Atmospheric electric field due to snow blizzard electrification at Syowa station, Antarctica

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The atmospheric electric field (AEF) exists positively (downward direction) with the value 100 V/m, in the area of fair weather. When a blizzard occurred, the intense of positive AEF in th blizzard condition become 10 times larger than that in the fair-weather condition (e.g. Minamoto and Kadokura, 2011). On the other hand, the most of snow particles during the blizzard are negatively charged according to field observation and laboratory. The intense AEF and the ambient negatively charged snow particles during the blizzard seems contradictory. So far, there has been no relevant explanation of the physical mechanism. In order to understand this mechanism, we examined the AEF measurements using field mills at two different heights (10 and 1.4 meters) and laser precipitation monitor (LPM) at 3 meter height at Syowa station. Then we speculate the gradient of negatively charged density proportional to the observed vertical profile of snow particle number density generates the positive AEF. The Poisson equation simulation with vertical profile of snow particle number density (Mann *et.al.*, 2000) supported the speculation. The AEF was observed positive during blizzards, while the negative AEF was barely observed after the blizzard. This might be caused by dominantly positive-charged snow surface just after the blizzard.

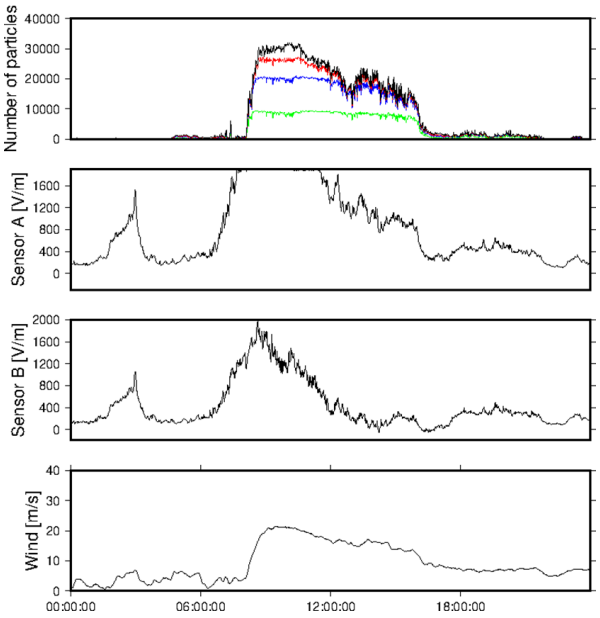

Figure 1. Positive AEF event on September 23 of 2015. Time series of 1-min sampling of the AEF variations at 10 m (Sensor A) and 1.4 m (Sensor B), number of particles at 3m by LPM, and the wind velocity on from 00UT to 24UT. In the plot of number of particles, Green line: Diameter of 0.2 mm or less, Blue line: Diameter of 0.4 mm or less, Red line: Diameter of 0.6 mm or less, and Black line: Total particle number.

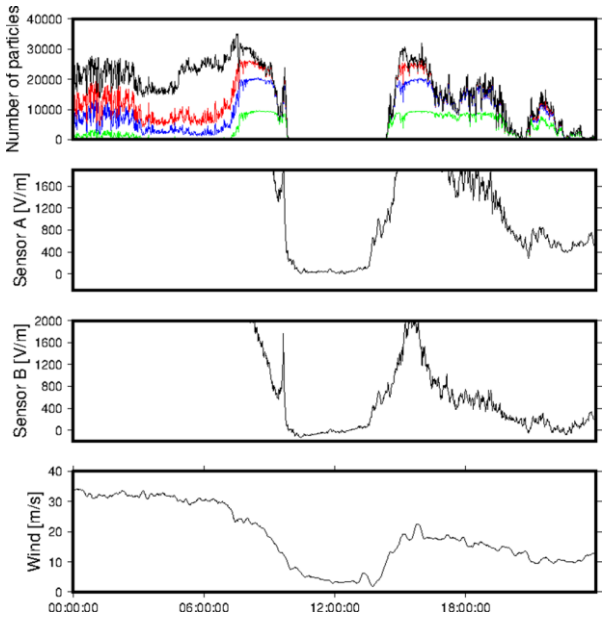

Figure 2. Negative AEF event on July 29 of 2015. Each plot is same in Figure 1.

References

Mann, G. W., Anderson, P. S., & Mobbs, S. D., Profile measurements of blowing snow at Halley, Antarctica. Journal of Geophysical Research: Atmospheres, 105(D19), 24491-24508, 2000.

Minamoto, Y., & Kadokura, A., Extracting fair-weather data from atmospheric electric-field observations at Syowa Station, Antarctica. Polar Science, 5(3), 313-318, 2011.