NOAA Data Report ERL SEL-2

A CATALOG OF LOW-FREQUENCY OSCILLATIONS OF THE EARTH'S MAGNETIC FIELD AS OBSERVED AT SMS-2 AND GOES-2 DURING DECEMBER 1977

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UNITED STATES DEPARTMENT OF COMMERCE
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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Richard A. Frank, Administrator

Environmental Research Laboratories
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A Catalog of Low-Frequency Oscillations of the Earth's Magnetic Field as Observed at SMS-2 and GOES-2 during December 1977

INTRODUCTION

It is generally accepted that hydromagnetic waves contain important information about the physical conditions in the plasma environment of the earth's magnetosphere (e. g. Troitskaya and Gul'elmi, 1970). Given a knowledge of the wave generation and propagation characteristics of the magnetosphere system, the parameters of geomagnetic pulsations can be used for remote diagnostics of magnetospheric parameters. In order to understand the effects of the magnetosphere-ionosphere system upon the waves, it is necessary to study the waves both on the ground and in the magnetospheric area where they are generated.

A large body of information is available on the characteristics of magnetic pulsations observed on the earth's surface, but relatively little is known about the physical aspects of the waves in space, due to the small number of properly instrumented satellites in orbit at any given time.

The SMS/GOES synchronous satellites provide a particularly good data base for compiling the occurrence statistics of magnetic pulsations in space and for event-by-event comparison of waves observed in space with those observed on the ground. The synchronous orbit provides a daily sampling of all local times at a fixed altitude, and lies within the magnetospheric ULF resonance region (Hughes et al., 1978). In addition to the fortuitous location of the synchronous

orbit, the NOAA Space Environment Laboratory fluxgate magnetometers aboard the satellites provide continuous monitoring starting in June, 1974.

In order to facilitate the statistical analysis of ULF magnetic waves observed at the synchronous orbit, and to expedite the selection of suitable intervals for comparison of SMS/GOES data with observations on the ground and on other satellites, we have begun a catalog of low-frequency magnetic oscillations observed at the SMS/GOES locations. This report covers the month of December 1977, and includes observations from the satellites SMS-2 and GOES-2, located at 115^{o} and 75^{o} west geographic longitude, respectively. This and subsequent reports will include the most recent data available, since these are of greatest interest to magnetospheric researchers. Eventually, historical data such as that published in the first report of this series (Newell and Barfield, 1978), will also be included.

OBSERVATIONS AND ANALYSIS

The present catalog is similar to the catalog of wave activity at the satellite ATS-1 by Cummings et al. (1973).

Pulsation events are catalogued which display at least five continuous cycles and a frequency which is roughly constant. When different frequencies are present at the same time, each is identified as an event. Events of any amplitude large enough to be readily identified are included in the catalog. Pulsations observed during magnetospheric substorms are not included.

A given event will typically last several hours and may include intervals as long as one hour each when no waves are observed. Beginning and ending times are sometimes difficult to specify due to low pulsation amplitudes or irregularities in the wave form. When the beginning or ending time of the event marks the end or beginning of a data gap or a magnetic substorm, the abbreviations (D.G.) or (S.S.) will appear next to the corresponding event time. Periods of missing data greater than one hour are specifically catalogued.

SMS-2 and GOES-2 are stationed in the geographical equatorial plane at a geocentric distance of 6.6 earth radii and at 115^{o} and 75^{o} west geographic longitude, respectively. Thus, the Local Time of an observation may be found by subtracting 8 hours or 5 hours, respectively, from the Universal Time.

The events are identified from 3-second-averaged microfilm data. The average period of the waves in each event is determined from at least five and usually ten peak-to-peak measurements of individual waves, spaced fairly evenly throughout the train. At least one wave is sampled from each hour of an event. The error associated with the average period is the standard deviation of the individual measurements of the period. This error is a measure of the variability of the period of selected waves rather than the uncertainty in determining these periods.

The average frequency is determined by inverting each individual wave-period measurement and then averaging these individual frequency measurements. The associated error is the standard deviation of the individual frequency measurements.

These average periods, frequencies, and errors are rounded off to the nearest whole unit, because of the uncertainties involved in selecting representative wave samples.

REFERENCES

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Troitskaya, V. A., and A. V. Gul'elmi, Geomagnetic Micropulsations and Diagnostics of the Magnetosphere, Space Sci. Rev., 7, 689, 1970.

A Catalog of Low-Frequency Oscillations
of the Earth's Magnetic Field as Observed at SMS-2
During December 1977

Begin		End		Average Period	Average Frequency
Day	Hour/Min.	Day	Hour/Min.	T (sec.)	f(Milli-Hz)
02	0139		0211	71 ± 9	14 ± 2
	1959-03/0337 missing				
03	1207		2232	39 ± 4	26 ± 3
	1733		2126	70 ± 10	15 ± 2
	2130	04	0017	50 ± 4	20 ± 2
04	0010		0227	100 ± 9	10 ± 1
05	0002		0233	88 ± 14	12 ± 2
	0431		0519	40 ± 8	26 ± 6
	1747		1845	509 ± 38	2 ± 0
	1850	06	0013	66 ± 8	16 ± 2
06	0335		0419	74 ± 7	14 ± 1
	1610		2333	100 ± 7	10 ± 1
07	0219		0302	100 ± 6	10 ± 1
	1414	08	0030	127 ± 14	8 ± 1
08	0813		0909	131 ± 14	8 ± 1
09	0515		0617	113 ± 18	9 ± 1
	2019		2044	33 ± 4	31 ± 4
10	1242		1840	47 ± 8	22 ± 4
	1736		1958	29 ± 3	35 ± 4
11	1412	12	0442	28 ± 3	35 ± 4
	1702	12	0125	79 ± 11	13 ± 2
	2338	12	0110	66 ± 8	15 ± 2
12	0128		0430	42 ± 2	24 ± 1
	0800		1156	60 ± 6	17 ± 2
	1314		1522	148 ± 16	7 ± 1
	1319		1334	36 ± 6	28 ± 5
	1551		2059	24 ± 2	42 ± 4

Begin Day	Hour/Min.	End Day	Hour/Min.	Average Period T (sec.)	Average Frequency f(Milli-Hz)
	1608		1617	61 ± 2	16 ± 1
	1800	13	0351	64 ± 9	16 ± 2
	2109		2212	42 ± 4	24 ± 2
13	0637		0750	54 ± 5	19 ± 2
	0940		1039	42 ± 5	24 ± 3
	1024		1036	94 ± 11	11 ± 1
	1224		2247	27 ± 5	38 ± 6
	1947	14	0217	42 ± 6	24 ± 3
14	0328		0352	97 ± 13	10 ± 1
	0506		0554	46 ± 3	22 ± 2
	0647		0659	111 ± 19	9 ± 2
	1737	15	0530	46 ± 5	22 ± 3
15	0711		0714	21 ± 2	48 ± 4
	1539		2237	28 ± 3	36 ± 6
	1912	16	0254	45 ± 3	22 ± 2
17	0645		0846	50 ± 5	20 ± 2
	1526		2337	68 ± 10	15 ± 2
	1837	18	0257	32 ± 5	33 ± 7
18	0054		0344	20 ± 2	52 ± 5
	0213		0455	76 ± 6	13 ± 1
	1503		2243	104 ± 6	10 ± 0
	1558		2225	37 ± 2	32 ± 5
	2015		2141	62 ± 5	16 ± 1
19	0214		0352	38 ± 6	27 ± 4
	0833		0853	91 ± 7	11 ± 1
	1706		2251	38 ± 3	26 ± 3
	1909		2137	140 ± 11	7 ± 0
20	0119		1127	34 ± 5	29 ± 4
	0248		0617	136 ± 13	7 ± 1
	1002		1141	72 ± 11	14 ± 2

Begin		End		Average Period	Average Frequency
Day	Hour/Min.	Day	Hour/Min.	T (sec.)	f(Milli-Hz)
21	0109		0300	38 ± 6	27 ± 5
	0916		0955	84 ± 11	12 ± 2
	1601		1847 1847	30 ± 3	34 ± 3
	1840		1915	75 ± 6	13 ± 1
	2216-22/0132 missing				
22	0509		0535	70 ± 10	13 ± 4
	1137		1631	67 ± 10	15 ± 2
	1316		1430	36 ± 4	28 ± 4
	1635		1852	34 ± 3	29 ± 2
	2350	23	0342	64 ± 5	16 ± 1
23	1318		1458	28 ± 4	36 ± 6
	1907	24	0150	32 ± 2	32 ± 2
	1935		1954	132 ± 6	8 ± 0
	2103		2141	166 ± 8	6 ± 0
	2301		2327	76 ± 6	13 ± 1
24	0207		0331	156 ± 25	6 ± 1
	0519		0646	167 ± 16	6 ± 1
	0715-1211 missing				
	1324		1432	76 ± 11	13 ± 2
	1639-1804 missing				
(D.G.)	1804	25	0222	52 ± 7	20 ± 3
	2137		2344	70 ± 11	14 ± 2
	2214	25	0452	28 ± 4	37 ± 6
25	0606		0616	74 ± 8	14 ± 1
	1022		1812	37 ± 4	27 ± 3
	2237	26	0236	30 ± 5	34 ± 6
26	0221		0415	132 ± 12	8 ± 1
	0249		0442	84 ± 11	12 ± 2
	0829		0859 (S.S.)	63 ± 10	16 ± 3
	1252		1814	24 ± 6	44 ± 11

Begin		End		Average Period	Average Frequency
Day	Hour/Min.	Day	Hour/Min.	T (sec.)	f(Milli-Hz)
26	1537	27	0046	31 ± 4	33 ± 4
	1645		1738	62 ± 8	16 ± 2
	1822		2016	199 ± 25	5 ± 1
27	0104		0135	234 ± 26	4 ± 0
	1106	28	0422	43 ± 5	24 ± 3
	1356		2029	24 ± 3	41 ± 5
28	1222		2257	39 ± 6	26 ± 4
	1333		1822	20 ± 3	51 ± 9
	2132	29	0345	124 ± 24	8 ± 2
29	0515		0634	49 ± 9	21 ± 3
	0720		0822	83 ± 6	12 ± 1
	1404		2058	20 ± 2	51 ± 7
	1701		2333	94 ± 10	11 ± 1
	2122	30	0339	40 ± 4	25 ± 3
30	0356		0449	119 ± 10	8 ± 1
	1106		1604	32 ± 5	32 ± 5
	1428		2052	51 ± 11	20 ± 3
	1805	31	1017	31 ± 5	33 ± 6
	2149		2354	168 ± 17	6 ± 1
31	1445		1953	27 ± 2	37 ± 3
	1639		1700	205 ± 20	5 ± 0
	1805		2300	36 ± 4	28 ± 3
	2005		2200	150 ± 24	7 ± 1
	2200		2237	101 ± 17	10 ± 2
	2253		2354	24 ± 4	42 ± 10

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Begin		End		Average Period	Average Frequency
Day	Hour/Min.	Day	Hour/Min.	T (sec.)	f(Milli-Hz)
01	0000-2400 missing				
02	1029		1116	219 ± 33	5 ± 1
	1220		1657	52 ± 7	20 ± 3
	2303	03	0044	50 ± 7	20 ± 3
	2307	03	0031	77 ± 11	13 ± 2
	2342		2351	43 ± 6	24 ± 4
03	0704		1448	48 ± 4	21 ± 2
	1353		1432	94 ± 10	11 ± 1
	1904		2215	140 ± 11	7 ± 0
	2225		2232	37 ± 4	27 ± 3
	2247		2348	81 ± 6	12 ± 1
	2339		2358	108 ± 9	9 ± 1
04	1403		1800	68 ± 8	15 ± 2
	2010		2317	180 ± 24	6 ± 1
	2324	05	0119	68 ± 9	15 ± 2
05	0316		0403	53 ± 7	19 ± 2
	0638		0653	40 ± 0	25 ± 0
	0730		0906	64 ± 7	16 ± 2
	0901		1259	42 ± 2	24 ± 1
	1315		1414	34 ± 5	30 ± 4
	1459		1639	358 ± 26	3 ± 0
	1633	06	0136	76 ± 9	13 ± 2
06	0906		1423	40 ± 4	25 ± 2
	1521		2017	78 ± 8	13 ± 2
	2000		2131	50 ± 3	20 ± 1
07	0808		0842	38 ± 3	26 ± 2
	1324		2240	134 ± 18	8 ± 1
	2318	08	0242	78 ± 7	13 ± 1

Begin Day	Hour/Min.	End Day	Hour/Min.	Average Period T (sec.)	Average Frequency f(Milli-Hz)
08	0513		0745	67 ± 9	15 ± 2
	1429		1556	40 ± 3	25 ± 2
	1940		2146	42 ± 6	24 ± 4
	2233		2315	110 ± 6	9 ± 0
09	0620		0700	99 ± 7	10 ± 1
	1302		2131	62 ± 7	16 ± 2
10	1611		1724	34 ± 4	30 ± 3
	1802		1854	39 ± 4	26 ± 2
11	1556		1935	96 ± 14	11 ± 2
	1935		2100	62 ± 6	16 ± 2
	2034		2104	28 ± 2	36 ± 3
	2309	12	0000	43 ± 6	24 ± 4
12	0708		1025	65 ± 10	16 ± 2
	1138		1252	52 ± 5	19 ± 2
	1313		1420	220 ± 14	4 ± 0
	1340		1539	82 ± 4	12 ± 0
	1442		1519	54 ± 6	19 ± 2
	1712		1920	97 ± 9	10 ± 1
	1902		1944	77 ± 16	14 ± 3
	1943		2146	236 ± 15	4 ± 0
	2100	13	0125	56 ± 6	16 ± 6
13	0251		0529	44 ± 7	23 ± 4
	0827		1511	38 ± 4	26 ± 3
	1026		1129	149 ± 13	8 ± 4
	1514		1658	60 ± 8	17 ± 2
	1722		2152	126 ± 17	8 ± 1
	2020		2248	34 ± 4	29 ± 3
	2136	14	0051	74 ± 6	12 ± 4
14	0504		0532	108 ± 8	9 ± 1
	0842		1347	36 ± 3	28 ± 3
	1841		2145	44 ± 5	23 ± 3

Begin Day	Hour/Min.	End Day	Hour/Min.	Average Period T (sec.)	Average Frequency f(Milli-Hz)
15	0348		0356	84 ± 7	12 ± 1
	1704		2132	40 ± 4	26 ± 2
16	1515		1555	87 ± 4	12 ± 0
17	0633	18	0242	79 ± 14	13 ± 2
18	0920		0957	113 ± 12	9 ± 1
	1202		1220	74 ± 6	14 ± 1
	1413		2126	128 ± 7	8 ± 0
19	1115		1733	89 ± 6	11 ± 1
	1845		2154	180 ± 10	6 ± 0
20	0125		0152	98 ± 10	10 ± 1
	0154		0358	170 ± 10	6 ± 0
	1724		1923	184 ± 12	5 ± 0
	2007		2245	112 ± 7	9 ± 0
21	0646		0948	114 ± 16	9 ± 1
	1503		1619	112 ± 7	9 ± 0
	2005		2215 (D.G.)	130 ± 11	8 ± 1
	2215-22/0133 missing				
22	0340		0526	65 ± 8	16 ± 2
	0413		0421	41 ± 3	25 ± 2
	1301		1759	42 ± 4	24 ± 2
	2330	23	0219	82 ± 11	12 ± 2
23	1500		1938	89 ± 4	11 ± 1
	1912		2151	28 ± 4	36 ± 5
	2208		2300	39 ± 4	26 ± 2
	2309		2316	80 ± 6	12 ± 1
24	0715-1211 missing				
	1310		1316	58 ± 4	17 ± 1
	1316		1727	79 ± 11	13 ± 2
	1806		1858	38 ± 4	26 ± 3
	2051	25	0005	70 ± 6	14 ± 1

Begin		End		Average Period	Average Frequency
Day	Hour/Min.	Day	Hour/Min.	T (sec.)	f(Milli-Hz)
25	0007		0052	46 ± 8	22 ± 4
	0701		0736	118 ± 15	8 ± 1
	1101		1520	38 ± 2	26 ± 2
26	0052		0158	116 ± 17	9 ± 1
	0803		1231	159 ± 15	6 ± 1
	2131	27	0047	102 ± 20	10 ± 2
27	0931		1706	29 ± 2	35 ± 3
	0946		1026	44 ± 3	23 ± 2
	1245		1253	48 ± 4	21 ± 2
	1402		1435	95 ± 10	11 ± 1
	1601	28	0012	104 ± 12	10 ± 1
	1848		2106	43 ± 5	24 ± 3
28	1015		1804	29 ± 4	35 ± 5
	1834		2058	114 ± 15	9 ± 1
	2310	29	0017	238 ± 52	4 ± 1
29	0008		0203	46 ± 7	22 ± 3
	0608		0750	77 ± 13	13 ± 3
	1106		1425	62 ± 7	16 ± 2
	1138		1219	228 ± 18	4 ± 1
	1503		2058	104 ± 9	10 ± 1
	1827		2005	30 ± 2	34 ± 3
	2300		2346	72 ± 10	14 ± 2
30	0009		0201	54 ± 7	19 ± 2
	0201		0209	82 ± 4	12 ± 1
	1345		2107	74 ± 10	14 ± 2
	1716		1817	123 ± 10	8 ± 1
	2123	31	0017	37 ± 3	27 ± 3
31	0017		0359	70 ± 6	14 ± 2
	1001		1142	68 ± 8	15 ± 2
	1425		1955	27 ± 5	37 ± 7
	1739	01	0107	90 ± 12	11 ± 1
	2129		2214	270 ± 30	4 ± 0