SHORT NOTES

CORRELATION BETWEEN SOLAR ACTIVITY AND THE ATMOSPHERIC POTENTIAL GRADIENT AT THE EARTH'S SURFACE IN THE POLAR REGIONS.

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The atmospheric potential gradient measured near the ground in Polar regions is shown to be correlated with solar radio emission on 1000 Mc/s.

The relation between the atmospheric potential gradient and solar activity has been investigated with respect to year to year variation of the annual mean value of the potential gradient on the basis of the data obtained for more than twenty years.[1] The result showed that the potential gradient at the Earth's surface is affected by solar activity in a general sense. This paper also deals with the same problem, but on a smaller time scale, because it was thought necessary to investigate the mechanism of the global circuit which consists of the conduction current flowing in the atmosphere between the Earth's surface and the ionosphere.

It is well known that the conductivity of the air increases markedly with increasing height, and this fact can be explained by the increased mobility of atmospheric ions in the low density atmosphere caused by the solar radiation flux. According to the global circuit concept, the electric potential of the ionosphere should also govern the potential gradient at the Earth's surface, and simultaneously, this potential gradient depends on the condition of the columnar resistanace between the ionosphere and the Earth. However, the potential gradient measured on land, in general, is rather disturbed by local meteorological or man-made factors and, therefore, it is difficult to determine from it the world wide nature of the phenomenon. Hence, the author examined the potential gradients observed in the polar region at Mürchison Bay.[2] The data were obtained by observations carried out in summer, that is June, July, August and September 1958 in the Arctic Circle. Except for the above-mentioned summer season, the majority of the data was abnormal, so that data obtained during the other seasons were rejected in this analysis. The daily mean values of the potential gradient are plotted in the upper diagram of Fig. 1 by averaging them over adjacent two day periods,

As for the selection of the most suitable data on the solar flux, the fundamental problem was the choice of the best observing frequency. The author investigated the result of solar radio emission observation at frequencies of 169, 536, 1000, 2000, 2800 and 9400 Mc/s. Of these, the intensity of the solar radio emission at a frequency of 1000 Mc/s observed at the Research Institute of Atmospherics[3] was found to show a similar seasonal variation to that of the potential gradient as is shown in the lower diagram of Fig. 1. However, it must be mentioned that although a similar relation was found at a frequency of 2000 Mc/s, the relation was not similar at higher and lower frequencies.

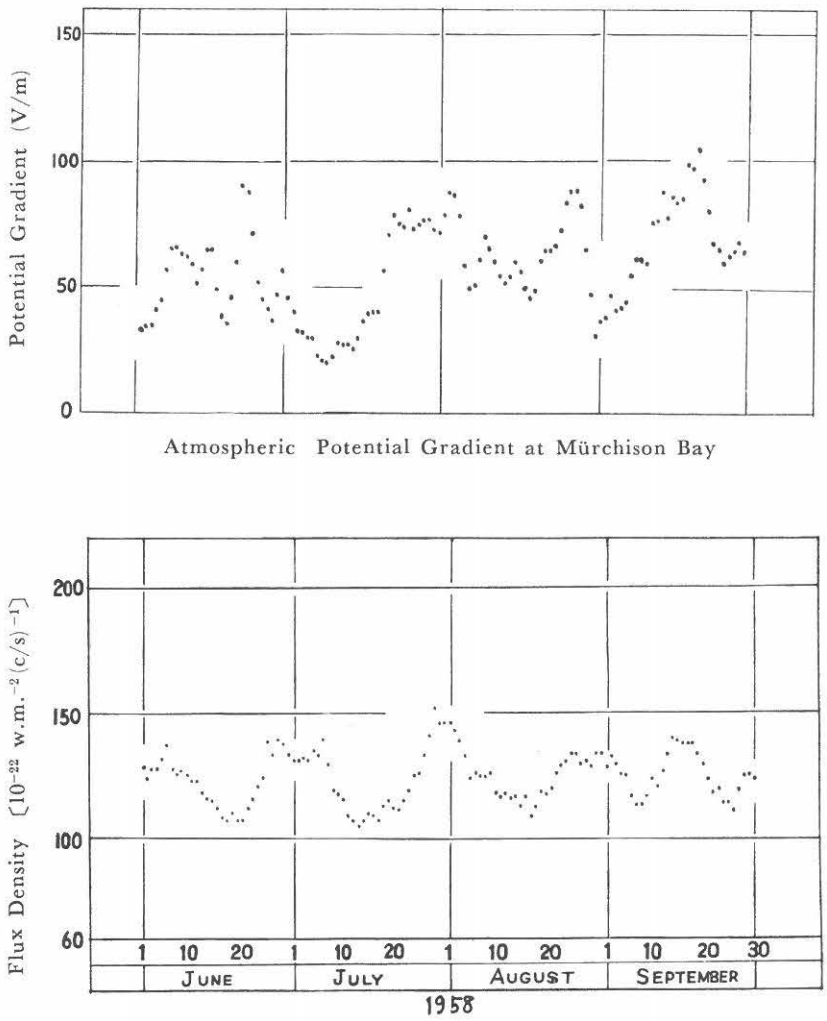

Fig. 1. Solar Radiation Flux Density at a Frequency of 1000 Mc/s Observed at Research Institute of Atmospherics

This effect may be explained in the following manner. During times of intense solar flux the upper part of the columnar resistance decreases because of the strong radiation from the Sun. Hence, the potential difference between the ionosphere and the Earth becomes concentrated in the lower part of the columnar resistance, near the Earth's surface. Thus, even if the electric potential of the ionosphere remains constant, the measured potential gradient at the Earth's surface shows an increased value principally because of the decreasing columnar resistance in the upper part of the atmosphere. An alternative explanation is that the potential gradient at the Earth's surface changes with the potential of the ionosphere due to the thunderstorm activity which may be related to the activity of the Sun. However, why the frequency near 1000 Mc/s does show such close correlation between solar activity and the potential gradient is an interesting problem for the future. Finally, it should be noted that this correlation could not be found at all in the analysis of the data obtained at the Kakioka Magnetic Observatory in Japan at a middle latitude.

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