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Assessing the Distribution Patterns of Radiocesium in a Small Watershed in Fukushima, Japan Using Soil Samples and Walk-through Air Dose Data

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A village in Fukushima, Japan, the study site of this paper, is located about 38 km northwest of the Fukushima Daiichi Nuclear Power Plant (FDNPP). The village was in the wind path of the radioactive plume which was emitted from the plant after the accident following the 2011 Tohoku Earthquake and Tsunami in March 2011. During the summer of 2016 and 2017, soil samples were collected from a small watershed in the village. Additionally, air dose measurements in the same watershed were collected by a walk-through in 2017. This study aims to identify the current distribution patterns of radiocesium, specifically Cs-137, at the study site to understand the movement of radiocesium in topography and utilize that gained knowledge for future decontamination. The soil data in 2017 showed that at the top edge of the watershed, approx. 658,000 Bq/kg of Cs-137 was contained in the top 4 cm of soils (average of two samples). At the bottom of the watershed, approx. 616,000 Bq/kg of Cs-137 was contained in the same depth. The physical distance between the sampling points was about 650 m and the elevation difference was about 120 m. However, some soil samples collected in much closer proximity displayed larger radiocesium concentration differences. The results indicate that geophysical processes in the watershed need to be taken into account to understand the distribution patterns. A walk-through air dose measurement at about 1 m above the ground showed an overall pattern that the air dose was elevated at the top edge of the watershed and lower at the channel outlet point area. On the top edge, a couple of locations facing the direction of the FDNPP recorded the highest air dose. Based on the air dose measurement, the ratio of the air dose (μSv/hour) to soil measurement (Bq/kg) in the top 4 cm of soils was approx. 1:200000 at the top of the watershed (air dose approx. 3.3 μSv/hour) and 1:268000 (air dose 2.3 μSv/hour) at the bottom of the watershed. These ratios indicate that although the air dose is slightly lower at the outlet area, the surface soils at the location had a larger ratio concentration of Cs-137 in relation to the air dose, compared with the top edge soils. A possible answer could be sediment accumulation, however this assumption needs to be proved by supporting data. In this paper, the results of these field samplings, including the ones stated above, as well as updated assumptions based on statistical analysis and GIS applications will be presented.