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Debye-like shielding effect on low-cloud electricity by the radioactive aerosol after the Fukushima nuclear accident

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The vertical (downward) component of the DC atmospheric electric field, or potential gradient (PG) at Kakioka, 150 km southwest of the Fukushima Dai-ichi Nuclear Power Plant (FNPP1) was analyzed before and after the FNPP1 accident to examine whether the influence of floating radioactive is visible in the PG data under the rain cloud. We used one-minute PG data since 2006 (digital data is available), and obtained the following statistical tendencies. (1) Ten-minute averaged PG during or just before the rain during 13-31 March shows less excursion toward the negative (upward field) side after the accident in 2011 than the average from 2006 to 2013, (2) occurrence frequency of negative PG peaks of about -200 to -700 V/m (corresponding to light rain) is consistently low during March-April period after the accident than the average of the same months of the other years, and (3) time constant around the negative PG peaks during March-April period is shorter after the accident than before the accident beyond annual differences for peak PGs of -200 to -800 V/m (corresponding to light rain), while no difference is seen in May between 2011 and the other years. The end of April 2011 corresponds to the time when the floating radioactive materials significantly decreased. The results suggest that the radioactive aerosol that was originated from the FNPP1 accident might have affected the PG under electrified clouds during light rain. Since the effect is not seen during heavy rain or positive PG reflecting high clouds, it is quite possible that the increased ion density in the atmosphere, that is still very low compared to ordinary plasma, enhanced the Debye shielding effect over the negative charges at the lower part of the cloud.