Variation of fair weather atmospheric electricity at Marsta Observatory, Sweden, 1993–1998

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Atmospheric electricity is controlled by factors of global, regional and local scale. The global component of variations of fair weather electricity is a subject of special attention because the physical integration of electrical circuit is a unique geophysical phenomenon that gives a possibility to watch the solar-terrestrial effects and secular changes in the global climate [*Williams,* 1994]. The most representative parameter is the voltage between ionosphere and ground called the ionospheric potential. Unfortunately, we do not know any technique for direct measurement of ionospheric potential. The indirect measurements are expensive and of low accuracy. Thus the ground level parameters as electric field and density of vertical air-earth current are essential source of information about global atmospheric electricity. The variation of these parameters is a mixture where global and local components have different weights. According to the traditional view [*Israel*, 1973] the local diurnal variation does not exist on polar caps, and it is strongly suppressed over the oceans. It does not follow that polar measurements present pure global variation because the random local variations caused e.g. by drifting snow can shadow the global effect. Actually, the best presentation of the global variation is found when calculating averages of oceanic electric field measurements.

Diurnal variations of continental measurements typically follow the local time. However, the behavior of ground level atmospheric electricity at Marsta Observatory occurs exceptional as shown below.

A modified atmospheric electrical station of the Kasemir-Dolezalek construction is continuously operating in the Marsta Observatory (59°56'N, 17°35'E) located in rural area 10 km north of Uppsala, Sweden. The routinely recorded parameters are electric field, positive and negative polar conductivities of air, and space charge density. The effect of possible local anthropogenic air pollution on the fair weather atmospheric electric measurements at Marsta is estimated according to *Sheftel et al*. [1994] comparing the Sunday and Weekday values of air conductivity. The effect of local air pollution appears extremely low and it is essentially less than in other evaluated continental atmospheric electric stations.

The natural periodic variations of fair weather electric field and vertical air-earth current averaged over many years at Marsta are similar to the periodic variations over the oceans and in polar stations where the global component of variations is dominating over the local component. The similarity is better for the vertical current when compared with the electric field (see Figure). The correlation between diurnal variations of winter measurements of vertical air-earth current at Marsta and electric field over oceans as measured during the Carnegie expeditions [*Whipple and Scrase*, 1936] reaches 98%.

The local periodic variations of fair weather atmospheric electricity are mediated by the local meteorological factors. It may be advanced a hypothesis that numerical reduction of the data according to the local temperature and wind variation could suppress the local component of fair weather atmospheric electric variations and help to learn the global component of variation. However, an attempt to reduce the direct effect of air temperature and wind using the regression model does not give wanted result. The reduction suppresses the annual variation but the shape of the diurnal variation remains the same and the correlation with the Carnegie curve is even worse than in the case of unreduced measurements.

The Marsta Observatory can be recommended as a basis station for long-term routine atmospheric electric measurements to gather data for study of the solar-terrestrial effects and the climate variation because of the large weight of global component in the variation of fair weather air-earth vertical current and electric field. The best global representativity is reached for vertical air-earth current measurement at Marsta during the winter season.

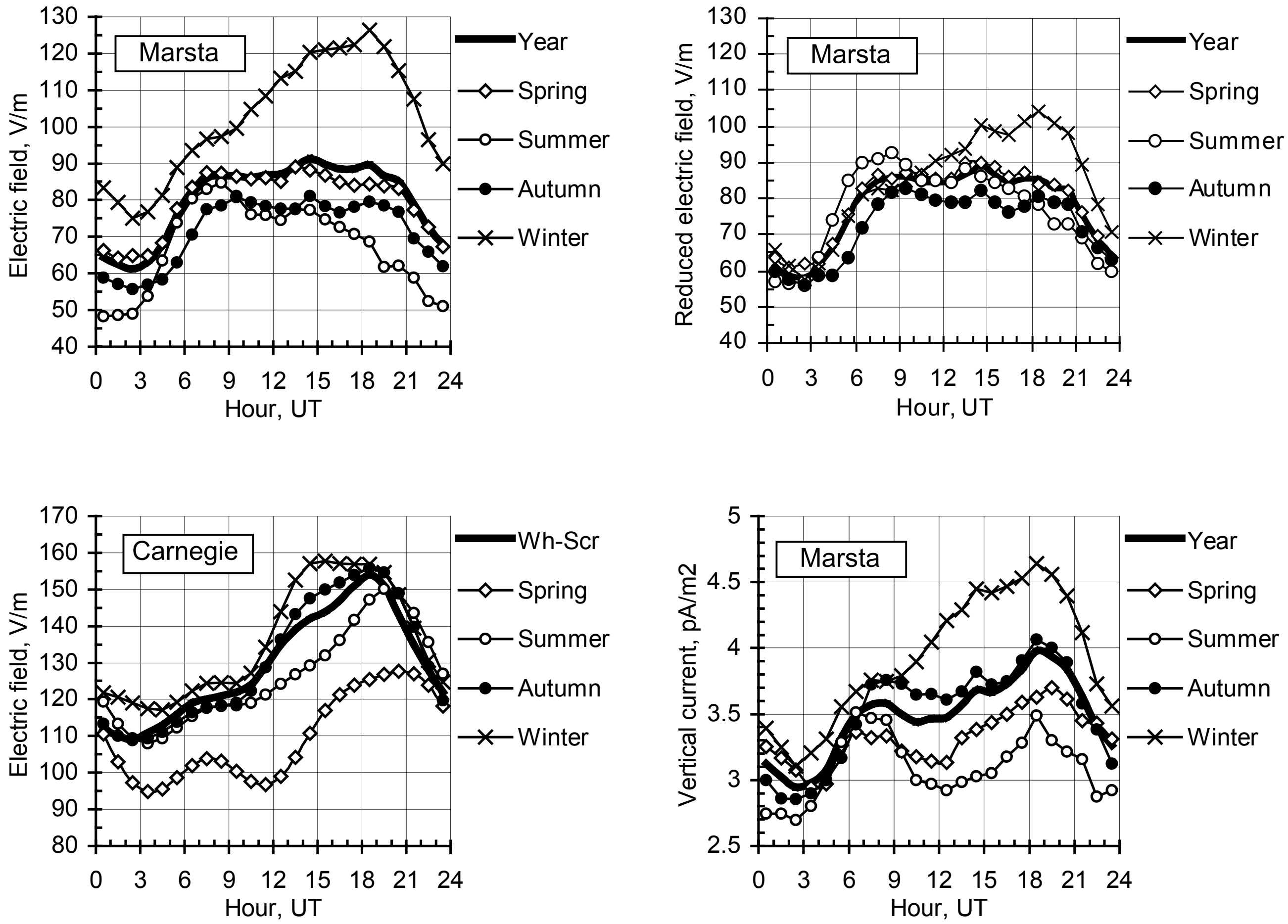

Figure. Diurnal variation of fair weather electric field and vertical air-earth current at Marsta 1993–1998 compared with the Carnegie curves. The Carnegie curve Wh-Scr is drawn according to the tabulated data from the paper [*Whipple and Scrase*, 1936]; the Carnegie curves for seasons are drawn according to Fourier presentations by *Parkinson and Torreson* [1931]. The second diagram presents the variation of electric field numerically reduced according to the variations of local temperature and wind.

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