Relation Between Geomagnetic Measurements and MW DX Conditions

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Because a variety of physical and chemical states of the ionosphere are responsible for differing reception conditions, it is difficult to find any useful measurement that can be used as a criterion of DX conditions. However, I would like to suggest that geomagnetic indices can be correlated to MW reception in at least a gross fashion. Since July of 1965, I have been receiving weekly reports from the U.S. Government[1] of geomagnetic values for each day of the week. Over the 2½ years, a period going from just after a sunspot minimum to near the peak of solar activity, DX conditions over very long paths have varied from quite good in Fall, 1965 to poorer (i.e., much less frequent) in late 1967. From a comparison of reception conditions with geomagnetic records, I would suggest that low geomagnetic activity is a necessary but not sufficient requirement for long distance east-west medium wave DX, and will illustrate and discuss this point below.

The measurements made by ESSA are reported as A_{Fr} units for each day of the week reported. A_{Fr} stands for Geomagnetic A-Index as measured at Fredericksburg, Virginia by the U.S. Coast and Geodetic Magnetic Observatory. A-Index values (on a linear scale of 0-400) measure the strength of geomagnetic disturbance. The A_{Fr} is an average of 8 readings taken 3 hours apart during the day, so that marked changes during the day are not obvious from the average values. In any case, the A_{Fr} is a readily obtained physical measure of ionospheric conditions for individual days. Values of A below 4 are low, and above 25 quite high, in terms useful to short wave users (especially with reference to paths near the polar zone). I have defined values of A_{Fr} of 3 or less as low geomagnetism, and values of 15 or above as high geomagnetism, as related to MW DX. There have been numerous days of A of 0 during the past 2½ years, and the highest reading - 156 - was on May 26, 1967, during a 3-day ionospheric disturbance.

There is a seasonal variation of geomagnetism. Days of high geomagnetism occur most often during the August-October period, with a lower peak occurring at the other equinox period in March. Values for the 1940-1951 period[2] show that both March and September had about the same number of days of very high geomagnetic activity, but that August and October were well above February and April in occurrence of very high geomagnetism. These data also showed that days of very low activity (equivalent to A of 0 - 2) occurred most frequently during the November to February period (1005 days, compared to 776 days for March to June, and 713 for July to October). These figures would appear significant to me in suggesting lower geomagnetism (and hence a more stable ionosphere) during the months nearest the winter solstice. In Table I, I have summarized the number of days of low and high geomagnetism in each month of the past 2½ years. Fewer days of low activity occurred during the periods of higher sunspot number and poorer day-to-day MW DX (e.g., column 1 figures for October-December for each of the past 3 years). Noticeable also is the September, 1966 period of good auroral DX, with 14 days of high A. The correspondence between high geomagnetism and auroral conditions is well established. Although this summary of data does show interesting trends, it is when we examine data for individual days that more striking correlations can be made.

As a measure of exceptional reception conditions, I have used TA reception from Southern California. There are several reasons for this: (1) the occurrence of split frequency stations relatively free from interference (e.g., BBC-1214, RTF-1205), (2) the rarity of reception, and (3) my interest in logging these stations during 1965 and 1966. I checked the band almost daily from early October, 1965 to January, 1966 during the first season, for example. Using dates of reception of West Coast North American stations in Britain (supplied by Ken Brownless), and dates of my own European reception from La Jolla, I have observed that a period of low geomagnetism was associated with each of these receptions. Certainly, there were days of low A_{Fr} when these stations were not logged, but many factors are involved in exceptional reception, not just the presence of low geomagnetism. But all cases checked were during periods of low A (below 4 in almost all cases). Table II shows the comparison between presence (and quality) of reception and A_{Fr}. Note that reception times are for early AM EST, and A_{Fr} is for the whole day. Days of TA reception with higher A (eg, Nov. 22, Nov. 30, and Dec. 18) were at the end of a multi day opening, and it is likely that the increase in A was later in the day than the TA reception (and possibly may have been related to the cause for ending of the opening). My TA reception during the autumn of 1966 was much less frequent but also occurred on days of low A.

Reciprocal reception of Europe and UC NA would appear not to be the only path showing this characteristic of requiring low A. Reception of TP Asia from Massachusetts (NRC) occurred during a period of low A (Oct. 20, 1965), and clearest receptions of deep TP Asians (eg., Macau-738, Thailand-543 and 1123, stations on 955 kc, Kiangsi-843, and the Philippines and/or Okinawa on 780 kc) from California (DXWW, 1965) occurred when the A was 8 or less (3 or below in all but 5 cases). In some cases, these were the same days on which TA reception occurred.

If the relationship of low A to chances for excellent BCB reception over long paths, and the high A to auroral DX, were to be of direct use to DXers, it would be necessary to show what the geomagnetic conditions were at any particular time, and what they were expected to be in the following hours. Unfortunately, such data is rarely available to us. During the IGSY (1964-1965), WWV did broadcast "alerts" of geomagnetic calms or storms expected. The usual propagation forecasts broadcast by WWV are intended for SW, and do not have much use for MW DXers.

Testing of the suggested association of excellent BCB DX on long east-west paths with low A would require a longterm systymetic study of reception conditions, and access to more complete geomagnetic records. The latter is not difficult. The reasonably good direct correlation between this physical measurement and DX conditions reported here suggest that a closer examination would be worthwhile.

References:

1. CRPL-Jc Reports. Telecommunications Disturbance Forecast Center, Environmental Science Services Administration, Box 178, Fort Belvoir, Virginia, 22060. $5.00 per year.

2) International Association of Geomagnetism and Aeronomy. Geomagnetic Data. 1961. IAGA Bull. No. 121.

Table I - Summary of Days of High and Low Geomagnetic Activity (July 1965-Dec 19

Month	Days of Low Activity*	Days of High Activity*
July, 1965	6	6
August	3	3
September	6	2
October	13	1
November	15	1
December	18	1
January, 1966	15	3
February	11	3
March	8	5
April	9	0
May, 1966	9	2
June	5	1
July	3	5
August	3	5
September	1	14
October	11	6
November	6	3
December	9	4
January, 1967	12	5
February	12	3
March	11	1
April	9	4
May	1	11
June	2	9
July	6	3
August	4	3
September	5	10
October	5	3
November	4	4
December	6	8

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Table II - Comparison of TA Reception from La Jolla, Cal. - 1965

Date	Quality of Reception	A_{Fr} Value
October 9	+	3
16	+	2
17	+	2
18	++	7
19	+	4
20	+	2
21	++	2
22	+++	13
November 1	+	4
8	+	3
10	++	0
15	+++	1
16	++	0
17	+	3
24	+	4
26	+	3
29	++	1
30	+	9
December 6	+	2
15	++	0
16	++	0
17	+++	1
18	++	10
22	+	2

+ + + = excellent reception conditions
+ + = fairly good
+ = fair or poor (but positive)

* - Days of low activity were defined as those having A_{Fr} value of 3 or less, those of high activity had A_{Fr} of 15 or above