in the lower half of the Figure, is marked by the vertical timing bar which in the movie film and the excerpts given in this report moves from left to right as time progresses. Universal time and date are identified at the top right of the contour plot.

4. Availability of Detailed Data

The full data set is available on a 16-mm movie film 575 feet in length. Each frame on the movie shows a frame like Figure 4 every 30 seconds, and is repeated two times to allow the viewers to follow the progression of the storm disturbances. Film copies may be obtained from the Data Studies Division, NOAA/EDS/NGSDC, Boulder, Colorado 80302, U.S.A., at a cost of $60.00 per film.

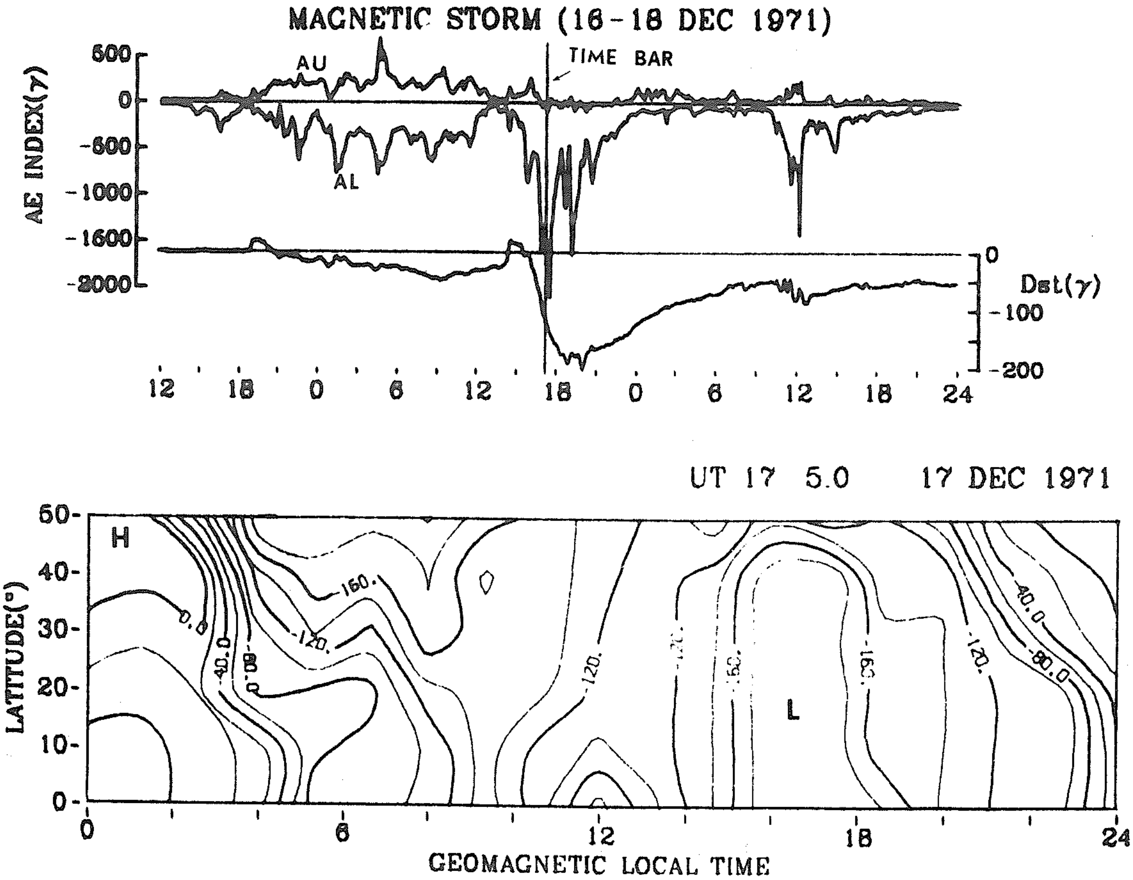

Fig. 4. Example of the iso-intensity contour and the corresponding geomagnetic activity indices.

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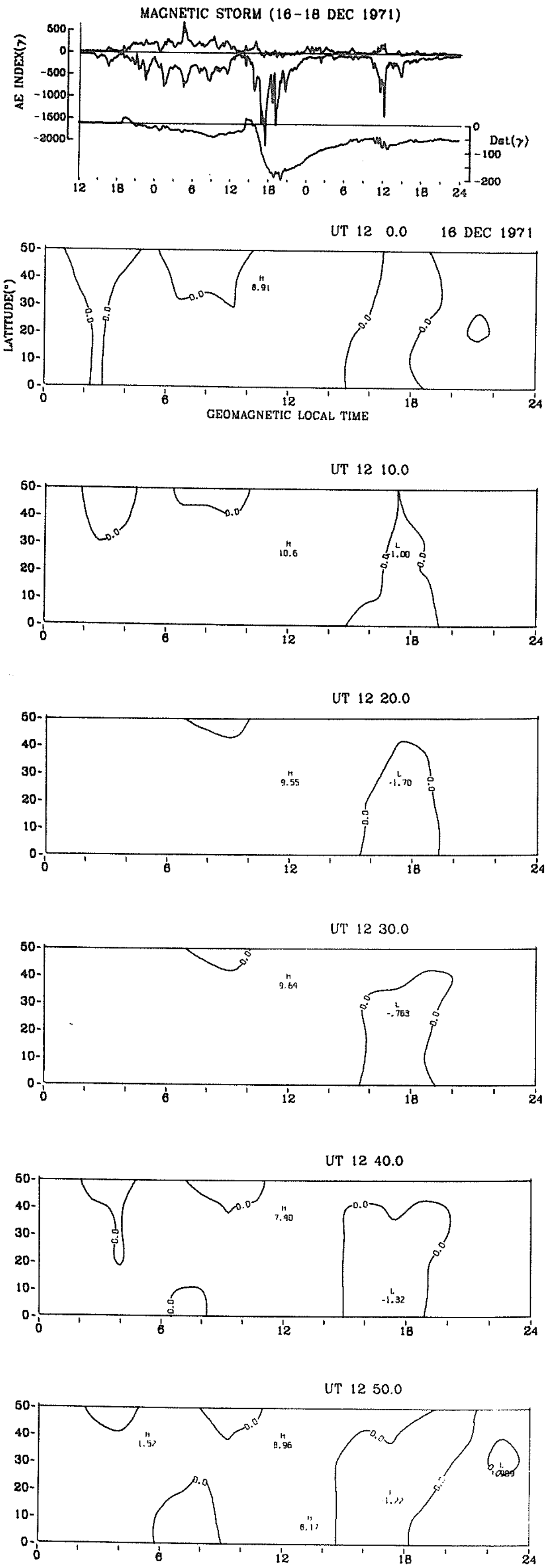
PART II

The 10-minute Plots

The iso-intensity contours are shown for every 10 minutes, with plots covering two hours on each page. At the top of each page the AU(11) and AL(11) indices and the equatorial Dst index are plotted for the entire 60-hr period with the timing bar corresponding to the Universal Time of the first contour map of each hour.

Universal Time and date are identified for each contour plot. Geomagnetic noon is fixed at the center of each contour plot, so that the earth's rotation effect is eliminated in seeing the progressive change of the contour pattern.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AE INDEX(γ)
Dst(γ)
UT 12 0.0
16 DEC 1971
LATITUDE(°)
GEOMAGNETIC LOCAL TIME
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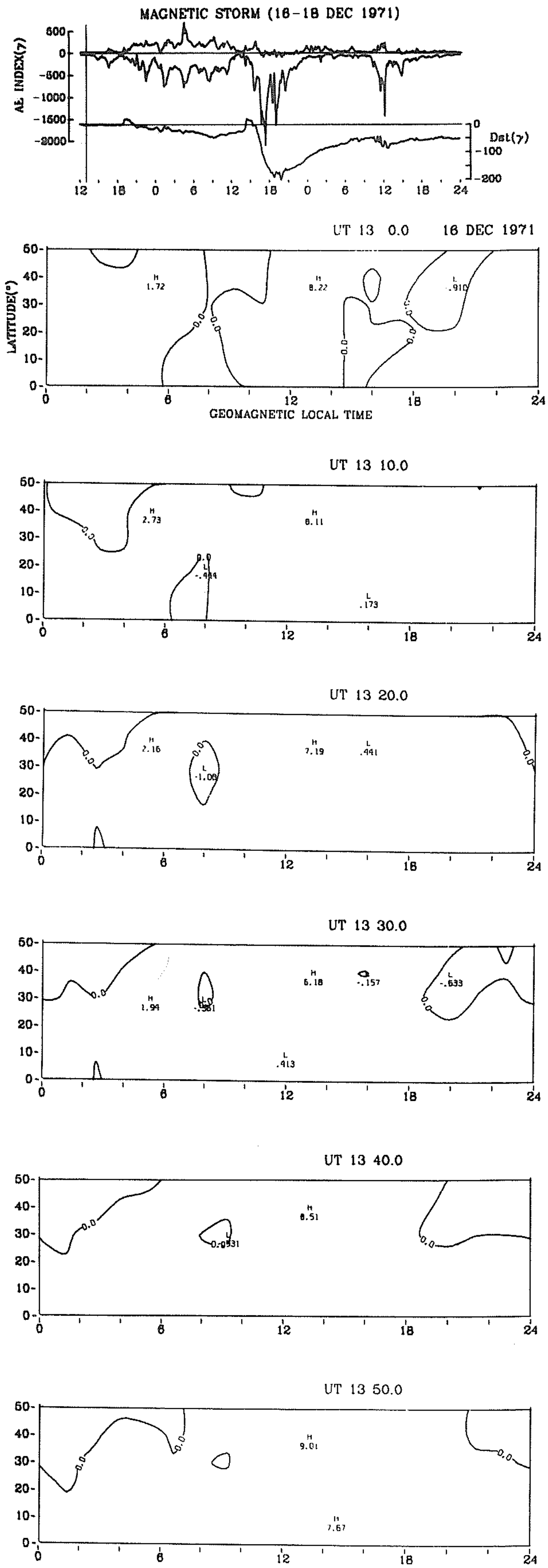
UT 12 20.0
UT 12 30.0
UT 12 40.0
UT 12 50.0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16 DEC 1971
LATITUDE(°)
GEOMAGNETIC LOCAL TIME
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UT 13 20.0
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UT 13 40.0
UT 13 50.0

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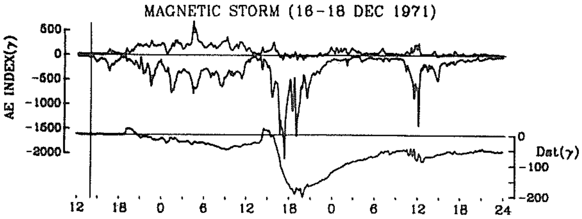

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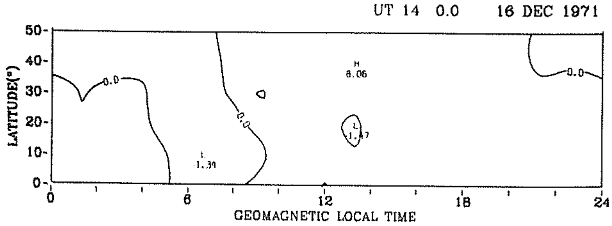

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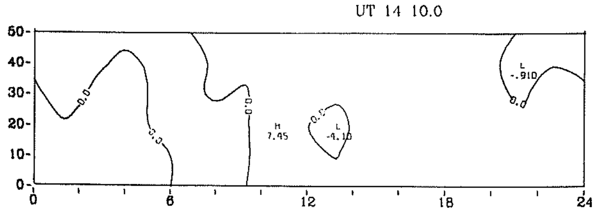

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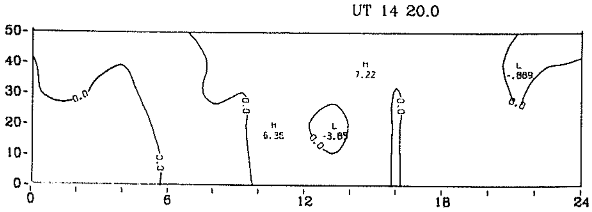

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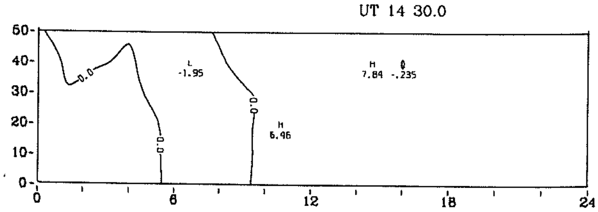

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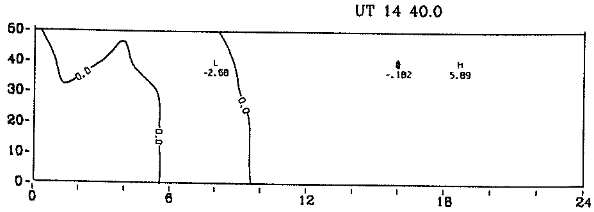

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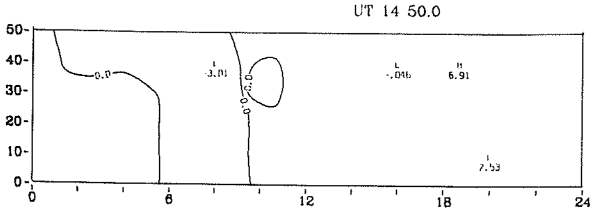

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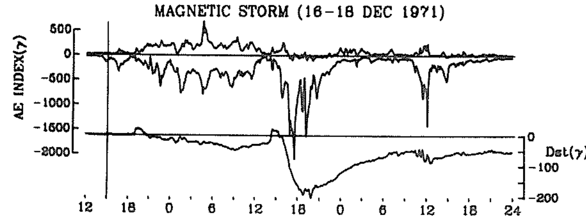

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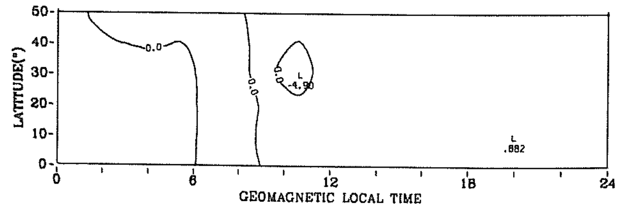

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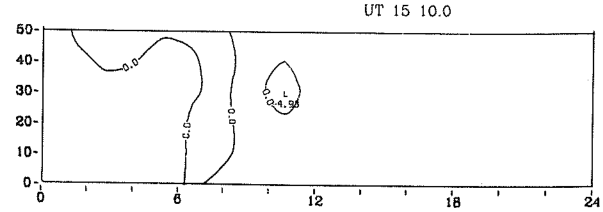

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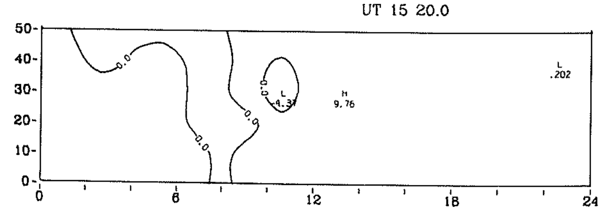

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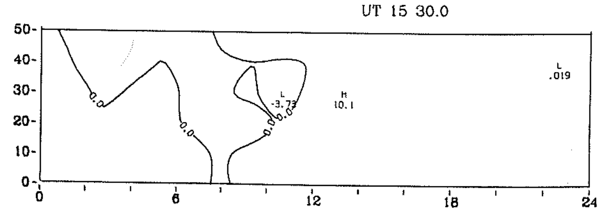

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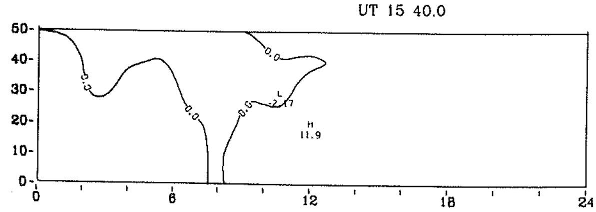

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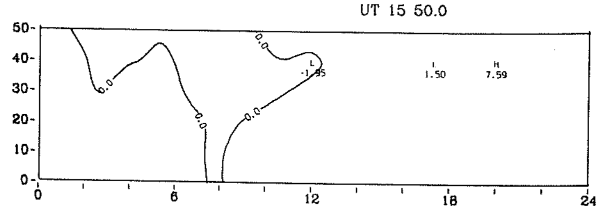

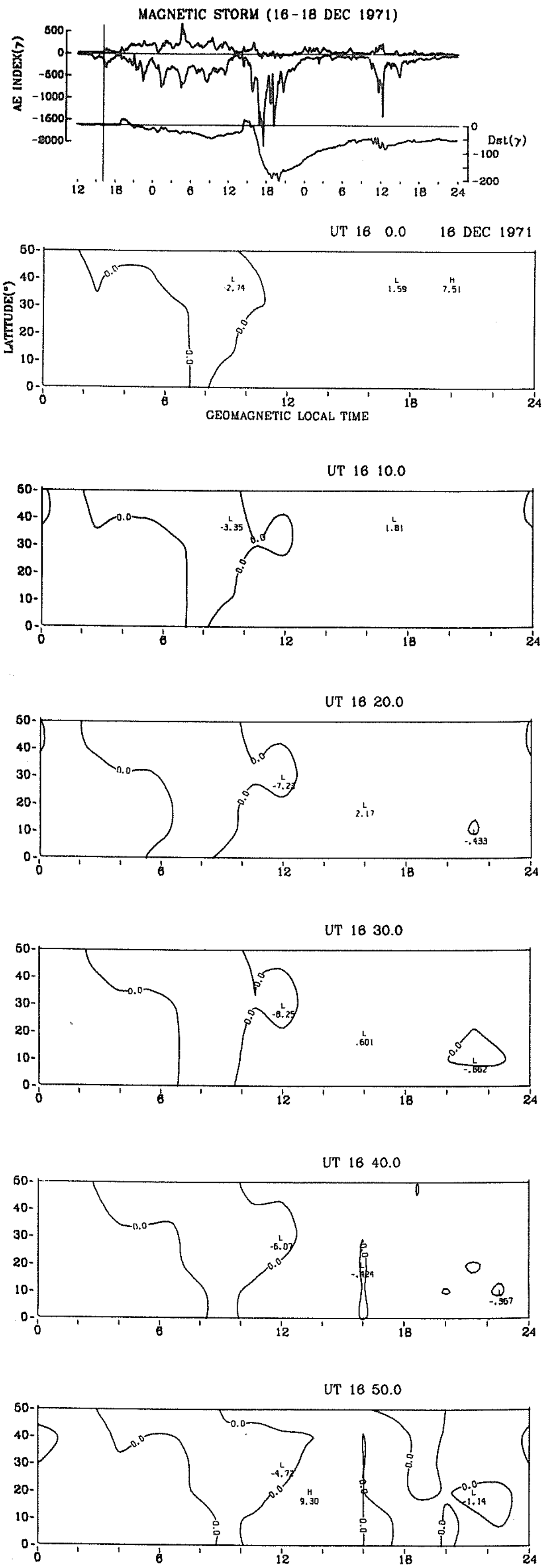
MAGNETIC STORM (16-18 DEC 1971)
AE INDEX(γ)
Dst(γ)
UT 16 0.0 16 DEC 1971
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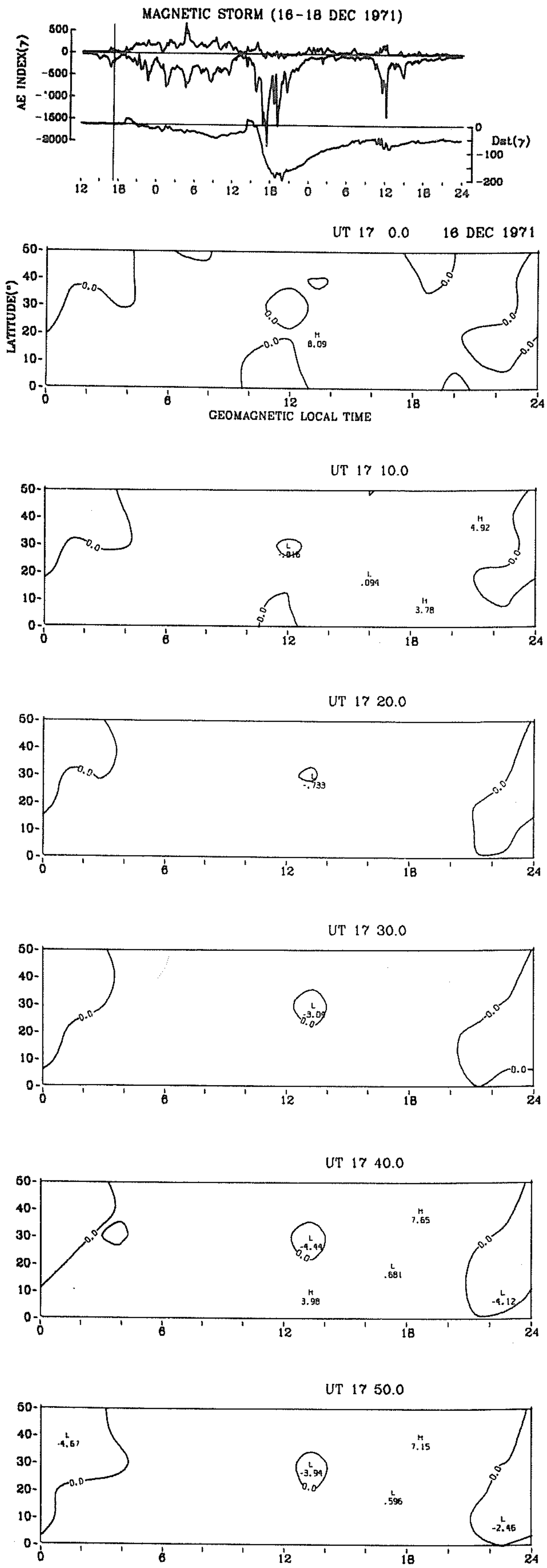
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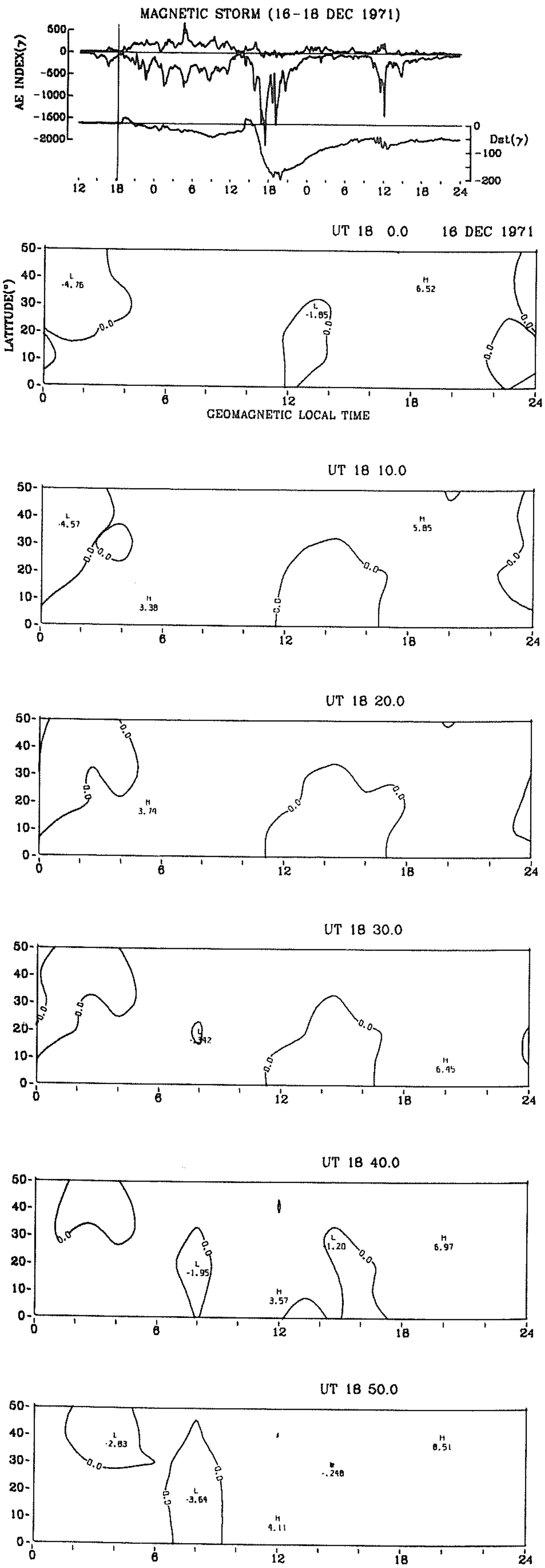
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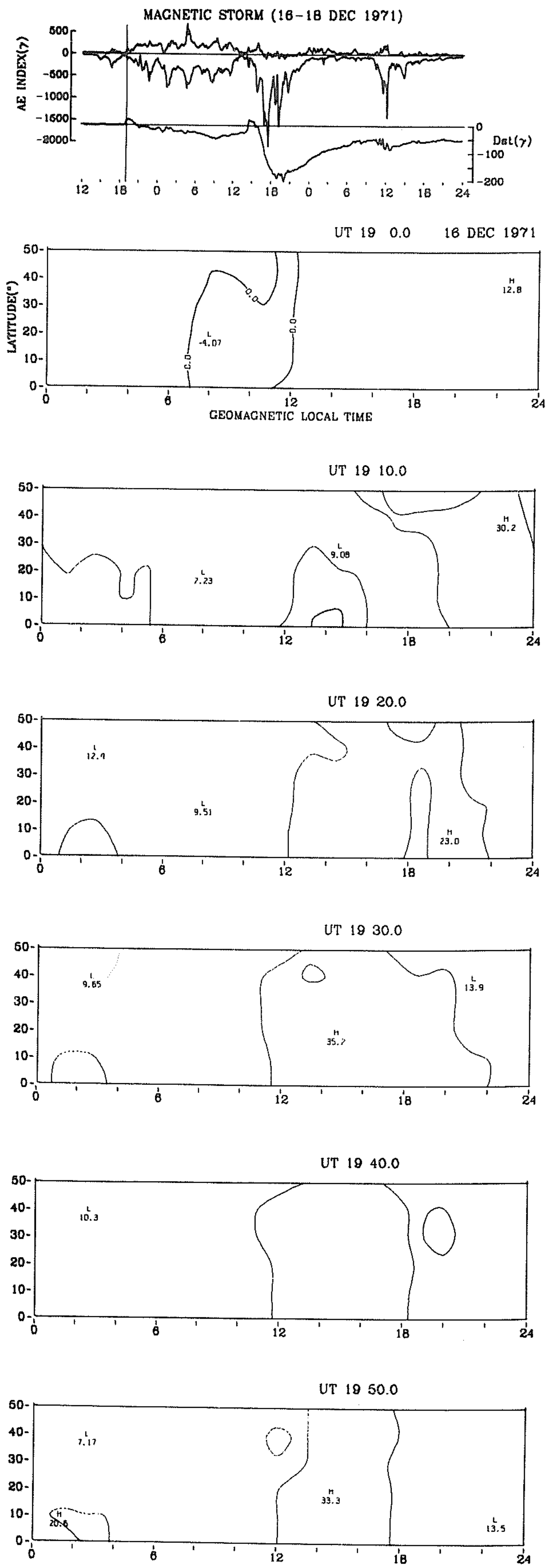
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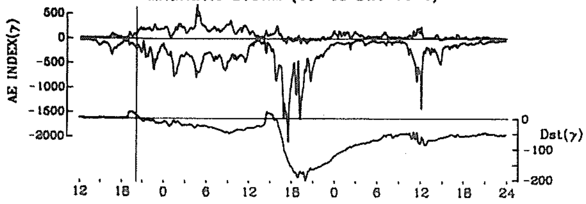

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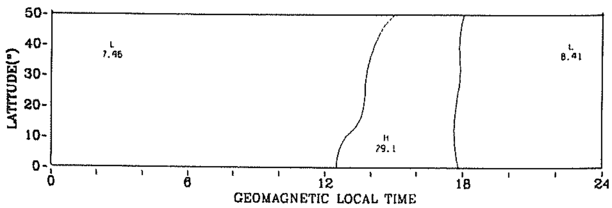

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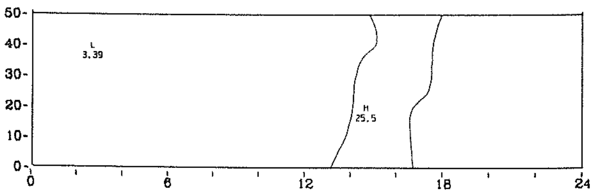

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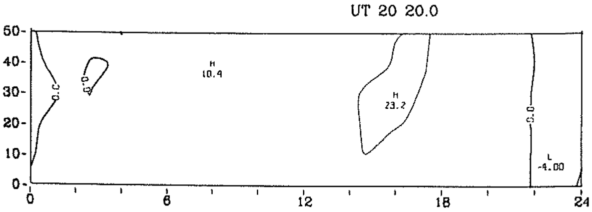

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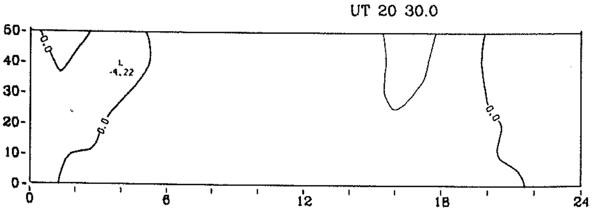

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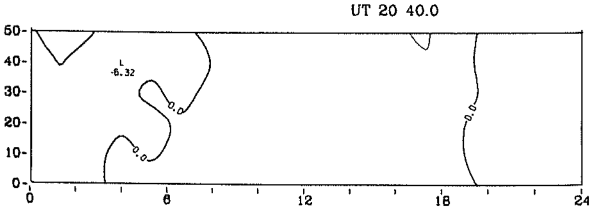

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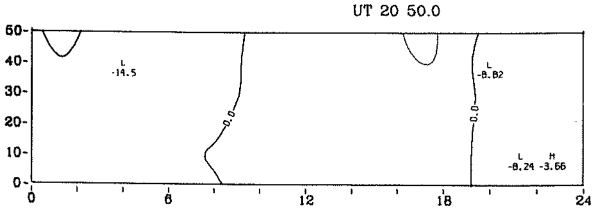

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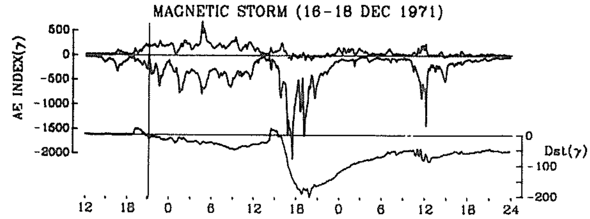

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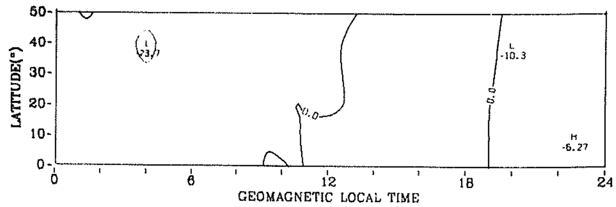

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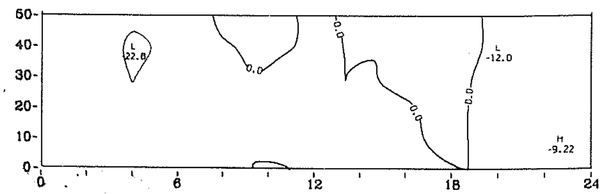

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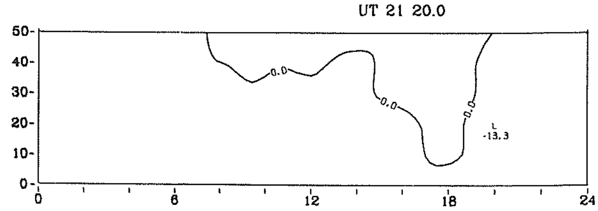

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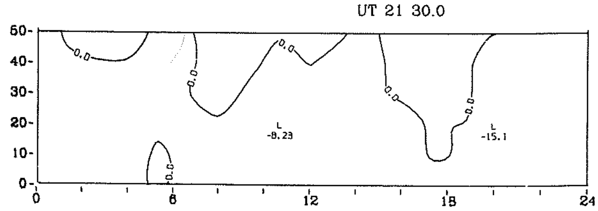

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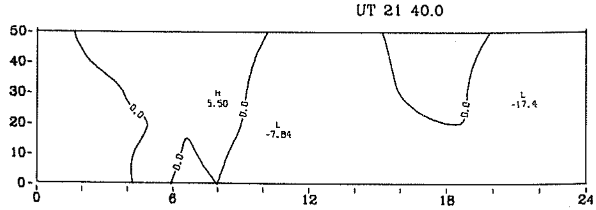

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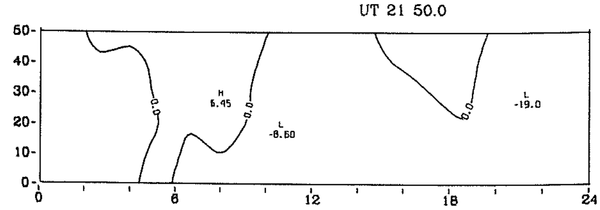

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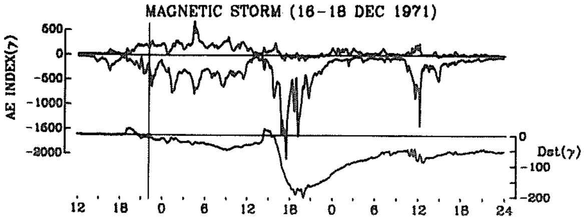

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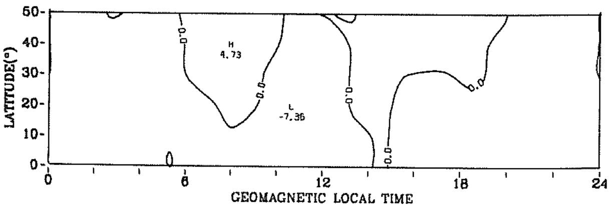

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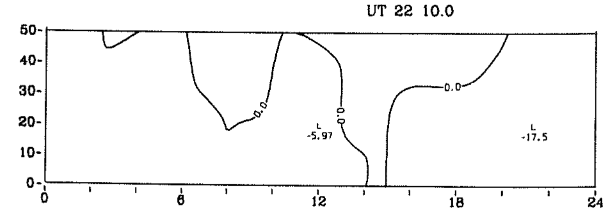

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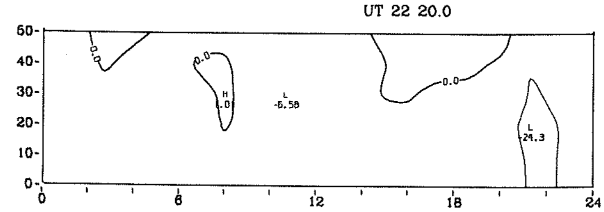

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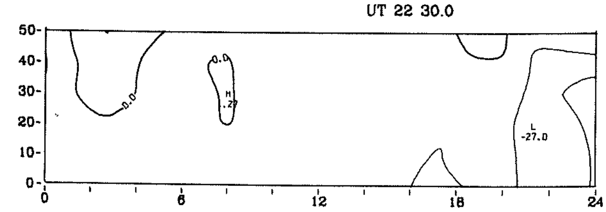

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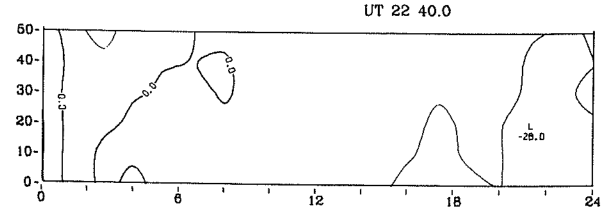

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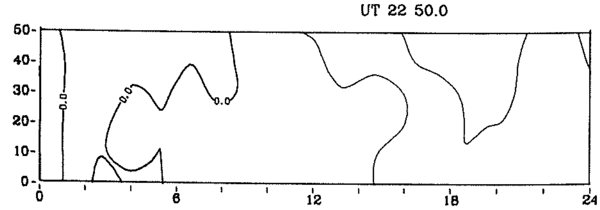

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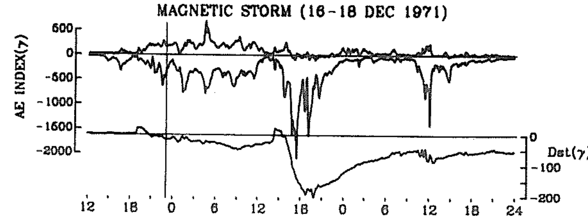

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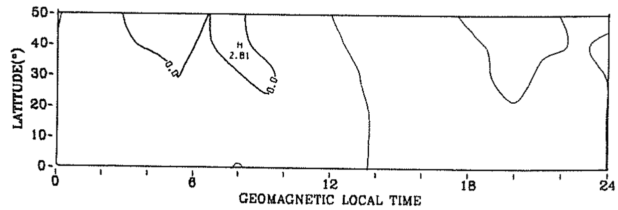

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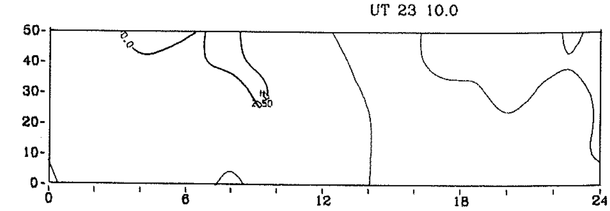

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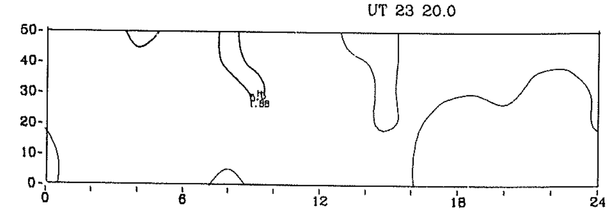

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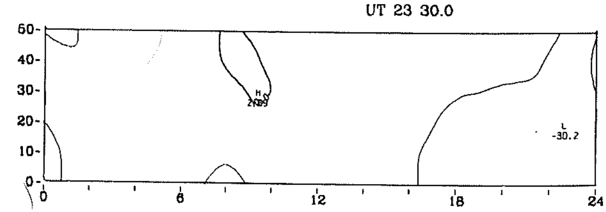

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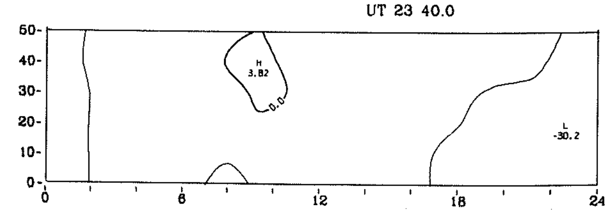

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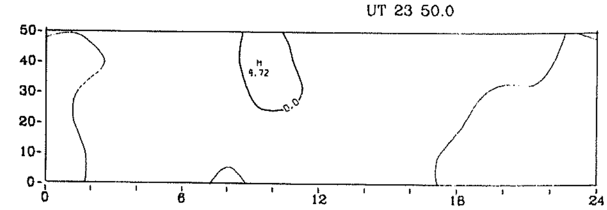

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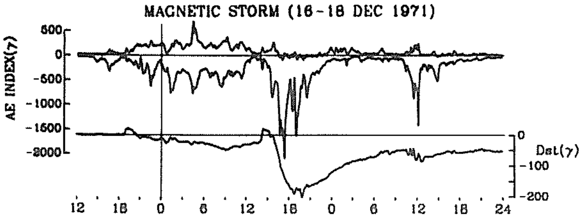

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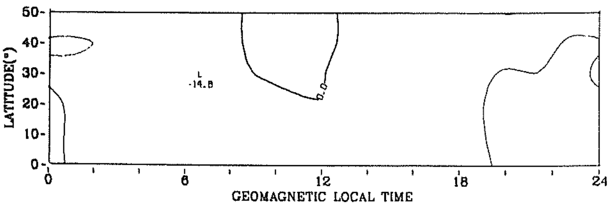

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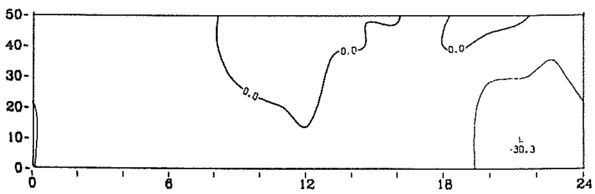

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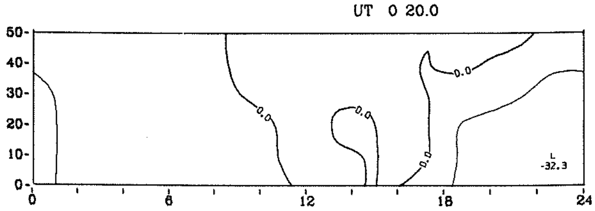

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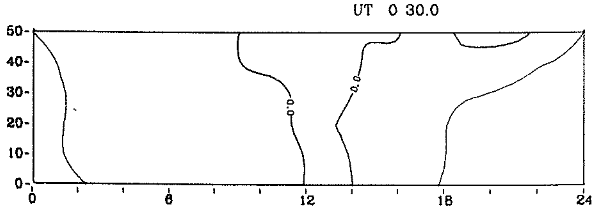

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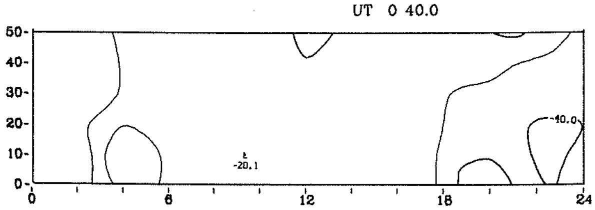

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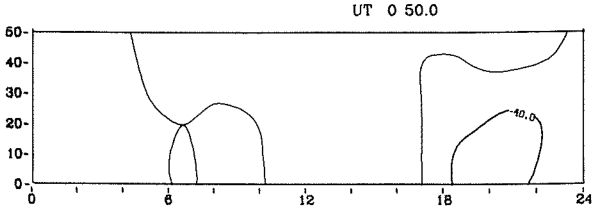

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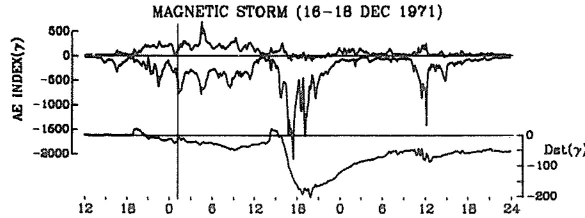

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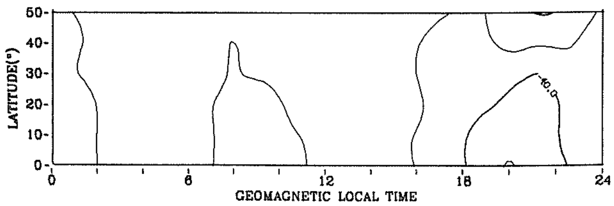

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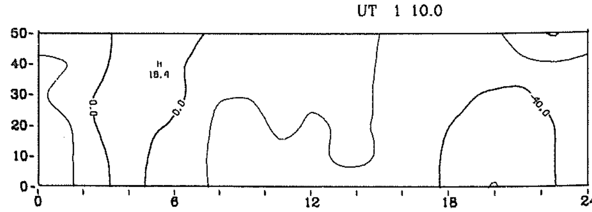

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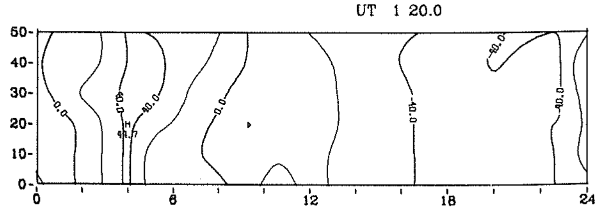

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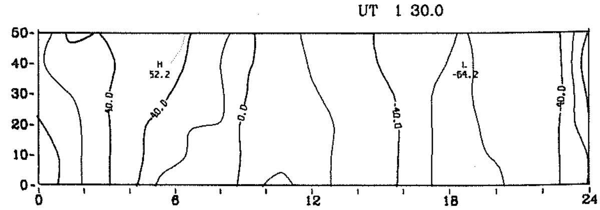

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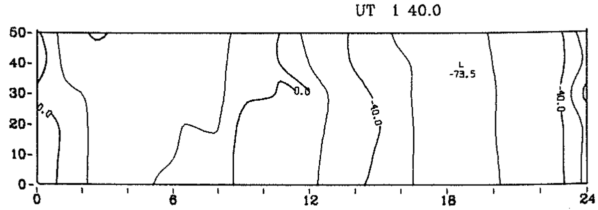

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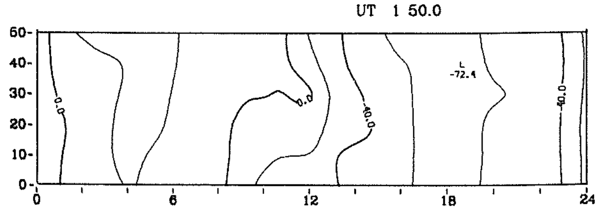

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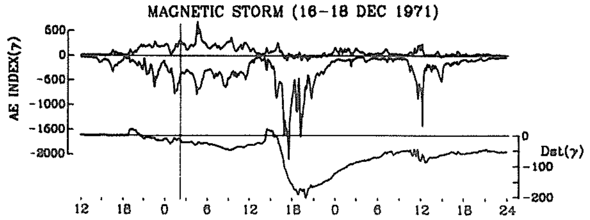

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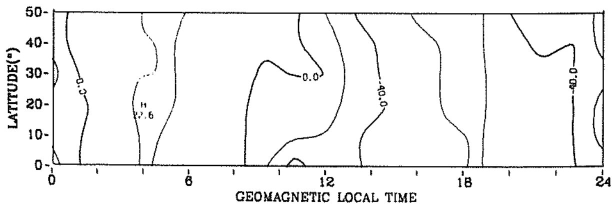

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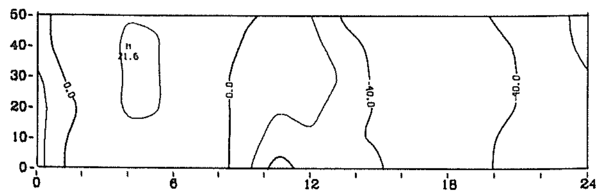

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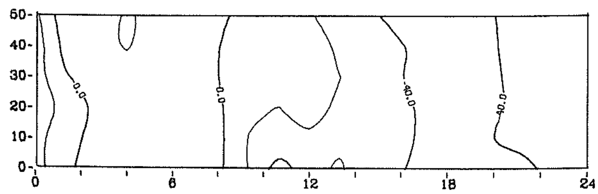

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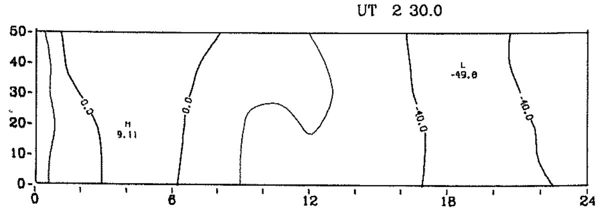

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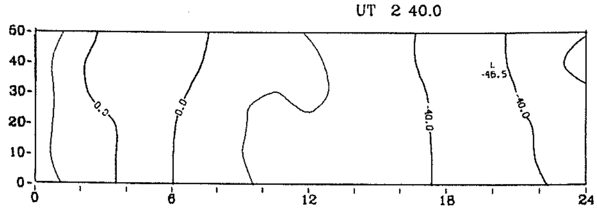

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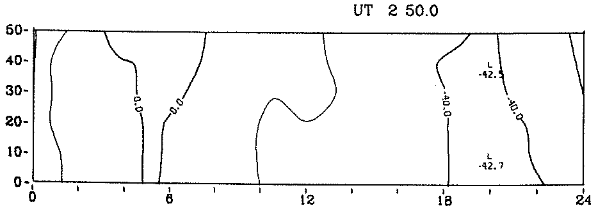

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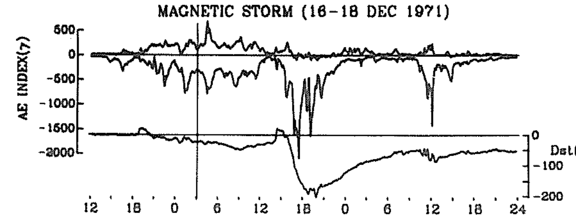

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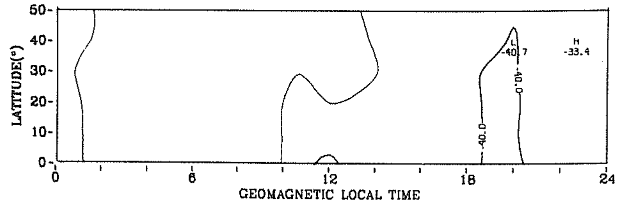

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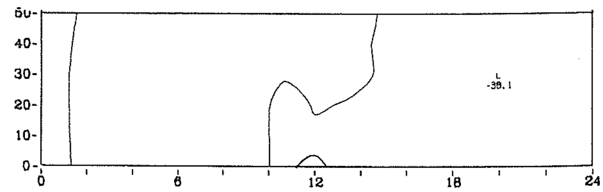

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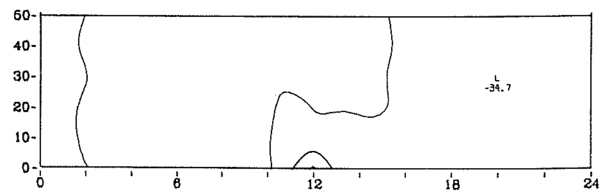

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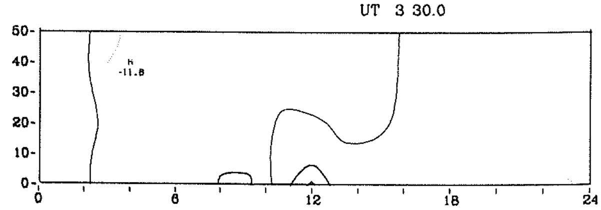

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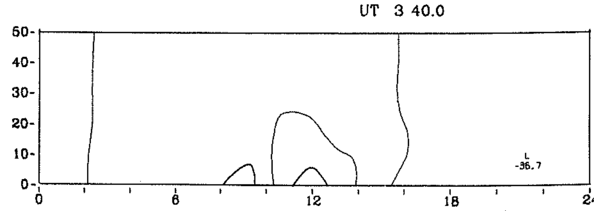

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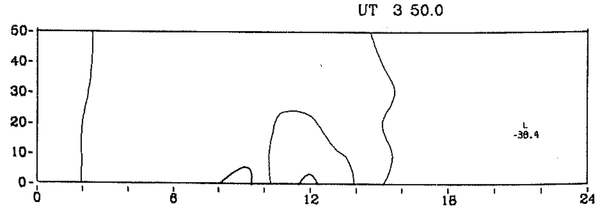

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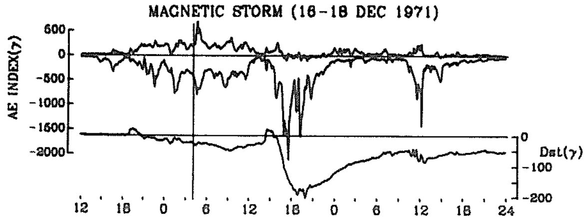

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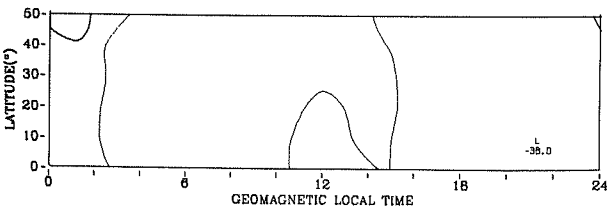

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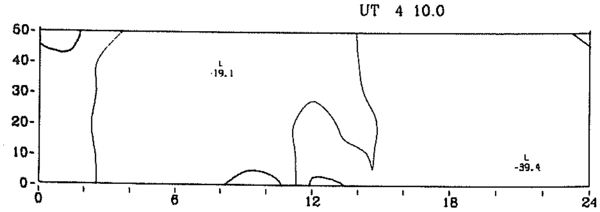

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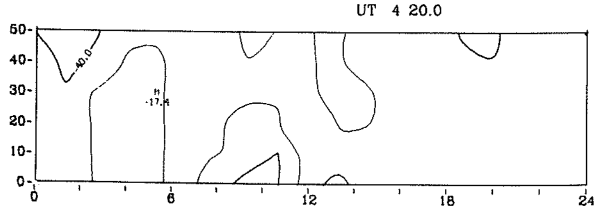

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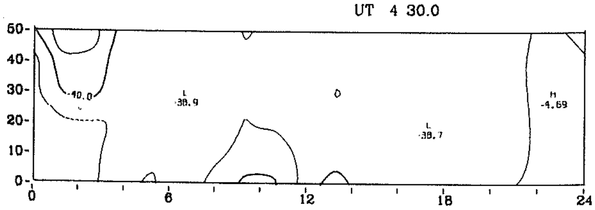

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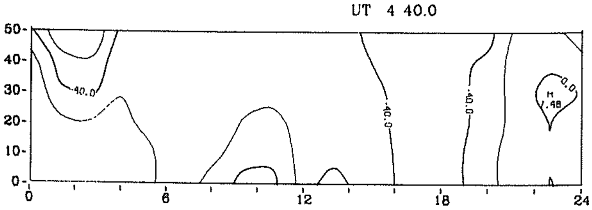

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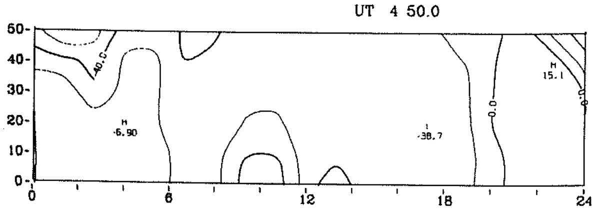

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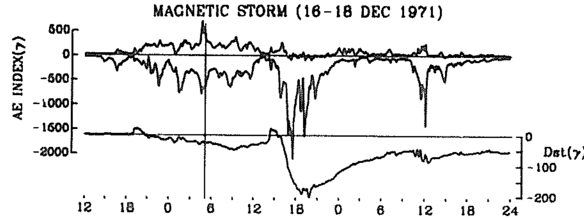

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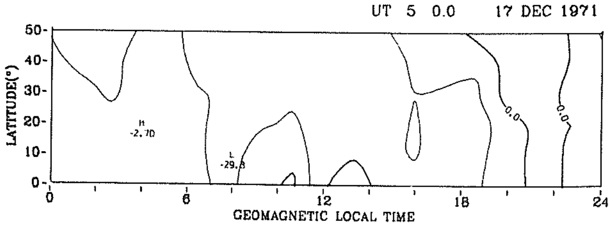

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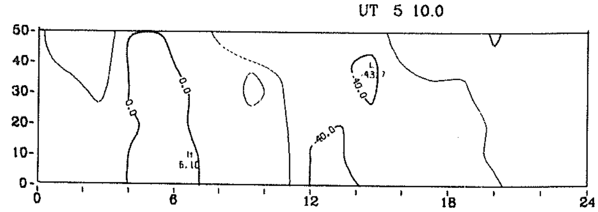
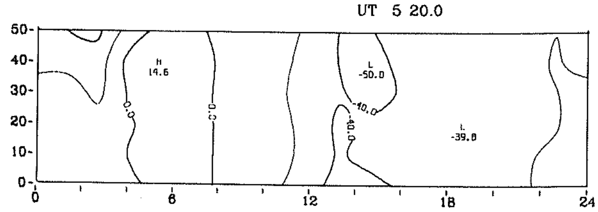
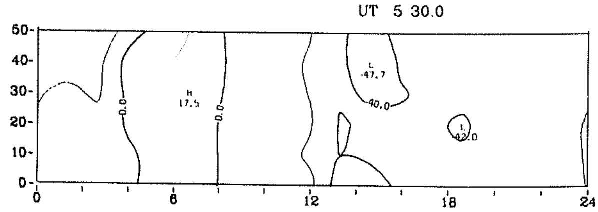


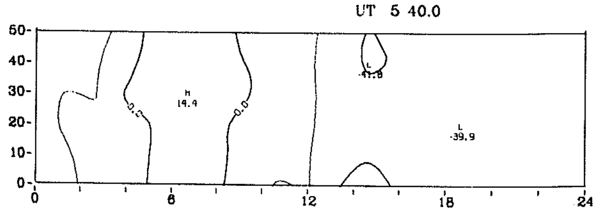
UT 5 20.0



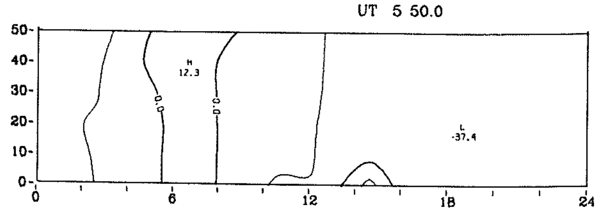
UT 5 30.0

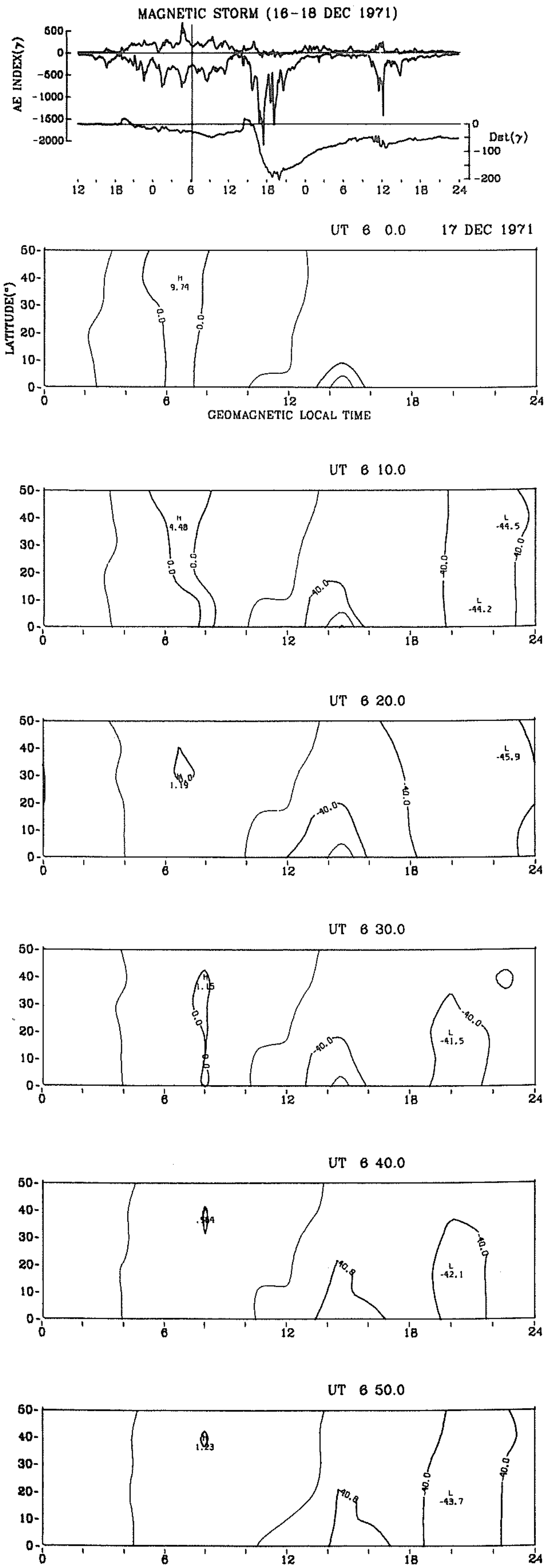


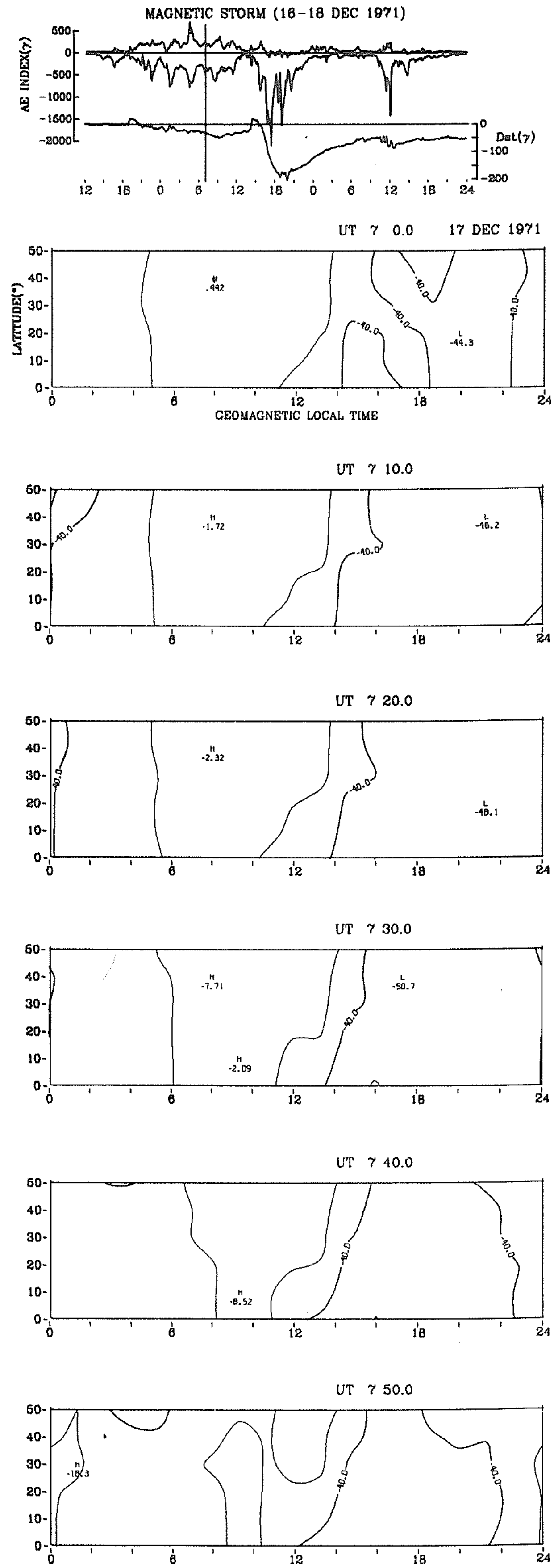
UT 5 40.0

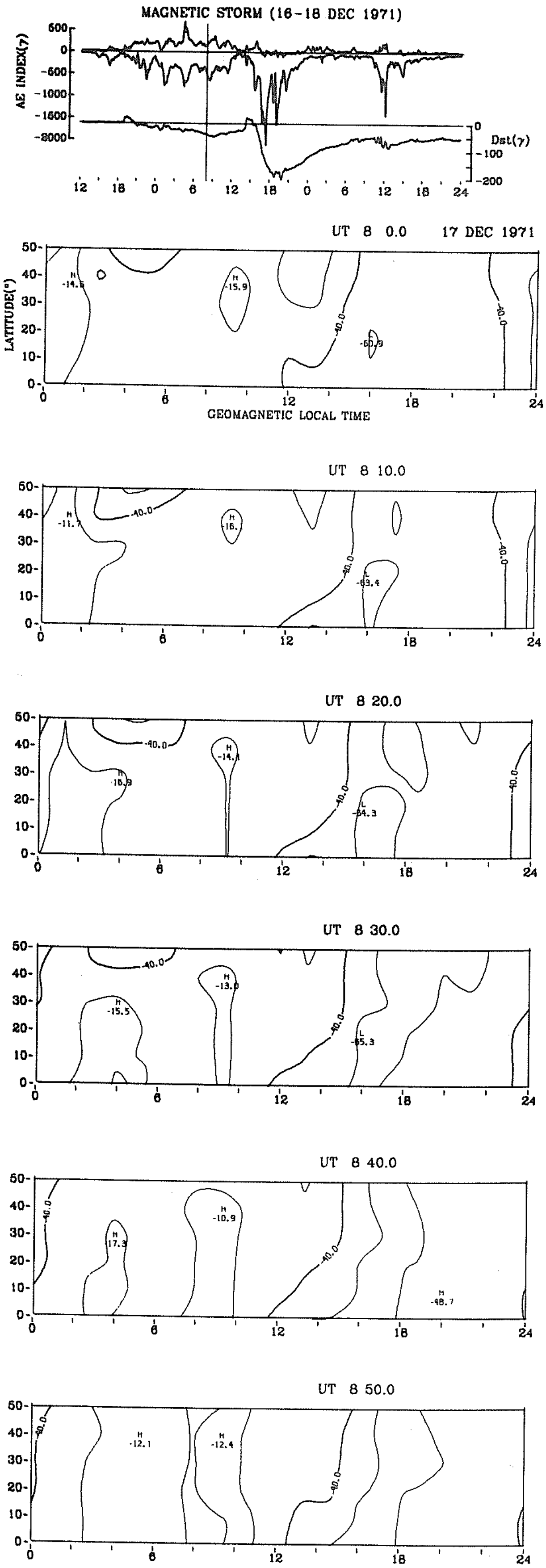


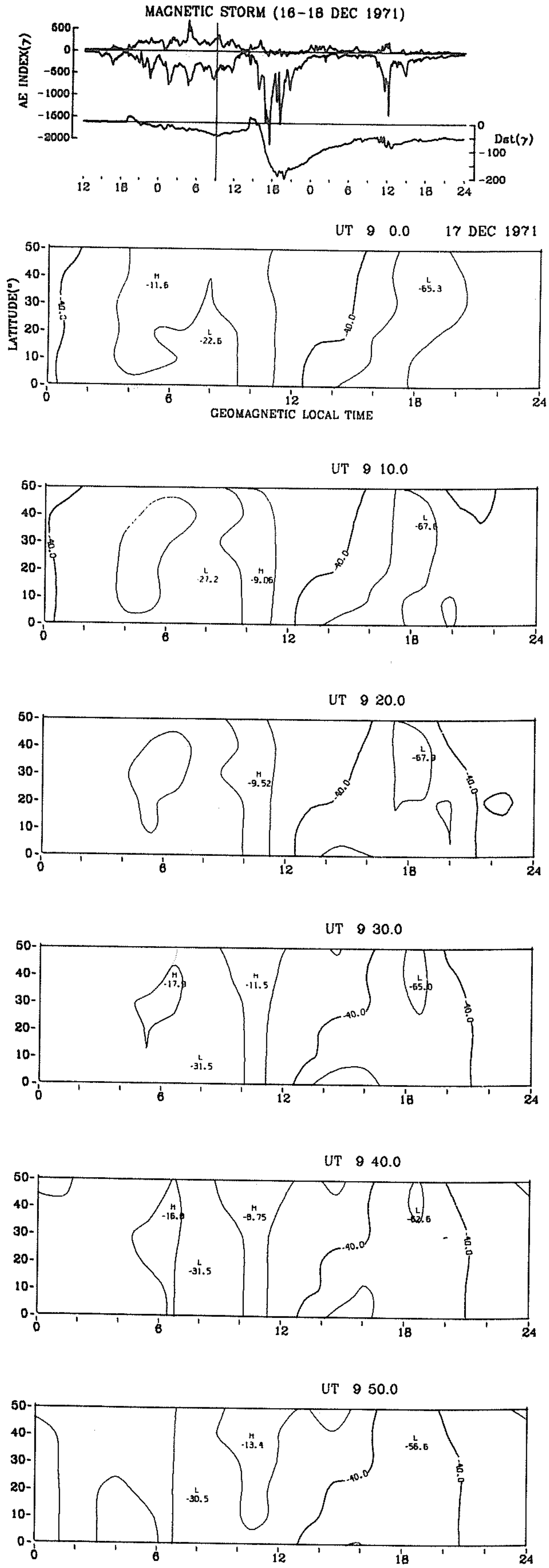
UT 5 50.0



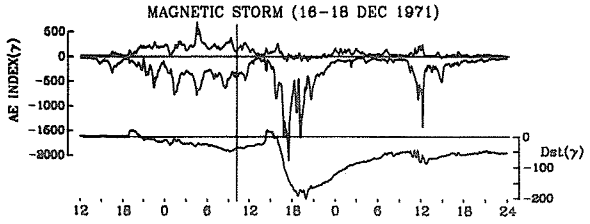

MAGNETIC STORM (16-18 DEC 1971)
AE INDEX(γ)
Dst(γ)
UT 6 0.0 17 DEC 1971
LATITUDE(°)
GEOMAGNETIC LOCAL TIME
UT 6 10.0
UT 6 20.0
UT 6 30.0
UT 6 40.0
UT 6 50.0


MAGNETIC STORM (16-18 DEC 1971)
AE INDEX(γ)
Dst(γ)
UT 7 0.0 17 DEC 1971
LATITUDE(°)
GEOMAGNETIC LOCAL TIME
UT 7 10.0
UT 7 20.0
UT 7 30.0
UT 7 40.0
UT 7 50.0

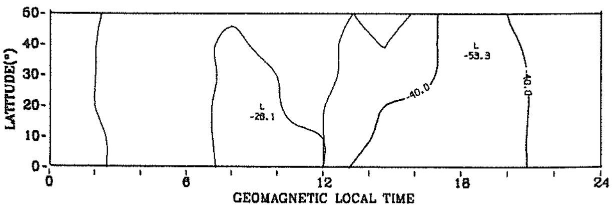

MAGNETIC STORM (16-18 DEC 1971)
AE INDEX(γ)
Dst(γ)
UT 8 0.0 17 DEC 1971
LATITUDE(°)
GEOMAGNETIC LOCAL TIME
UT 8 10.0
UT 8 20.0
UT 8 30.0
UT 8 40.0
UT 8 50.0


MAGNETIC STORM (16-18 DEC 1971)
AE INDEX(γ)
Dst(γ)
UT 9 0.0 17 DEC 1971
LATITUDE(°)
GEOMAGNETIC LOCAL TIME
UT 9 10.0
UT 9 20.0
UT 9 30.0
UT 9 40.0
UT 9 50.0

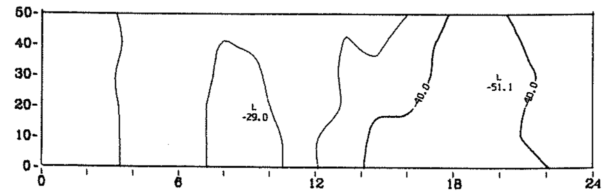
MAGNETIC STORM (16-18 DEC 1971)



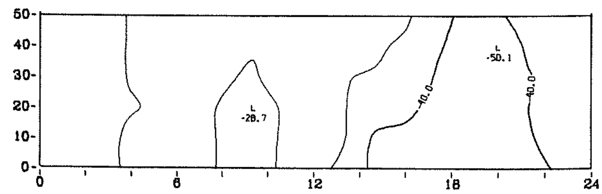
UT 10 0.0 17 DEC 1971



UT 10 10.0



UT 10 20.0



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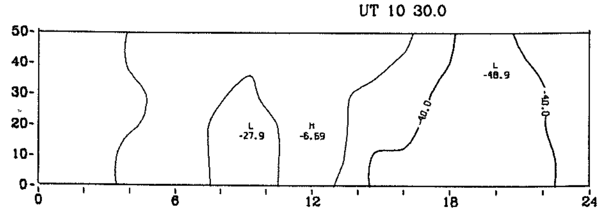
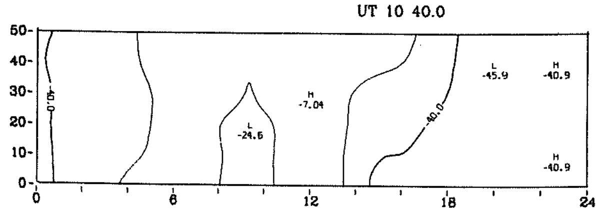


UT 10 40.0



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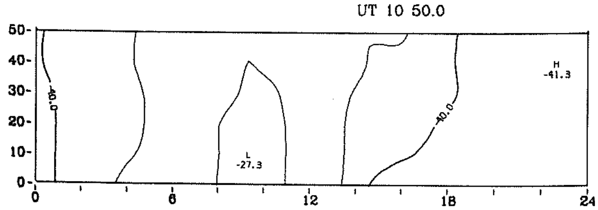
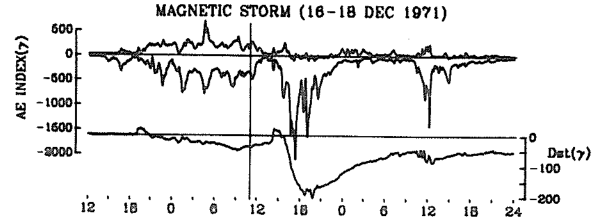
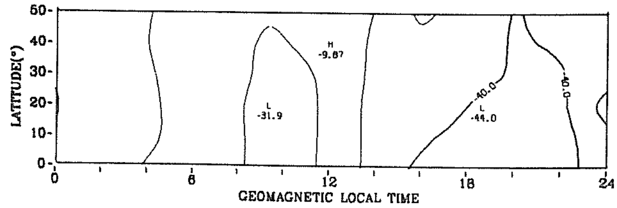


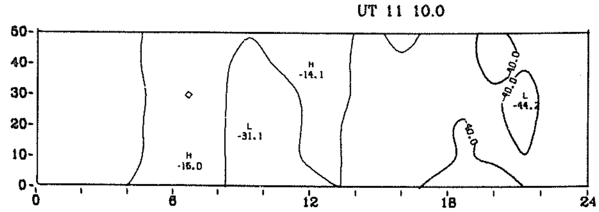
MAGNETIC STORM (16-18 DEC 1971)



UT 11 0.0 17 DEC 1971



UT 11 10.0



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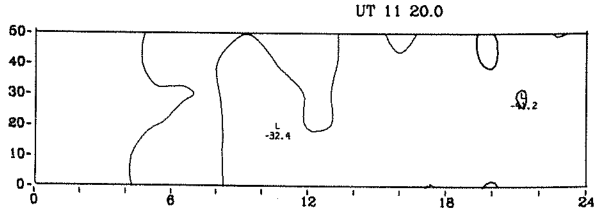

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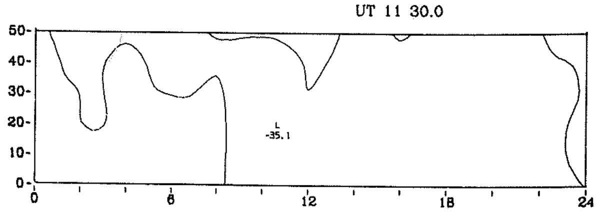

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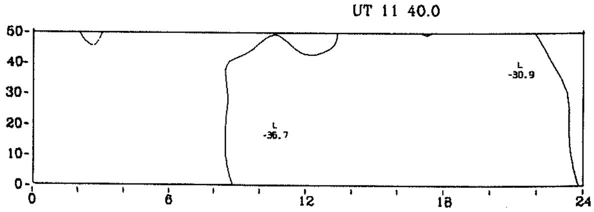

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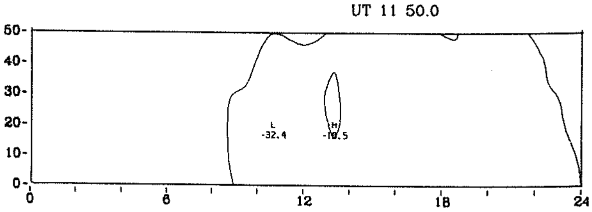
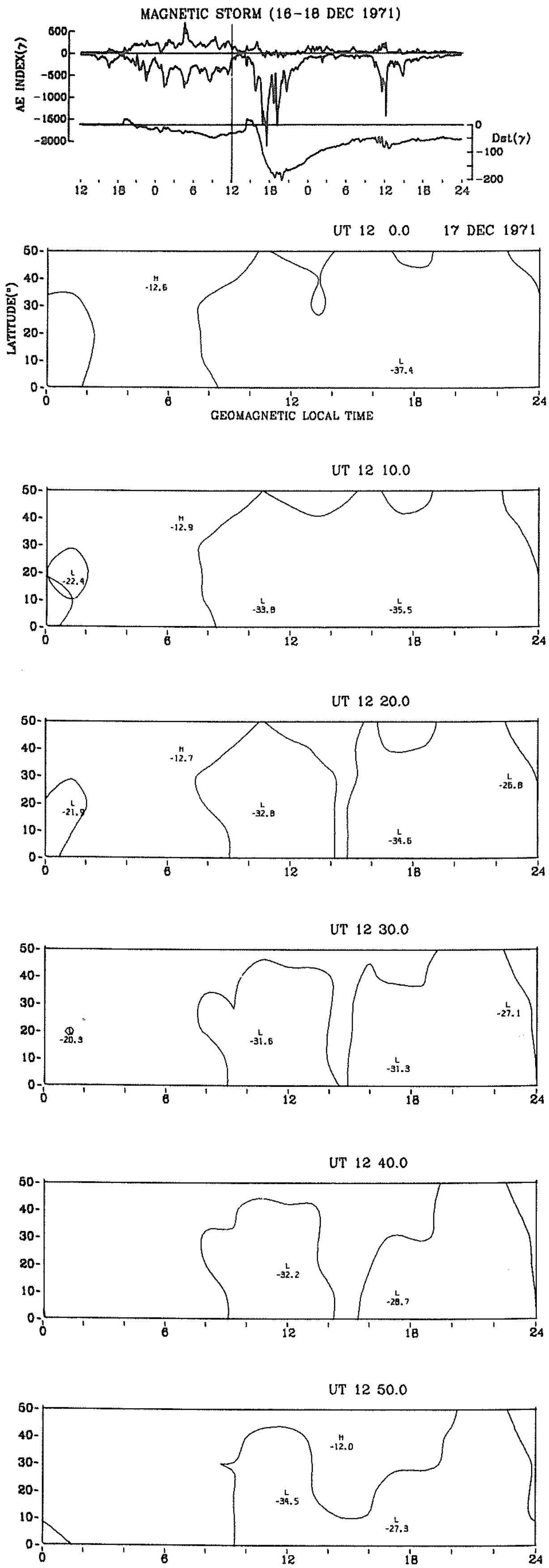
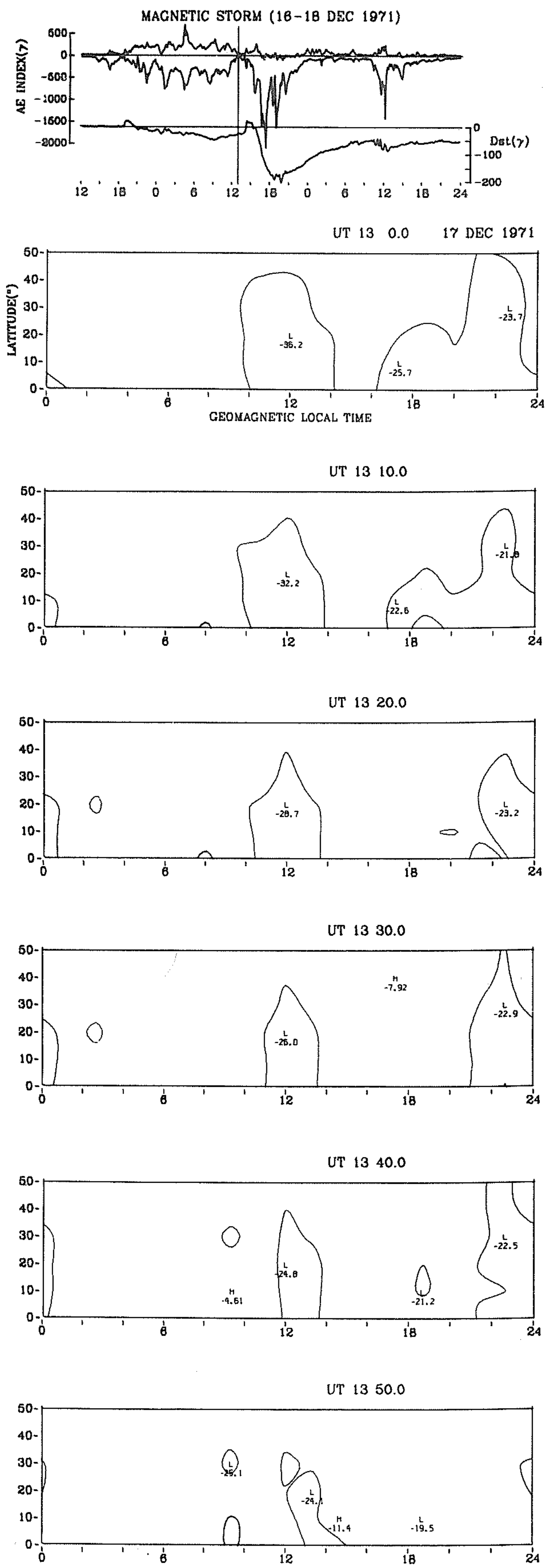


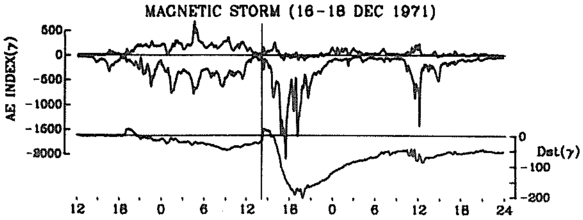


MAGNETIC STORM (16-18 DEC 1971)
AE INDEX(γ)
Dst(γ)
UT 12 0.0 17 DEC 1971
LATITUDE(°)
GEOMAGNETIC LOCAL TIME
H -12.6
L -37.4
UT 12 10.0
H -12.9
L -22.4
L -33.8
L -35.5
UT 12 20.0
H -12.7
L -21.9
L -32.8
L -34.6
L -26.8
UT 12 30.0
-20.3
L -31.6
L -31.3
L -27.1
UT 12 40.0
L -32.2
L -28.7
UT 12 50.0
H -12.0
L -34.5
L -27.3

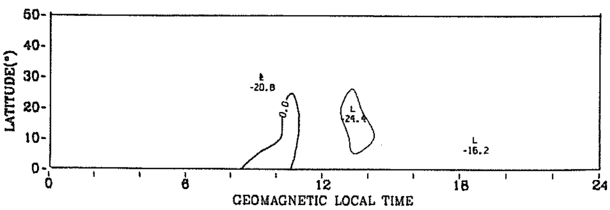


MAGNETIC STORM (16-18 DEC 1971)
AE INDEX(γ)
Dst(γ)
UT 13 0.0 17 DEC 1971
LATITUDE(°)
GEOMAGNETIC LOCAL TIME
L -36.2
L -25.7
L -23.7
UT 13 10.0
L -32.2
L -22.6
L -21.8
UT 13 20.0
L -28.7
L -23.2
UT 13 30.0
H -7.92
L -26.0
L -22.9
UT 13 40.0
H -4.61
L -24.8
L -21.2
L -22.5
UT 13 50.0
L -24.2
H -11.4
L -19.5

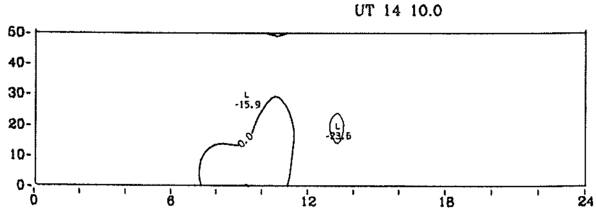
MAGNETIC STORM (16-18 DEC 1971)



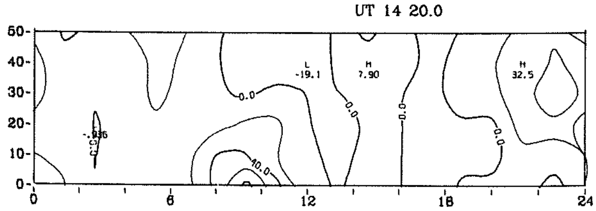
UT 14 0.0 17 DEC 1971



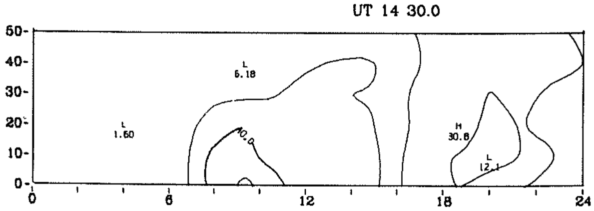
UT 14 10.0



UT 14 20.0



UT 14 30.0



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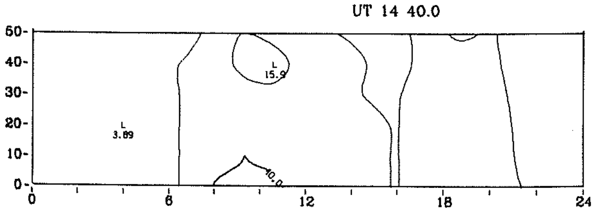
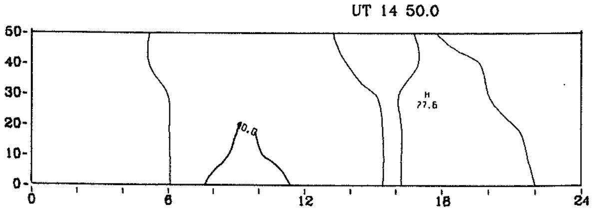
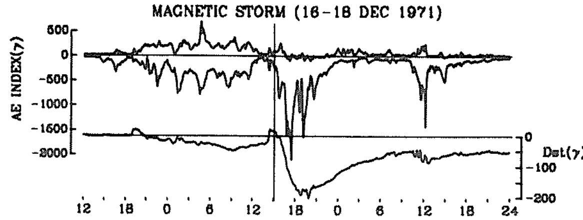


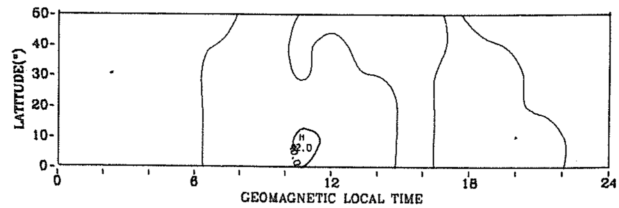
UT 14 50.0



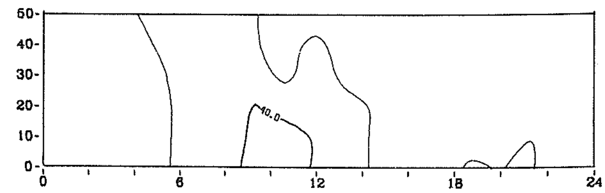
MAGNETIC STORM (16-18 DEC 1971)



UT 15 0.0 17 DEC 1971



UT 15 10.0



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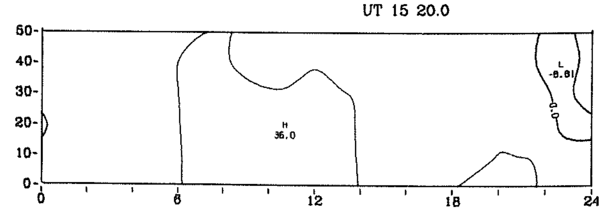

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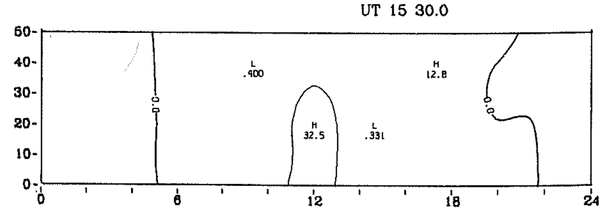

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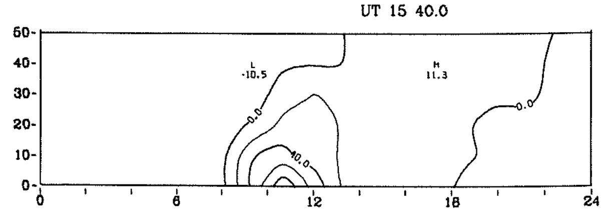
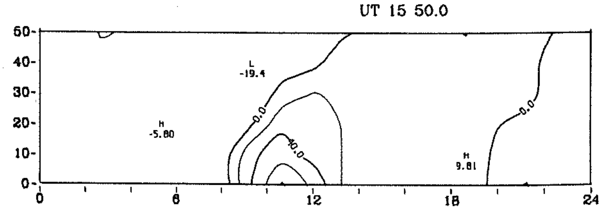
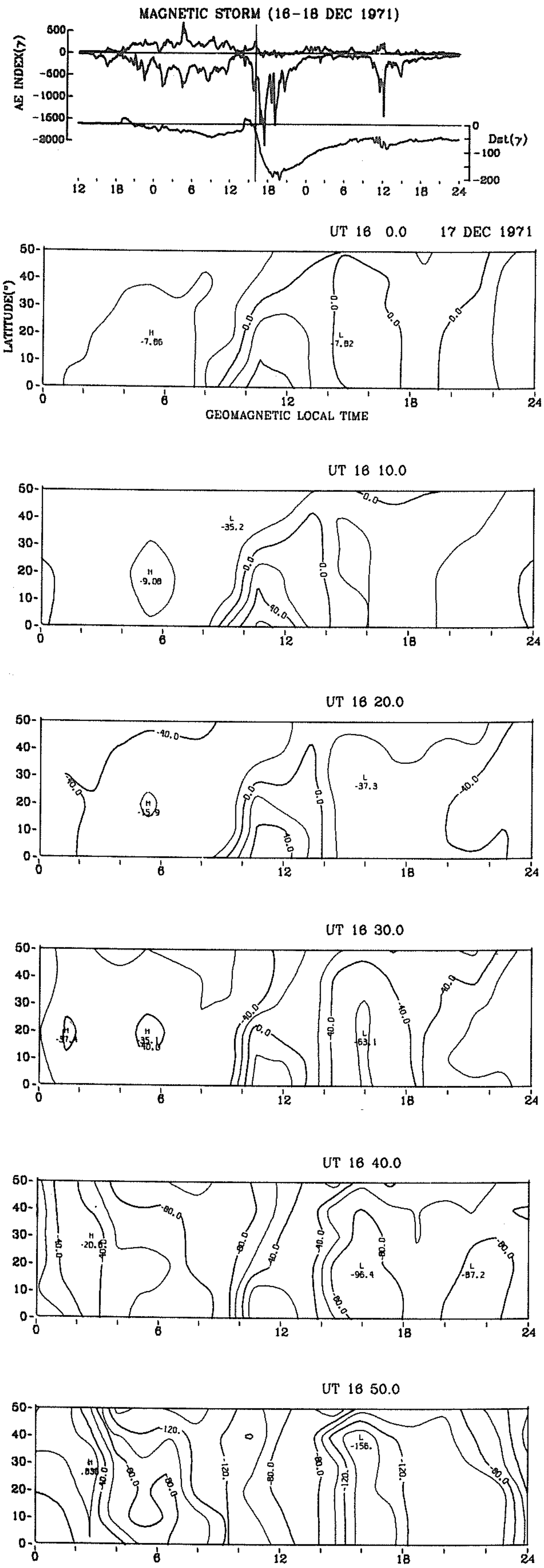
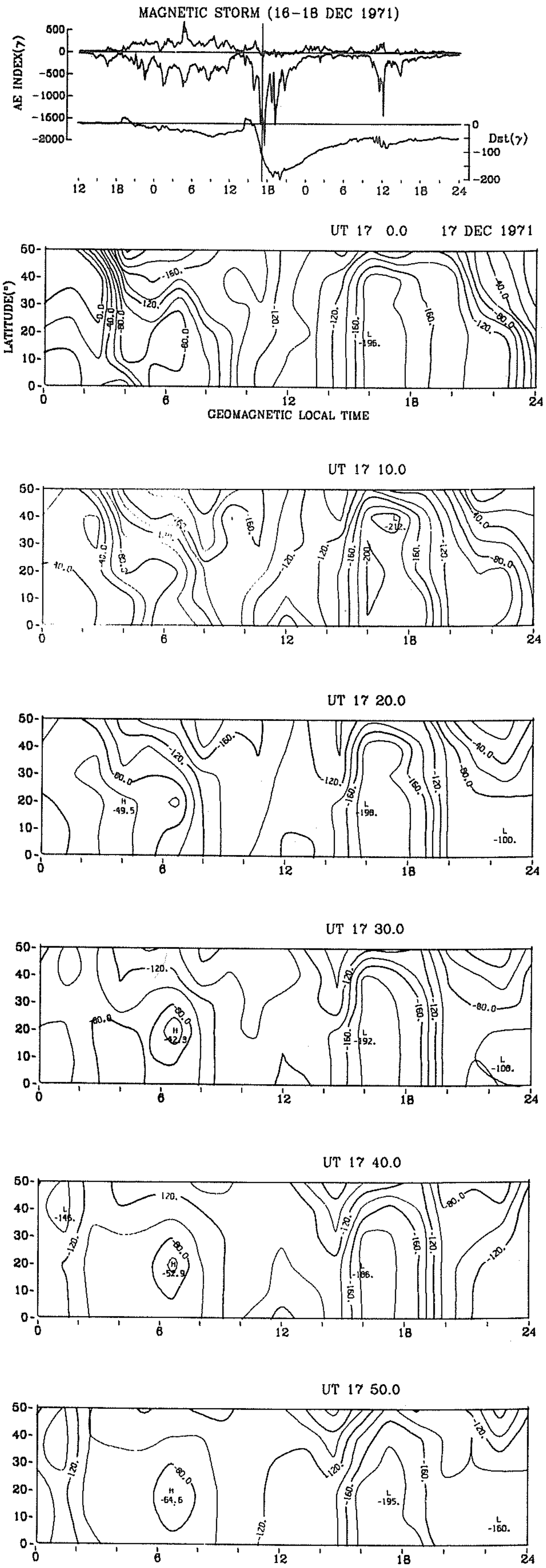
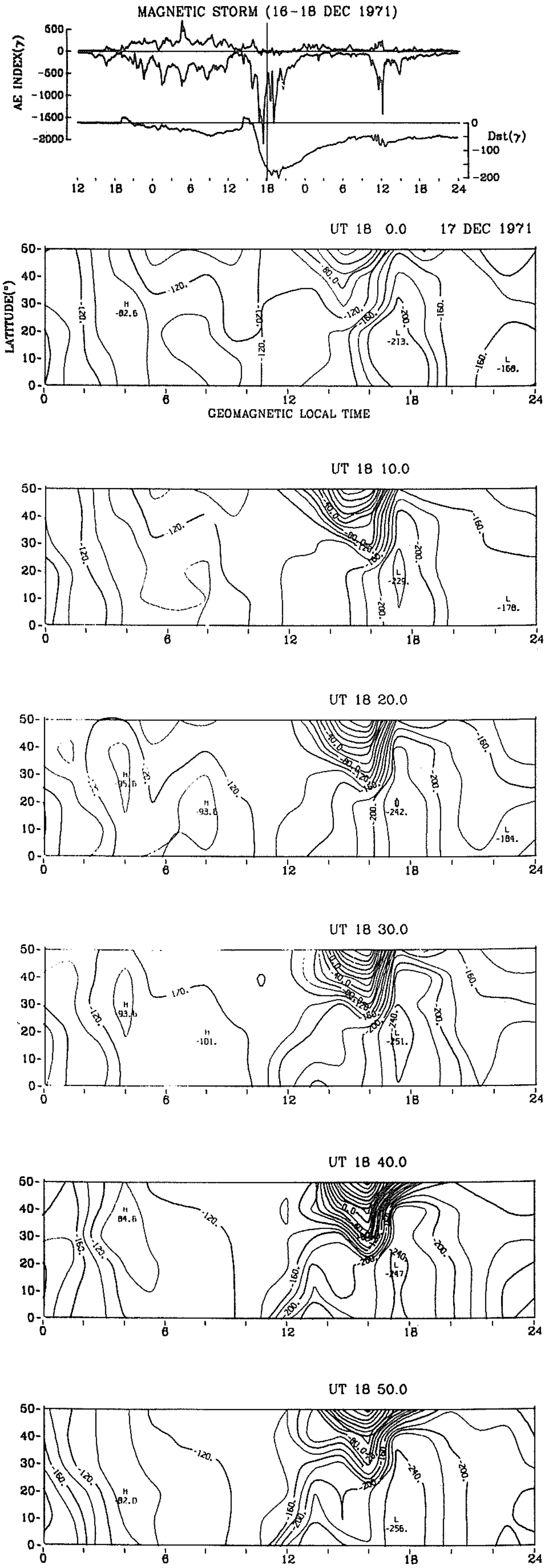


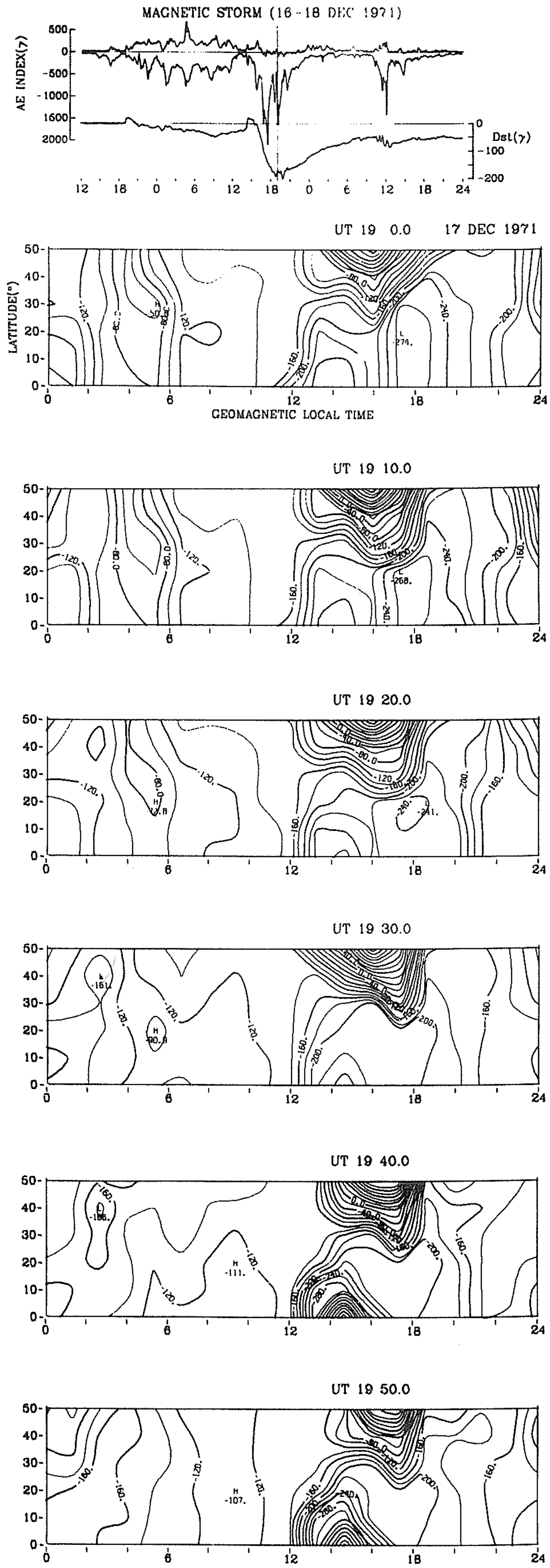
UT 15 50.0



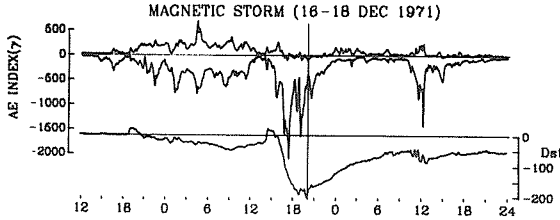

MAGNETIC STORM (16-18 DEC 1971)
AE INDEX(γ)
Dst(γ)
UT 16 0.0 17 DEC 1971
LATITUDE(°)
GEOMAGNETIC LOCAL TIME
UT 16 10.0
UT 16 20.0
UT 16 30.0
UT 16 40.0
UT 16 50.0


MAGNETIC STORM (16-18 DEC 1971)
AE INDEX(γ)
Dst(γ)
UT 17 0.0 17 DEC 1971
LATITUDE(°)
GEOMAGNETIC LOCAL TIME
UT 17 10.0
UT 17 20.0
UT 17 30.0
UT 17 40.0
UT 17 50.0

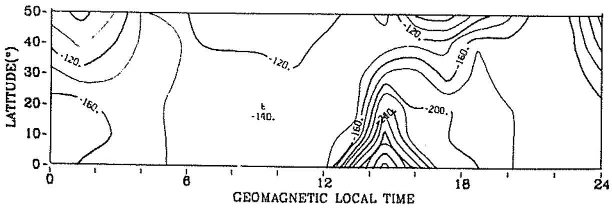

MAGNETIC STORM (16-18 DEC 1971)
AE INDEX(γ)
Dst(γ)
UT 18 0.0 17 DEC 1971
LATITUDE(°)
GEOMAGNETIC LOCAL TIME
UT 18 10.0
UT 18 20.0
UT 18 30.0
UT 18 40.0
UT 18 50.0


MAGNETIC STORM (16-18 DEC 1971)
AE INDEX(γ)
Dst(γ)
UT 19 0.0 17 DEC 1971
LATITUDE(°)
GEOMAGNETIC LOCAL TIME
UT 19 10.0
UT 19 20.0
UT 19 30.0
UT 19 40.0
UT 19 50.0

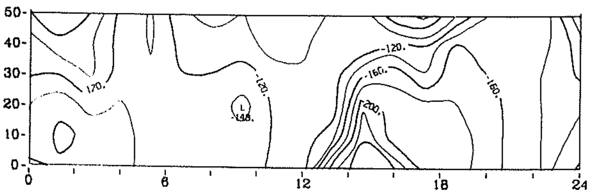
MAGNETIC STORM (16-18 DEC 1971)



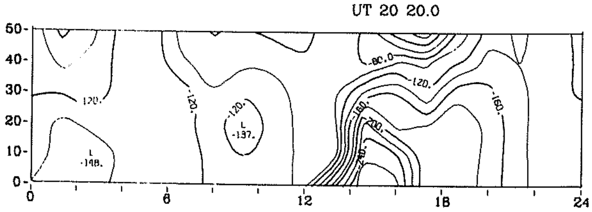
UT 20 0.0 17 DEC 1971



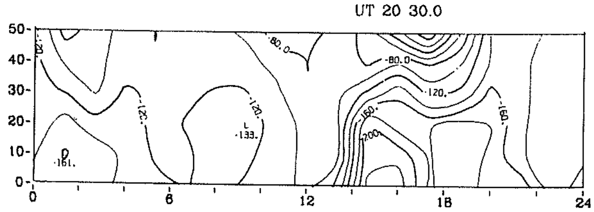
UT 20 10.0



UT 20 20.0



UT 20 30.0



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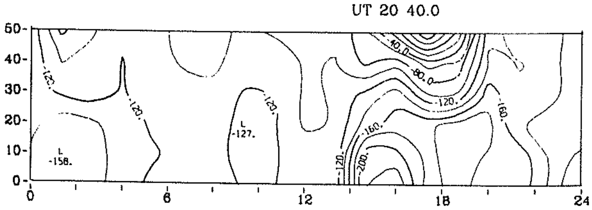

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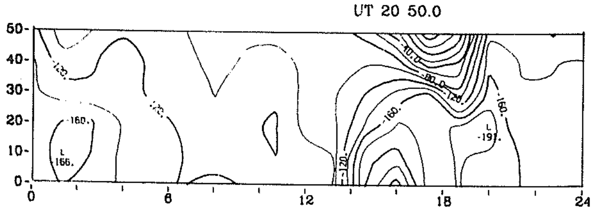
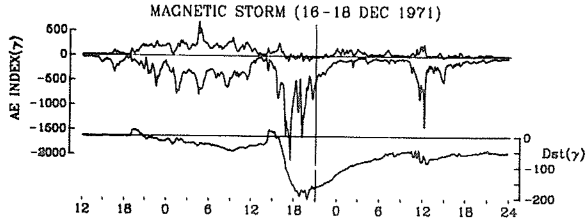
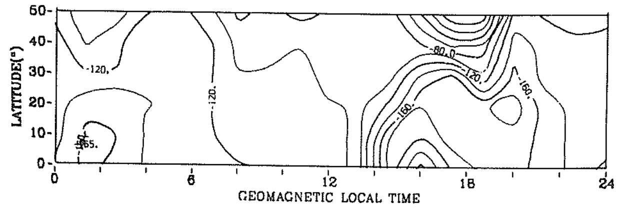


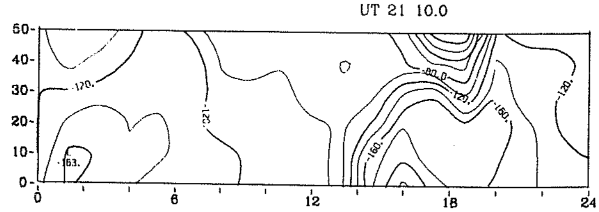
MAGNETIC STORM (16-18 DEC 1971)



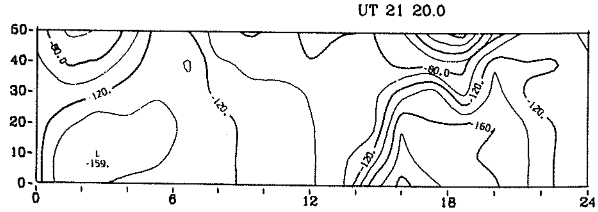
UT 21 0.0 17 DEC 1971



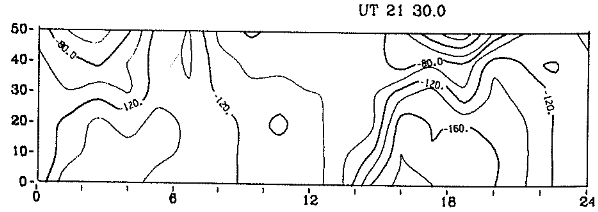
UT 21 10.0



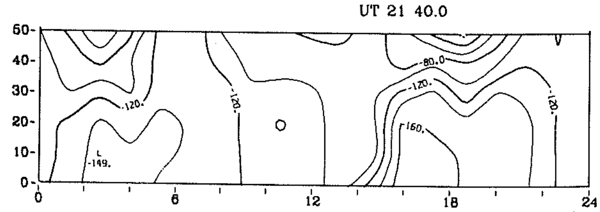
UT 21 20.0



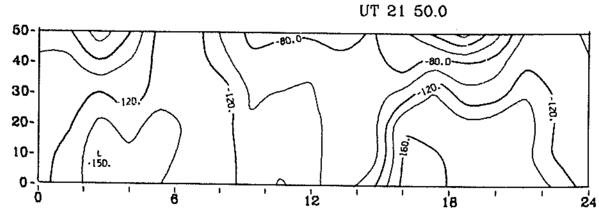
UT 21 30.0



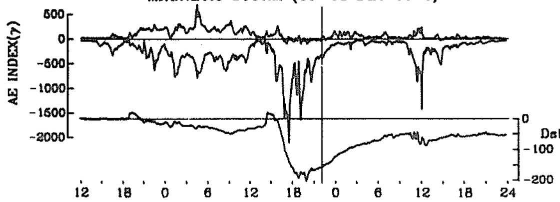
UT 21 40.0



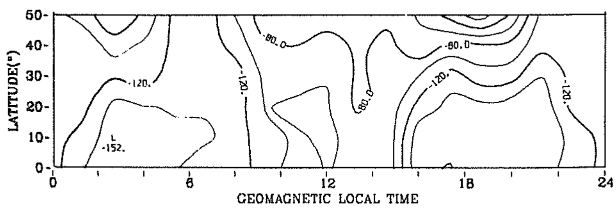
UT 21 50.0



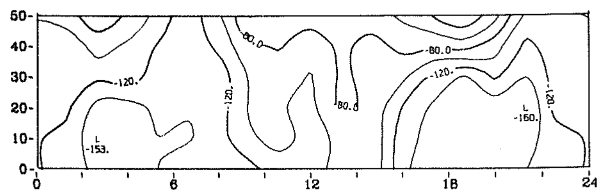
MAGNETIC STORM (16-18 DEC 1971)



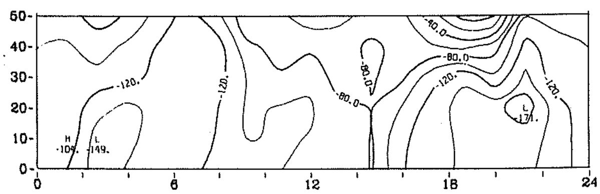
UT 22 0.0 17 DEC 1971



UT 22 10.0



UT 22 20.0



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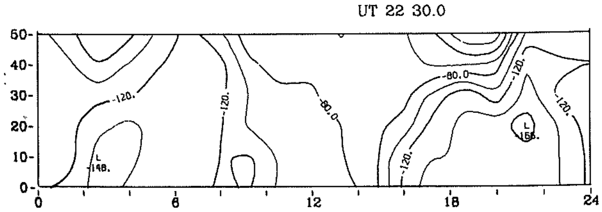
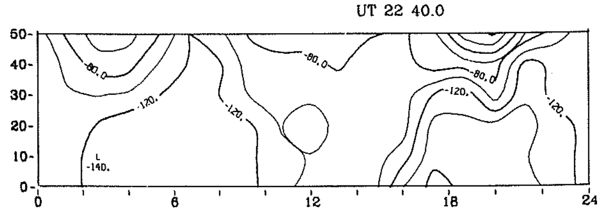


UT 22 40.0



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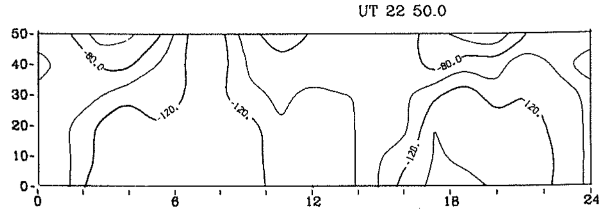
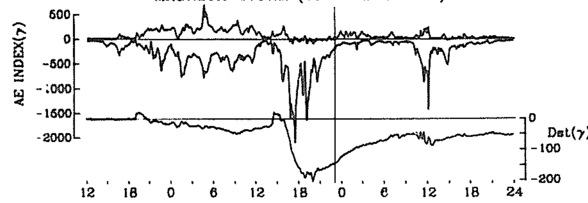
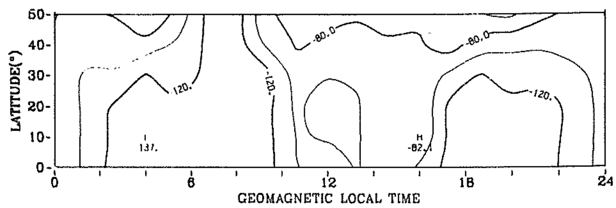


MAGNETIC STORM (16-18 DEC 1971)



UT 23 0.0 17 DEC 1971



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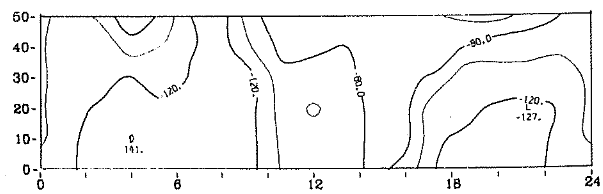

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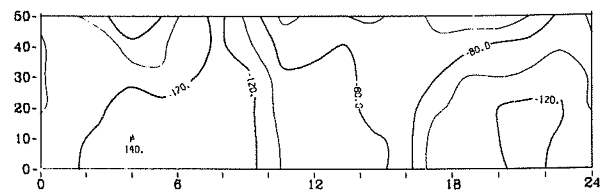

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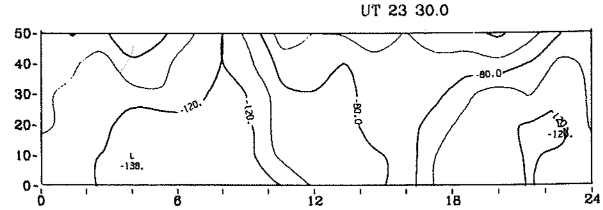

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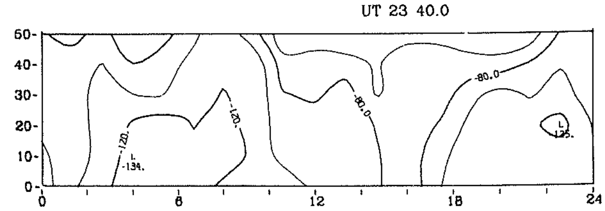

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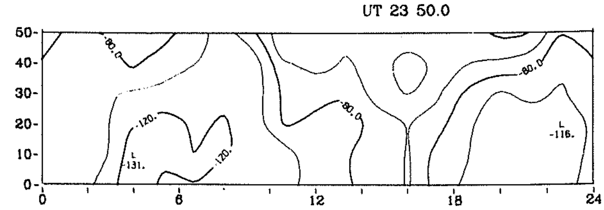

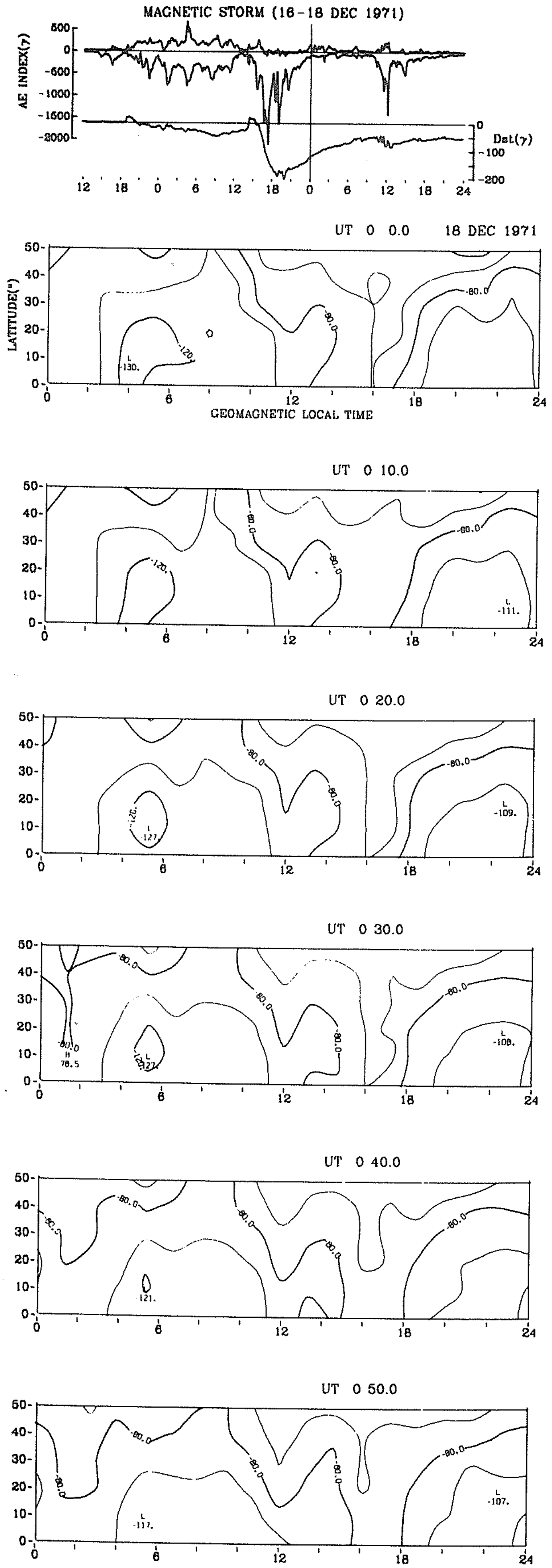
MAGNETIC STORM (16-18 DEC 1971)
AE INDEX(γ)
Dst(γ)
UT 0 0.0 18 DEC 1971
LATITUDE(°)
GEOMAGNETIC LOCAL TIME
UT 0 10.0
UT 0 20.0
UT 0 30.0
UT 0 40.0
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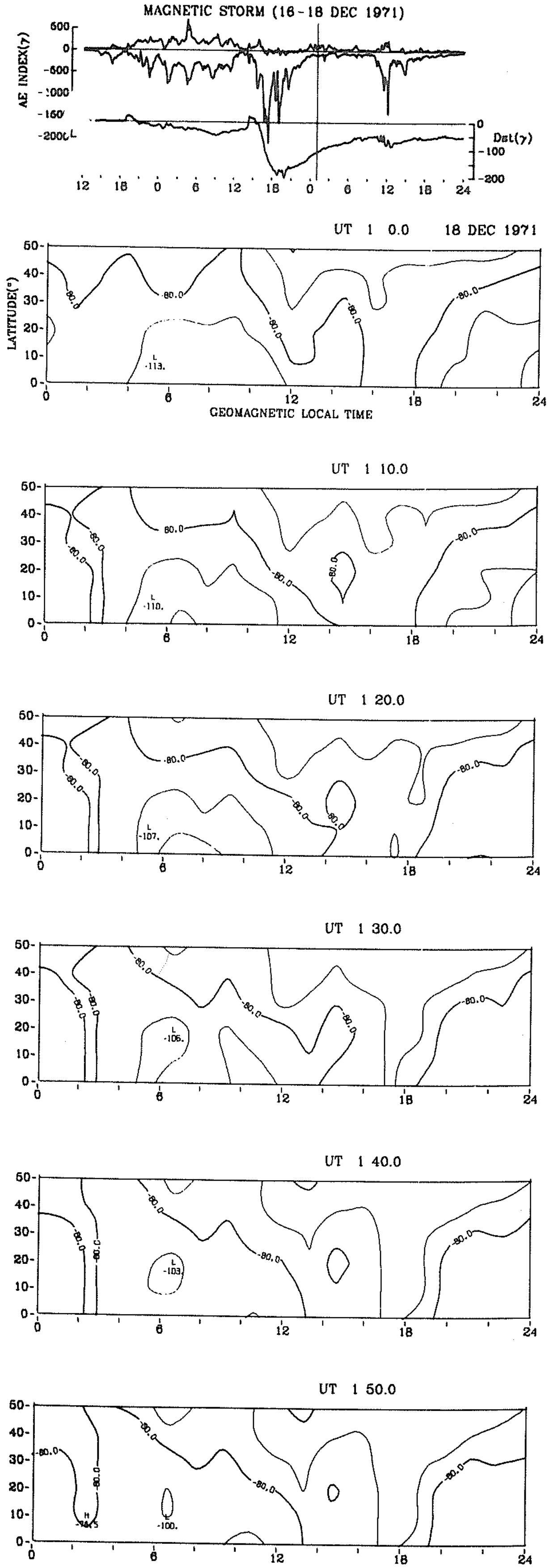
MAGNETIC STORM (16-18 DEC 1971)
AE INDEX(γ)
Dst(γ)
UT 1 0.0 18 DEC 1971
LATITUDE(°)
GEOMAGNETIC LOCAL TIME
UT 1 10.0
UT 1 20.0
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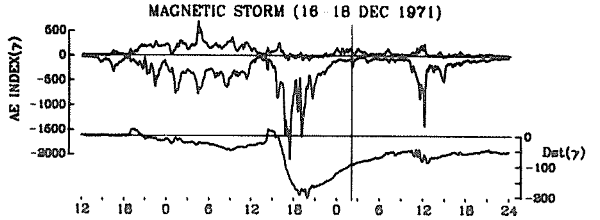
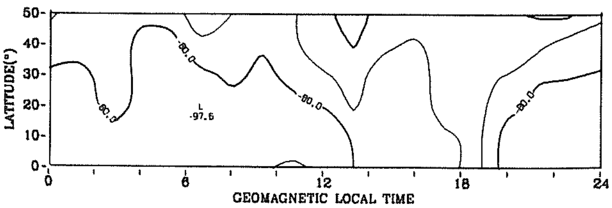
UT 1 40.0
UT 1 50.0

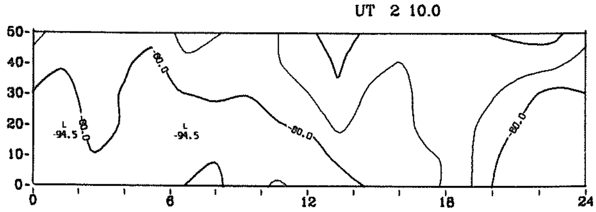
MAGNETIC STORM (16 18 DEC 1971)



UT 2 0.0 18 DEC 1971



UT 2 10.0



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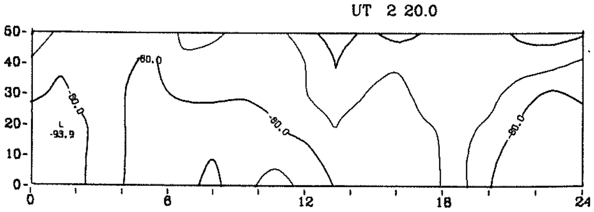

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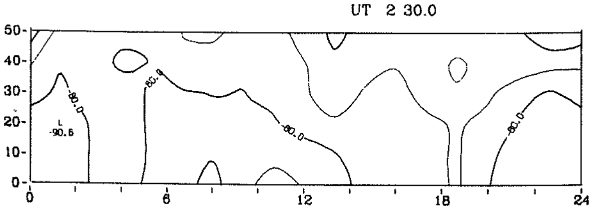

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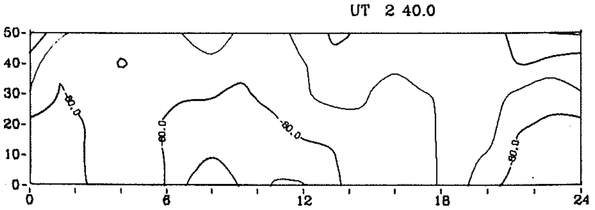

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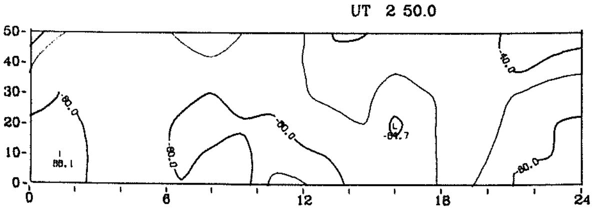
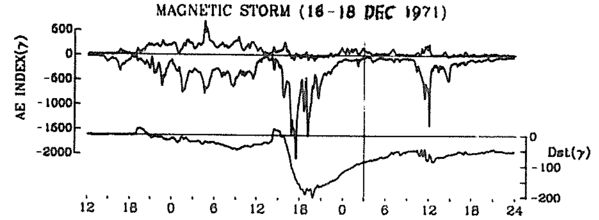
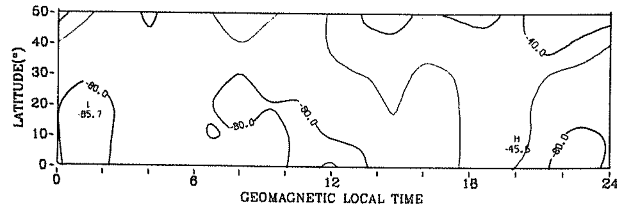


MAGNETIC STORM (16-18 DEC 1971)



UT 3 0.0 18 DEC 1971



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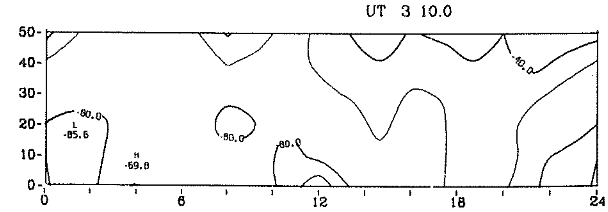

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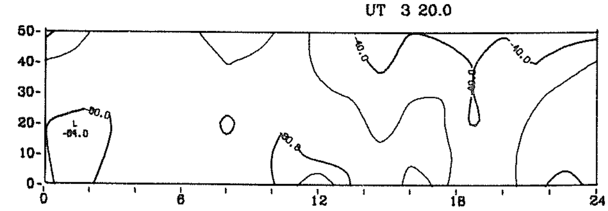

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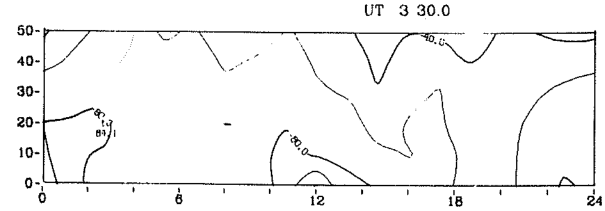

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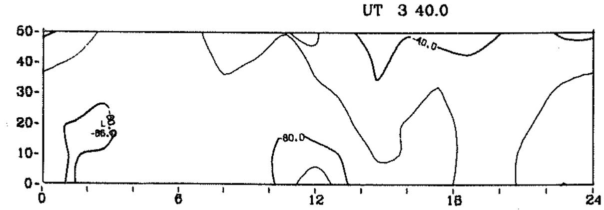

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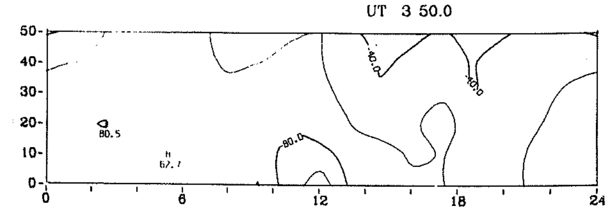
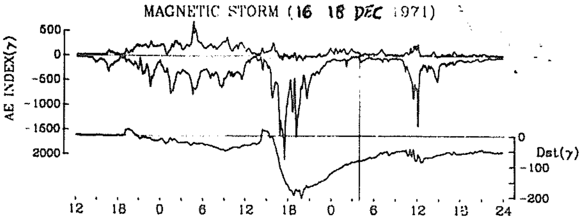
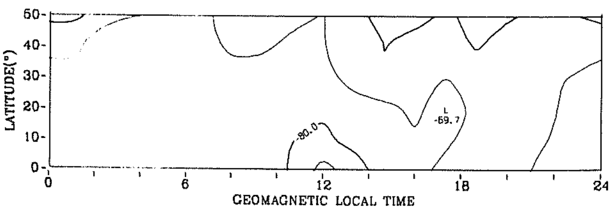


MAGNETIC STORM (16 18 DEC 1971)



UT 4 0.0 18 DEC 1971



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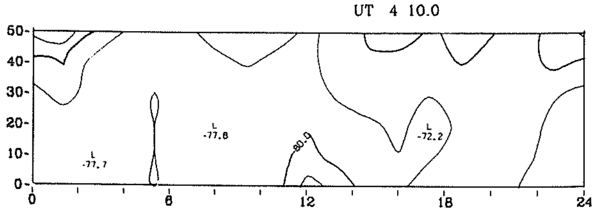

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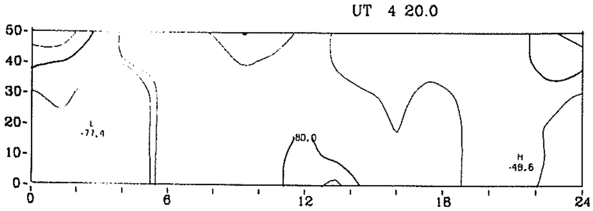

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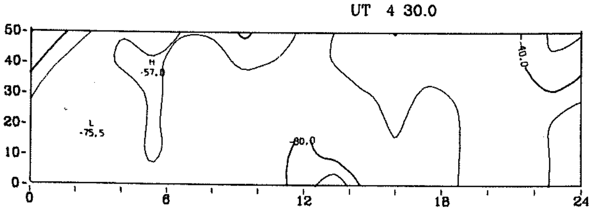

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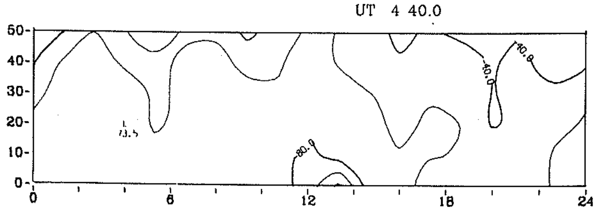

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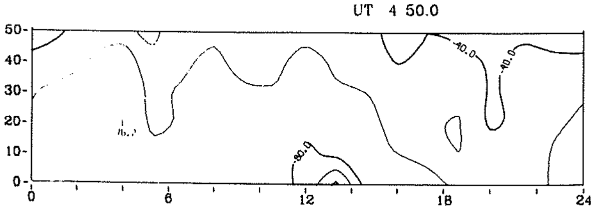
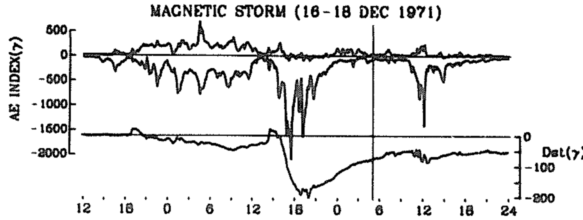
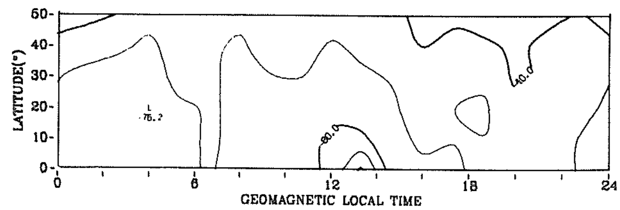


MAGNETIC STORM (16-18 DEC 1971)



UT 5 0.0 18 DEC 1971



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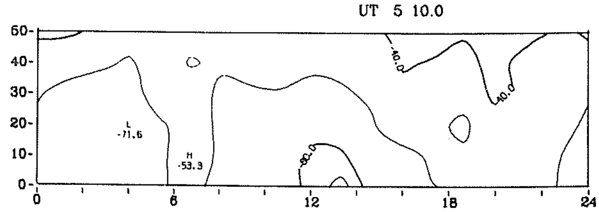

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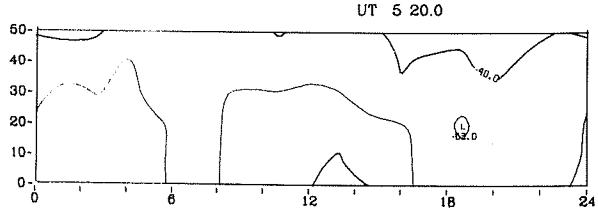

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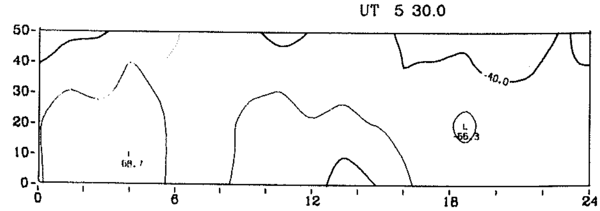

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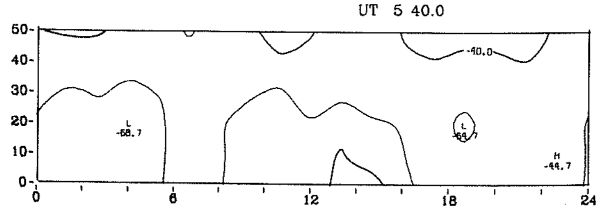

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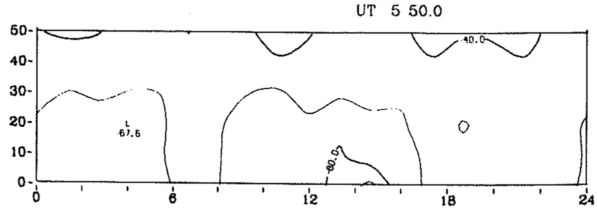

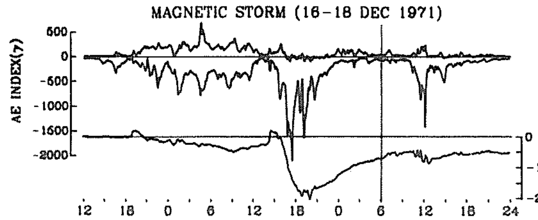

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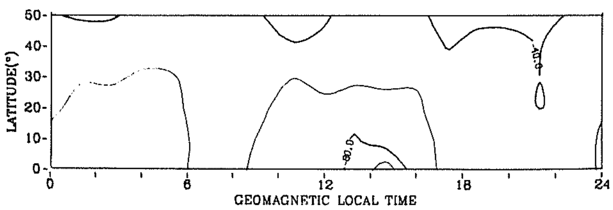

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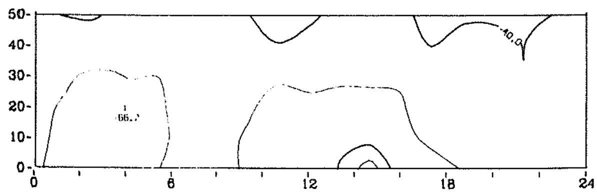

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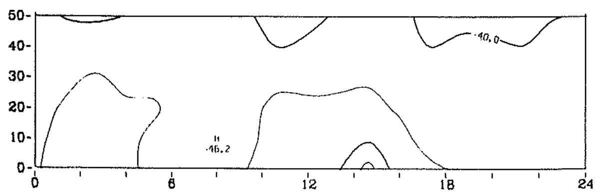

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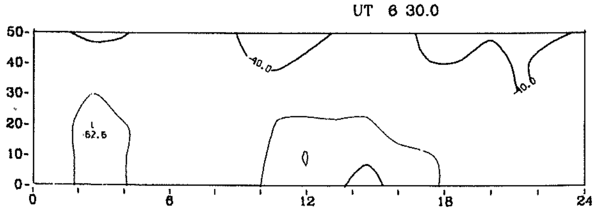

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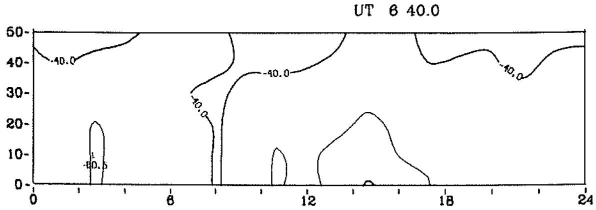

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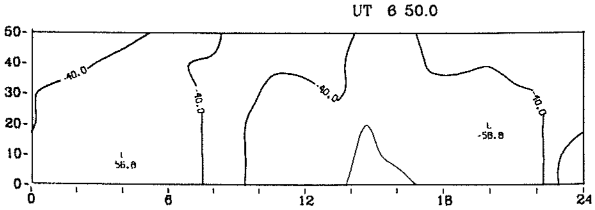
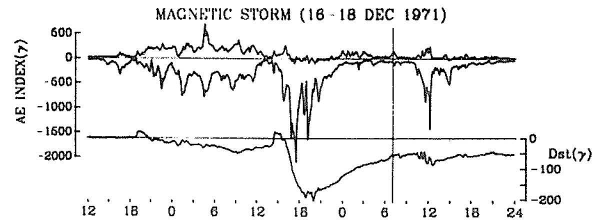
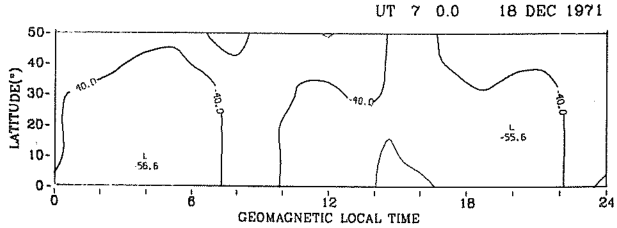




UT 7 0.0 18 DEC 1971



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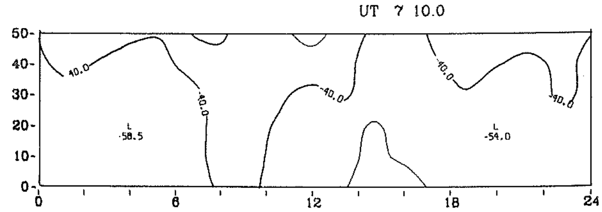

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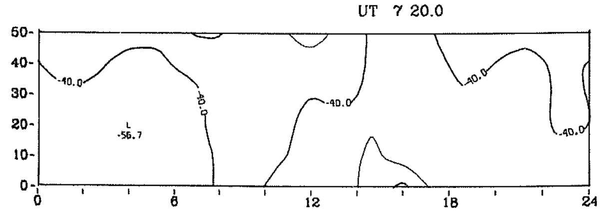

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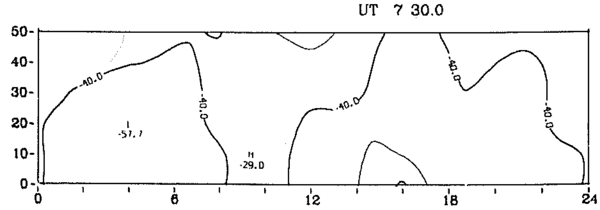

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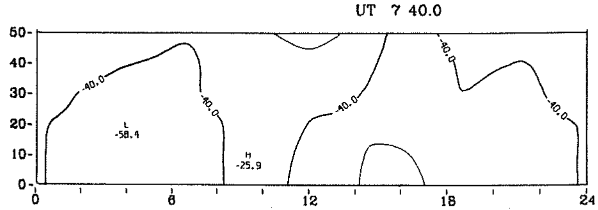

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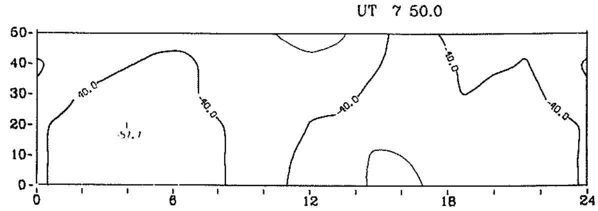
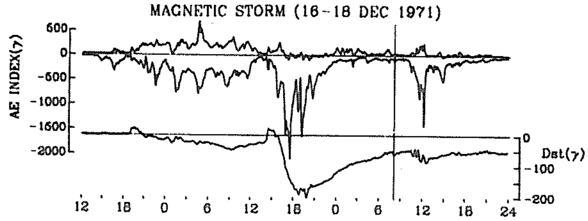
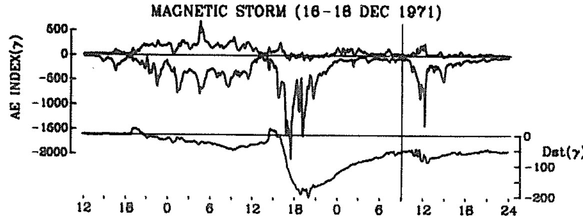


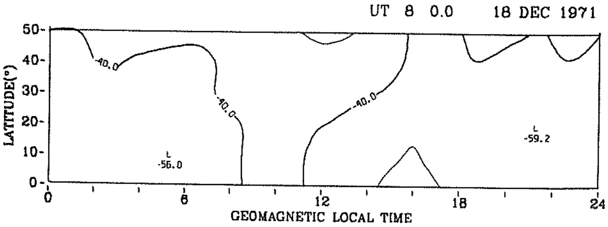
MAGNETIC STORM (16-18 DEC 1971)



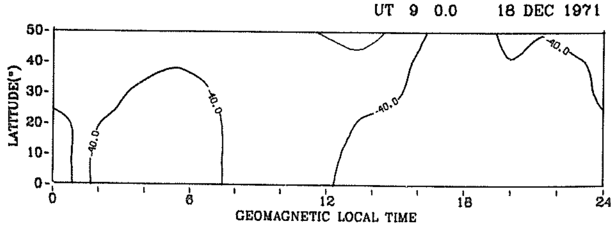
MAGNETIC STORM (16-18 DEC 1971)



UT 8 0.0 18 DEC 1971



UT 9 0.0 18 DEC 1971



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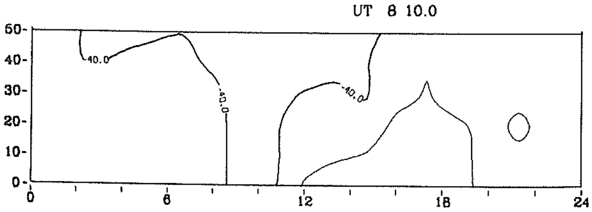

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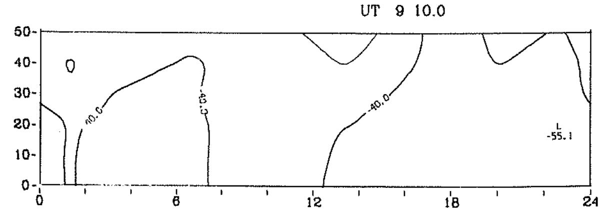

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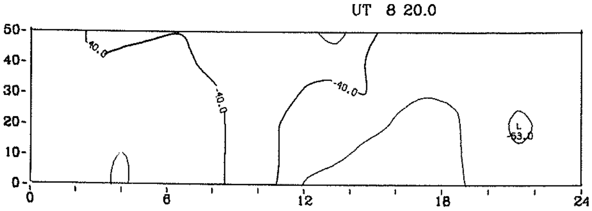

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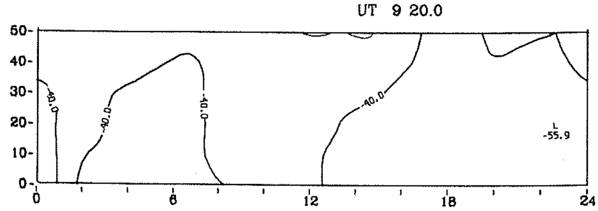

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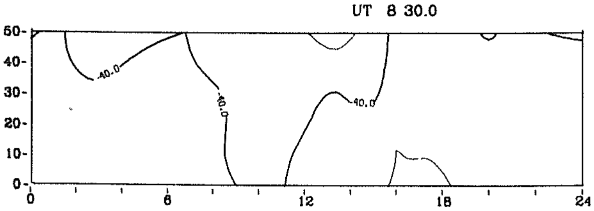

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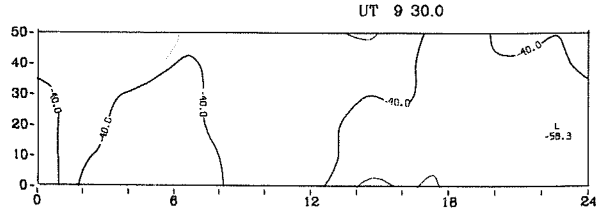

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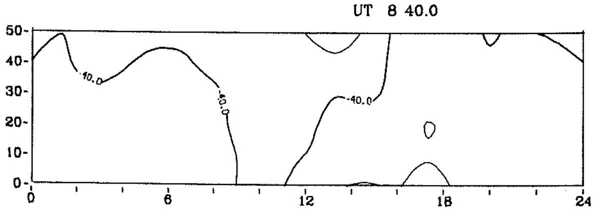

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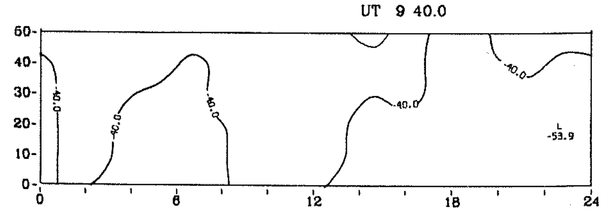

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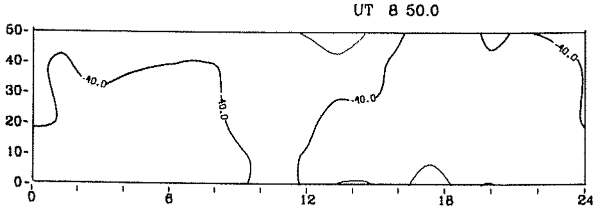

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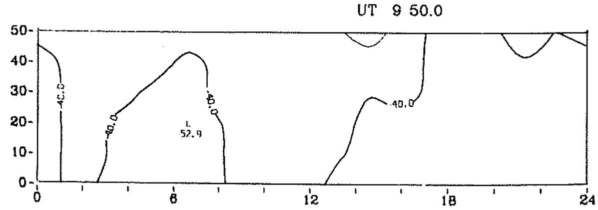
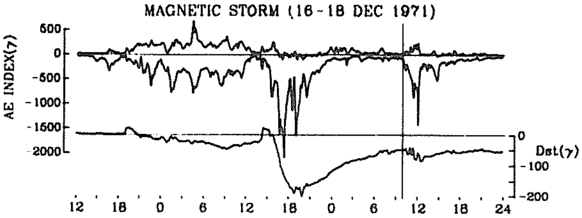
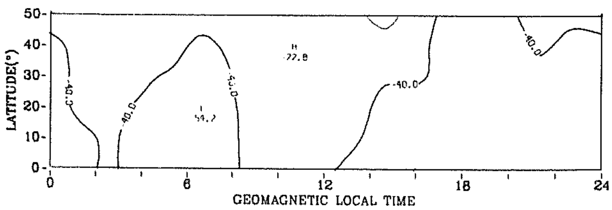


MAGNETIC STORM (16-18 DEC 1971)



UT 10 0.0 18 DEC 1971



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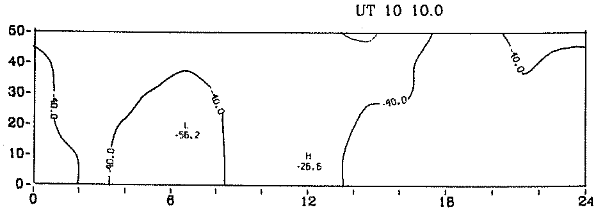

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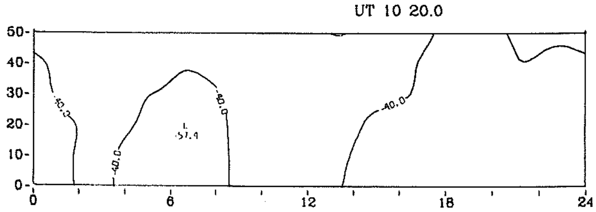

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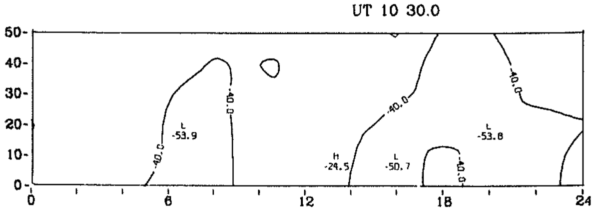

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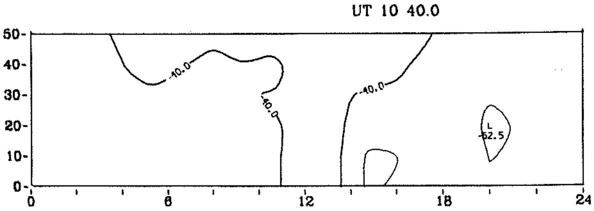

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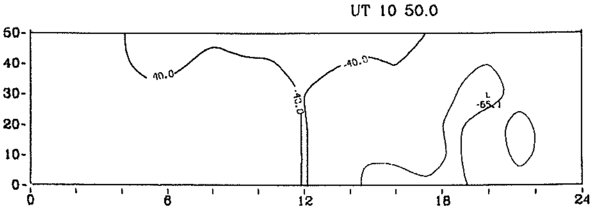
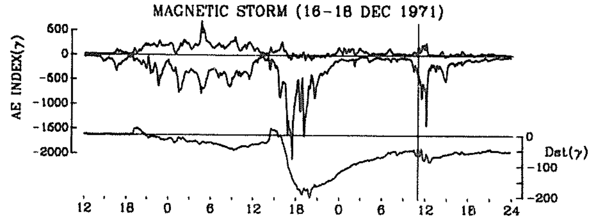


MAGNETIC STORM (16-18 DEC 1971)



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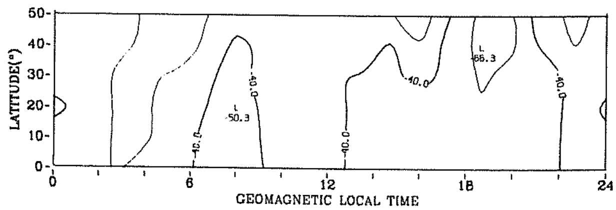

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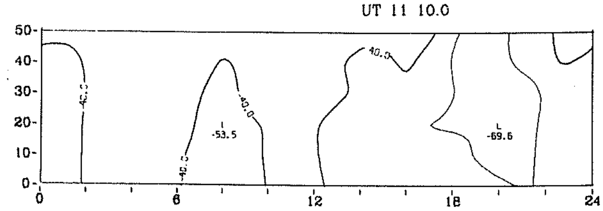

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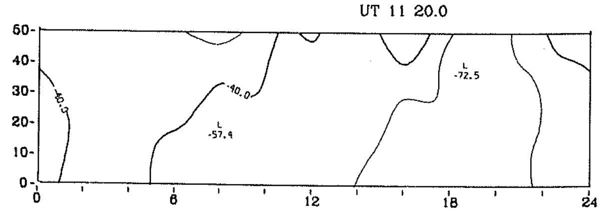

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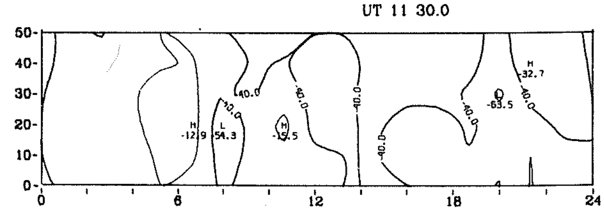

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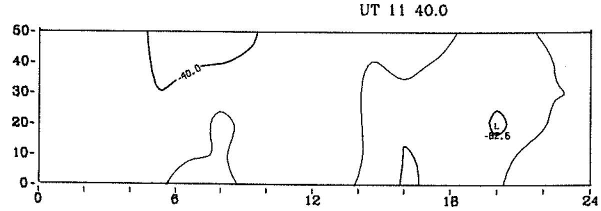

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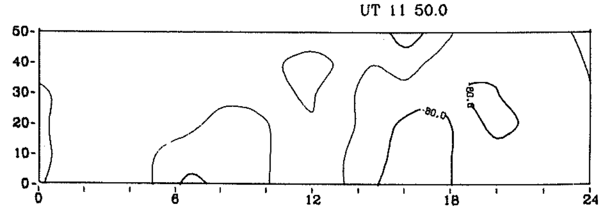

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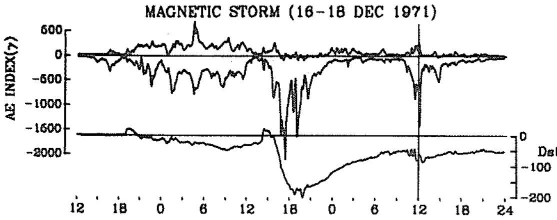

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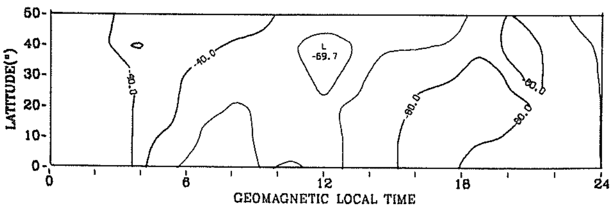

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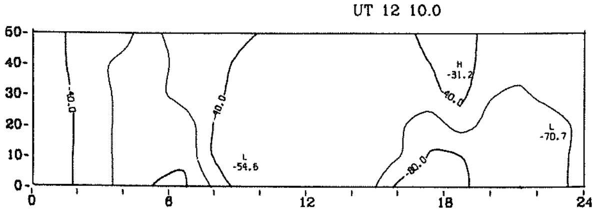

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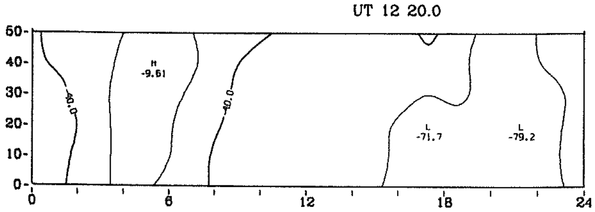

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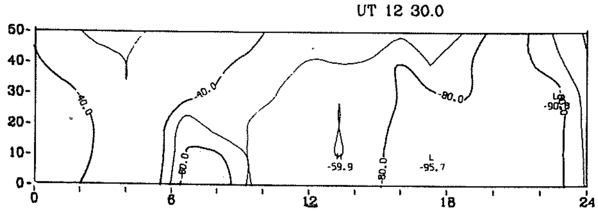

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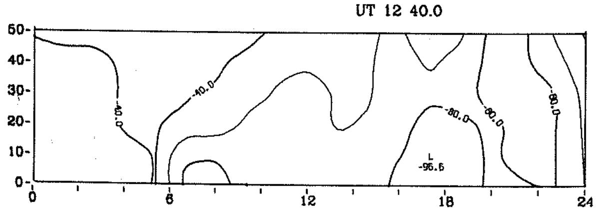

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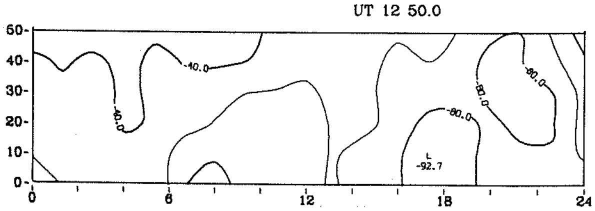

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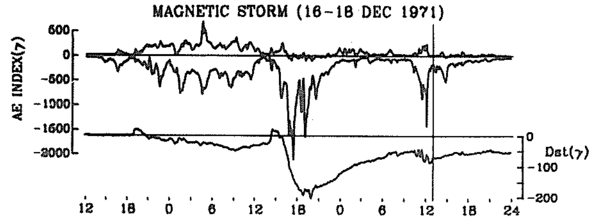

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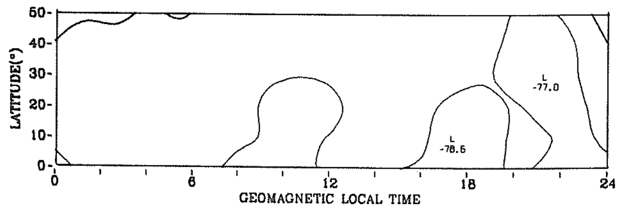

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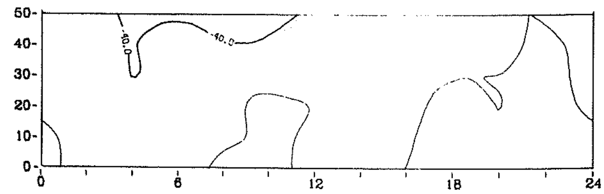

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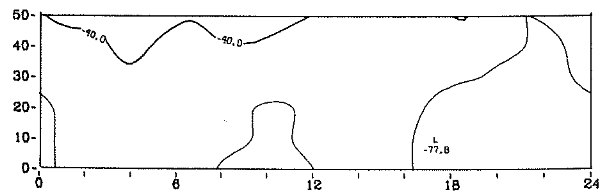

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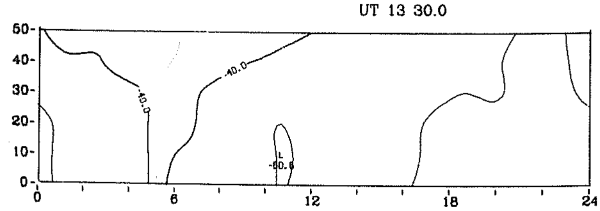

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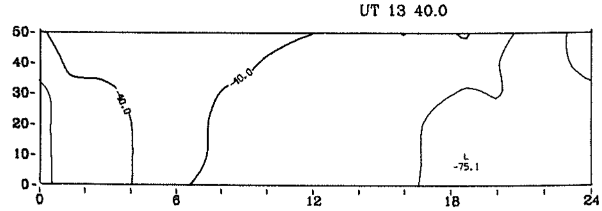

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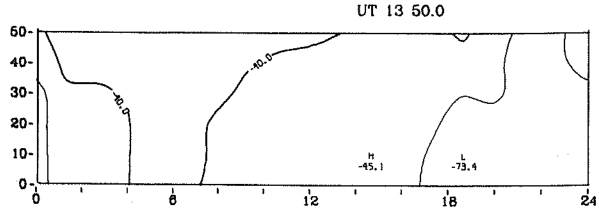

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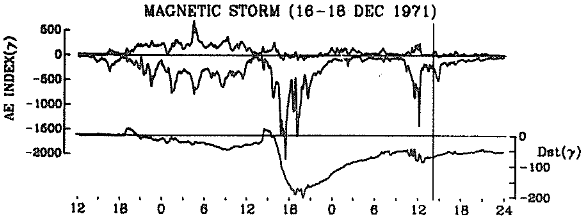

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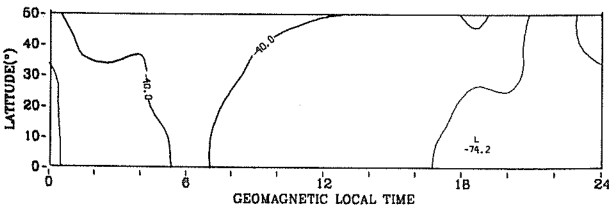

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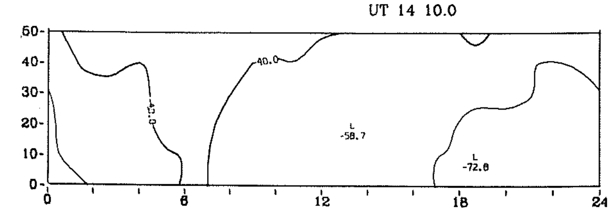

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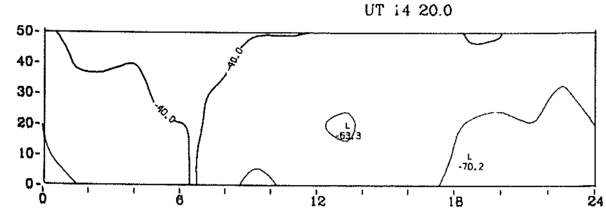

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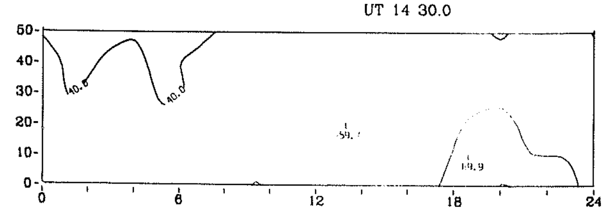

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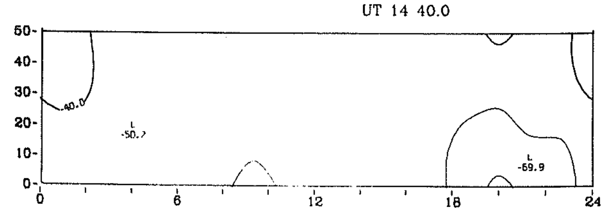

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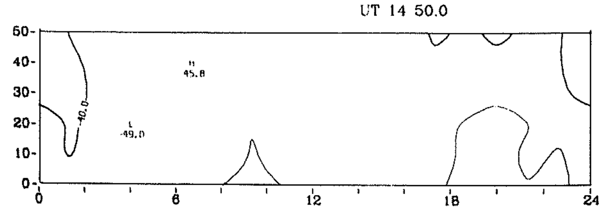

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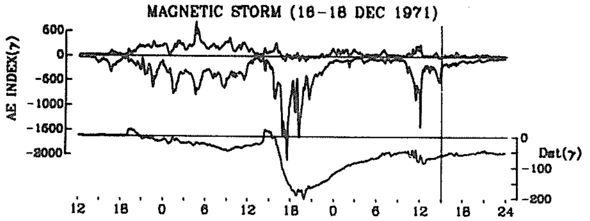

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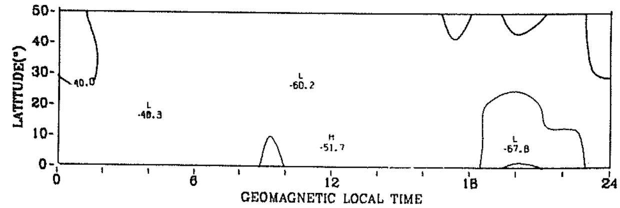

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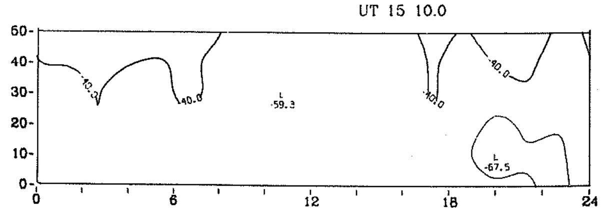

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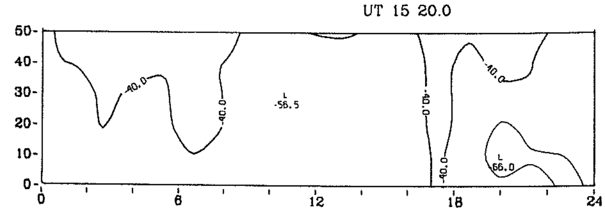

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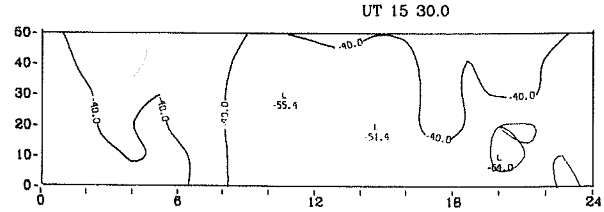

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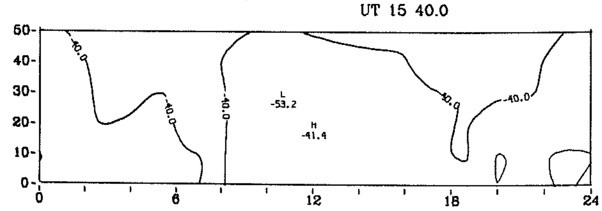

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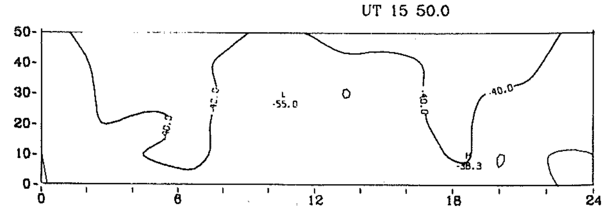

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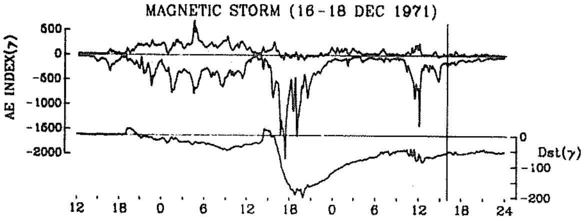

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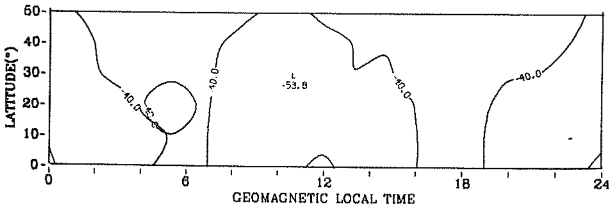

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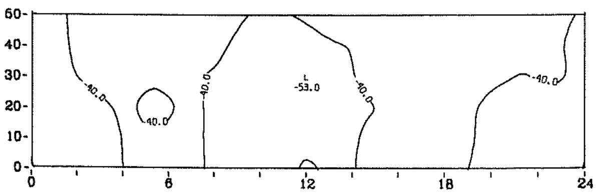

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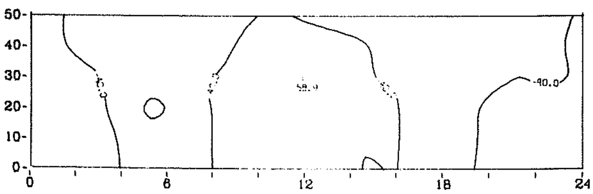

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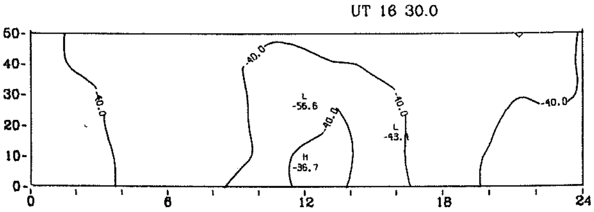

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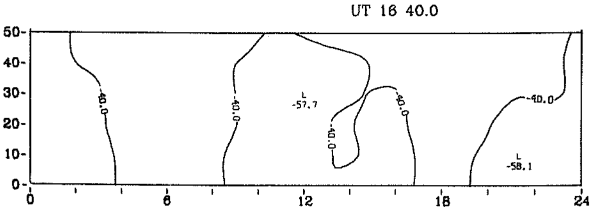

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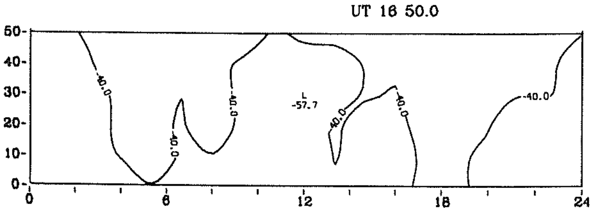

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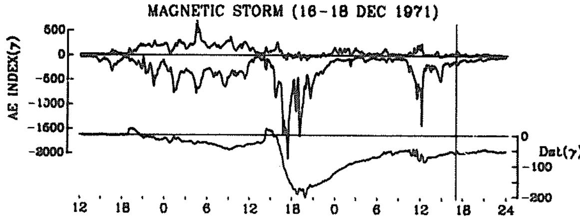

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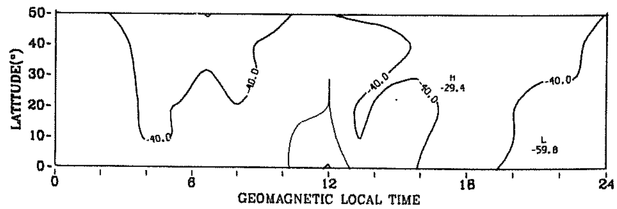

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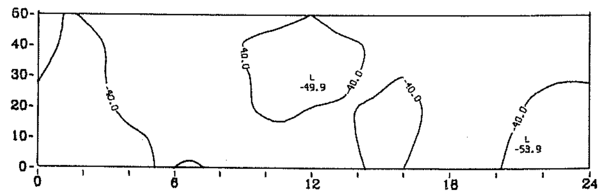

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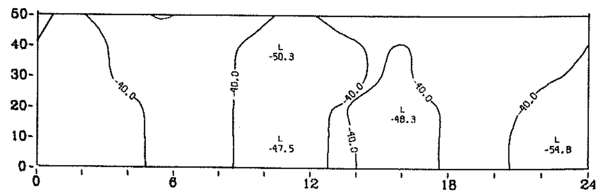

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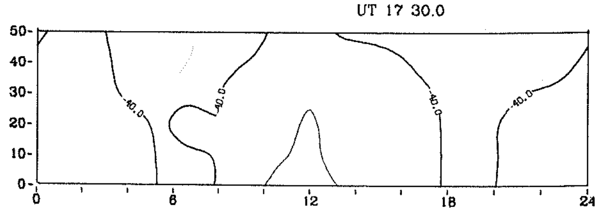

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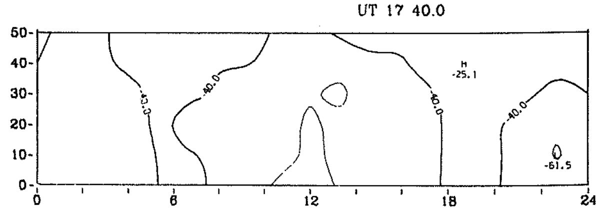

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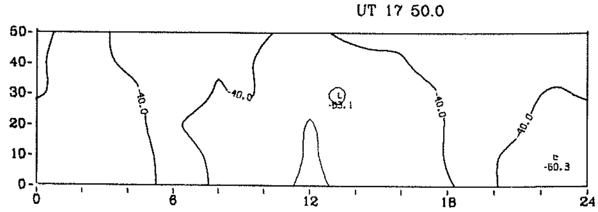

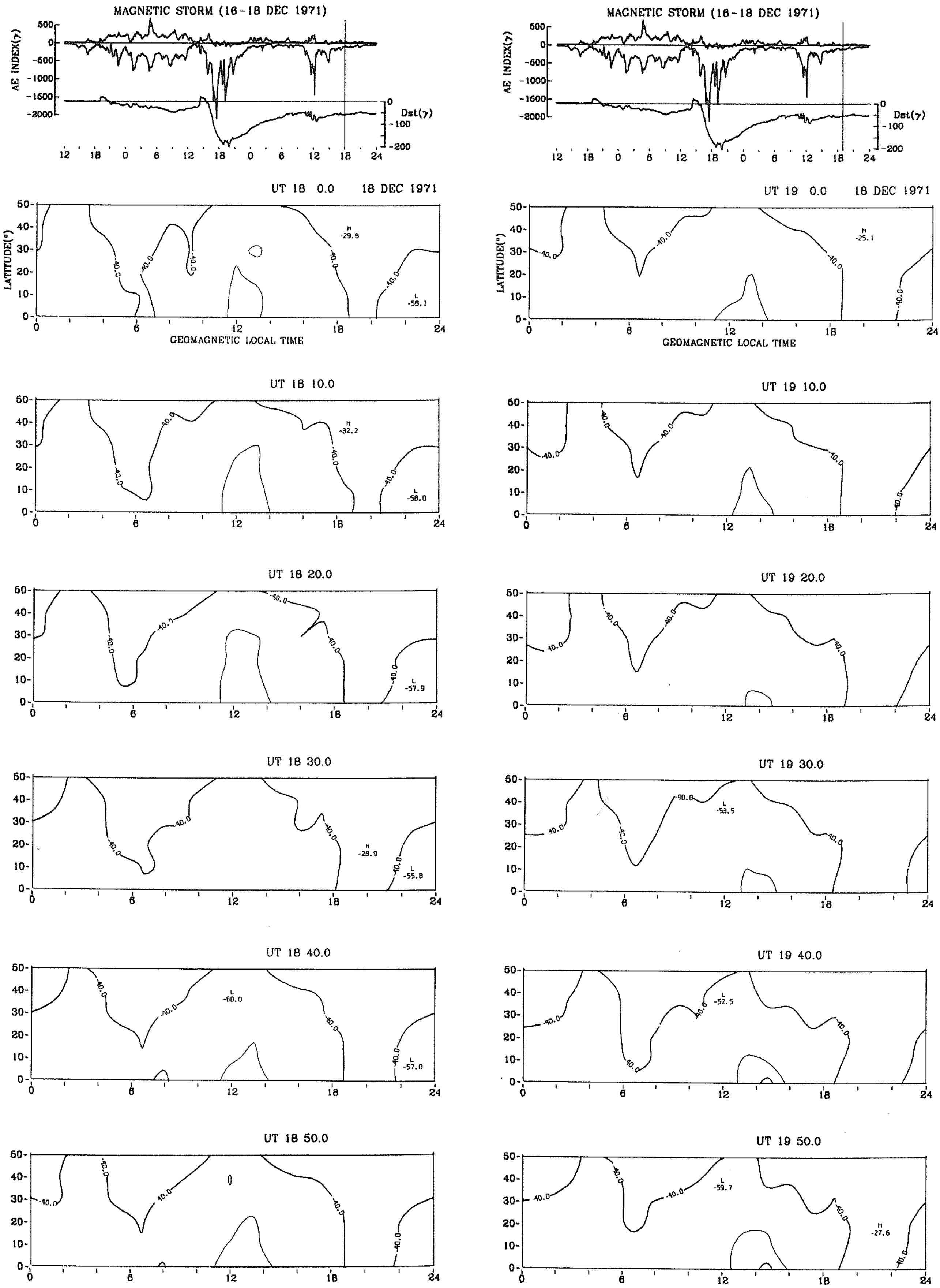

MAGNETIC STORM (16-18 DEC 1971)
AE INDEX(γ)
Dst(γ)
MAGNETIC STORM (16-18 DEC 1971)
AE INDEX(γ)
Dst(γ)
UT 18 0.0 18 DEC 1971
UT 19 0.0 18 DEC 1971
LATITUDE(°)
GEOMAGNETIC LOCAL TIME
UT 18 10.0
UT 19 10.0
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UT 19 20.0
UT 18 30.0
UT 19 30.0
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UT 18 50.0
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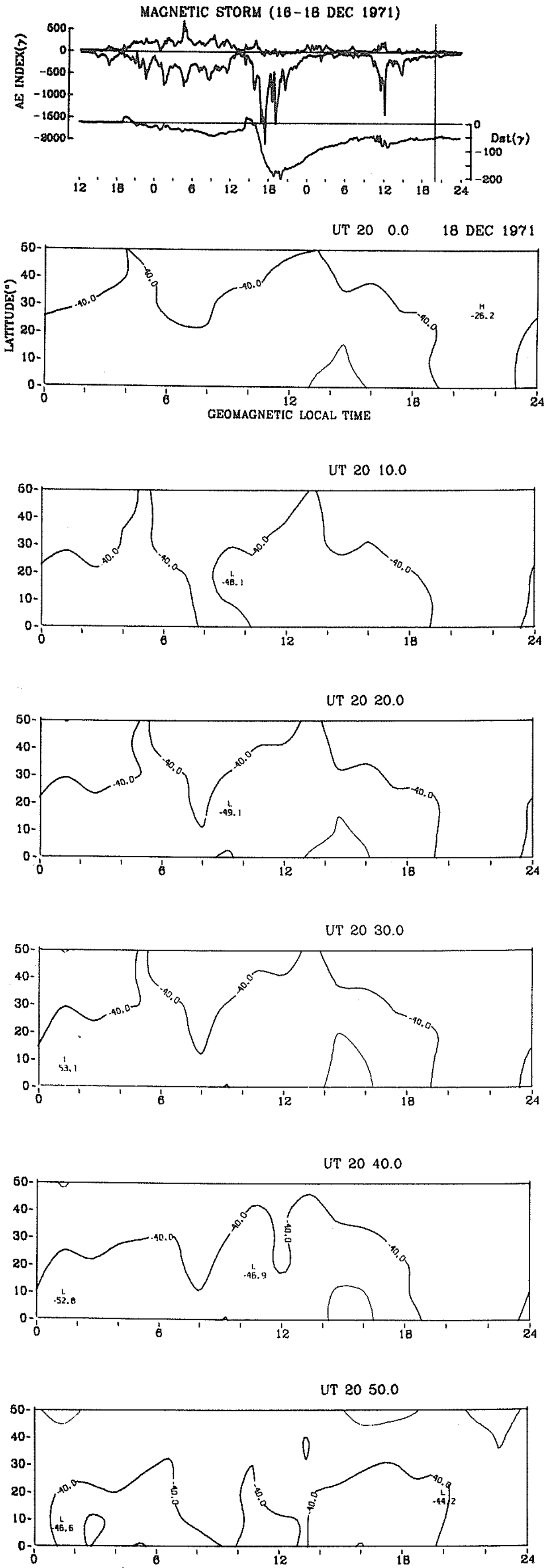

MAGNETIC STORM (16-18 DEC 1971)
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Dst(γ)
UT 20 0.0 18 DEC 1971
LATITUDE(°)
GEOMAGNETIC LOCAL TIME
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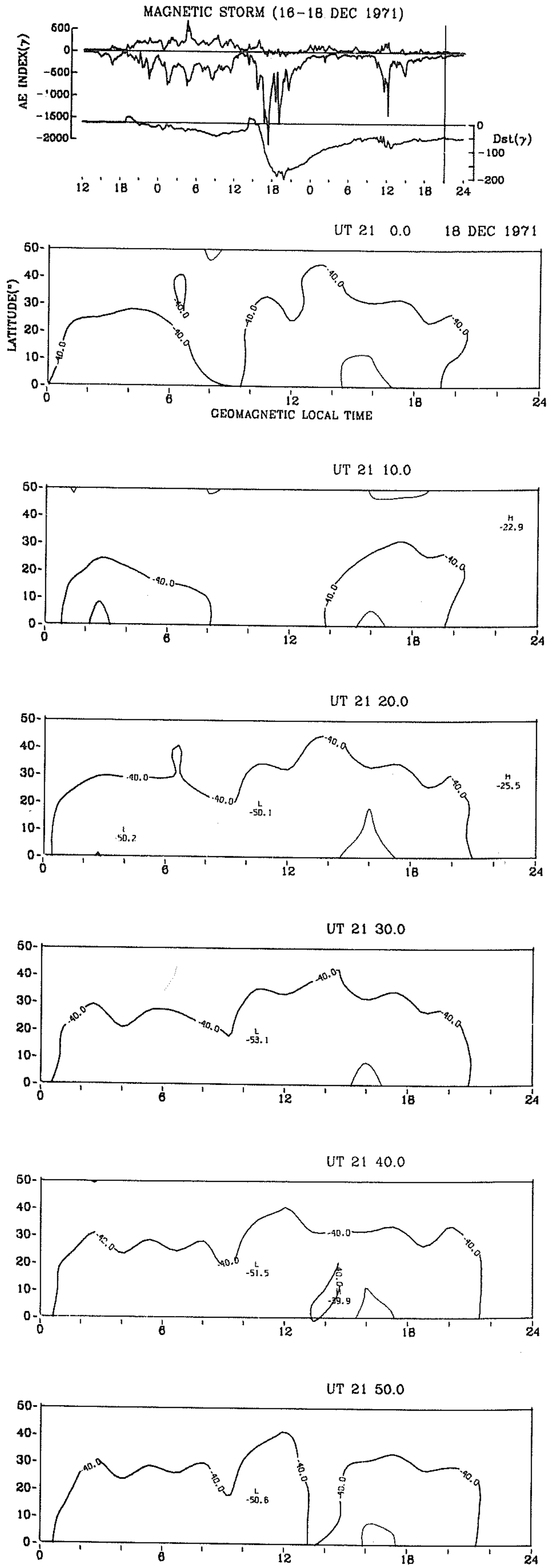

MAGNETIC STORM (16-18 DEC 1971)
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Dst(γ)
UT 21 0.0 18 DEC 1971
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GEOMAGNETIC LOCAL TIME
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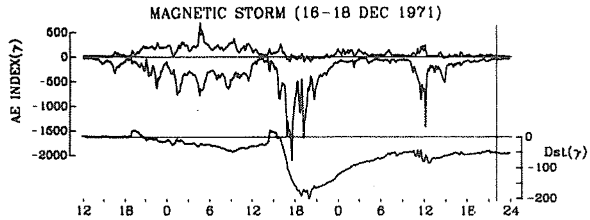

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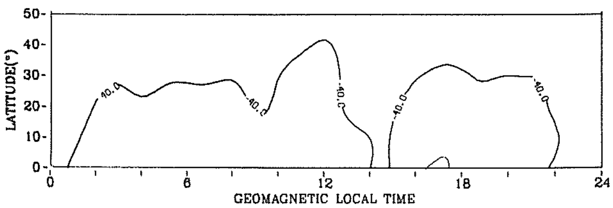

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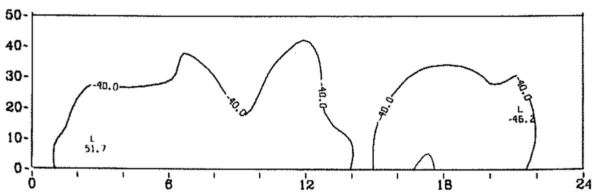

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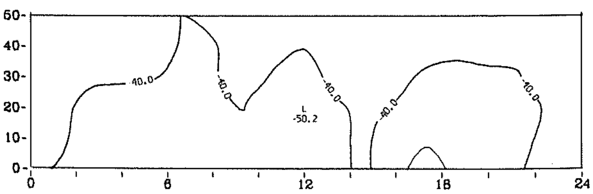

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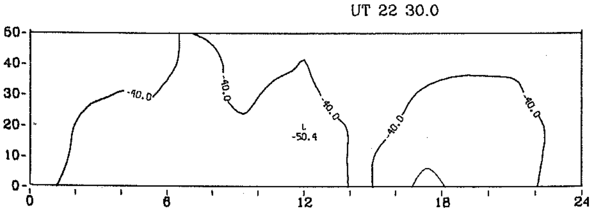

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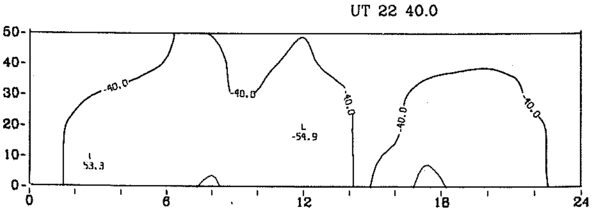

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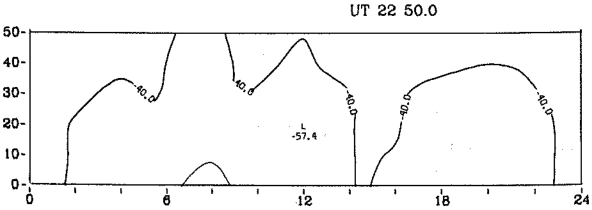

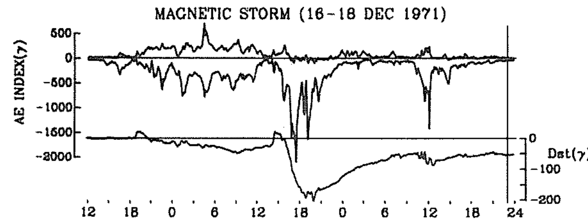

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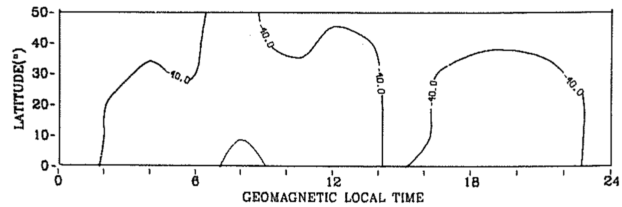

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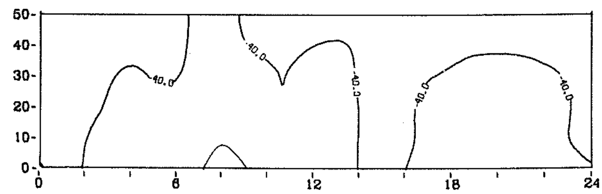

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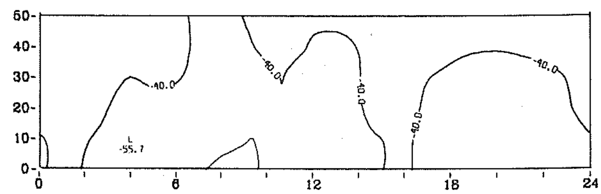

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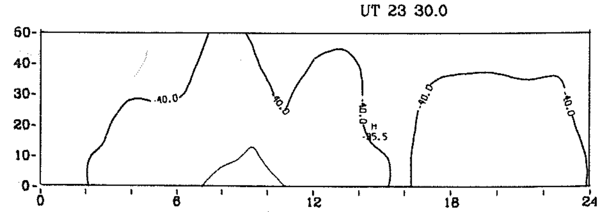

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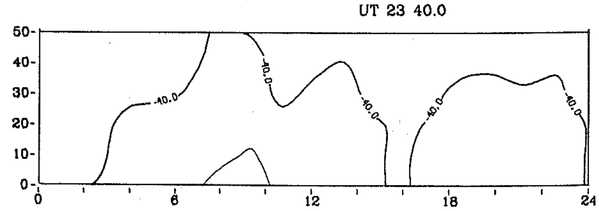

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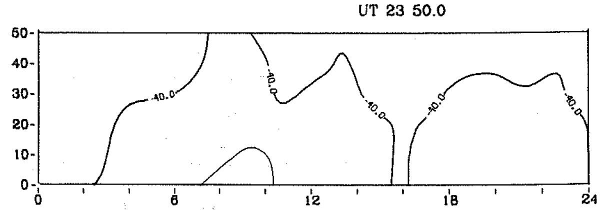

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