Analysis of deposition parameters after the Fukushima Dai-ichi nuclear power plant accident

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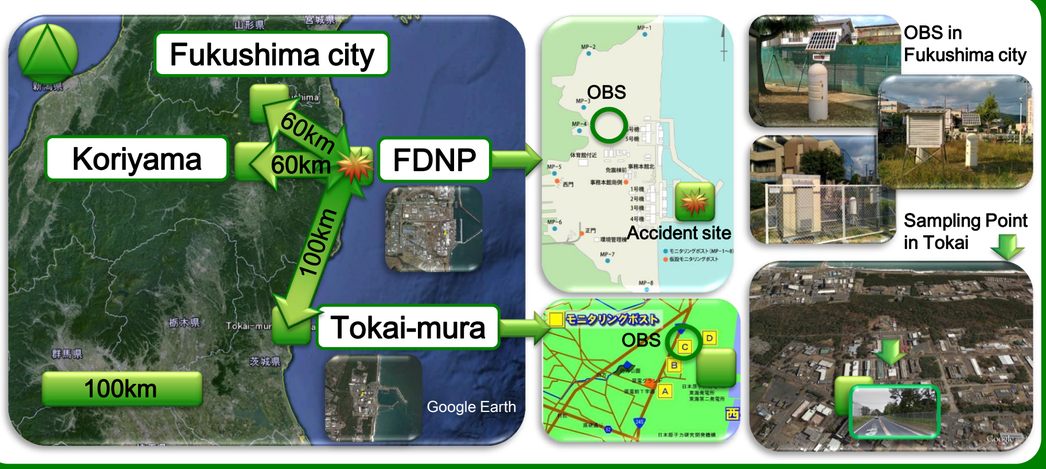
Introduction

We gathered observed data on air concentration: C (Bq/m^3), falling dust amount: F (Bq/m^2/sec) and soil deposition: D (Bq/m^2) for Iodine (^{131}I) and Caesium (^{134}Cs and ^{137}Cs) in Fukushima city and Tokai-mura, and analyzed the deposition velocity, based on the following equations. The air concentration was analyzed from the filter of sampler, and the falling dust amount from the tray placed near the ground.

Deposition velocity: V_d (m/sec)= C (Bq/m^3) /F (Bq/m^2/sec)



Fukushima city

Time histories of air concentration and falling dust amount for Caesium (^{137}Cs) in Fukushima city are shown in Figure 1. This data were observed at the housetop of the building.

a) Air concentration: C (Bq/m^3) b) Falling dust amount: F (Bq/m^2/sec)

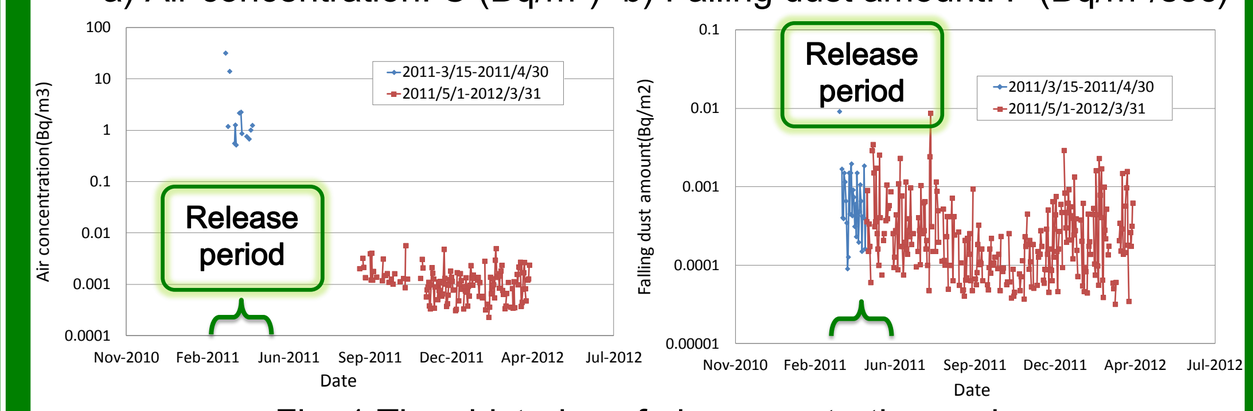


Fig. 1 Time histories of air concentration and falling dust amount in Fukushima city

From the time histories in Fig. 1, the observed data can be divided into two groups; the first month after the accident, and the data thereafter. The former group seems to be dominated by the release of radioactive materials from FDNP, while the latter group is dominated by the re-suspended particulate materials. Then we analysed the deposition velocity Vd, from these data and got the result for Caesium (^{137}Cs) shown in Fig. 2

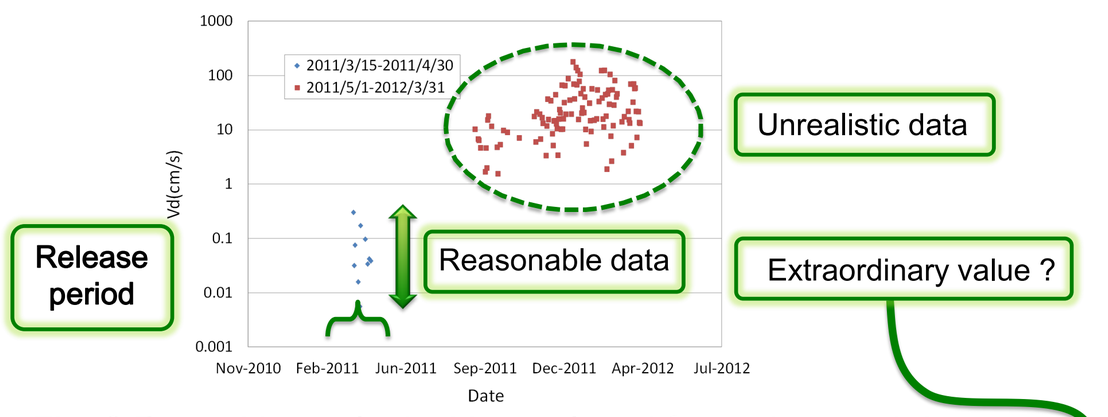


Fig. 2 Deposition velocity V_d, analyzed from observed data in Fukushima city

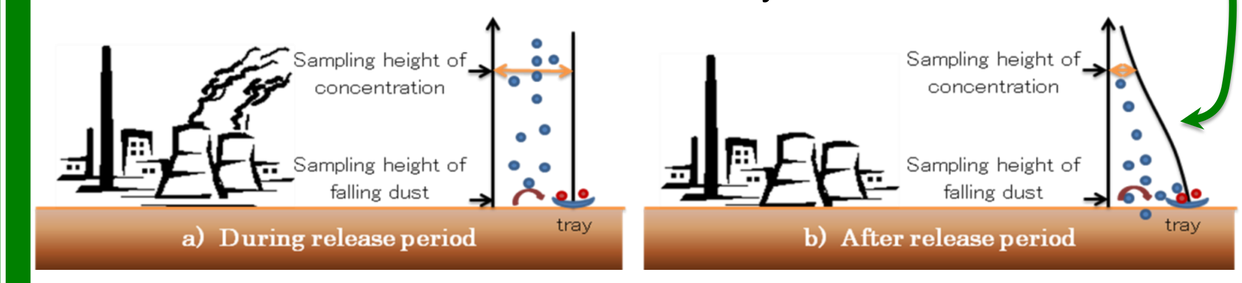


Fig. 3 Hypothesis of the reason why the large value of deposition velocity appeared after massive release stopped

The deposition velocity of 100cm/sec corresponds to the gravitational falling velocity of particle with its diameter of larger than 100 micron meters. Therefore, these high values of deposition velocity are due to the re-suspension phenomena, and considered to be unrealistic to be used as the deposition velocity, judging from the physical sense.

Tokai-mura

Time histories of air concentration and falling dust amount for Iodine (^{131}I) and Caesium (^{137}Cs) in Tokai-mura are shown in Figs. 4 and 5. It was found from them that the variance of ^{131}I is much larger than ^{137}Cs by order of 2, because ^{131}I has larger radioactive half-decay rate than ^{137}Cs, and has a tendency to become a large aerosol.

a) Air concentration: C (Bq/m^3) b) Falling dust amount: F (Bq/m^2/sec)

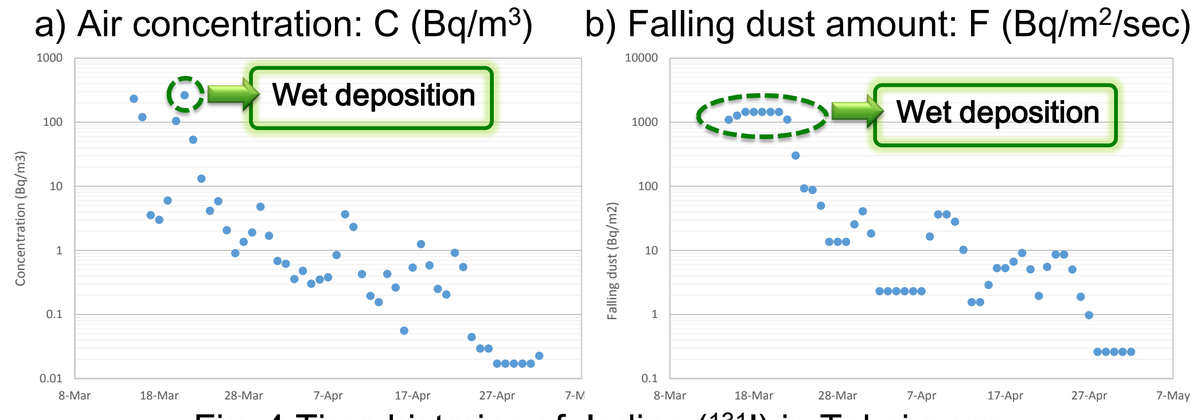


Fig. 4 Time histories of Iodine (^{131}I) in Tokai-mura

a) Air concentration: C (Bq/m^3) b) Falling dust amount: F (Bq/m^2/sec)

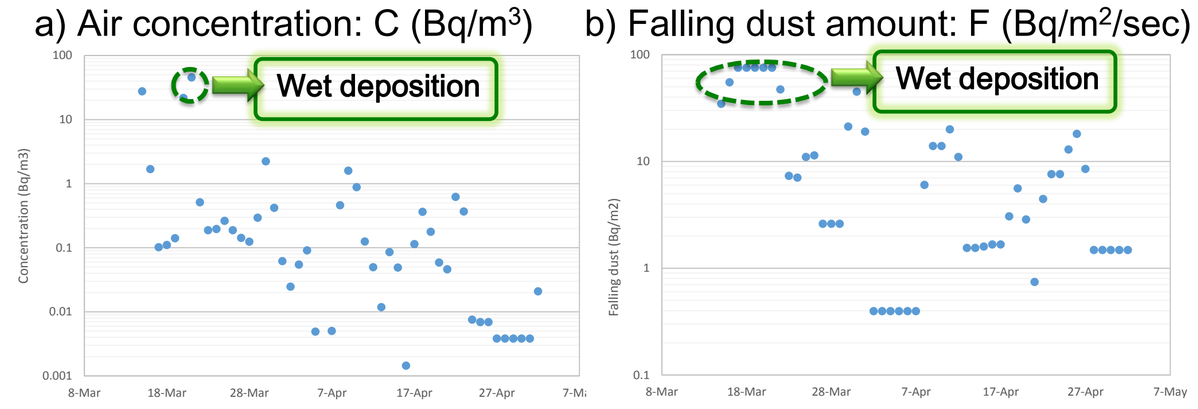


Fig. 5 Time histories of Caesium (^{137}Cs) in Tokai-mura

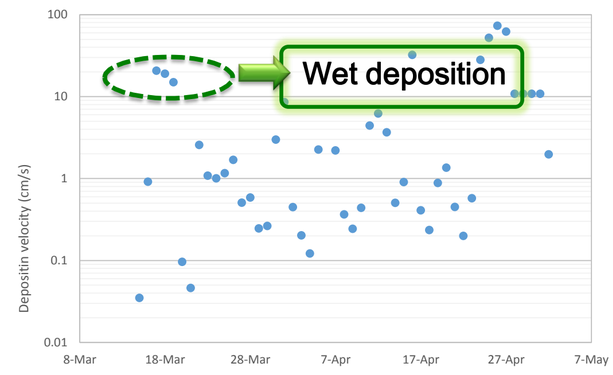


Fig. 6 Ddeposition velocity V_d of ^{137}Cs in Tokai-mura

Fig. 7 Surface ground conditions near the observation point in Tokai-mura

a) March 15th – 30th: Relatively reasonable (excluding the data of wet deposition)

b) March 31st – May 2nd: Overestimate (excluding the data of wet deposition)

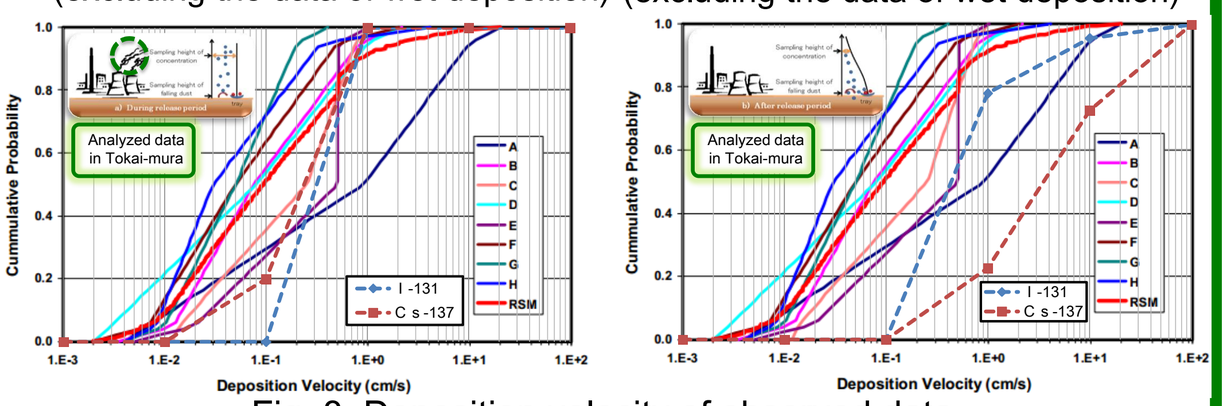


Fig. 8 Deposition velocity of observed data in Tokai-mura and NRC/NUREG/CR-7161

Consideration

The relatively reasonable value of deposition velocity was obtained during massive release period, which in almost agree with the cumulative probability distribution of deposition velocity summarized by NRC. However, it was overestimated after massive release period. It seems to be considered that the re-suspension phenomena from the ground and the forest, has some effects on the overestimation of the deposition belocity after massive release period.

Acknowledgment

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