# Prediction of water discharge and sediment runoff from a small forested catchment for evaluating radioactive cesium discharge

*Takuhei Yamasaki[1], Shoichiro Hamamoto[1], Taku Nishimura[1]

1. University of Tokyo

INTRODUCTION

Vast amount of radioactive materials fell out in Fukushima Prefecture due to the accident of Fukushima Daiichi nuclear power plant on March 2011. The fate of radioactive cesium-137 (RCs) in the environments is important since it has long half-life (30.2 years) and large amount of deposition.

RCs in the river water is divided into two forms; water soluble form and particulate one that is absorbed on the small particles such as organic matter and clay particles. During normal flow condition between storms, water soluble RCs is dominant, while during the storm events particulate RCs becomes dominant. Totally, particulate RCs is important because storm events make much larger water discharge.

Dynamics of particulate RCs is controlled by the carrier, small particles. Small particles are released into the river water by the soil erosion during the storms. Hence, it is expected that RCs discharge from a catchment can be discussed by evaluating the sediment runoff from the catchment. The aim of this study is to verify our hypothesis. We started from calculation of the water discharge and sediment load from a small catchment by using the GIS-based soil erosion model, which can evaluate where the sediment comes as well as how much sediment flows out.

METHODS

Study site is a small forested catchment sited southeastern part of Iitate village, Fukushima prefecture. Catchment area is about 56 ha. Estimated RCs deposition is 1-3 kBq $m^{-2}$. At the basin end, we measured river water level for converting to the discharge, and turbidity continuously. During the storm events, river water sample was taken to measure suspended solids concentration, and RCs concentration. We set the meteorological station near the basin end.

GeoWEPP (Renschler, 2003) which is based on Water Erosion Prediction Project developed by National Soil Erosion Research Laboratory, USDA, was used for the calculation of sediment runoff. GeoWEPP requires four kinds of data: climate, topography, land use, and soil properties. Among the climate input data, daily temperature and rainfall were measured at the meteorological station. The other monthly weather data were collected from the nearest AMeDAS (Iitate). Topography was based on the 10 m spacing DEM provided by the Geospatial Information Authority of Japan. Land use was set to the forest because whole study area is covered by the forest. Soil properties were calibrated manually to reproduce discharge at the storm events. Calculation period was from June 2016 to December 2017.

RESULTS and DISCUSSION

Calculated daily water discharge qualitatively reproduced the observed one during high flow period; peak flow and later decay. However, model underestimated the water discharge during the low flow period, especially in the summer season. It is partly because GeoWEPP does not consider return flow of water once draining from the surface soil layer. Nonetheless, low reproducibility during the low flow period did not affect the sediment runoff so much.

Calculated sediment runoff also reproduced the observed one regarding runoff timing and the ratio of sediment runoff to the annual sediment load. Moreover, numerical calculation expressed the hysteretic relation between water discharge and sediment runoff; high sediment yield at the hydrograph build-up, and low yield in the diminishing period. Annual calculated sediment runoff was 4.1 t $ha^{-1}$ $year^{-1}$, but sediment from the hillslope was only 10 % of total runoff. In the catchment, sediment source was limited at the valley bottom near the channel. This implies that the RCs effluent locally occurs and most of deposited RCs will stay in the hillslope area for a long time.

ACKNNOWLEDGEMENT
This work is supported by JSPS grant 15H02467, and FY2017 subsidy for operating cost to promote practical development, etc. for are rehabilitation by METI and Fukushima prefecture.

Keywords: Radioactive Cesium, Cesium discharge, GeoWEPP

 