ON THE CORRELATION OF SOLAR-WIND ENERGY FLUX AND GEOMAGNETIC ACTIVITY

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Abstract: Solar-wind data, recorded by Vela 3 in 1965—1967, were used as the basis for considering the correlation between F_E and K_p.

All the data, divided into 3 subgroups, according to geomagnetic activity (usual, disturbed and quiet days, respectively) have provided the following solar-wind velocities: $\bar{V}_1 = 409.7$ km/sec; $\bar{V}_2 = 446.1$ km/sec; $\bar{V}_3 = 347.7$ km/sec. The solar-wind energy fluxes are 0.070 ergs cm^{-2} sec$^{-1} \leqslant F_E \leqslant 5.209$ ergs cm^{-2} sec^{-1}.

The correlation coefficients calculated for the usual, disturbed, and quiet days, respectively, are: $r_1 = +0.582 \pm 0.01$; $r_2 = +0.424 \pm 0.02$; $r_3 = +0.402 \pm 0.04$; $r_4 = +0.370 \pm 0.03$. Evidently high correlation exists for the first two cases in spite of the data being incomplete (2231 instead of 6904).

In orded to show the characteristic parameters of F_E and V_S, we have selected 161 minimum and 120 maximum values and we have obtained the following average values: $\bar{F}_E^{min} = 0.121$ ergs cm^{-2} sec^{-1}; $\bar{K}_p^{min} = 0.55$; $\bar{\varrho}^{min} = 4.62$ cm^{-3}; $\bar{V}_S^{min} = 322.9$ km/sec; $\bar{F}_E^{max} = 1.53$ ergs cm^{-2} sec^{-1}; $\bar{K}_p^{max} = 4.01$; $\bar{\varrho}^{max} = -15.55$ cm^{-3} and $\bar{V}_S^{max} = 503.8$ km/sec, which are characteristic of a structurless and disturbed solar wind.

These results show that the main agent of $\bar{F}_E^{max}$ are solar-wind velocities of the order of 500 km/sec with $K_p \approx 4$ associated with them. This interesting result has also been confirmed by the analysis of Pioneer 6 and Pioneer 7 solar-wind data.

Solar-wind parameters covering the years 1965 to 1967 have been acquired from Vela satellite observations (Bame et al., 1971), namely solar-wind velocities, concentrations of protons, particle temperatures and deviations of the solar-wind flux from the Sun—Earth line. All quantities are given as 3-hour means with their standard deviations.

The data mentioned above are of great importance, because they have been recorded in the close neighbourhood of the Earth ($R_{Vela} \leqslant 20\ R_E$) and, therefore, can be correlated with the planetary indices K_p, obtained from terrestrial observations.

First of all, we calculated the solar-wind energy fluxes, according to the formula

$$F_E = 1/2\ \varrho\ V^3\ m_p\ , \qquad (1)$$

F_E for the available data ($N = 2231$). In Eq. (1) ϱ is the concentration of protons, V the solar-wind velocity, and m_p the mass of the proton.

All the available data were divided into three subgroups, in accordance with the geomagnetic activity of the considered days:

D — days with 386 data, Q + QQ days with 727 data, usual — days with 1118 data.

The calculated values of the solar-wind energy fluxes fall within the interval

$$0.070 \text{ ergs cm}^{-2} \text{ sec}^{-1} \leqslant F_E \leqslant 5.209 \text{ ergs cm}^{-2} \text{ sec}^{-1}$$

so that we can state that the diapazon of the change of F_E is very large.

As an illustration of the analysed data, we have summarized 161 minimum values of F_E and ϱ, v, and K_p subordinated to them in Table 1. The mean values of the data mentioned above and the subordinated parameters are as follows:

$$\bar{\varrho} = 4.62 \text{ cm}^{-3}; \quad \bar{v} = 322.9 \text{ km sec}^{-1}; \quad \bar{F}_E = 0.121 \text{ ergs cm}^{-2} \text{ sec}^{-1}; \quad \bar{K}_p = 0.55 .$$

The maximum values of the parameters mentioned above — 120 in all — are summarized in Table 2. The mean values of these parameters are as follows:

$$\bar{\varrho} = 15.55 \text{ cm}^{-3}; \quad \bar{v} = 503.8 \text{ km sec}^{-1}; \quad \bar{F}_E = 1.503 \text{ ergs cm}^{-2} \text{ sec}^{-1}; \quad \bar{K}_p = 4.01 .$$

If we take 12 extremely high values of the solar-wind energy fluxex from Table 2 and sum-

Table 1

Date	N_p	V_S	F_E	K_p	Date	N_p	V_S	F_E	K_p	Note
65.09.14	4.11	3.064	0.099	1.00	65.09.14	4.64	3.153	0.122	1.33	
21	3.89	3.481	0.137	1.00	30	1.86	3.784	0.084	1.00	N_p[cm^{-3}]
30	2.94	3.486	0.104	0.33	30	2.65	3.359	0.084	0.00	
10.01	3.60	3.198	0.098	0.00	10.01	3.96	3.215	0.110	0.00	V_S [10^7 cm sec^{-1}]
01	5.14	3.131	0.132	0.00	01	5.35	3.085	0.131	0.33	
01	5.48	3.052	0.130	0.33	01	6.04	2.936	0.128	0.33	F_E [ergs cm^{-2} sec^{-1}]
04	3.49	3.283	0.103	0.00	04	3.70	2.956	0.080	0.00	
17	4.88	2.983	0.108	0.00	17	6.35	2.976	0.140	0.67	
17	7.18	2.848	0.139	0.33	17	8.15	2.769	0.145	0.33	
11.03	2.07	3.635	0.083	0.00	11.05	2.52	3.592	0.098	0.67	
09	5.21	3.228	0.147	0.33	11	7.09	2.824	0.134	0.33	
12	6.84	2.970	0.150	0.00	66.01.01	3.58	3.187	0.097	0.33	
66.01.01	4.39	3.399	0.144	0.33	05	3.44	3.610	0.135	0.33	
05	3.85	3.411	0.128	1.33	06	3.95	3.372	0.127	0.00	
06	3.35	3.386	0.109	0.00	02.07	4.45	3.336	0.138	1.33	
02.15	5.70	3.125	0.145	0.33	19	4.51	3.128	0.115	1.33	
03.01	6.54	2.817	0.122	0.33	03.01	6.86	2.932	0.145	1.33	
01	6.29	2.959	0.136	0.33	05	3.36	3.480	0.118	1.33	
05	3.75	3.501	0.135	1.33	08	5.27	3.176	0.141	0.33	
08	5.10	3.111	0.128	1.00	08	3.72	2.954	0.080	0.00	
13	1.74	3.838	0.082	0.67	13	2.49	4.138	0.148	1.33	
22	0.91	4.517	0.070	0.67	22	1.56	4.459	0.116	0.67	
31	4.18	3.320	0.128	0.33	31	4.00	3.241	0.114	0.33	
04.09	2.86	3.542	0.106	0.67	04.10	5.13	3.245	0.147	1.00	
11	3.63	3.281	0.107	0.33	11	4.29	3.271	0.126	0.33	
11	5.52	3.171	0.147	0.33	12	5.01	3.242	0.143	0.67	
25	1.24	4.103	0.072	0.33	26	5.48	3.195	0.149	1.00	
66.04.27	4.60	3.162	0.122	0.00	66.04.29	4.99	3.164	0.132	0.67	
05.10	3.80	3.128	0.097	0.00	05.10	4.55	3.151	0.119	0.00	
10	4.84	2.924	0.101	0.33	15	5.89	3.082	0.144	0.67	
15	5.64	3.087	0.139	0.67	15	3.76	3.049	0.089	0.33	
19	4.59	3.214	0.127	0.33	19	3.89	3.240	0.111	0.33	
19	5.63	3.158	0.148	0.33	19	5.17	3.234	0.146	0.67	
19	4.67	3.192	0.127	1.33	24	4.62	3.098	0.115	0.00	
24	5.77	3.071	0.140	0.33	29	2.92	3.808	0.135	0.67	
29	2.23	3.724	0.096	0.67	08.17	4.15	2.961	0.090	0.67	
08.17	4.26	3.019	0.098	1.00	17	5.10	3.010	0.116	1.33	
18	6.38	2.937	0.135	0.67	09.05	2.13	3.851	0.102	1.00	
09.12	3.49	3.294	0.104	0.67	12	3.44	3.356	0.109	1.33	
13	3.93	2.879	0.078	0.67	10.02	3.57	3.497	0.128	0.67	
10.08	2.37	3.925	0.120	1.00	22	7.06	2.933	0.149	0.33	
11.07	3.31	3.186	0.090	0.33	11.07	3.51	3.193	0.096	0.33	
07	4.17	3.240	0.119	1.33	27	2.36	4.005	0.127	0.33	
67.01.04	2.30	4.275	0.150	0.00	67.01.22	6.36	3.035	0.149	0.67	
22	6.30	2.930	0.133	1.33	31	4.39	3.106	0.110	1.00	
02.01	6.50	2.988	0.145	0.33	02.12	3.77	3.568	0.143	0.33	
13	3.71	3.479	0.131	0.00	13	3.43	3.487	0.118	0.33	
13	4.04	3.452	0.143	0.67	15	7.78	2.837	0.149	0.67	
28	3.03	3.745	0.133	1.00	03.10	4.59	3.344	0.144	0.33	
03.11	4.75	3.282	0.140	0.00	11	4.49	3.204	0.124	0.00	
11	4.58	3.189	0.124	1.00	11	5.36	3.205	0.148	0.33	
11	5.22	3.228	0.147	0.67	11	4.27	3.212	0.118	0.33	
12	6.16	3.091	0.152	0.33	12	6.91	2.977	0.152	0.33	
13	4.57	2.990	0.102	0.00	14	6.24	2.598	0.092	1.00	
67.03.15	7.09	2.676	0.114	0.33	67.03.15	7.10	2.691	0.116	0.33	
15	8.92	2.558	0.125	0.00	15	5.79	2.632	0.088	0.33	
15	8.66	2.593	0.126	0.67	17	7.62	2.740	0.131	0.33	
17	7.68	2.758	0.135	1.00	17	7.54	2.812	0.140	1.00	
22	2.72	3.516	0.099	0.33	22	2.74	3.560	0.103	0.67	
22	3.44	3.451	0.118	0.33	23	4.13	3.333	0.128	0.00	

Table 1 — continued

Date	N_P	V_S	F_E	K_P	Date	N_P	V_S	F_E	K_P	Note
23	4.72	3.302	0.142	0.00	31	4.34	3.202	0.119	0.67	
31	3.64	3.267	0.106	0.33	31	3.73	3.229	0.105	1.00	N_P [cm^{-3}]
04.01	3.69	3.003	0.084	1.33	04.01	5.35	2.999	0.121	0,00	
09	4.73	3.137	0.122	0.67	10	4.38	3.313	0.133	1.33	V_S [10^7 cm sec^{-1}]
10	4.84	3.287	0.144	1.33	11	5.19	2.920	0.108	0.33	
11	4.52	2.990	0.101	0.33	11	4.84	2.826	0.091	0.33	F_E [ergs cm^{-2} sec^{-1}]
11	5.12	2.973	0.113	1.33	12	4.95	2.672	0.079	0.67	
12	7.00	2.808	0.130	0.33	12	5.05	2.768	0.090	0.33	
12	5.98	2.721	0.101	0.00	12	5.76	2.750	0.100	0.67	
13	4.75	2.649	0.074	0.67	13	5.75	2.591	0.084	0.67	
13	5.21	2.597	0.076	0.33	15	7.63	2.737	0.131	0.33	
15	8.11	2.607	0.120	0.67	26	2.46	4.156	0.148	0.33	
26	2.32	4.120	0.136	0.33	26	2.23	4.111	0.130	0.33	
27	2.74	3.927	0.139	1.00	27	2.50	3.884	0.123	0.67	
27	2.99	3.628	0.119	0.67	27	3.56	3.767	0.159	0.33	
27	3.71	3.508	0.134	0.67	29	5.68	3.097	0.141	1.00	
06.24	7.93	2.790	0.144	1.33	07.08	5.05	3.029	0.117	0.33	
07.09	5.11	3.134	0.132	0.67	09	5.37	3.068	0.130	0.67	
22	5.78	3.102	0.144	1.00	08.01	3.08	3.579	0.118	0.33	
08.02	3.57	3.619	0.141	0.33	09.27	4.71	3.278	0.139	0.67	
10.02	2.99	3.970	0.156	1.00	Mean values	4.62	3.229	0.121	0.55	

Table 2

Date	N_P	V_S	F_E	K_P	Date	N_P	V_S	F_E	K_P	Note
65.07.27	18.91	4.331	1.285	2.00	65.07.27	16.82	4.434	1.226	2.33	
29	6.49	5.755	1.034	3.33	08.07	34.72	3.476	1.219	2.00	N_P [cm^{-3}]
08.18	29.36	3.935	1.496	3.33	18	25.34	3.996	1.352	6.33	
19	12.65	4.752	1.135	3.67	19	10.84	4.894	1.063	5.00	V_S [10^7 cm sec^{-1}]
19	11.66	4.826	1.096	5.33	19	9.27	5.082	1.017	4.00	
19	8.42	5,258	1.024	3.33	20	8.80	5.204	1.037	3.00	F_E [ergs cm^{-2} sec^{-1}]
10.27	8.35	5.259	1.016	1.33	10.28	7.90	5.427	1.056	4.00	
28	11.44	5.131	1.292	1.33	28	9.66	5.206	1.140	4.00	
11.30	27.36	3.539	1.014	3.67	12.01	20.65	3.994	1.100	2.33	
12.10	10.23	4.914	1.015	4.33	11	10.52	5.093	1.162	2.67	
18	38.65	3.522	1.412	2.33	28	6.82	5.722	1.068	3.00	
28	6.01	5.856	1.009	3.33	66.01.22	15.53	5.393	2.037	4.67	
66.01.22	8.21	5.586	1.197	5.33	26	6.18	5.817	1.017	3.00	
21	11.36	4.732	1.007	4.00	02.04	9.78	5.030	1.041	2.33	
02.19	26.25	4.942	2.650	4.33	19	12.78	4.958	1.303	3.00	
20	12.72	6.117	2.435	3.67	20	7.78	6.486	1.775	3.67	
20	4.56	6.815	1.207	3.33	03.19	19.79	4.288	1.305	3.33	
03.19	13:18	5.026	1.399	2.33	19	12.77	4.950	1.295	3.67	
19	10.11	5.807	1.656	3.33	19	9.59	5.793	1.559	2.67	
26	7.34	5.569	1.060	2.00	04.01	24.01	3.910	1.200	4.00	
04.22	16.75	4.514	1.288	2.00	22	14.30	4.012	1.021	3.67	
06.02	18.07	4.234	1.147	3.33	08.23	16.49	4.281	1.082	2.67	
08.23	14.06	4.459	1.042	2.67	23	10.04	5.664	1.526	4.00	
09.02	5.93	6.162	1.160	4.00	09.03	13.03	5.091	1.438	8.67	
06	12.05	4.820	1.128	4.67	19	10.43	5.303	1.303	1.00	
10.04	27.82	3.800	1.277	3.67	10.04	18.58	4.023	1.012	5.33	
04	21.53	4.027	1.176	6.00	31	10.80	4.963	1.104	4.67	
11.01	8.37	5.240	1.007	3.00	11.28	9.90	5.348	1.266	5.00	
66.11.28	12.35	4.988	1.282	3.33	66.12.04	20.16	4.242	1.287	4.67	
12.13	21.15	4.156	1.270	3.67	13	25.57	4.505	1.955	4.33	

Date	N_p	V_S	F_E	K_p	Date	N_p	V_S	F_E	K_p	Note
14	11.11	5.369	1.438	5.33	15	10.46	5.178	1.214	5.00	
15	9.61	5.015	1.014	3.33	23	16.05	4.217	1.007	2.67	N_p [cm^{-3}]
25	12.30	4.732	1.090	3.67	26	11.74	5.150	1.341	3.67	
26	9.46	5.851	1.585	3.33	27	8.89	6.560	2.099	4.67	V_S [10^7 cm sec^{-1}]
27	8.68	5.917	1.504	4.33	27	7.43	6.175	1.463	4.00	
67.01.13	17.51	4.310	1.172	5.67	67.01.13	19.37	4.108	1.123	2.67	F_E [ergs cm^{-2} sec^{-1}]
13	18.58	4.055	1.036	4.33	14	22.27	3.973	1.168	7.33	
02.07	26.41	4.746	2.361	5.33	02.07	16.13	5.634	2.412	5.67	
07	15.90	5.513	2.228	6.33	08	33.30	5.719	5.205	6.00	
08	20.96	5.728	3.294	4.67	08	14.32	5.033	1.527	4.67	
08	11.74	5.709	1.827	4.67	16	30.73	4.148	1.834	3.67	
16	26.63	4.116	1.553	3.33	16	30.89	4.797	2.851	5.00	
16	18.79	6.106	3.577	8.00	16	15.67	6.405	3.443	7.00	
04.04	19.03	5.053	2.053	4.00	04.23	30.40	3.716	1.305	3.33	
23	14.91	4.748	1.335	5.00	23	12.11	5.360	1.559	3.33	
24	12.23	6.001	2.210	5.00	24	6.51	6.486	1.485	5.00	
24	6.88	6.650	1.692	3.33	05.01	26.09	4.912	2.586	4.67	
05.01	22.93	4.958	2.337	4.33	02	24.34	5.024	2.581	2.67	
02	25.63	4.780	2.341	2.00	02	25.60	4.662	2.169	2.67	
02	37.38	4.316	2.513	5.33	24	17.62	4.149	1.052	2.33	
25	17.23	4.156	1.034	1.67	25	17.15	4.403	1.224	5.33	
25	7.21	6.497	1.653	9.00	26	6.78	6.494	1.553	9.00	
28	14.08	5.363	1.817	5.67	30	14.23	5.369	1.842	5.67	
30	19.18	5.307	2.397	5.67	31	14.21	5.824	2.347	3.67	
06.06	12.69	5.062	1.376	2.00	06.06	11.58	4.873	1.121	4.33	
67.06.09	11.24	4.861	1.080	3.33	67.08.11	18.96	4.426	1.375	3.67	
10.29	14.30	5.324	1.805	2.33	10.30	15.28	5.480	2.103	5.33	
11.08	17.84	4.494	1.354	4.33	11.12	9.04	5.830	1.498	4.67	
13	6.59	5.957	1.176	3.00	13	9.38	5.320	1.181	2.67	
22	19.58	4.154	1.174	3.00	12.06	12.10	5.213	1.433	4.00	
Mean values	15.55	5.038	1.536	4.01						

Table 3

Date	N_p	V_S	F_E	K_p	Note
67.02.08	33.30	5.719	5.209	6.00	
16	18.79	6.106	3.577	8.00	N_p [cm^{-3}]
16	15.67	6.405	3.443	7.00	
08	20.96	5.728	3.294	4.67	V_S [10^7 cm sec^{-1}]
16	30.89	4.797	2.281	5.00	
66.02.19	26.25	4.942	2.650	4.33	F_E [ergs cm^{-2} sec^{-1}]
67.05.01	26.09	4.912	2.586	4.67	
02	24.34	5.024	2.581	2.67	
02	37.38	4.316	2.513	5.33	
02.20	12.72	6.117	2.435	3.67	
02.07	16.13	5.364	2.412	5.67	
05.30	19.18	5.307	2.397	5.67	
Mean values	23.47	541.5	2.995	5.22	

marize them in Table 3, we can say that the main agent of the maximum solar-wind energy fluxes are the solar-wind velocities of the order of 500 km sec^{-1}, with the characteristic value of $K_p \approx 4$.

Let us now take 16 extremely low values of the solar-wind energy fluxes from Table 1 and summarize them in Table 4. It is easy to see that the extremely low values of the solar-wind energy fluxes are characterized by solar-wind velocities of the order of 315 km sec^{-1} with $K_p \approx 0.48$. This solar-wind velocity is in the range of the lowspeed solar wind, indicated by Hundhausen (1972), namely 300 km $sec^{-1} \leqslant v \leqslant 325$ km sec^{-1}, which is — in some sense — characteristic of a structureless solar wind.

Table 4

Date	N_p	V_S	F_E	K_p	Note
66.03.22	0.91	4.517	0.070	0.67	
67.04.13	5.21	2.597	0.076	0.33	N_p [cm^{-3}]
13	4.75	2.649	0.074	0.67	
12	4.95	2.672	0.079	0.67	V_s [10^7 cm sec^{-1}]
66.09.13	3.93	2.879	0.078	0.67	
04.25	1.24	4.103	0.072	0.33	F_E [ergs cm^{-2} sec^{-1}]
03.08	3.72	2.954	0.080	0.00	
65.10.04	3.70	2.956	0.080	0.00	
11.03	2.07	3.635	0.083	0.00	
67.04.01	3.69	3.003	0.084	1.33	
65.09.30	1.86	3.784	0.084	1.00	
09.30	2.65	3.359	0.084	0.00	
66.05.15	3.76	3.049	0.089	0.33	
67.03.15	5.79	2.632	0.088	0.33	
67.03.13	5.75	2.591	0.084	0.67	
66.08.17	4.15	2.961	0.090	0.67	
Mean values	3.63	3.146	0.081	0.48	

Before we calculate the correlation coefficients between K_p and F_E, we must give some explanation of the analysed data.

First of all, we should say that we have a group of data that is incomplete in two senses: instead of the total possible number of data (6904) corresponding to the period of observations (from July 26, 1965 do December 6, 1967), we only have 2231 data; secondly only a part of the days (17 at all) is characterized by 8 mean solar-wind velocities, while the other days are only characterized by 7 or less data, or are without data (the Vela orbit was inside the magnetosphere or inside the magnetosheath).

In order to obtain a review of the time distribution of the available data during the period of observation, we have drawn the following characteristics in Figure 1:

(a) total number of observed data for each day;

(b) geomagnetic characteristic of the days in consideration;

(c) number of solar rotation.

So we can see that the time distribution of the analysed data is rather scarce, especially for solar rotations 1832—1839. The time distribution of the F_E and K_p values is shown in Figure 2, arranged in the same manner as in Figure 1. In spite of the data being incomplete we have a good foundation for the following analysis.

If we put $X_i = F_i$, $Y_i = K_p$, $x_i = X_i - M_x$, $y_i = Y_i - M_y$, where M_x and M_y are the arithmetic means of the solar-wind energy flux and the arithmetic means of the K_p indices, we can calculate the correlation coefficient and its standard deviation according to the formulae

$$r = \frac{\sum_i^N x_i y_i}{\sqrt{\sum_i^N x_i^2 \sum_i^N y_i^2}}, \quad (2)$$

$$\sigma_r = \pm \frac{1 - r^2}{\sqrt{N}}. \quad (3)$$

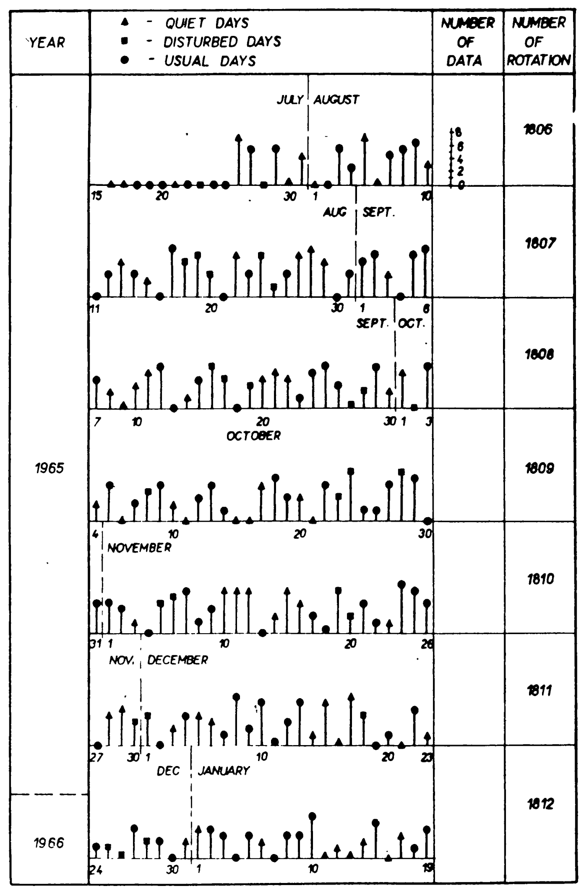
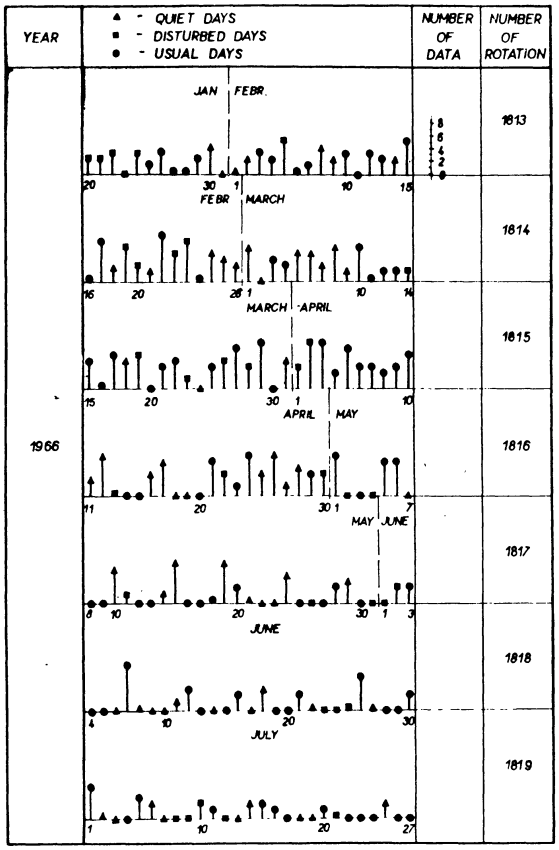
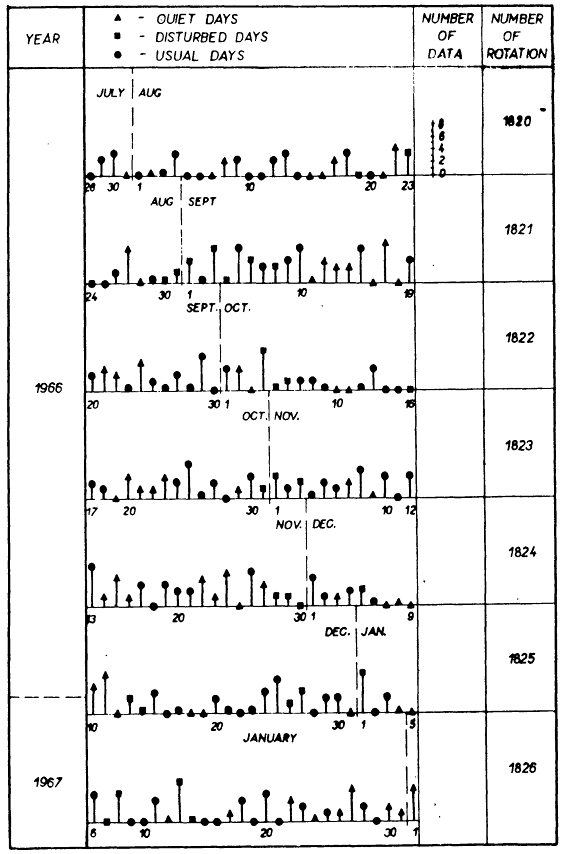
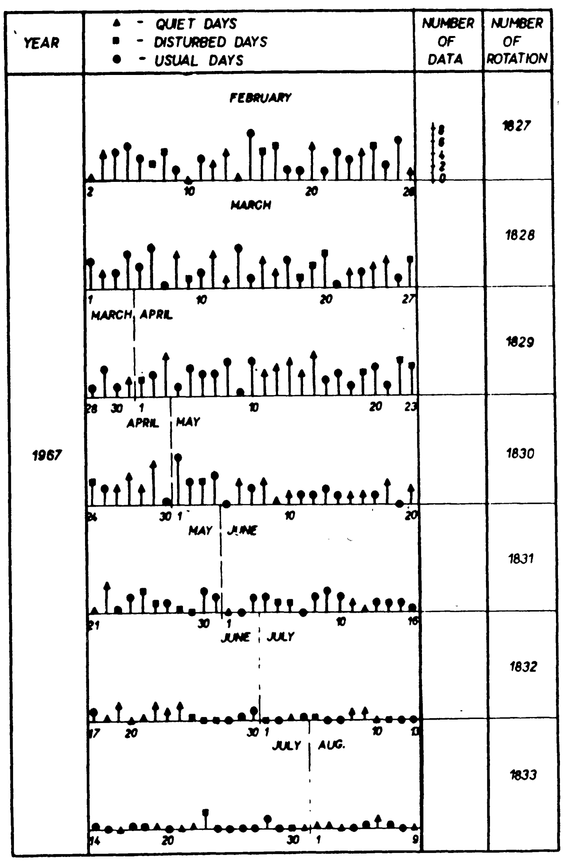
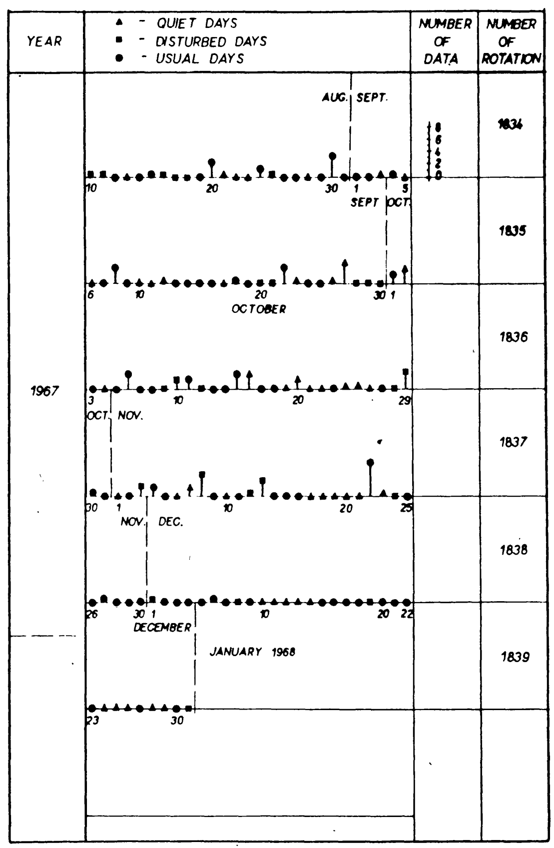


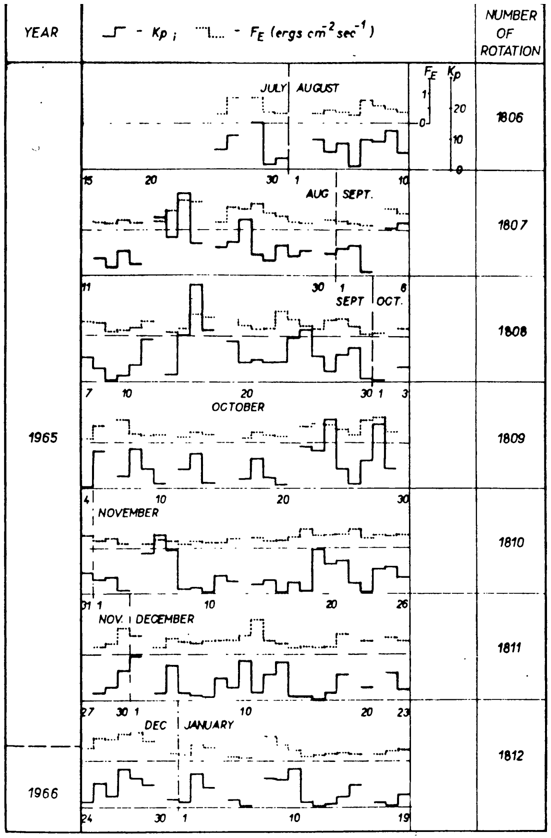
Fig. 1a—e.

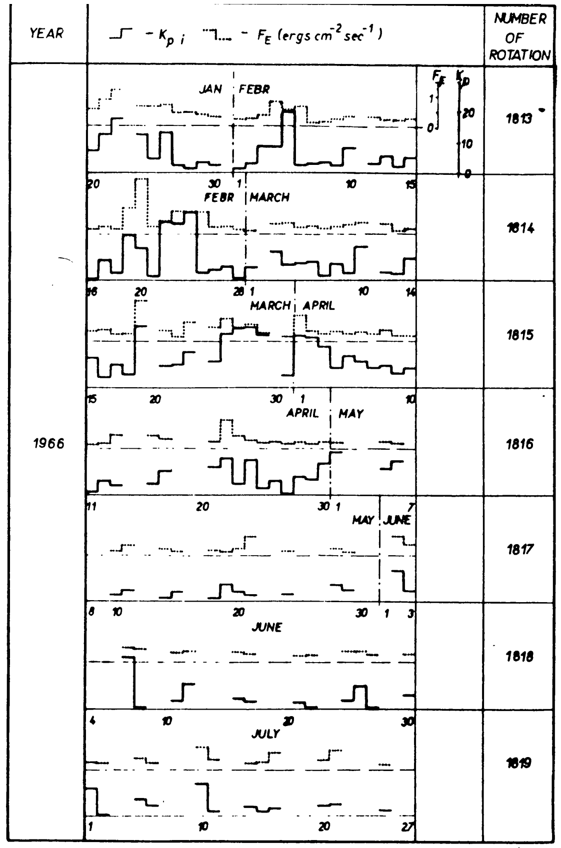

YEAR
▲ - QUIET DAYS
■ - DISTURBED DAYS
● - USUAL DAYS
NUMBER OF DATA
NUMBER OF ROTATION
1966
JAN FEBR.
FEBR MARCH
MARCH APRIL
APRIL MAY
MAY JUNE
JUNE
JULY
1813
1814
1815
1816
1817
1818
1819


YEAR
▲ - QUIET DAYS
■ - DISTURBED DAYS
● - USUAL DAYS
NUMBER OF DATA
NUMBER OF ROTATION
1966
1967
JULY AUG
AUG SEPT
SEPT. OCT.
OCT. NOV.
NOV. DEC.
DEC. JAN.
JANUARY
1820
1821
1822
1823
1824
1825
1826


YEAR
▲ - QUIET DAYS
■ - DISTURBED DAYS
● - USUAL DAYS
NUMBER OF DATA
NUMBER OF ROTATION
1967
FEBRUARY
MARCH
MARCH APRIL
APRIL MAY
MAY JUNE
JUNE JULY
JULY AUG.
1827
1828
1829
1830
1831
1832
1833


YEAR
▲ - QUIET DAYS
■ - DISTURBED DAYS
● - USUAL DAYS
NUMBER OF DATA
NUMBER OF ROTATION
1967
AUG. SEPT.
SEPT OCT.
OCTOBER
OCT. NOV.
NOV. DEC.
DECEMBER
JANUARY 1968
1834
1835
1836
1837
1838
1839


YEAR
Kp ; FE (ergs cm-2 sec-1)
NUMBER OF ROTATION
1965
1966
JULY AUGUST
AUG SEPT.
SEPT OCT.
OCTOBER
NOVEMBER
NOV. DECEMBER
DEC JANUARY
1806
1807
1808
1809
1810
1811
1812


YEAR
Kp ; FE (ergs cm-2 sec-1)
NUMBER OF ROTATION
1966
JAN FEBR
FEBR MARCH
MARCH APRIL
APRIL MAY
MAY JUNE
JUNE
JULY
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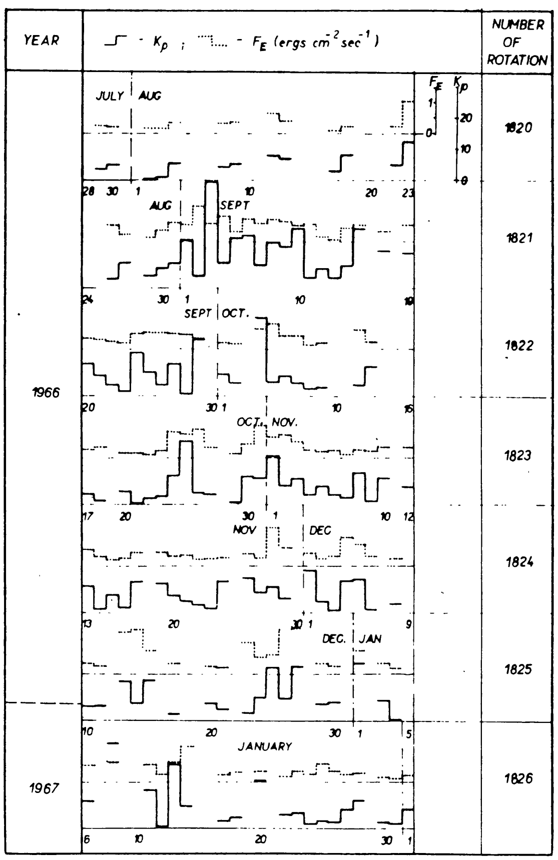
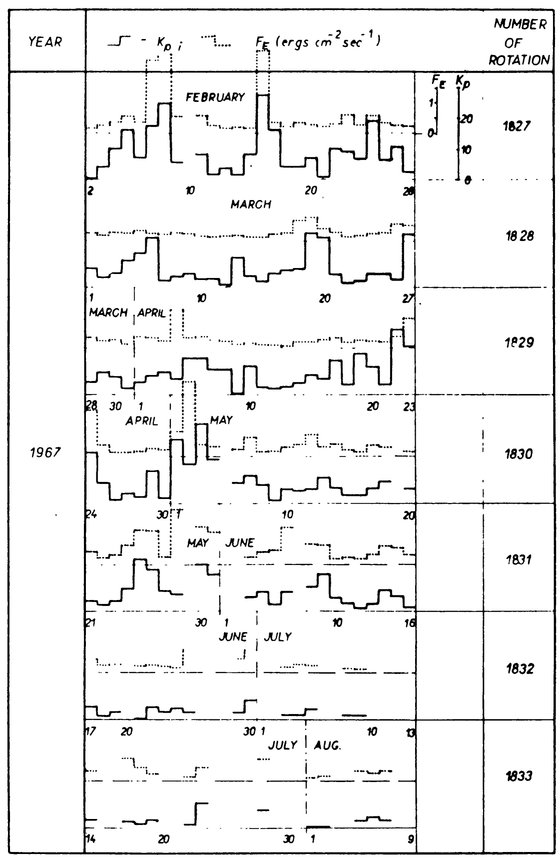
1816
1817
1818
1819


YEAR
Kp ; FE (ergs cm-2 sec-1)
NUMBER OF ROTATION
1966
1967
JULY AUG
AUG SEPT
SEPT OCT.
OCT. NOV.
NOV DEC
DEC. JAN
JANUARY
1820
1821
1822
1823
1824
1825
1826


YEAR
Kp ; FE (ergs cm-2 sec-1)
NUMBER OF ROTATION
1967
FEBRUARY
MARCH
MARCH APRIL
APRIL MAY
MAY JUNE
JUNE JULY
JULY AUG.
1827
1828
1829
1830
1831
1832
1833

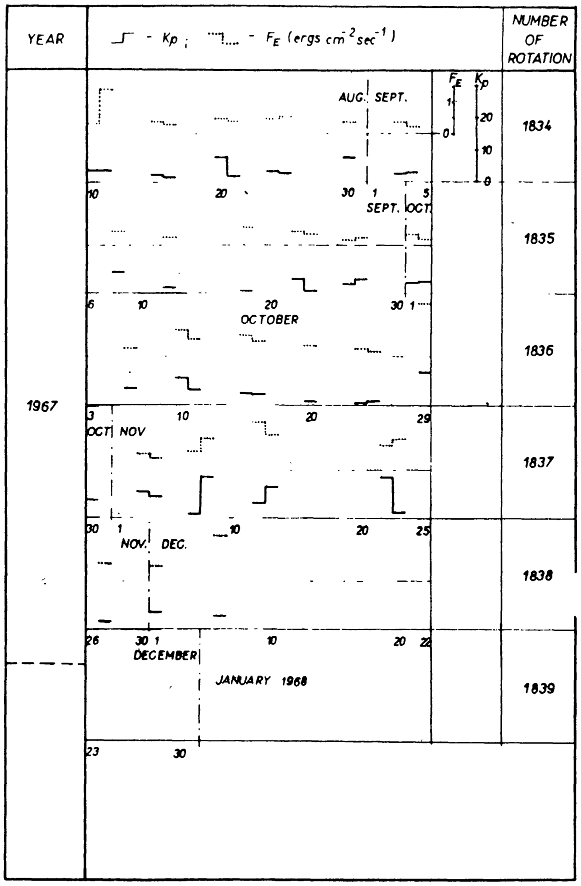


Fig. 2a—e.

For all the data ($N=2231$) we obtained

$$\{r\}_{\text{all days}} = +0.5852 \pm 0.0139\,, \qquad (4)$$

which shows a relative high degree of correlation between F_E and V_s, characterized by a low standard deviation.

For the subgroups mentioned above (D — days; Q+Q — days; usual — days) we have obtained the following correlation coefficients:

$$\{r\}_{\text{D-days}} = +0.4017 \pm 0.0427\,, \qquad (5)$$

$$\{r\}_{\text{Q+QQ-days}} = +0.3704 \pm 0.0320\,, \qquad (6)$$

$$\{r\}_{\text{usual days}} = +0.4240 \pm 0.0245\,. \qquad (7)$$

Evidently a high correlation exists between F_E and K_p, at least for the two cases (all days and usual days) in spite of the incompleteness of the data, due to the time intervals during which the Vela orbit passed inside magnetosphere or inside the magnetosheath.

All obtained results are arranged in Table 5, where the mean solar-wind velocities for the analysed epoch are shown namely for all days, for D days, for Q+QQ days and for usual days.

Conclusion

By comparing the result obtained in our paper, $\bar{V}_v = 396$ km sec^{-1}, with the other mean solar-wind velocities, e.g., with the one from Mariner 2, $\bar{V}_M = 504$ km sec^{-1}, acquired during a period of higher solar activity (Brandt, 1970), or with the one from Pioneers 6 and 7 during the years 1966—1970 (Krajčovič, 1972), $\bar{V}_P = 435$ km sec^{-1}, we can only state that all mean solar-wind velocities are of the order of 400 km sec^{-1}, with a tendency to be higher during the period of enhanced solar activity.

In order to obtain a unique dependence of the mean solar-wind velocity on the enhanced solar activity, periods of solar-wind velocity observations comparable with the solar cycle period, or much longer, must be available.

On the other hand, the analysis of the Pioneers 6 and 7 solar-wind velocities, confirms the results obtained in this paper:

1. the main agent of the solar-wind energy flux are velocities of the order of 500 km sec^{-1};

2. it is worth studying the solar-wind energy fluxes and their correlations with geomagnetic activity, which can throw some light on the mechanism of the energy transfer from the solar wind into the magnetosphere.

Table 5

Group	Mean velocity	e	σ_r	Note
All-days	395.7 km sec^{-1}	+0.5852	±0.0139	$N_{3\text{hour}}=2231$
D-days	446.1 km sec^{-1}	+0.4017	±0.0427	$N_{3\text{hour}}=386$
Q+QQ-days	347.2 km sec^{-1}	+0.3704	±0.0320	$N_{3\text{hour}}=727$
Usual-days	409.7 km sec^{-1}	+0.4240	±0.0245	$N_{3\text{hour}}=1118$

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BRANDT, J. C. (1970): Introduction to the Solar Wind. San Francisco.

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