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MAGNETIC ALERT MESSAGES

by

J. HRUSKA

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Geological Survey of Canada
Geophysics Division
May 1987

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1. Abstract.

This report describes the Magnetic Alert Message issued since 1980 by the Geophysics Division, GSC, EMR (formerly Earth Physics Branch) and outlines its purpose. The large magnetic disturbances can have profound adverse effects on various types of human enterprise (e.g. radio-communications, power transmission, satellites, etc.) A Magnetic Alert Message (MAM) is issued before and/or during large geomagnetic storms and, in co-operation with the Emergency Preparedness Canada (EPC) DND, is transmitted to users. The manual for issuing MAM and an example of a Magnetic Alert Message are included in the appendices.

2. Introduction.

The 27-day and 72-hour forecasts of geomagnetic activity serve the majority of the users well. However, for a few users such as power companies and Telesat there is a need for a special Magnetic Alert Message (MAM). Their activities could be severely affected by large magnetic storms which could produce devastating consequences to transmission lines and satellites. Consultation with the Emergency Preparedness Canada personnel on the possibility of using their communication system resulted in co-operation in the dissemination of MAM to the users. A special, short message regarding the possible or actual occurrence of a large magnetic storm is prepared and issued by the Geophysics Division of the Geological Survey of Canada and then transmitted to the EPC in Ottawa. EPC Ottawa then notifies all regional EPC in the country and MAM is communicated to the power companies and other users in each province by them. In the beginning MAM was issued only when the magnetic index K was expected to reach the value of 7 to 9. Some studies, however, showed that a value of $K=5$ is already critical for the occurrences of some adverse effects related to the geomagnetic activity [2]. Therefore, MAM is now issued under a modified set of criteria. The magnetic conditions necessary for issuing Magnetic Alert Message are described in the Appendix III and an example of MAM with all magnetic data is in the Appendix II.

During the past decade or so, the impact of the geomagnetic activity on human enterprise has become more noticeable due to developments of modern technology which are more prone to these types of disturbances. This is particularly true in northern locations where the geomagnetic disturbances are the most intense.

3. Summary of adverse effects on power transmissions, radio-communications and satellities.

With the advancement of our technological civilization, the understanding of the earth's magnetic field and its variations has assumed a more important role. A schematic picture (Fig.1) shows the relationship between large magnetic disturbances and affected areas of human activity. The impact of magnetic storms on long man-made conductors has been observed for over one hundred years. Since Marconi's discovery of wireless communication (1901) the effects on radio-wave propagation have been observed and studied. The disruptions of magnetic and telluric surveys due to magnetic storms have been recognized in the exploration industry since magnetic instruments were first used. The latest acknowledged effects are the satellite anomalies. Although all these adverse effects from magnetic storms have been observed many years, yet an understanding of the links between these natural phenomena and man-made systems has emerged only in the last 20-30 years.

We will summarize the main characteristics of adverse effects of magnetic storms on human enterprises - as are relevant to the users of Magnetic Alert Messages.

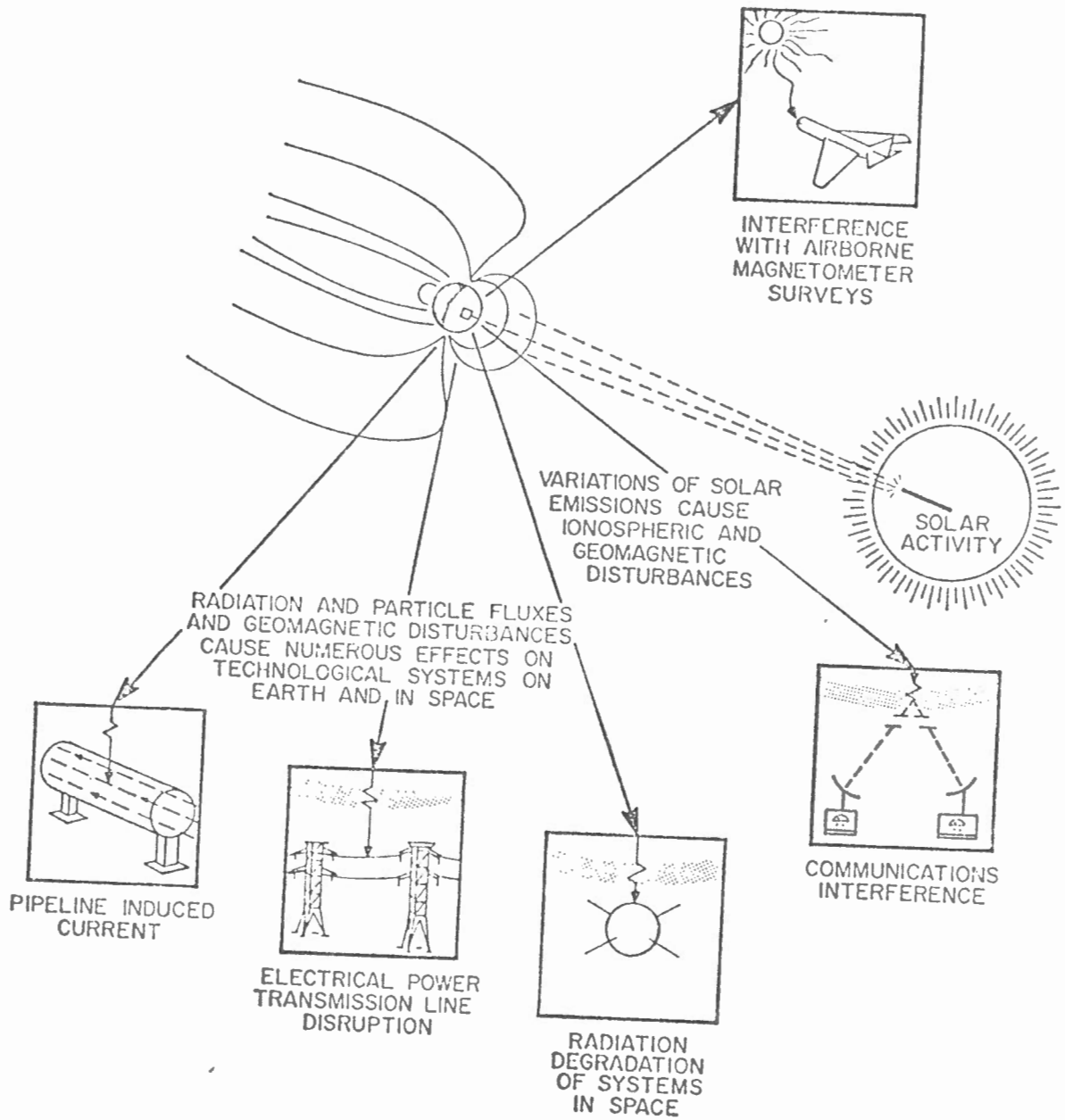


Figure 1: An illustration of how solar activity causes variations in Earth's outer environment, which in turn cause effects near or on Earth's surface. (from Blake [11]).

Transmission systems.

Power lines running in east-west directions mainly in high latitude locations are known, in general, to be affected by magnetic disturbances more strongly than those in north-south directions. The cause of this is the auroral electrojet, substorm-causing electric current, flowing in an eastward or westward direction in the auroral region. The adverse effects in power lines are caused by geomagnetically induced currents (GIC's). A complete list of storm-caused adverse effects is given by Watanabe and Shier [1]. These are the most often reported adverse effects:

- 1/ generation of excessive harmonics,
- 2/ misoperation of protective relays,
- 3/ system voltage fluctuations,
- 4/ increase in system reactive power requirements,
- 5/ degraded performance of current transformers.

Research in these problems is presently conducted in Canada at UBC, B.C.Hydro, Manitoba Hydro and at the IREQ (Institut de recherche de l'Hydro-Québec). The Geomagnetism Section of the Geophysics Division is actively contributing to this work by providing data from the Canadian Magnetic Observatory Network and by extensive consultations [2,3].

Ionospheric radio-wave propagation

The ionosphere is a ionized multilayer. It is a dynamic region, located approximately between 60 and 700 km above the Earth, which enables propagation and reflection of radio-waves. The structure of the ionosphere and its spatial and temporal variations have been studied since the beginning of this century [6]. The changes in ionospheric conditions are dependent upon many factors such as universal and local time, season, latitude and solar and magnetic activity. In spite of the growing use of satellites and microwave links for communications, radio-wave propagations through ionosphere are still vital links especially in high latitudes where surface circuits are uneconomical. Users of the ionospheric communications include the military for point-to-point communications, navigation and surveillance as well as civilians for international broadcasting and amateur radio operations [5]. The description of ionospheric conditions and their correlations with geomagnetic phenomena is a subject of numerous studies and is beyond the scope of this report. Although most ionospheric disturbances are genetically related to geomagnetic storms, the ionospheric predictions have to deal with special requirements concerned directly with radio-wave propagations, for example: forecasts of MUF (maximum usable frequency) and of foF2 (critical frequency of F2 layer), etc. Our geomagnetic forecasts and MAM are not designed for radio communications. Nevertheless they are used by many radio operators [4] and some local radio-clubs are directly notified of MAM by provincial EPC offices.

Effects on satellites and on other types of human activity.

Changes in solar and geomagnetic activity can induce changes in atmospheric density. Because the atmospheric drag on satellite is proportional to the atmospheric density, these changes could have an important impact on satellite trajectory [10]. These effects have different characteristics depending on the position and technical set-up of each satellite. Generally they increase with the orbit altitude and inclination; similarly, solar-induced variations in the radiation environment increase with the same parameters. A severe event could cause a temporary loss of control and a consequent increase of consumption of fuel. An unusually severe event that occurred on the Canadian telecommunication satellite Anik D2 on March 8, 1985 is given by Wadham [8]. During this event the Anik D2 control system malfunctioned and the net result was an unexpected large consumption of fuel. This particular usage of fuel was equivalent to the yearly supply for stationkeeping. Telesat Canada receives MAM, consults the Geomagnetism section on individual cases of satellite anomalies and uses Canadian magnetic data when relevant [8].

Resently the Satellite Anomaly Data Base was established at the National Geophysical Data Center, USA. Reports on satellites anomalies are now collected and studied [9].

For the benefit of those users who are not directly notified of Magnetic Alert Messages when issued, MAMs are recorded together with 72-hour forecasts on the automatic answering machine (613 992 1299). These recorded MAM are used by radio operators and exploration companies, whose field work is practically halted during large magnetic storms.

We should also note that there are other variously reported adverse magnetic-storm-related effects on computers, manufacturing of microchips, human health and behaviour, meteorological events, animal behaviour, etc. So far none of these relations has been proved; their existence, however, cannot be disregarded without further studies.

4. Co-operation with the Emergency Preparedness Canada, DND.

Discussions between EPC and the Geophysics Division were held in July 1980 and resulted in the following agreement:

- 1) The Geophysics Division (former Earth Physics Branch) will issue the Magnetic Alert Message whenever the magnetic conditions will require it. This short message will be telephoned or transmitted to the Operations Office of EPC.
- 2) The Ottawa EPC will transmit this message to all regional EPC offices in each province. The provincial EPC will notify as soon as possible all power authorities and other users in their area.

- 3) A short review of the observed magnetic activity will be issued after the MAM period expires. This review has the same distribution as MAM.
- 4) The Geophysics Division will provide relevant information on magnetic disturbances and their potential effects on human enterprises to the MAM's users. Two articles on this topic were published in the Emergency Planning Digest in 1980. Other relevant publications were distributed to the EPC offices and to MAM's users.
- 5) The ALERT messages issued by SESC in Boulder originally came through the EPC communication system. Since a direct communication link was established between SESC Boulder and the Geophysics Division these messages are transmitted directly to us.

During the period from 1980 to 1986 approximately 30 MAM were issued. The co-operation with EPC is continuing and is a productive one. Direct discussions and consultations are held between appropriate personnel when necessary.

The importance and the necessity of a fast and dependable communication system for MAM is well illustrated by the case of a magnetic storm on 13-14 July, 1982. The MAM issued by the Ottawa Magnetic Observatory (where originally MAMs were issued) was the first announcement to reach electric utilities in the MAPP (Mid-Continental Area Power Pool) through the Saskatchewan Power Corporation. The relevant documents are enclosed in Appendix I.

Recently, some changes in the format of MAM (e.g. bilingual forms), as well as some changes in the communications between the Geomagnetism section and EPC Operation Office were implemented (e.g. use of facsimile transmissions).

5. Discussion and Recommendations.

The introduction of the Magnetic Alert Messages in the Canadian forecasting services has proved to be very useful and timely. This service should continue and here we present some recommendations on how it could be improved.

From the research point of view, the predictability of the basic characteristics of magnetic disturbances with regards to their size and duration should be studied further. The correlations between these parameters (size, duration) and solar sources, as well as the latitudinal differences and other characteristics important for large magnetic disturbances should be analysed.

From the operational point of view the following possibilities should be explored:

- 1) A survey on all users of our 27-day forecasts should be conducted and their requirements and interests in receiving MAM should be assessed.
- 2) New ways of disseminating MAM should be explored. (For example, computer information system, news releases, broadcasting.)

- 3) Explore the possibility of introducing a "public response system" after very large magnetic disturbances - similar to seismology's "after-quake questionnaire".
- 4) Maintain the collections of publications and information on adverse effects on all various aspects of human activity.
- 5) Increase the awareness of adverse effects of magnetic storms by publications in GEOS and other relevant journals.
- 6) Feasibility and necessity of weekend duties should be assessed. Presently MAMs are not issued and cannot be transmitted outside the working hours. Geomagnetism section and EPC do not operate on weekends.

Acknowledgements

I would like to express my thanks to Dr. R. L. Coles and to Dr.H.-L. Lam for their comments and discussions.

6. References:

- [1] Watanabe T. and Shier R. M. : Magnetic Storm Effects on Power Transmission System. Geomagnetic Bulletin 2 - 82, EPB, EMR, 1982.
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- [3] Roberge G., Lafleur Y., Blais G., Que Bui Van : Groupe de travail sur les orages magnetiques, Rapport et Recommandations, Hydro- Quebec, Avril 1986.
- [4] Goodacre A.K.: Geomagnetic Predictions and Amateur Radio Geomagnetic Bulletin 2 - 81. EPB, EMR, 1981.
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- [7] Johnson W.G., Parnell T.A., W.Vaughan.: Solar-Induced Variations of Environment Affecting Manned Spaced Flight and Spacecraft Operations. Solar-terrestrial Predictions Proceedings, Vol.2 NOAA 1979, 89 - 103.

- [8] Wadham P.N.: The Effects of Electrostatic Discharge Phenomena on Telesat's Domestic Communications Satellites Lecture on NATO conference, 1986.
- [9] Allan J.H.: NGDC Satellite Anomaly Data Base and Solar-Terrestrial Activity. NOAA, Nat.Geophysical Data Center, Newsletter 1986.
- [10] Escudier P.: Use of Solar and Geomagnetic Activity Indices for Orbit Computation. Solar-terrestrial Predictions Proceedings, Meudon 1984, 591-595.
- [11] Blake R.L.: Potential Prediction Needs in Support of Energy System. Solar-terrestrial Predictions Proceedings, Meudon 1984, 200.

APPENDIX I :

THE RESPONSE TO MAGNETIC ALERT MESSAGE OF JULY 13, 1982.

- 1/ Magnetic Alert Message issued 13.7.1982.
- 2/ Letter from Regional Director EPC, Saskatchewan (15.7.1982).
- 3/ Letter from Planning Officer EMO, Regina (14.7.1982).
- 4/ Transcripts of telex messages between members of MAPP on
13.7.1982.

1/ Magnetic Alert Message issued on July 13. 1982. (transcript)

Earth Physics Branch, EMR
Ottawa Magnetic Observatory
13. July 1982.
12.50.UT

Geomagnetic storm is in progress. Active magnetic conditions will
continue probably next 20 to 36 hours.

J.Hruska
telephoned to EPC 13.00 UT
13.7.1982

2/ Letter from Regional Director EPC, Saskatchewan.



Emergency Planning Planification d'urgence
Canada Canada

850 Avord Tower
2002 Victoria Avenue
Regina, Saskatchewan
S4P 0R7

15 July 1982

Your file Votre référence

Our file Notre référence

2800-40

Dr. J. Hruska
Ottawa Magnetic Observatory
Earth Physics Branch
Energy, Mines and Resources
1 Observatory Crescent
Ottawa, Ontario
K1A 0Y3

Dear Dr. Hruska:

I guess like most of us you sometimes wonder if the information you send out ever reaches the correct people and if it is of value to them. I cannot speak for other regions, but I believe the attached correspondence from Saskatchewan Power Corporation to Saskatchewan Emergency Measures Organization and telex traffic on the night of 13 July 1982 among the Mid-Continent Area Power Pool (MAPP) will give you some indication that your magnetic storm information is used and appreciated in this province. I have marked the pertinent section of the telex.

You will note that Saskatchewan Power does not have it quite right as to who originates the magnetic storm forecasts. I will see that they are correctly advised.

It is interesting that of all the power companies involved in MAPP only Saskatchewan Power had any warning of the magnetic storm. I would guess this situation will change.

I am sure I can speak for both Saskatchewan Emergency Measures Organization and Saskatchewan Power when I thank you for your efforts and I look forward to receiving the information from you on the other services offered by the Magnetic Observatory.

Yours sincerely,

L.F. French
Regional Director (Saskatchewan)

/cb

Att.

cc: A.F. Wigglesworth, EPC, Ottawa

21
3/ Letter from Planning Officer EMO, Regina.

2025 Victoria Ave.
Regina, Sask.
1982 July 14

Mr. J. T. Eaton
Director
Saskatchewan EMO
2151 Scarth Street
REGINA, Sask.

Dear Mr. Eaton,

Re: Effects of Magnetic Disturbances

Enclosed for your information and reference is two copies of the TELEX exchange of messages which took place last night in the Mid-Continent Area Power Pool (MAPP).

As you will notice, the advance information concerning ^{forecast} magnetic disturbances in our area which you relayed before 14:00 on July 13 was of particular value to the operators. This was even more valuable since the other utilities did not appear to have received the advisory.

We therefore appreciate your communication very much and thought you would like to have some feedback on the effects of solar storms on the power transmission network.

J. H. Campbell
Planning Officer, EMO for
Sask. Power Corporation.

4/ Transcripts of telex messages between the members of MAPP on
13.7.1982.

MPLD TO MAPP
Minnesota Power 18:15 SEVERE VOLTAGE SWING IN OUR NORTHERN DIVISION
and Light (Dakota) NO LINE TRIPPING ANYWHERE. ANYONE ELSE SEE IT?

ROGER 18:23 07/13/82

MAPP HQ MPLO 1941
RE: ASS 19:40

THE FREQUENCY CHART REFLECTS THE UPSWING, BUT THE METERS INDICATE MINIMAL
SHIFT. NO FURTHER INFO INTO MCC AT THIS TIME.

STEVE 18:29 07/13/82

UPA to BC* 1947
UNITED POWER ASSOC. (Eillior Minnesota)

MCHENRY REACTOR OPENED ON LOW VOLTAGE
ONLY SMALL FLOW CHANGE

PB 18:30 07/13/82

MPLD TO MAPP UM 1955
18:32 ANOTHER VOLTAGE DROP AND RESTORATION

ROGER 18:33 07/13/82

SPC TO MAPP MPLD UPA BC 1965
SASK. POWER CORP

OUR RECORDERS SHOW FREQ. UPSWING AT 13:16 - THIS MAY BE COMMON KNOWLEDGE BUT
WE HAVE BEEN NOTIFIED OF ELECTRO-MAGNETIC STORMS IN THE SASKATCHEWAN AREA
FOR THE 20 HR TIME PERIOD BEGINNING AT 13:00 TODAY.

AL 18:38 07/13/82

APDB to BC

* NOTE - BC = ALL STATIONS

APDB 18:40 07/13/82

OTTER TAIL POWER TO BC MAPP
HAVE VOLTAGE SWINGS HERE ALSO
DON'T KNOW WHERE THE PROBLEM IS EITHER

1974

THANKS

LOREN 18:42 07/13/82

OTP TO BC
VOLTAGE GOING BAD.....

1992

WHO IS DOING WHAT????

LOREN 18:55 07/13/82

NSPF TO MAPP BC
JUST SAW THE VOLTAGE SWING AGAIN IN FARGO
LR 18:56 07/13/82

1994

OPA TO BC MAPP
SAW VOLTAGE SWING AT OUR WILLMAR STATION ALSO....

1993

DAVE 18:59 07/13/82

IPM TO BC
JUST LOST OUR 101/345 BUS AT LAKEFIELD JCT. HAVE MAN ON THE WAY

1998

HH 19:00 07/13/82

IPLW TO MAPP BC
SAW THE VOLTAGE SWING AT OUR SYCAMORE STATION

1999

PETE 19:01 07/13/82

MHEB TO OTA BC*

2001

FROM THE LOOKS OF THINGS WE'RE EXPERIENCING A MAGNETIC STORM.
OUR 500 KV IS MONITORED FOR SOLAR ACTIVITY AND ITS ALARMING CONSTANTLY.
ALSO OUR SYNCHRONOUS CONDENSERS AT DORSEY ARE SEEING IT AND TRYING TO
COMPENSATE FOR THE VOLTAGE DIPS.
MUST BE HAVING FAIR AMOUNT OF SOLAR FLARES CAUSE WE HAVEN'T SEEN IT THIS BAD
FOR A LONG TIME.

ED 19:04 07/13/82

IPLN TO BC

2045

FOR WHATEVER ITS WORTH:
ACCORDING TO A FRIEND OF MINE THE 15-40-20-45 AND 10 METER BAND OF AMATEUR
RADIO FREQUENCIES ARE ALL FLAT USUALLY AT LEAST ONE IS WORKABLE OF THE M
BANDS....

GW 19:31 07/13/82

IPW TO BC MAPP

2061

HAVE OUR LAKEFIELD SUB BACK TO NORMAL AT 1945, NOT SURE YET WHAT IS WRONG.
WE HAVE SOME TARGETS TO BE ANALYZED....

HH 19:49 07/13/82

WAPA TO SPC

2093

ACK MSG 2082 AND THANKS
WHERE'D YOUR INFO COME FROM ON THOSE ELECTRO-MAGNETIC STORMS?
JUST CURIOUS

DAVE 20:24 07/13/82

SPC TO WAPA

HAVE A NOTE HERE INDICATING ADVISORY FROM EMERGENCY MEASURES OR ONTARIO BUT
THE ADVISORIES COME FROM ENVIRONMENT CANADA. SORRY BUT NOTE DOES NOT
ELABORATE OTHER THAN THE 20 HR TIME PERIOD BEGINNING AT 13:00 TODAY.

AL 20:33 07/13/82

WAPA TO SPC

2115

BACK MSG 2108 AND THANKS
I SENT THA MSG ON TO MAPP AS STEVE UP THERE IS TRYING TO CONFIRM THESE STORMS
WITH U.S. WEATHER OFFICIALS AND NO ONE SEEMS TO KNOW ANYTHING ABOUT IT.

DAVE 20:38 07/13/82

SPC TO WAPA MAPP 2116
I CAN CALL THE PERSON WHO LEFT THE NOTE FOR CLARIFICTION IF U WANT???

AL 20:39 07/13/82

MAPP TO BC PC MHEB 2141
RE: REPORTED MAGNETIC STORM DISTURBANCE

HAVE TRIED THE FOLLOWING FOR CONFIRMATION AND ADDITIONAL INFORMATION
UNIVERSITY OF MINNESOTA PHYSICS DEPT.....NO ANSWER (AFTER HOURS)
NATONAL WEATHER SERVICE.....NO KNOWLEDGE OF PROBLEM
U.S. COMMERCE DEPTS. ENVIRONMENTAL RESEARCH LABORATORY.....NO ANSWER
WILL KEEP THE BOOK OPEN ON THIS ONE AND PASS ALONG PERTAINING INFO AS IT
BECOMES AVAILABLE

THANKS
STEVE 20:58 07/13/82

OPPD TO MAPP AHEB SPC BC 2346
IN REGARDS TO THE MAGNETIC DISTURBANCES, CURRENT INFORMATION CAN BE OBTAINED
BY CALLING THE SPACE ENVIRONMENTAL SERVICE CENTER IN BOULDER COLO. FOR 24 HOUR
SERVICE CALL 303-497-3171 AND DURING WORKING HOURS CALL MR. JOE HERMAN AT
303-497-5688. HOPE YOU ALL CAN USE THIS HOT INFO...THANKS

SMITTY 22:59 07/13/82

SPC TO MAPP 23:52

I WAS TALKING TO STEVE EARLIER RE: ELECTRO-MAGNETIC STORMS AND HAVE COMPILED
THE FOLLOWING INFO.

ENVIRONMENT CANADA - OTTAWA, ONTARIO - ATMOSPHERICAL ADVISORY SERVICE NOTIFY
EMERGENCY PLANNING CANADA OF IMPENDING STORMS, (TIMES, DURATION AND AREAS
AFFECTED) - THIS FEDERAL AGENCY IN TURN NOTIFIES THE PROVINCIAL EMERGENCY
MEASURES ORGANIZATION AND WE GET OUR NOTIFICATION FROM THEM.

FOR FURTHER INFORMATION U CAN CONTACT MR. J.T. EATON, DIRECTOR, EMERGENCY
MEASURES ORGANIZATION - PALLISER SQUARE, 2151 SCARTH STREET, TEL:
(306) 525-8121

AL 23:23 07/13/82 PLEASE ACK ASG 23:52

APPENDIX II :

EXAMPLE OF DATA SET FOR MAGNETIC ALERT MESSAGE OF 21.AUGUST 1986
AND FOR REVIEW OF 25.AUGUST 1986.

- 1) Magnetic Alert Message, issued on 21.8.1986, 12.45 UT
- 2) Magnetogram from Ottawa Magnetic Observatory for August 20,
with ssc and for August 21, 1986 when MAM was issued.
- 3) TVS reports from FCC and YKC on 21.8.1986.
- 4) Canadian 27 day forecasts: for period 14.8. - 9.9. 1986.:
 - a) regular
 - b) three zone (experimental)
- 5) East-West solar scans from the Algonquin Radio Observatory
(NRC) for period 18.8. - 24.8.1986.
- 6) SESC Boulder Report on Solar and Geophysical Activity issued
22.00 UT 20.8.1986.
- 7) Geomagnetic Activity Recurrence Plots for Bartels Rotation
Period 2090 and 2091.
- 8) Magnetic synoptic charts for Canadian Magnetic Observatory
Network for period 20.8. to 24.8.1986.
- 9) Hourly Ranges, Xcomponent from Canadian Magnetic Observatory
Network for period: 20.8. to 23.8.1986.
- 10) K Indices from OIT, MEA and VIC for 20.8. to 24.8.1986.
- 11) Review of Magnetic Activity for period 20 to 25 August 1986.

1) Magnetic Alert Message, issued on 21.8.1986, 12.45 UT

Geophysical Division, GSC

EMR, Ottawa

To: Emergency Planning Canada, DND

Dr. M.J.Berry, Director

Geophysical Division, GSC

Hydro-Québec: G.Roberge, Planification

Repartiteur Reseau C.C.R.

Magnetic Alert Message

Magnetic storm is in progress. Active condition will probably
continue during next 24 to 36 hours.

J.Hruska

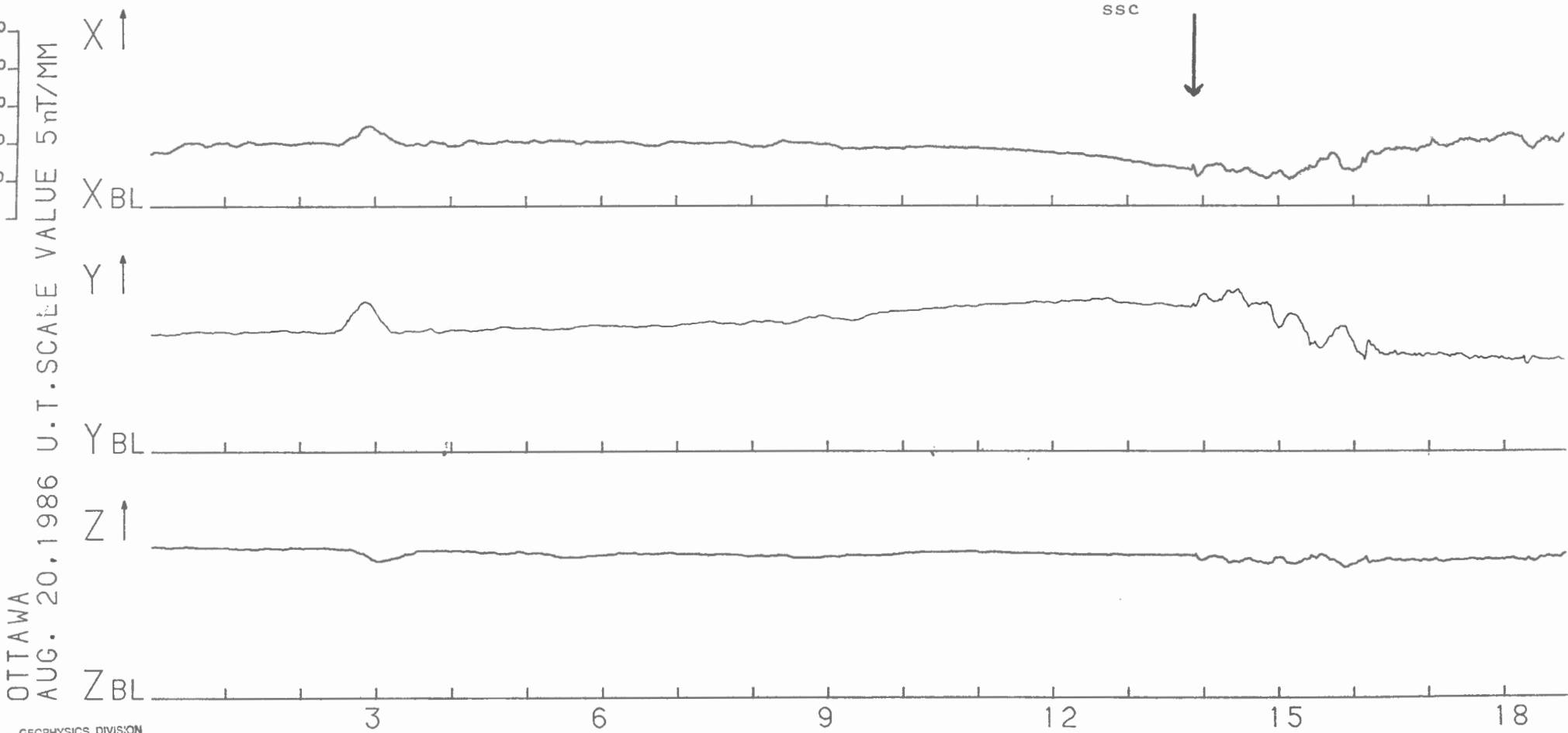
Ottawa 21.8.1986, 12.45 U.T.

Remarks: ssc

verified with EPC, all transmitted o.k.

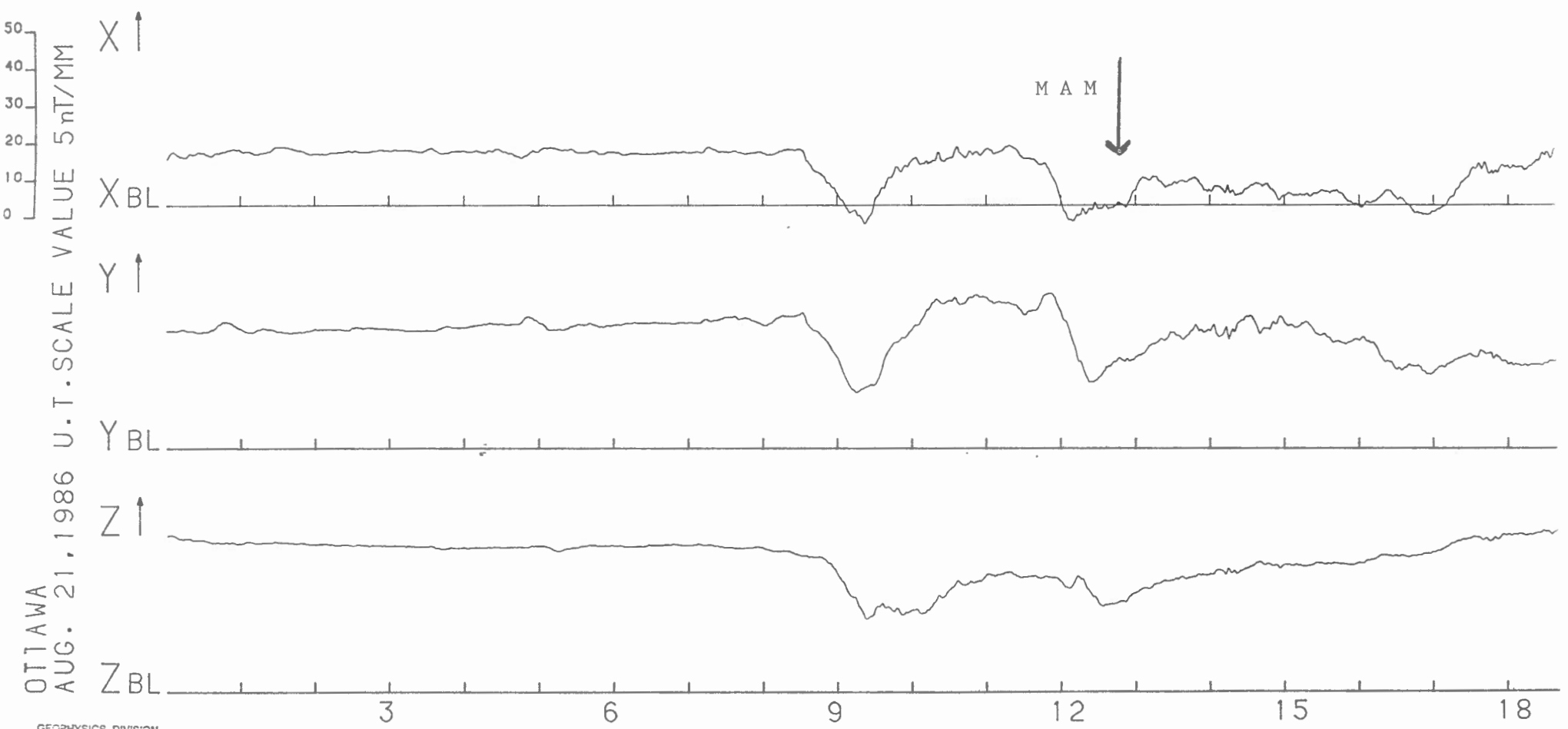
14.00. called to EPC with ranges values.

2) Magnetogram from Ottawa Magnetic Observatory for August 20,
with ssc and for August 21, 1986 when MAM was issued.



OTTAWA
 AUG. 20, 1986

GEOPHYSICS DIVISION
 GEOLOGICAL SURVEY OF CANADA, E.M.R.
 DIVISION DE LA GÉOPHYSIQUE
 COMMISSION GÉOLOGIQUE DU CANADA, E.M.R.
 OTTAWA, CANADA K1A 0Y3



OTTAWA
 AUG. 21, 1986

GEOPHYSICS DIVISION
 GEOLOGICAL SURVEY OF CANADA, E.M.R.
 DIVISION DE LA GÉOPHYSIQUE
 COMMISSION GÉOLOGIQUE DU CANADA, E.M.R.
 OTTAWA, CANADA K1A 0Y3

3) TVS reports from FCC and YKC on 21.8.1986

TVS REPORT: 21 AUG 1986 - 233 DAY
HOURLY RANGES X,Y,Z: 00.00 TO 12:00 UT

05 : FORT CHURCHILL

05 233 01 X 0063 0028 0043 0021 0035 0063 0063 0037 0044 0233 0428 0281 0252
05 233 01 Y 0036 0036 0017 0031 0027 0074 0025 0022 0078 0290 0247 0179
05 233 01 Z 0062 0030 0022 0027 0024 0035 0019 0089 0305 02276 0180 0195

10 : YELLOWKNIFE

10 233 01 X 0058 0080 0058 0052 0059 0027 0015 0136 0470 0577 0447 0113
10 233 01 Y 0037 0048 0037 0023 0012 0026 0023 0112 0332 0419 0238 0080
10 233 01 Z 0027 0039 0022 0012 0030 0019 0034 0108 0397 0549 0298 0194

4) Canadian 27 day forecasts: for period 14.8. - 9.9. 1986.:

a) regular

b) three zone (experimental)



Energy, Mines and
Resources Canada

Énergie, Mines et
Ressources Canada

Earth Sciences

Sciences de la Terre

Geological Survey of Canada
Geophysics Division
1 Observatory Crescent
Ottawa, Ontario
K1A 0Y3

Commission géologique du Canada
Division de la géophysique
1, place de l'Observatoire
Ottawa (Ontario)
K1A 0Y3

FORECAST OF GEOMAGNETIC ACTIVITY FOR PERIOD: AUG. 14 - SEP. 9

1986

LA PREVISION DE L'ACTIVITE GEOMAGNETIQUE POUR LA DUREE: AOUT 14 - SEP 9

The geomagnetic field is expected to be:

Le champ géomagnétique sera probablement:

active : AUG. 14-15, 21-23, 31 SEP. 5-6
actif : AOUT SEP.

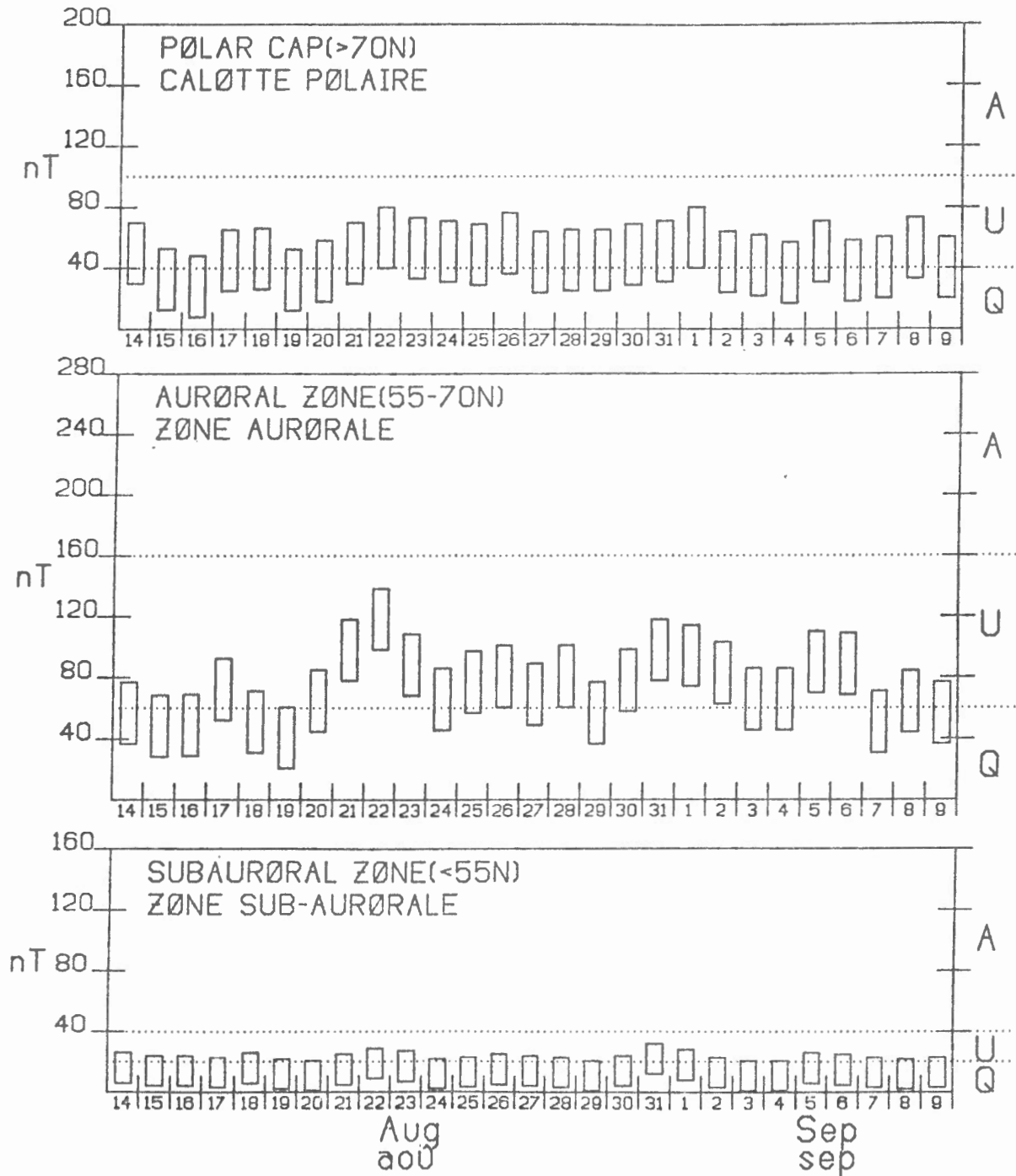
unsettled : The rest of the forecast period.
agité : Le reste de la période prévue.

quiet : AUG. 18-19, 28-29 SEP. 3-4
calme : AOUT SEP.

EMR CANADA OTTAWA

FØRECASTED DAILY MEAN ØF HØURLY RANGES

PREVISION DU MØYEN QUØTIDIEN DES AMPLITUDES HØRAIRES



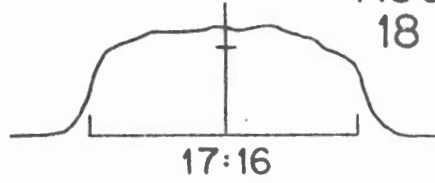
Q,U and A represent quiet, unsettled and active levels of geomagnetic activity.
 Q,U and A reprØsentent des niveaux calmes, agitØs, et actifs de l'activitØ gØomagnØtique.

For 72-hr forecast, dial : 1-613-992-1299
 Pour la prØvision de 72-h, tØlØphoner: 1-613-992-1299

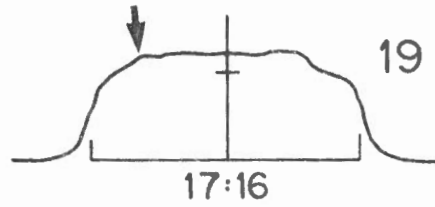
5) East-West solar scans for period: 18.8. - 24.8.1986.

ALGONQUIN RADIO OBSERVATORY
CANADA

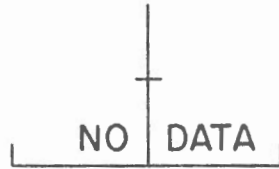
AUG
18



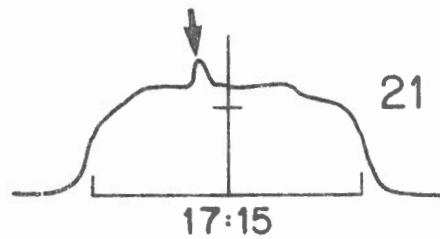
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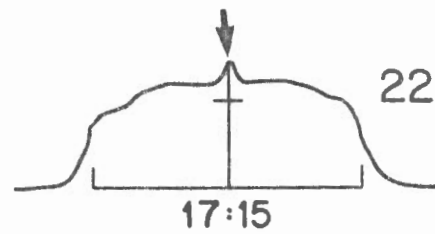
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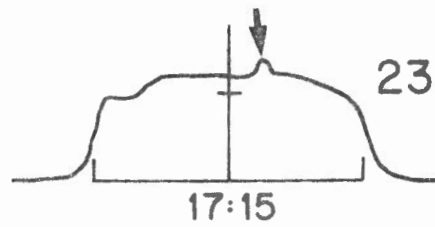
21



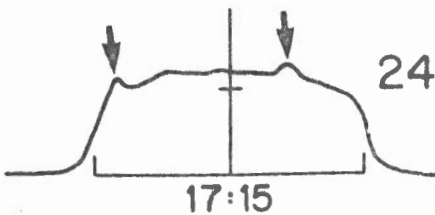
22



23



24



6) SESC Boulder Report on Solar and Geophysical Activity.

EASYLINK 4677286A003 20AUG86 16:38/16:38 EST

FROM: TLX 888776 NOAA BLDR

NOAA DEPT OF COMMERCE

TO: 389534941

ATTN: DR. HRUSKA

FROM SPACE ENVIRONMENT SERVICES CENTER, BOULDER, COLORADO

SDF NUMBER 232

JOINT USAF/NOAA REPORT OF SOLAR AND GEOPHYSICAL ACTIVITY.

ISSUED 2200Z 20 AUG 1986

IA. ANALYSIS OF SOLAR ACTIVE REGIONS AND ACTIVITY FROM 19/2100 TO 20/2100Z: SOLAR ACTIVITY HAS BEEN VERY LOW. REGION 4743 (S11E28) WAS NUMBERED TODAY AS A SMALL BXO TYPE SPOT GROUP. THE REGION HAS A MAGNETIC CONFIGURATION THAT IS LEADER-POSITIVE AND TRAILER-NEGATIVE. THIS IS REVERSED FROM WHAT IS EXPECTED DURING THE CURRENT SUNSPOT CYCLE NUMBER 21. THE REGION PRODUCED ONLY MINOR FLARE ACTIVITY. A 10 DEGREE LONG FILAMENT DISAPPEARED FROM THE NORTHWEST QUADRANT EARLY IN THE DAY. THE REST OF THE DISK AND LIMBS WERE QUIET.

IB. SOLAR ACTIVITY FORECAST: SOLAR ACTIVITY IS EXPECTED TO REMAIN VERY LOW FOR THE NEXT THREE DAYS. REGION 4741 (N08, L-235 CLASS/AREA DKI/200 ON 29 JULY) IS DUE TO RETURN LATE ON 22 AUGUST. REGION 4741 WAS A REVERSED POLARITY REGION WHICH PRODUCED TWENTY MINOR FLARES ON THE LAST SOLAR ROTATION. IT WAS RELATIVELY INACTIVE WHEN IT ROTATED OFF THE DISK ON 09 AUGUST.

IIA. GEOPHYSICAL ACTIVITY SUMMARY FROM 19/2100Z to 20/2100Z: THE GEOMAGNETIC FIELD WAS GENERALLY QUIET TO UNSETTLED EARLY IN THE PERIOD AND AT MINOR STORM LATER IN THE PERIOD. A SUDDEN IMPULSE RECORDED AT SEVERAL MIDDLE LATITUDE STATIONS AT APPROXIMATELY 1350 UT 20 AUGUST MARKED THE CHANGE IN ACTIVITY. THE CHANGE MAY BE PART OF A RECURRENT PATTERN OF SEVERAL PAST SOLAR ROTATIONS OR THE EFFECTS OF A LARGE FILAMENT DISRUPTION ON 15 AUGUST OR A COMBINATION OF BOTH.

IIB. GEOPHYSICAL ACTIVITY FORECAST: THE GEOMAGNETIC FIELD IS EXPECTED TO BE ACTIVE AT MIDDLE LATITUDES (MINOR STORM AT HIGH LATITUDES) FOR THE NEXT 48 HOURS WITH GENERALLY ACTIVE CONDITIONS AT ALL LATITUDES FOR THE SUBSEQUENT 24 HOURS. PERIODS OF MINOR STORM CONDITIONS AT MIDDLE LATITUDES (MAJOR STORM CONDITIONS AT HIGH LATITUDES) ARE POSSIBLE DURING THIS THREE DAY INTERVAL, ESPECIALLY IN THE LOCAL NIGHTTIME SECTORS.

III. EVENT PROBABILITIES 21 AUG-23 AUG

CLASS M 02/02/02

CLASS X 01/01/01

PROTON 01/01/01

PCAF GREEN

IV. OTTAWA 10.7 CM FLUX

OBSERVED 20 AUG 069

PREDICTED 21 AUG-23 AUG 070/070/071

90 DAY MEAN 20 AUG 069

V. GEOMAGNETIC A INDICES

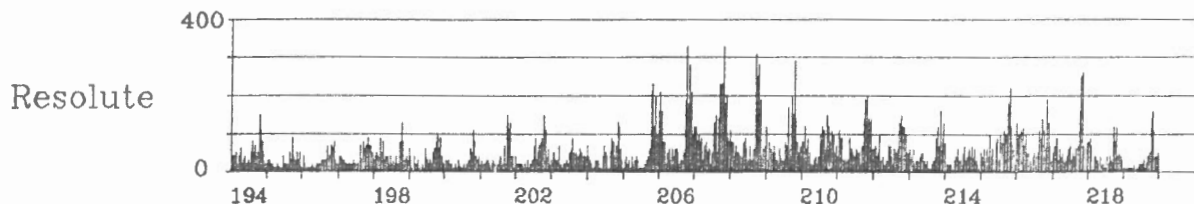
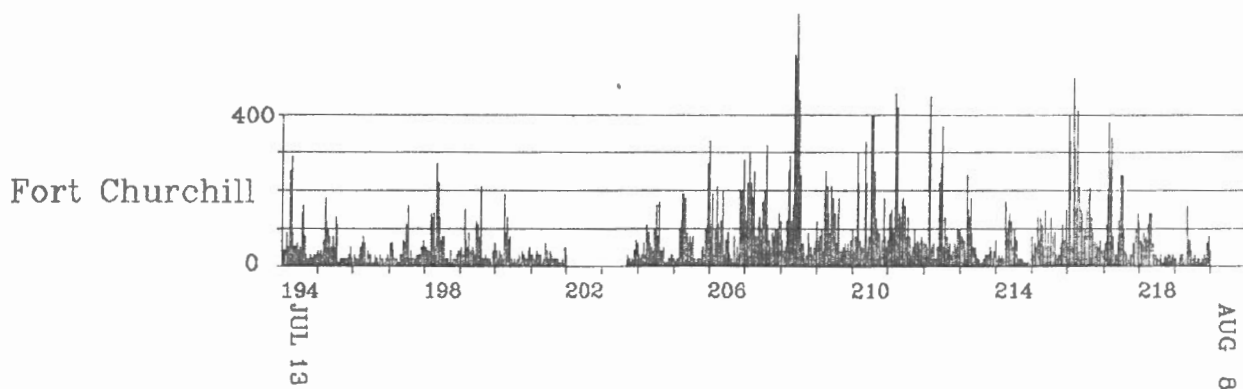
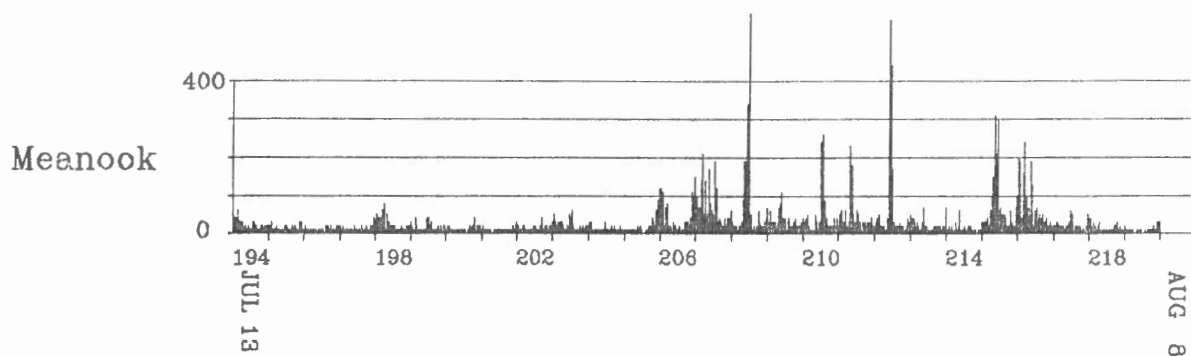
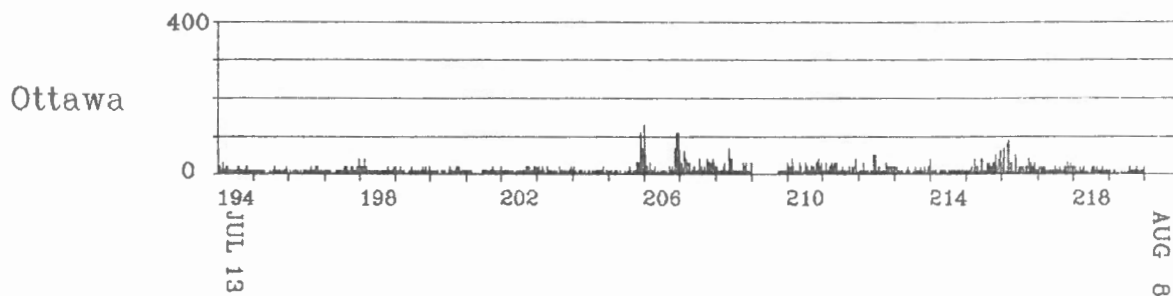
OBSERVED AFR/AP 19 AUG 006/011

ESTIMATED AFR/AP 20 AUG 020/025

PREDICTED AFR/AP 21 AUG-23 AUG 020/030-020/030-018/020

7) Geomagnetic Activity Recurrence Plots for Bartels Rotation
Period 2090 and 2091.

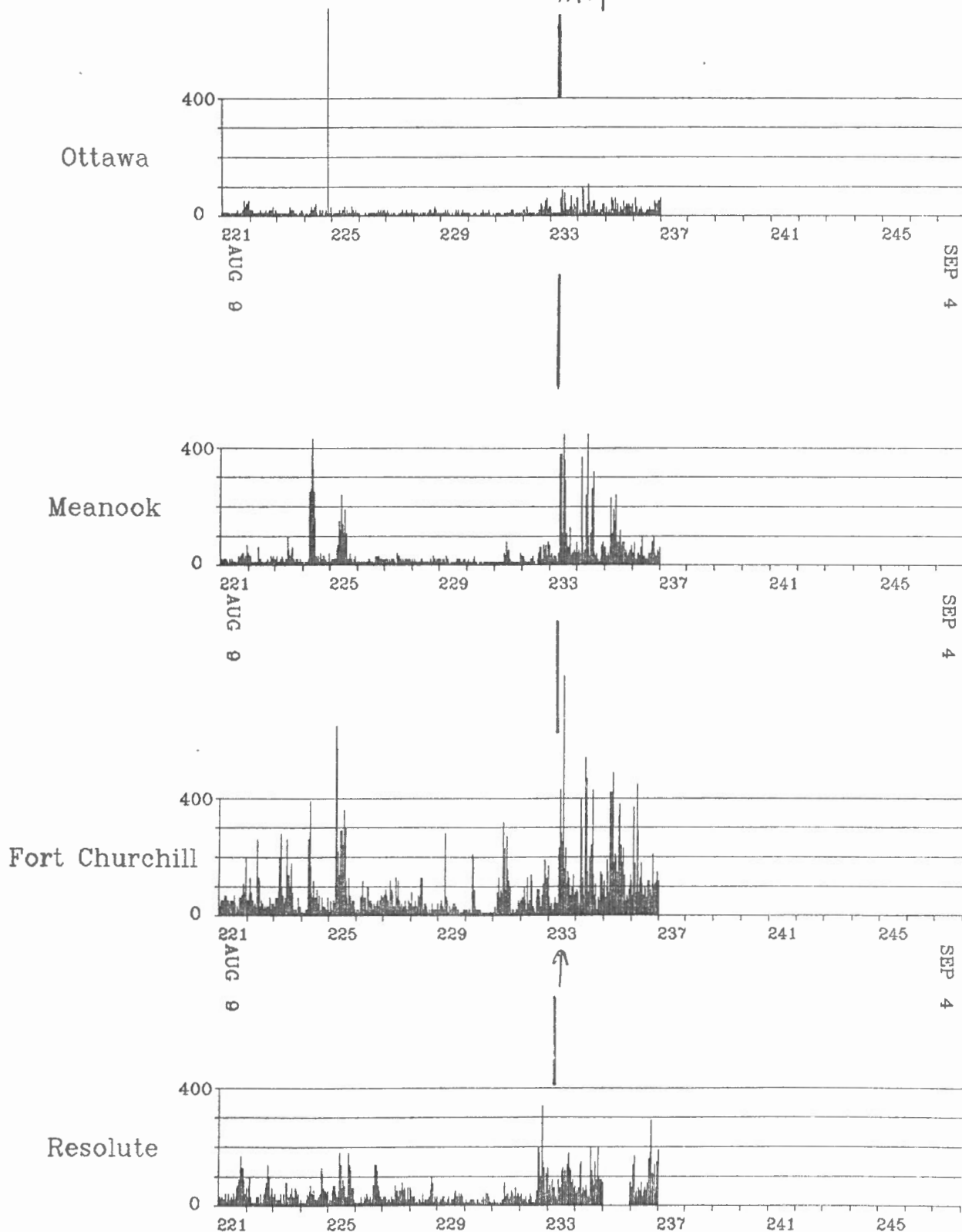
EMR Canada Earth Physics Branch
Geomagnetic Activity Recurrence Plots
Canadian Magnetic Observatory (AMOS III) Network
27-day Bartels Solar Rotation Period 2090
hourly ranges (nT) for component X
1986



EMR Canada Earth Physics Branch
Geomagnetic Activity Recurrence Plots
Canadian Magnetic Observatory (AMOS III) Network
27-day Bartels Solar Rotation Period 2091
hourly ranges (nT) for component X

1986

MAM

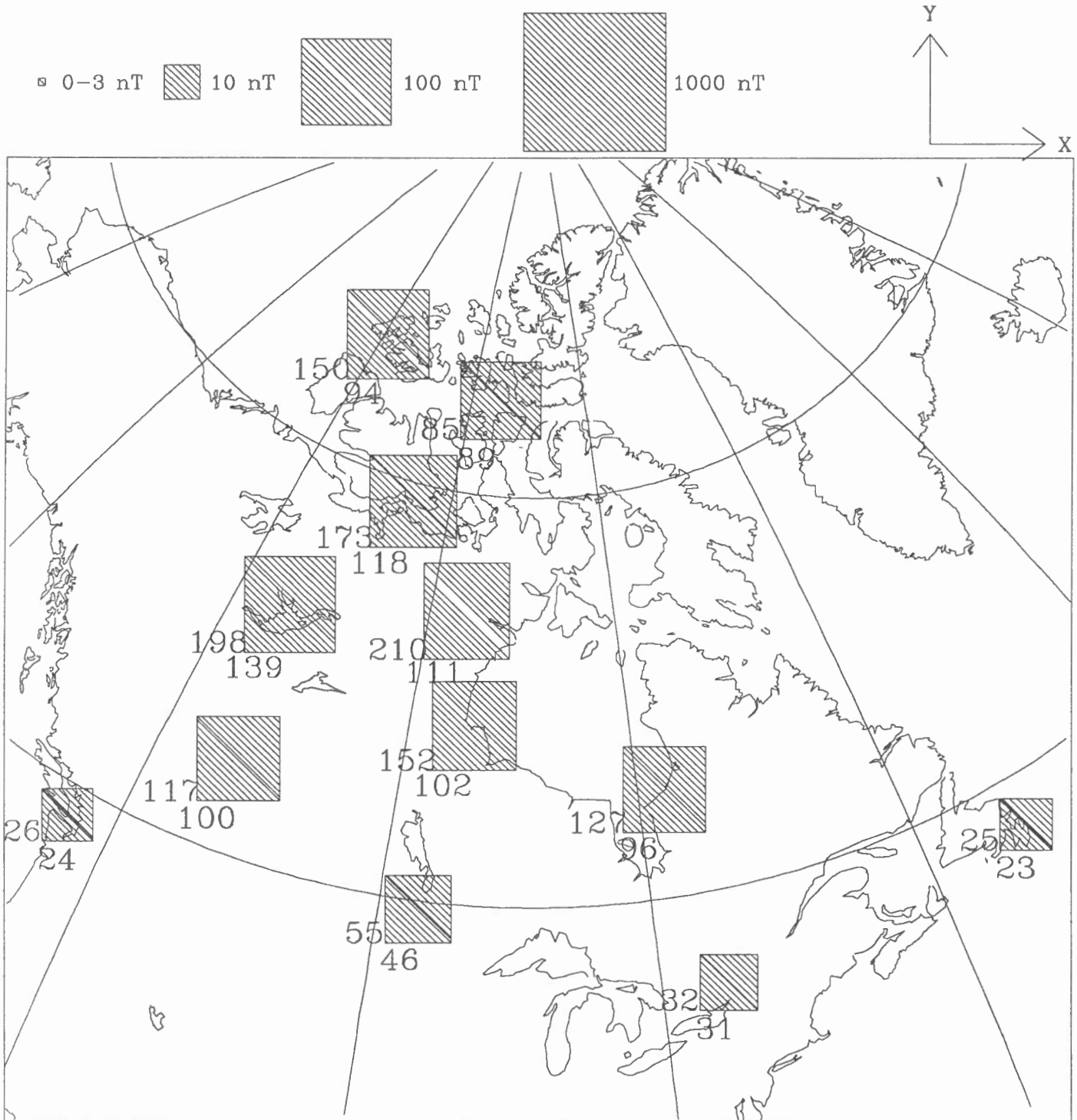


8) Magnetic synoptic charts for Canadian Magnetic Observatory
Network for period 20.8. to 24.8.1986.

EMR Canada Earth Physics Branch Geomagnetic Activity Synoptic Charts

Canadian Magnetic Observatory (AMOS III) Network

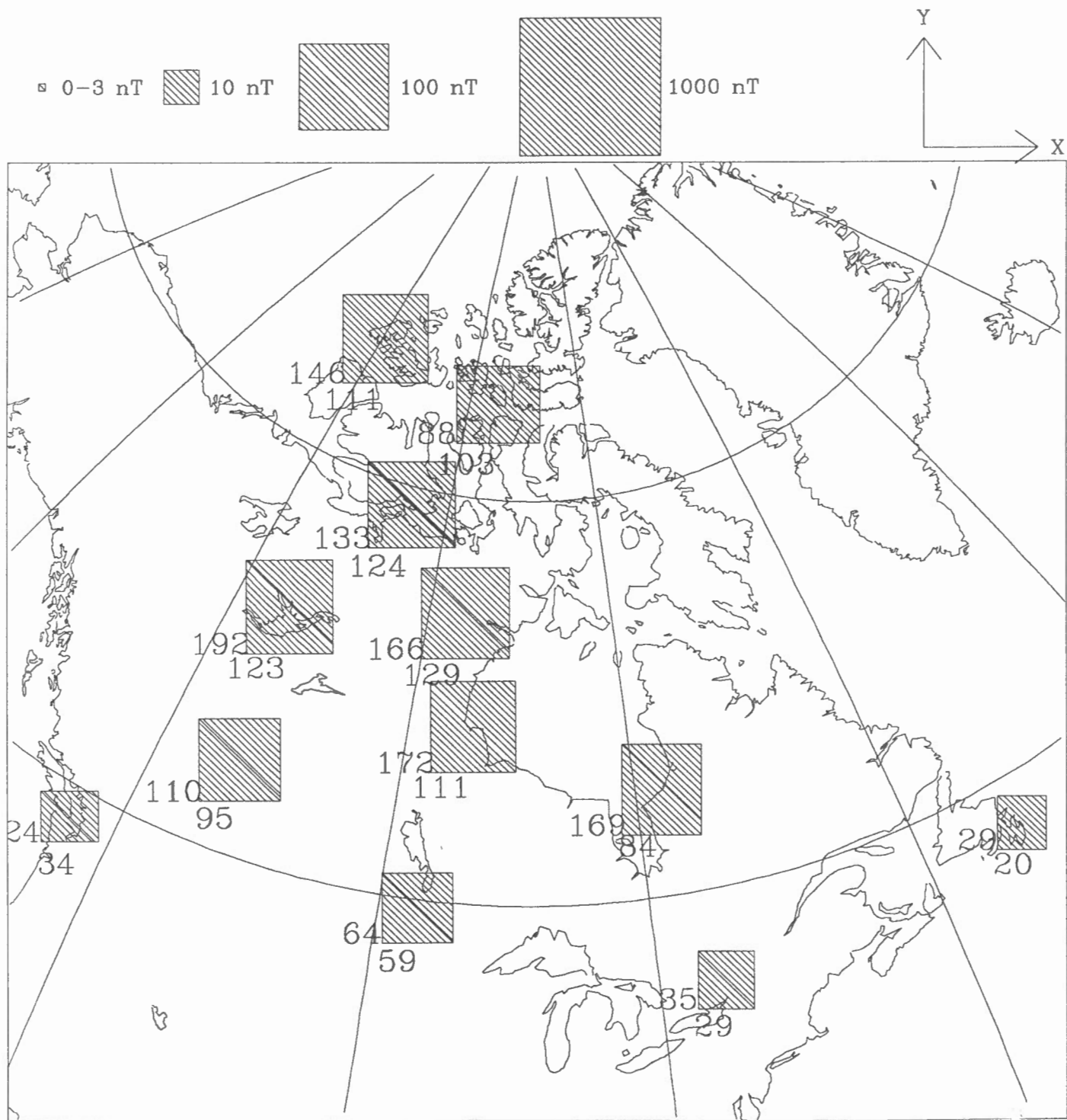
Daily means of hourly ranges for X and Y components
for 1986-day 233 86-AUG-21



EMR Canada Earth Physics Branch Geomagnetic Activity Synoptic Charts

Canadian Magnetic Observatory (AMOS III) Network

Daily means of hourly ranges for X and Y components
for 1986-day 234 86-AUG-22

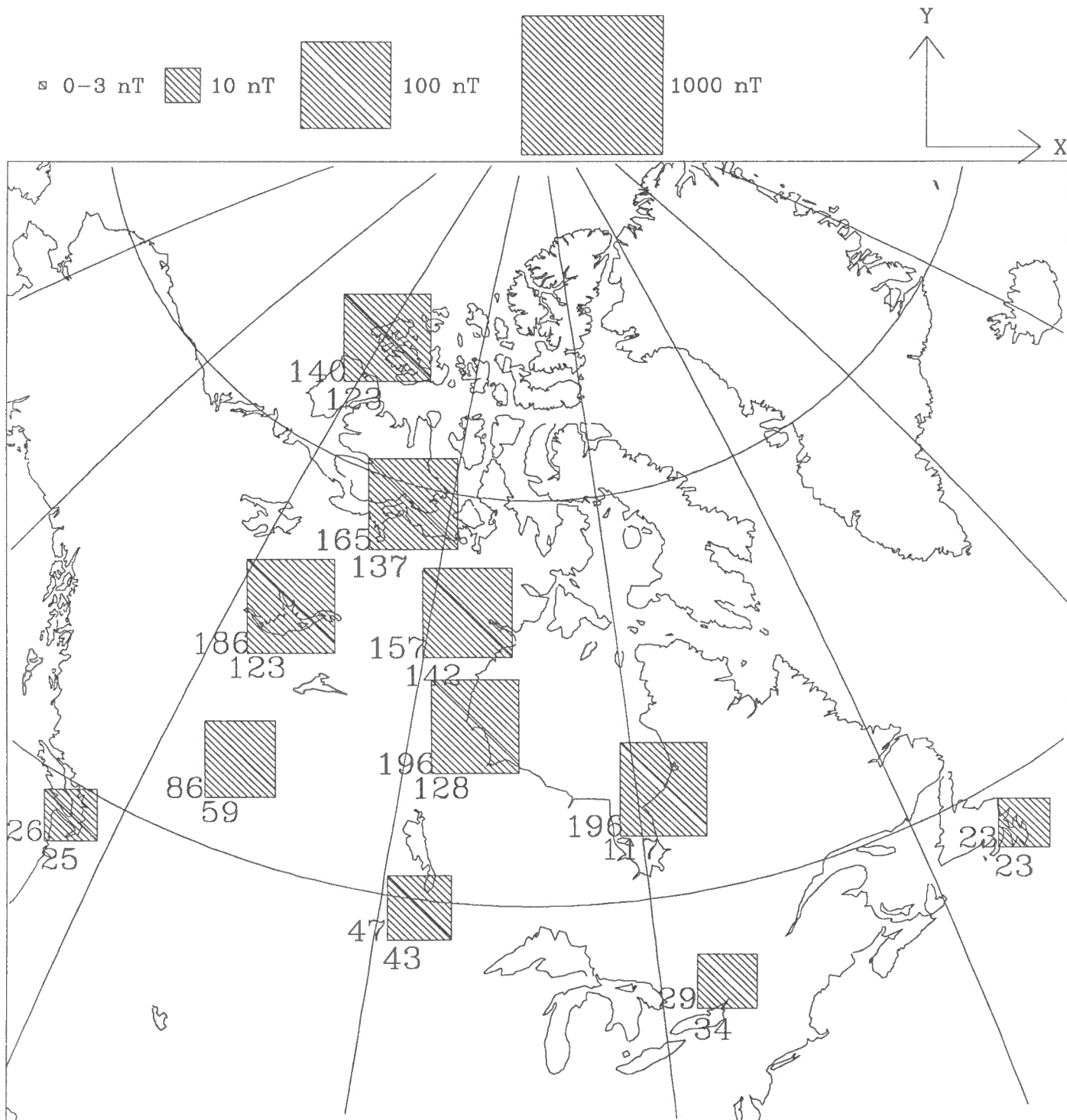


EMR Canada Earth Physics Branch Geomagnetic Activity Synoptic Charts

Canadian Magnetic Observatory (AMOS III) Network

Daily means of hourly ranges for X and Y components

for 1986-day 235 86-AUG-23

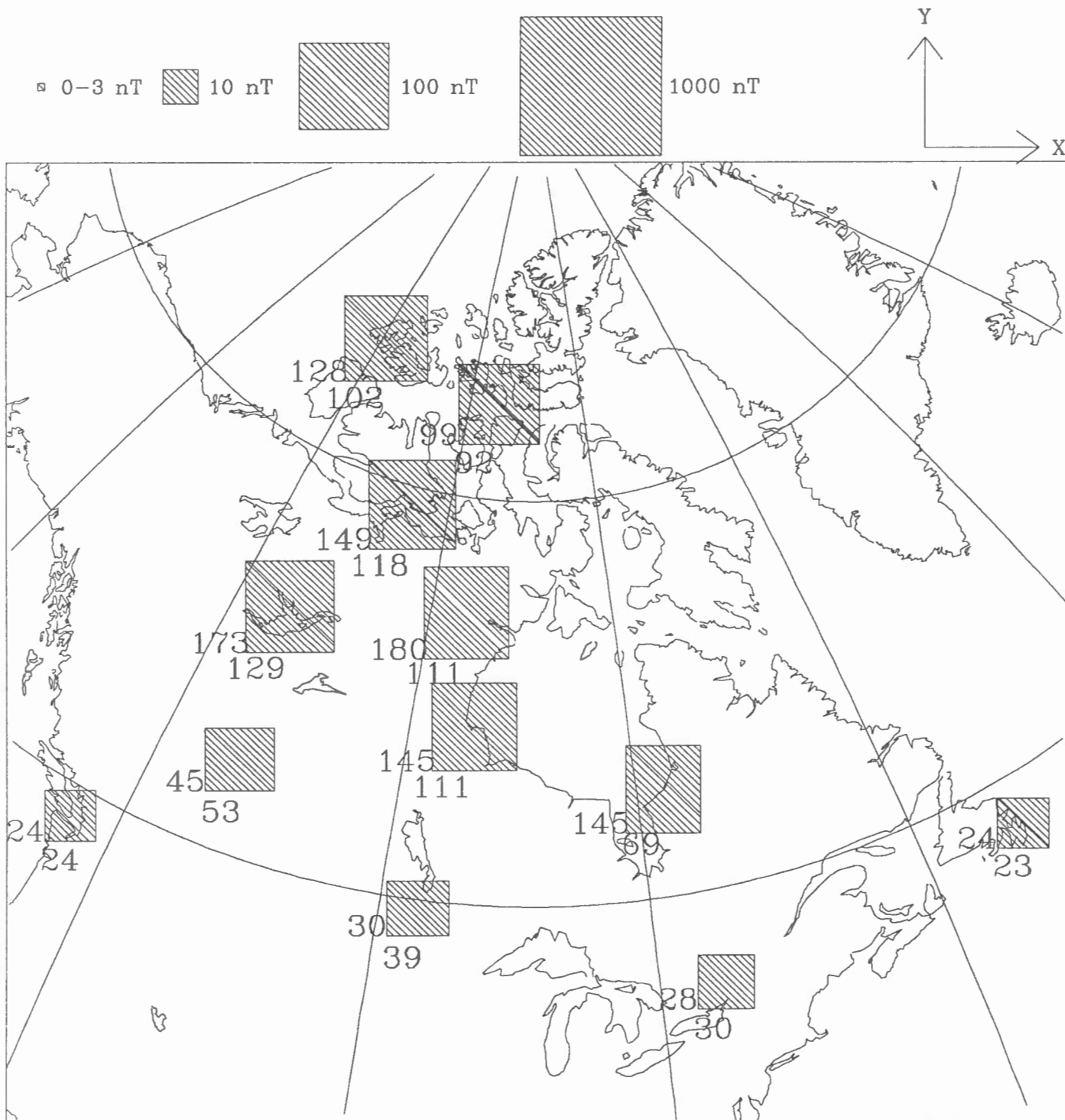


EMR Canada Earth Physics Branch Geomagnetic Activity Synoptic Charts

Canadian Magnetic Observatory (AMOS III) Network

Daily means of hourly ranges for X and Y components

for 1986-day 236 86-AUG-24



9) Hourly Ranges, X component from the Canadian Magnetic
Observatory Network: 20.8 to 23.8.1986

Canadian Magnetic Observatory Network

Hourly ranges, X component: X RNG

20 Aug 1986

Station	OTT 1	STJ 2	MEA 3	VIC 4	FCC 5	BLC 6	CBB 7	PBQ 8	RES 9	YKC 10	GLN 11	ALE 12	MBC 13
Hour													
1	16	13	26	13	64	34	31	28	42	62	15	9999	9999
2	6	6	19	8	60	40	38	45	24	41	7	9999	9999
3	26	9	8	5	101	41	21	261	18	43	20	9999	9999
4	23	7	12	10	48	22	20	263	22	27	23	9999	9999
5	9	3	12	8	20	17	10	122	27	24	8	9999	9999
6	5	4	10	8	126	11	10	132	12	18	7	9999	9999
7	6	5	9	10	42	11	21	31	13	20	9	9999	9999
8	7	5	24	9	51	16	19	68	19	21	6	9999	9999
9	8	4	24	9	137	24	16	61	36	72	12	9999	9999
10	6	4	28	6	123	32	27	47	25	80	11	9999	9999
11	3	10	5	2	34	24	17	5	10	46	4	9999	9999
12	6	9	4	3	21	12	9	9	11	7	3	9999	9999
13 1350	11	11	4	2	12	16	19	11	8	14	5	9999	9999
14 SSC	22	11	17	20	55	94	62	40	16	26	11	9999	9999
15	20	11	37	15	90	193	60	38	47	234	35	9999	9999
16	35	31	57	29	94	195	180	52	201	173	55	9999	9999
17	33	34	58	31	62	221	130	47	180	119	40	9999	9999
18	17	24	22	10	30	86	157	20	103	32	14	9999	9999
19	30	47	66	40	69	124	169	57	339	88	24	9999	9999
20	45	40	49	47	114	174	242	151	151	66	35	9999	9999
21	60	71	71	57	188	401	374	301	131	211	39	9999	9999
22	24	31	26	17	135	217	205	140	39	92	26	9999	9999
23	33	12	79	22	131	120	146	94	112	122	56	9999	9999
24	28	18	72	28	172	91	135	149	134	151	43	9999	9999

21 Aug. 1986

Station	1	2	3	4	5	6	7	8	9	10	11	12	13
Hour													
1	14	16	31	8	63	39	98	68	50	58	12	9999	9999
2	10	6	38	21	28	36	65	65	66	80	17	9999	9999
3	6	7	18	9	43	23	39	29	36	58	8	9999	9999
4	6	6	27	11	21	40	50	25	86	52	10	9999	9999
5	12	10	25	11	35	36	39	37	64	59	10	9999	9999
6	10	9	22	10	63	34	29	65	56	27	15	9999	9999
7	5	3	6	4	37	16	18	23	31	15	6	9999	9999
8	10	8	37	7	44	34	42	124	22	136	6	9999	9999
9	61	33	381	69	233	36	54	165	93	470	136	9999	9999
10	86	51	380	57	428	560	348	401	63	577	143	9999	9999
11	24	26	112	22	281	432	371	378	58	447	110	9999	9999
12 MAM	76	60	445	35	252	103	43	259	123	113	196	9999	9999
13 issued	42	41	359	66	816	857	308	376	131	764	204	9999	9999
14	20	24	293	57	160	549	249	167	102	352	65	9999	9999
15	23	27	106	22	226	122	137	99	117	214	38	9999	9999
16	21	10	59	36	111	247	71	35	80	171	27	9999	9999
17	33	32	56	15	153	683	347	85	142	417	23	9999	9999
18	66	80	129	28	133	372	527	69	183	278	78	9999	9999
19	33	27	28	10	72	139	335	46	128	70	17	9999	9999
20	24	17	39	16	72	111	316	67	115	75	19	9999	9999
21	41	16	35	18	100	196	133	98	81	83	28	9999	9999
22	26	14	52	24	135	95	247	88	88	97	42	9999	9999
23	61	26	41	28	70	159	155	144	63	53	53	9999	9999
24	58	49	82	39	82	115	131	138	67	97	50	9999	9999

22 Aug. 1986

Station	OTT 1	STJ 2	MEA 3	VIC 4	FCC 5	BLC 6	CBB 7	PBQ 8	RES 9	YKC 10	GLN 11	ALE 12	MBC 13
Hour													
1	12	14	36	23	87	37	46	138	42	77	31	9999	125
2	19	18	45	12	76	57	80	84	54	84	27	9999	67
3	13	16	37	17	38	27	66	102	60	68	13	9999	90
4	104	78	371	82	398	569	128	426	142	652	126	9999	208
5	87	74	97	48	295	681	120	562	154	347	127	9999	255
6	19	21	41	14	134	27	29	110	43	47	20	9999	77
7	14	12	50	14	71	32	23	121	161	51	21	9999	42
8	44	28	244	15	535	57	81	351	51	378	100	9999	71
9	108	43	452	104	464	413	320	373	67	621	286	9999	306
10	50	36	99	31	150	77	155	281	51	323	193	9999	144
11	10	15	34	10	79	35	54	52	34	39	13	9999	23
12	25	25	105	7	195	50	61	104	33	83	48	9999	36
13	49	49	263	27	237	62	82	226	196	213	98	9999	306
14	52	54	323	9	434	173	86	264	120	402	134	9999	297
15	20	9	42	11	136	317	71	46	85	261	26	9999	107
16	21	19	28	18	66	105	156	41	74	114	23	9999	77
17	19	21	43	14	111	262	187	39	151	203	25	9999	82
18	12	19	16	8	22	57	139	20	85	46	12	9999	45
19	23	25	14	7	60	65	189	79	199	42	15	9999	97
20	21	22	16	10	45	138	244	85	96	41	14	9999	164
21	44	22	70	16	150	278	365	158	87	154	51	9999	274
22	24	26	74	42	108	245	286	87	56	127	44	9999	228
23	39	23	80	25	141	124	185	128	91	148	48	9999	281
24	13	22	56	20	88	113	49	170	81	97	37	9999	92

23 Aug. 1986

Station	1	2	3	4	5	6	7	8	9	10	11	12	13
Hour													
1	25	21	56	18	122	54	71	151	9999	72	38	9999	66
2	14	10	32	19	56	54	64	85	9999	87	26	9999	117
3	23	18	39	24	188	25	29	360	9999	94	28	9999	148
4	11	16	33	24	153	49	30	243	9999	74	25	9999	119
5	17	12	58	24	82	32	38	351	9999	93	26	9999	80
6	57	36	225	75	422	798	750	549	9999	373	118	9999	190
7	53	19	105	37	416	369	511	537	9999	346	98	9999	98
8	16	37	189	34	475	352	132	505	9999	544	96	9999	148
9	55	22	154	18	184	45	40	227	9999	289	109	9999	100
10	17	8	238	32	211	108	187	116	9999	294	57	9999	98
11	36	24	84	29	198	185	146	373	9999	250	39	9999	100
12	11	15	82	17	148	137	48	2	9999	122	32	9999	69
13	34	35	95	31	341	105	71	104	9999	101	49	9999	52
14	16	10	121	27	375	119	55	141	9999	93	26	9999	56
15	17	21	72	15	241	134	135	107	9999	223	21	9999	91
16	47	35	78	30	175	251	211	89	9999	321	48	9999	156
17	34	44	75	19	234	211	160	148	9999	340	52	9999	98
18	37	39	52	16	141	175	334	80	9999	176	23	9999	122
19	29	20	42	17	53	111	270	67	9999	81	34	9999	263
20	39	32	29	14	69	82	192	50	9999	73	43	9999	214
21	25	10	42	18	61	83	102	51	9999	82	36	9999	246
22	30	18	54	25	91	91	159	66	9999	86	34	9999	237
23	36	24	73	30	412	121	98	129	78	124	57	9999	287
24	11	28	42	19	123	88	25	72	81	116	23	9999	173

10) K Indices from DIT, MEA and VIC for 20.8. to 24.8.1986.

K-INDICES OF GEOMAGNETIC ACTIVITY at Meanook

Year/Month 1986 Aug		Range for K=9 1500 nT				SCALE VALUES OF VARIOMETER in nT/mm Y = 5 X = 5				
U.T. DAY	00h- 03h	03h- 06h	06h- 09h	09h- 12h	12h- 15h	15h- 18h	18h- 21h	21h- 24h	SUM	
20	1	1	2	2	2	3	3	3	17	
21	2	2	6	6	7	4	2	3	32	
22	3	6	7	4	6	2	3	3	34	
23	3	5	5	5	4	3	3	3	31	
24	4	3	4	2	2	3	3	3	24	

K-INDICES OF GEOMAGNETIC ACTIVITY at Ottawa

Year/Month 1986 Aug		Range for K=9 750 nT				SCALE VALUES OF VARIOMETER in nT/mm Y = 5 X = 5				
U.T. DAY	00h- 03h	03h- 06h	06h- 09h	09h- 12h	12h- 15h	15h- 18h	18h- 21h	21h- 24h	SUM	
20	3	2	1	1	3	3	3	3	19	
21	2	2	4	5	4	4	3	4	28	
22	3	5	5	3	4	2	3	3	28	
23	3	4	4	3	3	4	3	3	27	
24	4	3	3	2	2	3	3	4	24	

K-INDICES OF GEOMAGNETIC ACTIVITY at Victoria

Year/Month 1986 Aug		Range for K=9 650 nT				SCALE VALUES OF VARIOMETER in nT/mm Y = 5 X = 5				
U.T. DAY	00h- 03h	03h- 06h	06h- 09h	09h- 12h	12h- 15h	15h- 18h	18h- 21h	21h- 24h	SUM	
20	2	2	2	1	3	3	4	3	20	
21	2	2	4	4	5	4	2	3	26	
22	3	6	5	3	4	2	3	3	29	
23	3	5	4	3	3	3	3	3	27	
24	4	4	3	2	3	3	4	3	26	

11) Review of Magnetic Activity for period 20 to 25 August 1986.

Geophysical Division, GSC
1 NF, Ottawa .
Date:

REVIEW OF GEOMAGNETIC ACTIVITY FOR PERIOD.....*20-25 Aug 86*

TO: Emergency Planning Canada
Telesat Canada (via EPC)
Hydro Quebec (via EPC)

Dr. M. Berry,
Director, Geophysical Division, GSC

The magnetic storm started at *13:50* UT on *20 Aug 86* and lasted
.....*3*.....~~hours~~ (days). The peak of the activity was recorded
on *21.8.* at the *Baker Lake* observatory at *13:00* UT.
The maximum value of hourly ranges was *857* nT.

Detailed information on this magnetic storm are available
from:

Geomagnetic Section,
Geophysics Division
Geological Survey of Canada
1 Observatory Crescent
Ottawa, Ontario
K1A 0Y3

Name: *J. Hruska*

Date: *25.8.86*

Time: *13:30*

Geophysics Division

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APPENDIX III :

INSTRUCTIONS FOR ISSUING MAGNETIC ALERT MESSAGES.

April 1987

- 1/ Magnetic and Solar conditions
- 2/ Checking points
- 3/ Procedure recommended for issuing MAM
- 4/ Review of MAM's period
- 5/ Forms for Magnetic Alert Message
- 6/ Forms for Review

1/ Magnetic and Solar Conditions :

- a) ssc was observed or reported by any observatory or by satellite
- b) At Ottawa Magnetic Observatory large variations are recorded, hourly ranges (HR) are at least 100nT, preliminary K are 5 or larger.
- c) At northern observatories (mainly in the auroral zone) hourly ranges are reaching at least 400 nT
- d) Solar reports during past 3 to 5 days have reported (individually or in various combinations): solar flare, CMP of coronal hole, disappeared filament, active region.
- e) Solar scans have " peaks " corresponding to active regions. These "peaks" have increased during past 3 to 5 days.
- f) Reports of solar radio bursts type II and IV.
- g) Solar wind speed increased during last 3 days.
- h) During last rotation active conditions were recorded, corresponding to 27 day recurrence

Usually not all the observations are available. Therefore, use of common sense and judgment is highly recommended.

2/ Checking points :

- a) Magnetic chart from OTT
- b) TVS: latest magnetic values from auroral and polar cap observatories
- c) 27 day forecasts from Ottawa and Boulder.
- d) Daily solar-geophysical reports, alert messages from SESC
- e) Weekly SESC reports on solar observations
- f) URSIGRAMS
- g) Daily solar scans, their changes, new peaks
- h) Magnetic activity during past 2-3 rotations

When at least two or three of these points are observed, reported and checked, the Magnetic Alert Message should be issued.

3/ Procedure recommended for issuing MAM:

- a) Prepare the text for MAM (version 1 or 2). Copies of all forms are in the file : ALERT
- b) Fill-in the appropriate form : Facsimile Transmission Message supply of forms is on the table next to telecopier.
- c) Preferably via facsimile (Rapicon 120 is located in Xerox room on main floor) transmit the MAM to Emergency Preparedness Canada. (The instructions for use of facsimile are briefly described on the sheet above facsimile and

- detailed instruction are in instructional booklet.)
- d) Emergency Preparedness Canada: Facsimile number: 996 0995
Telephone number: 992 5585
Manager: Don Smith.
Mailing address: Emergency Preparedness Canada
Attn. Mr. D. Smith
141 Laurier Ave West
Ottawa, Ont.
K1A 0W6
- e) If facsimile gives Error Report, check it and either retransmit the message (following the instructions in the booklet), or use telephone. EPC is supposed to contact Telesat Canada and Hydro-Québec directly. If some communications difficulties occur, transmit MAM directly to Telesat Canada and to Hydro-Québec.
- f) Telesat Canada- Attn. to Mr. Wadham or Mr. Behmann
Telephone number: 746 5920
Telex number : 053 4184
Facsimile number: 748 8712,
748 8718
- g) Hydro-Québec: Facsimile number : 1-514 282 0842
att. S. del Pozo
Telex number : 055 61047
Telephone number : 1-514 289 4499
- h) A copy of MAM directly to Dr. Berry's office.
- i) Record MAM on the Automatic Answering Machine together with 72 hrs forecast.
- j) Store the original message and all data connected with the predicted storm in the ALERT file.

4/ Review of magnetic activity for MAM's period

After the period for expected magnetic storm expires, or after the magnetic storm subsides, issue the "Review of magnetic activity". Distribution is the same as for MAM, e.g. send it via telecopier, or by telephone, or by mail to the EPC Ottawa and they will transmit to all users.

The forms: Review 1 or Review 2 are on the file : ALERT

The magnetic data for the Review :

- a) Time in UT of observed ssc, or approximate time of start of magnetic storm, if no ssc was reported.
- b) Time, day and location of period of maximum activity as recorded at the canadian magnetic network.
- c) Duration of magnetic storm in hours or days
- d) Estimated maximum value of K index from OTT, MEA or VIC.

Version 1

EPC: 996 0995 (facsimile)
992 5585 (telephone)

Geophysics Division, GSC
EMR, Ottawa
992 8401 (tel.)
993 6753 (facs.)

Division de la géophysique, CGC
EMR, Ottawa
992 8401 (tel.)
993 6753 (facs.)

MAGNETIC ALERT MESSAGE

AVIS D'ALERTE MAGNETIQUE

TO:
Emergency Preparedness Canada
Telesat Canada (via EPC Ott)
Hydro-Québec (via EPC Qué)

A:
Protection civile Canada
Télésat Canada (via PCC Ott)
Hydro-Québec (via PCC Qué)

Dr. M.J.Berry, Director
Geophysics Division, GSC

Dr. M.J.Berry, directeur
Division de la géophysique, CGC

Magnetic storm started atU.T. Active conditions will
continue probably during the next hours.

L'orage magnétique a débuté àT.U. Le champ géomagnétique
restera actif probablement pendant les prochaines.....heures.

Name:
Nom :

Date , Time :
Date , heure:

Version 2:

EPC 996 0995 (facsimile)
992 5585 (telephone)

Geophysics Division, GSC
EMR, Ottawa
613 992 8401 (tel.)
613 993 6753 (facs.)

Division de la géophysique CGC
EMR, Ottawa
613 992 8401 (tel.)
613 993 6753 (facs.)

MAGNETIC ALERT MESSAGE

AVIS D'ALERTE MAGNETIQUE

TO:
Emergency Preparedness Canada
Telesat Canada (via EPC Ott)
Hydro-Québec (via EPC Qué)

Dr. M. J. Berry, Director
Geophysics Division, GSC

A:
Protection civile Canada
Télésat Canada (via PCC Ott)
Hydro-Québec (via PCC Qué)

Dr. M. J. Berry, directeur
Division de la géophysique, CGC

Magnetic storm will start probably during the nexthours.
active conditions will continue probably during the next
.....hours.

Le début d'un orage magnétique est prévu probablement pendant la
période deheures qui suit. Le champ géomagnétique
restera actif probablement pendant les prochainesheures.

Name:
.....
Nom :

Date, time:
.....
Date, heure:

Review 1

EPC :996 0995 (facsimile)
992 5585 (telephone)

Geophysics Division, GSC
EMR, Ottawa
613 992 8401 (tel.)
613 993 6753 (facs.)

Division de la géophysique, CGC
EMR, Ottawa
613 992 8401 (tel.)
613 993 6753 (facs.)

REVIEW OF GEOMAGNETIC ACTIVITY
FOR PERIOD:

COMPTE RENDU DE L'ACTIVITE
MAGNETIQUE POUR:

TO:
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The magnetic storm started atUT, on and
lasted forhours. The peak of the activity was recorded
atUT on.....at theobservatory.
Estimated maximum value of K indices in
was

L'orage magnétique a débuté àT.U. leet a
continué pendantheures. L'activité maximale fut
enregistrée àT.U. le.....à l'observatoire
de La valeur maximale estimée des indices K
à fut

Name:
.....
Nom:

Date, time:
.....
Date, heure:

Review 2:

EPC: 996 0995 (facsimile)
992 5585 (telephone)

Geophysics Division, GSC
EMR, Ottawa
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EMR, Ottawa
613 992 8401 (tel.)
613 993 6753 (facs.)

REVIEW OF GEOMAGNETIC
ACTIVITY FOR PERIOD:

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MAGNETIQUE POUR:

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The magnetic storm expected on did not occur.

Magnetic field was (quiet, unsettled)

L'orage magnétique prévu pour le n'a pas eu lieu.

Le champ géomagnétique était..... (calme, agité).

Name:
.....
Nom :

Date, time:
.....
Date, heure:

Review 2:

EPC: 996 0995 (facsimile)
992 5585 (telephone)

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EMR, Ottawa
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REVIEW OF GEOMAGNETIC
ACTIVITY FOR PERIOD:

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Name:
.....
Nom :

Date, time:
.....
Date, heure: