SOME RESULTS OF ANALYSES BASED ON ATMOSPHERIC ELECTRIC AND IONOSPHERIC DATA OF PREVIOUS OBSERVATORY REPORTS

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Atmospheric electric potential gradient and the 11-year solar cycle

Earlier investigations described by Märcz and Bencze (1981) have not found a regular potential gradient variation with the 11-year solar cycle. An additional analysis using means of early morning values determined for late winters (January-February) over two solar cycles (from 1964 to 1986) has detected a connection between the potential gradient and solar activity regarding the 11-year period (Märcz 1990). Nevertheless, this connection could only be revealed when the potential gradient data were separated according to the two phases of the Quasi-Biennial Oscillation (QBO), similarly to that done by Labitzke (1987) in the case of investigating north polar winter temperature data at 30 mb. The Nagycenk potential gradient showed a positive and significant correlation with the 11-year solar cycle in the QBO west phase, while a negative and less significant correlation was found between the two parameters in the QBO east phase. The basic results are presented in Fig. 1.

Variations in the point-discharge current

Based on data of the point-discharge current measurements carried out at the Nagycenk observatory between 1961 and 1996, variations on different time scales have been analysed. The results have been published in the paper by Märcz and Bencze (1998). In Figure 2, the diurnal variation of this atmospheric electric parameter is displayed by the hourly means of positive and negative charges transferred to the ground by a metal point elevated to a height of about 8 m. There is a morning minimum and an afternoon maximum in the diurnal variation of the point-discharge current (Fig. 2 top), whereby a surplus of negative charge flow appears over almost the whole day as shown in Fig. 2 bottom. The annual variation of this atmospheric electric parameter is characterized by a summer maximum and a winter minimum in Fig. 3, where a predominance of negative charge flow can also be seen. The lat-

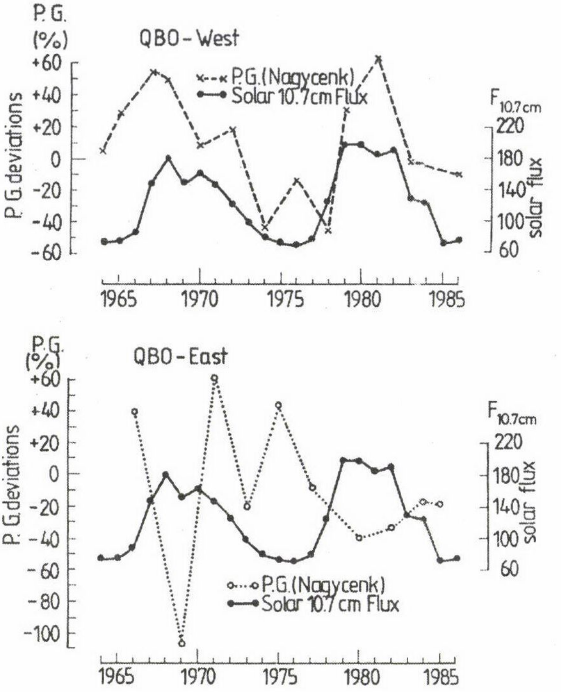

Fig. 1.

ter behaviour appears on an even longer time scale as demonstrated by the yearly averaged ratio of negative to positive charge for the years between 1961 and 1996 in Fig. 4. Additionally, this ratio seemed to increase over the investigated period.

Enhanced ionospheric absorption of radio waves following geomagnetic disturbances

Ionospheric absorption of radio waves might be enhanced following certain geomagnetic storms as shown by different analyses based on data published in earlier reports of the Nagycenk observatory. Using data of the interval from 1967 to 1973, a previous work has found an absorption increase around and after selected geomagnetic disturbances both for sunset and night-time (Märcz 1980). Latter results are presented in Fig. 5. Ionospheric absorption is enhanced by the increase of ionization in the lower ionosphere due to particles (mostly to energetic electrons) precipitating from the magnetosphere into the ionosphere after certain geomagnetic storms (Lauter and Knuth 1967).

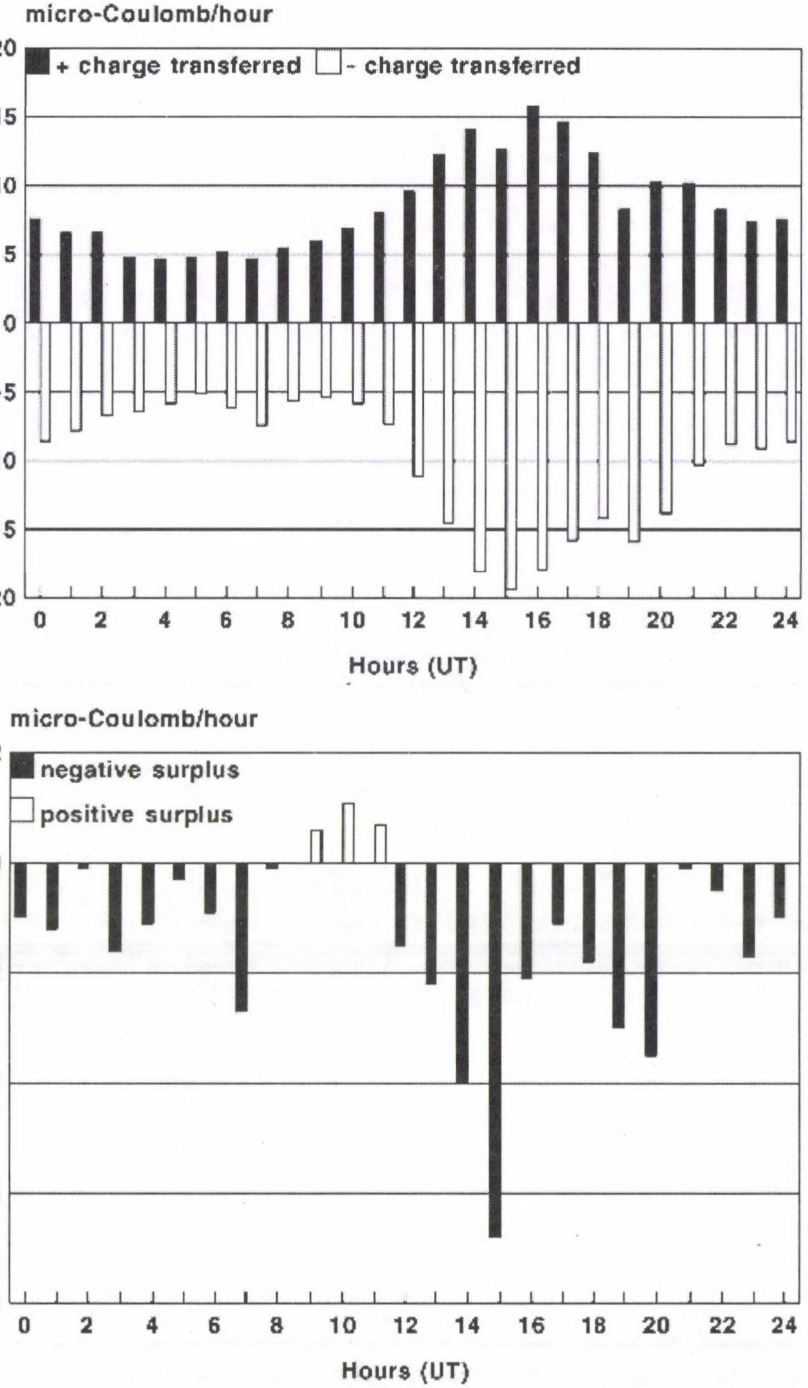
micro-Coulomb/hour
20
15
10
5
0
-5
-10
-15
-20
+ charge transferred
- charge transferred
0 2 4 6 8 10 12 14 16 18 20 22 24
Hours (UT)
micro-Coulomb/hour
2
0
-2
-4
-6
-8
negative surplus
positive surplus
0 2 4 6 8 10 12 14 16 18 20 22 24
Hours (UT)

Fig. 2.

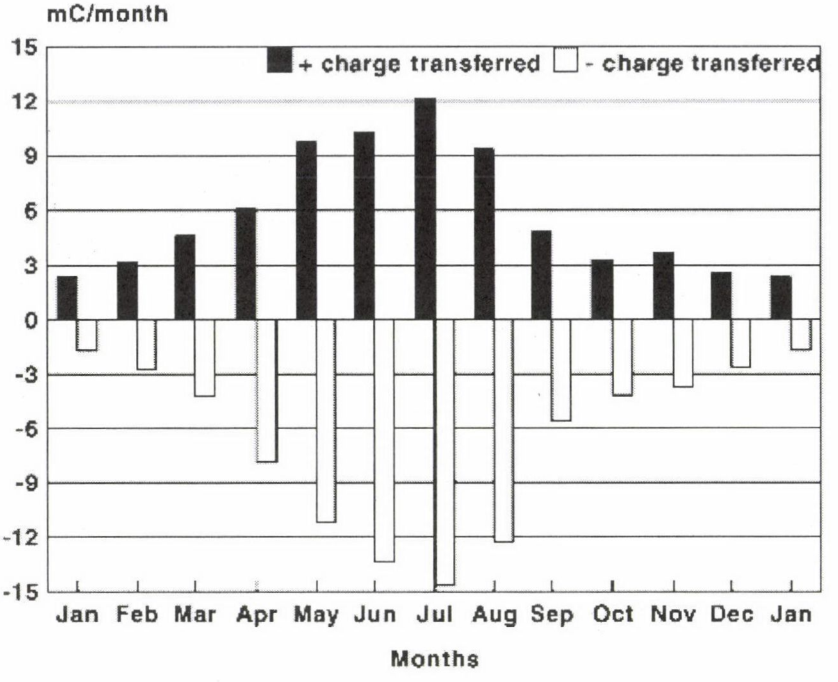
mC/month
15
12
9
6
3
0
-3
-6
-9
-12
-15
+ charge transferred
- charge transferred
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Months

Fig. 3.

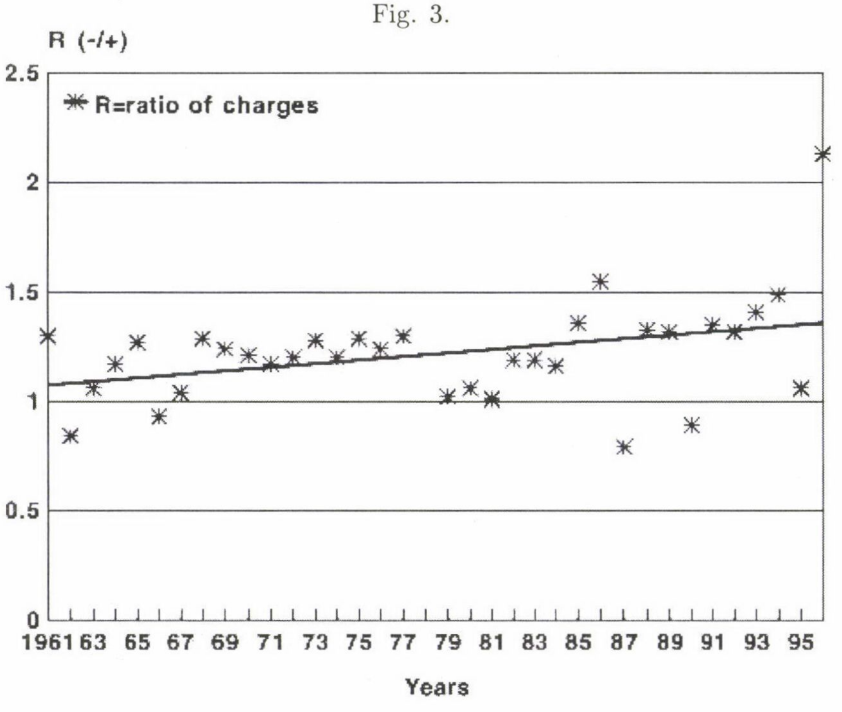
R (-/+)
2.5
2
1.5
1
0.5
0
R=ratio of charges
1961 63 65 67 69 71 73 75 77 79 81 83 85 87 89 91 93 95
Years

Fig. 4.

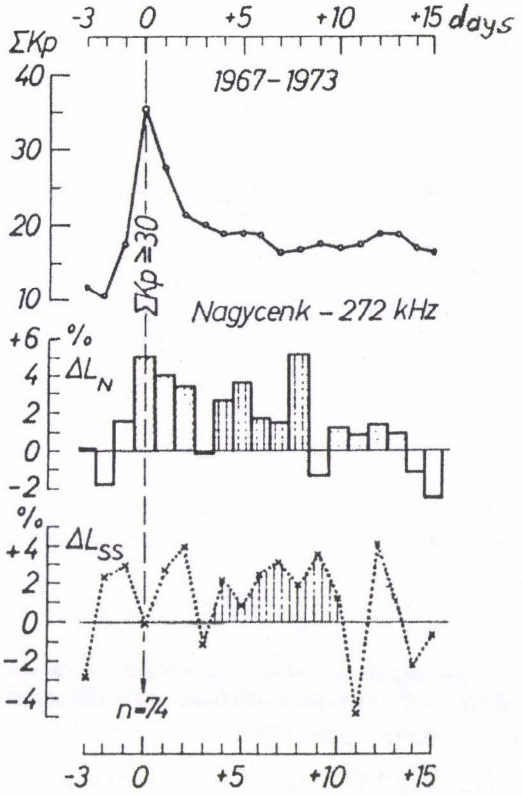

Fig. 5.

Changes in atmospheric electricity associated with events in ionospheric absorption

Simultaneous measurements of atmospheric electric and ionospheric parameters yielded the opportunity for detecting relations between them on the basis of corresponding data series. For 1967 (which was a year around solar activity maximum), seven cases were selected when the ionospheric night absorption determined at Nagycenk was anomalously high. Appropriate potential gradient data have been analysed around the selected absorption events by the superposed epoch method. (Earlier, it was proved that potential gradient values determined for night or morning are more favourable for using them in comparative analyses. During night and early morning hours, the local environmental conditions are less disturbed than in other intervals of the day; this is especially true regarding the vertical and horizontal air motions). The results presented in Fig. 6 show a distinct increase of

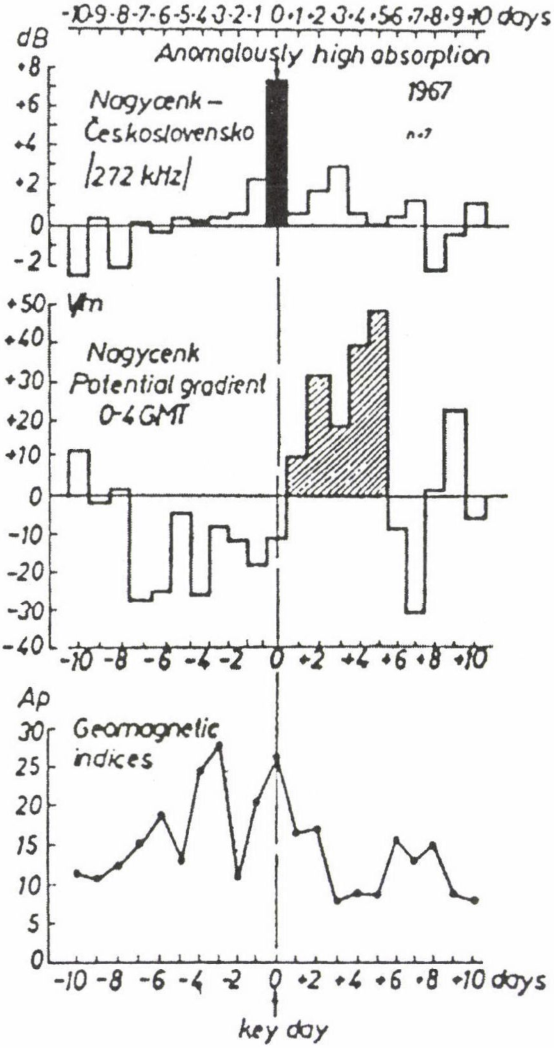

Fig. 6.

the potential gradient (as related to the corresponding monthly mean) for five days after the absorption event. As the geomagnetic activity (represented by Ap-indices) is enhanced before the key day, the increased absorption can be regarded as a sign of after-effect which is due to particle precipitation. All these hint at the fact that a chain of processes (solar, magnetospheric and ionospheric ones) can really lead to changes in the atmospheric electric field measured at the ground. Further results on this topic are included in the paper by Märcz (1976).

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