Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

AAS24-P02 Room:Convention Hall Time:May 20 18:15-19:30

Evaluation of fluctuation in the concentrations of radioactive aerosols as a stochastic process

Hiroyuki Ichige[1*]

[1]Graduate School of Systems and Information Engineering, University of Tsukuba

It is an important task to estimate the future state of the polluted site near the Fukushima plant.
The major method for predicting the future concentration of radioactive aerosols is, as well known, the computer simulations that are based on the numerical fluid dynamics. Those simulations are an effective and powerful, but we propose a different approach.
In the present study we deal with a phenomenological model that considers stochastic processes.

At the Fukushima accident, a lot of radionuclides have released into the atmosphere. The diffusion process of such nuclides is complicated and is not described in the usual diffusion equation. Furthermore, the measured aerosol concentration varies a lot day by day, depending on the meteorological condition. On a day of high concentration, the risk, especially the internal exposure risk, becomes large.

This research aims at developing a new model that can evaluate the magnitude of fluctuations in the concentration of radioactive aerosols. In our previous studies, we derived a formula C(t) ~ exp(-at) t^(-b)
which reproduce the long-term, averaged concentration of aerosols. In the present study, we make a model to reproduce the day-by-day fluctuations and thereby evaluate the deviations from the averaged behavior.

We assume that the logarithm of the day-by-day concentration changes as the Brownian motion. We found that the log-concentration can be well approximated by the Ornstein-Uhlenbeck process, one of the stochastic processes.
We solved a stochastic differential equation of the process and obtained the analytical solution.The solution shows that the increments between observations follow the log-normal distribution. Both the mean and the variance of the distribution do not depend on time; both of them serve as fixed values.
Finally, we make a figure (below) in which the long-term concentrations together with the range of their fluctuations every standard deviation.

Keywords: predicting the future, fluctuations in the concentration of radioactive aerosols, stochastic processes, Ornstein-Uhlenbeck process, log-normal distribution