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Effect of the ionizing radiation on the rain-time atmospheric electric field

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The atmospheric electric field, or potential gradient (PG) at Kakioka, 150 southwest of the Fukushima Nuclear Power Plant (NPP) shows peculiar behaviors after the accident, March 2012 due to the conductivity enhancement in the air by the ionizing radiation. This means that the PG provides significant information on the dynamics of the radioactive materials. During last EGU assembly 2012, we showed that the fine-weather PG decreased by one-two orders of magnitudes at the arrival of the radioactive plume, and that the PG recovered in various way depending on various types of re-suspension processes in addition to the physical decay of the deposited radioactive materials.

We extended this work to the rain-time PG, which is very simple because of high variability of the PG depending on the cloud types and distribution. We yet found a statistical difference between rain-time PGs before and after the Fukushima NPP Accident: one-hour averaged rain-time PG during the first 45 days after the accident is not as much scattered to the negative side as those during the same period of different years or during 40 days before accident. Further examination of one-minute averaged data (1 Hz sampling) during the second half March for 2006-2012 revealed that this difference comes from short time-spans of negative peaks rather than the peak value after the accident compared to those before the accident. On the other hand, characteristics of positive peaks (cloud without rain) are unchanged.

The results suggest either (1) the effect on the local charges in the rain cloud is narrowed under high dose of ionized radiation, making positive charges in the cloud less shielded by the negative charges, or (2) negative charge of ionized aerosol decays much faster under higher dose of ionized radiation due to the shortened time constant of the ionized aerosol ($\propto 1/\sigma$, where σ is the atmospheric electric conductivity).