SOLAR-WIND VELOCITY VARIATIONS AND GEOMAGNETIC DISTURBANCES

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Abstract: The correlation coefficient between solar wind velocities and the geomagnetic index A_p was determined for solar rotations 1543—1596 (1969—1972). In 31 of the cases under consideration the values of this coefficient were significant from the Student test point of view. The high correlation coefficients were obtained during the solar rotations when high speed solar-wind streams ($v \gtrsim 600$ km/sec) were in evidence. In all the cases these solar-wind streams were associated with some very active regions of the Sun. During the solar rotations where the values of the correlation coefficient are low or negative, the general trend of solar activity displays some depressions.

To explain the cause of geomagnetic activity and to determine the degree to which the solar activity influences the disturbances in the geomagnetic field, it is necessary to know the relations between the physical parameters involved in this so complicated interaction.

For this purpose we decided to analyse the correlation coefficient between the main parameter of the solar wind, the speed, and the planetary geomagnetic index A_p.

The data for the solar-wind velocities and for the A_p index were taken from the publication Solar Geophysical Data in the years 1969—1972 [1]. The daily mean values of the solar-wind velocities have been determined from the Vela 3, 5 and Pioneer VI, IX satellite reports.

The correlation coefficient between the solar-wind velocities and the A_p index was calculated, following the method used at the Bukarest Observatory by Nită (1972), for every solar rotation, beginning with rotation 1543 (January 5, 1969) and ending with rotation 1596 (January 16, 1973). The results are presented in Table 1. The number of pairs of parameters, considered in the calculation, varied between 10 and 25 for every solar rotation.

Analysing the threshold of significance by the Student test, we found it good in 31 of 54 cases under consideration.

From an analysis of the solar activity, solar-wind speed and geomagnetic conditions during the interval of time when the correlation coefficient r exceeded the value of 0.6, we found that there were the active regions of peculiar importance on the Sun, which were producing solar flares of

Table 1. The correlation coefficient between the solar-wind velocity and the geomagnetic index A_p during solar rotations 1543—1596

Year	Rotation	Interval of time	r
1969	1543	5. I. — 31. I.	0.465
	1544	1. II. — 28. II	0.562
	1545	1. III. — 27. III.	0.190
	1546	28. III — 23. IV.	0.579
	1547	24. IV. — 20. V.	0.609
	1548	21. V. — 17. VI.	0.489
	1549	18. VI. — 14. VII.	0.176
	1550	15. VII. — 10. VIII.	0.448
	1551	11. VIII. — 6. IX.	0.014
	1552	7. IX. — 4. X.	−0.182
	1553	5. X. — 31. X.	0.453
	1554	1. XI. — 27. XI.	0.890
	1555	28. XI. — 24. XII.	0.736
1970	1556	25. XII. — 21. I.	0.572
	1557	22. I. — 17. II.	0.527
	1558	18. II. — 16. III.	0.197
	1559	17. III. — 13. IV.	0.277
	1560	14. IV. — 10. V.	−0.059
	1561	11. V. — 6. VI.	0.160
	1562	7. VI. — 3. VII.	0.922
	1563	4. VII. — 31. VII.	0.593
	1564	1. VIII. — 27. VIII.	0.445
	1565	28. VIII. — 23. IX.	0.332
	1566	24. IX. — 20. X.	0.321
	1567	21. X. — 17. XI.	0.370
	1568	18. XI. — 14. XII.	0.565
	1569	15. XII. — 10. I. (1971)	0.627

1971	1570	11. I.	— 7. II.	0.516
	1571	8. II.	— 6. III.	0.649
	1572	7. III.	— 2. IV.	0.599
	1573	3. IV.	— 30. IV.	0.240
	1574	1. V.	— 27. V.	0.511
	1575	28. V.	— 23. VI.	0.615
	1576	24. VI.	— 20. VII.	0.140
	1577	21. VII.	— 16. VIII.	−0.090
	1578	17.VIII.	— 13. IX.	0.551
	1579	14. IX.	— 10. X.	0.327
	1580	11. X.	— 6. XI.	0.715
	1581	7. XI.	— 4. XII.	0.686
	1582	5. XII.	— 31. XII.	0.169
1972	1583	1. I.	— 21. I.	0.132
	1584	28. I.	— 24. II.	0.273'
	1585	25. II.	— 22. III.	0.718
	1586	23. III.	— 18. IV.	−0.198
	1587	19. IV.	— 15. V.	−0.115
	1588	16. V.	— 12. VI.	−0.090
	1589	13. VI.	— 9. VII.	0.366
	1590	10. VII.	— 5. VIII.	0.912
	1591	6. VIII.	— 1. IX.	0.650
	1592	2. IX.	— 29. IX.	0.731
	1593	30. IX.	— 26. X.	0.604
	1594	27. X.	— 22. XI.	0.302
	1595	23. XI.	— 19. XII.	0.692
	1596	20. XII.	— 16. I.(1973)	0.517

importance two or more, and solar wind streams exceeding 600 km/sec and geomagnetic SSC's were also observed. It must be noted, for example, that during solar rotation 1590, which was marked by the well-known active McMath region 11976, from the beginning of August 1972, the correlation coefficient took the value of 0.912. A similar situation developed for rotations 1546, 1554, 1562, 1567, 1571, 1580, 1585, etc., when the solar-wind speed was in good correlation with the geomagnetic index A_p.

The association between the solar-wind velocity and the geomagnetic index K_p was studied earlier by Krajčovič (1972) for the periods around January 24 and September 1, 1971, using the method of the superposition of epochs. The correlation coefficients we obtained for solar rotations 1570 and 1578, which contain the interval mentioned above, were 0.516 and 0.551 respectively.

As regards the intervals of time where the correlation coefficient displays low and negative values, these may be associated with some depressions in the general trend of solar activity.

References

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