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A consideration on the electric field formed by blowing snow particles

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Fluctuations of the atmospheric electric field strength have been reported during blowing snow events. A primary factor of this phenomenon is the electrification of the blowing snow particles. Electric force applied to the blowing snow particles may be a contributing factor in the formation of snow drifts and snow cornices and changing particles' trajectory motion. These can cause natural disaster such as an avalanche and visibility deterioration. Therefore, charging phenomenon of the blowing snow particles is an important issue in terms of not only precise understanding of the particle motion but disaster prevention. The purpose of this study was to clarify the fluctuation characteristics of the electric field. In previous studies, some numerical models have been proposed; however, these models did not consider the dependency of the particle charges on the particle diameter or the height dependency of the horizontal mass flux. Taking into account those dependencies, we estimated the vertical electric field distribution. In this study, an experimental equation (Omiya et al., 2011), which can estimate the individual particle charge from the particle diameter and the air temperature, was used. In addition, the approximation equations of the vertical distribution of wind speed, the horizontal mass flux, and the average particle diameter were also used. A hot-wire anemometer was used to measure the wind speed. A snow particle counter (SPC) was used to measure the horizontal mass flux and the particle diameter distribution. This experiment was conducted in a cold wind tunnel (Ice and Snow Research Center, NIED, JAPAN) at an air temperature of -10 degree Celsius. In this calculation, for simplicity, some assumptions were considered; 1) The particle diameter and the particle number density are horizontally constant and uniform. (The electric field formed by the blowing snow particles is uniform horizontally.) 2) All the blowing snow particles are electrified negatively, and the individual charge can be obtained by the experimental equation (Omiya et al., 2011). 3) The snow surface is electrified in positive, and the absolute value of the charge-to-mass ratio is equal with the charges of the blowing snow particles. 4) A charge separation occurs only between the snow particle and the snow surface.
As a result of our calculation, we obtained electric fields that were all negative (upward pointing), increasing with the density of the blowing snow particles and closer to the snow surface.

(REFERENCE)
Omiya et al. (2011): Estimation of the electrostatic charge of individual blowing snow particles by wind tunnel experiment. Ann. Glaciol., 52(58), 148–152.