森林小流域からの懸濁態放射性セシウム負荷量推定に向けた水土砂流出解析

Calculation of water and sediment discharge from a small forested catchment for evaluating load of the particulate radioactive cesium

*山崎 琢平[1]、濱本 昌一郎[1]、西村 拓[1]
*Takuhei Yamasaki[1], Shoichiro Hamamoto[1], Taku Nishimura[1]

1. 東京大学大学院農学生命科学研究科
1. University of Tokyo

Vast amount of radionuclides was released into the environments by the accident of the Fukushima Dai-ichi Nuclear Power Plant (FDNPP) on March 2011. By 2018, decontamination of deposited radionuclides in the agricultural and residential areas has completed except for a zone with high air-dose rate near the FDNPP. Forested areas, however, are not planned to decontaminate radionuclides. Hence, dynamics of radionuclides, especially radioactive cesium (RCs), in forests are major concern for not only human health (external exposure), but also recontamination in the decontaminated areas (downstream migration).
Total RCs discharge for a year from the forested areas was generally small, less than 1% of the catchment deposition. However, once a large storm event occurs, RCs adsorbing on the fine sediments such as clay and silt particles and organic matter (called particulate RCs) was eroded and released into the river. Production and movement of particulate RCs were controlled by the soil erosion process, which has been well studied for a long time. Hence, it is expected that RCs discharge from a catchment can be estimated by evaluating the sediment runoff from the catchment. The aim of our study is to verify our hypothesis.

Method
Study site is located at the southeast part of the Iitate village, Fukushima Prefecture. Catchment area is 56 ha. Catchment geology was weathered granite, and whole catchment is covered with mixed forest. At the basin outlet, we measured water runoff and turbidity in every 10 min, and sampled channel water when water level exceeds threshold value due to rainfall events.
We used process based soil erosion model, GeoWEPP (Renschler, 2003), to evaluate sediment yield from the catchment. This model requires four types of input data, climate, topography, land use, and soil data. Climate data was based on the observed temperature and rainfall depth at the study site. The other weather data, daily solar radiation, wind velocity and dew point, was collected from the AMeDAS Iitate or Fukushima. Topography data was made with DEM provided by Geospatial Information Authority of Japan. Land use was set to “forest”, pre-set parameter set in GeoWEPP. Soil hydraulic parameter was fitted to reproduce observed daily direct runoff, since soil erosion mainly occurs during high flow periods just after the rainfall event. Soil erodibility was set as a granitic forest soil and channel calibrated by the gauged station with granitic rock in central Japan. Calibration was done using observed data in 2016, and fitted parameters were validated with 2017 data.

Results and Discussion
GeoWEPP well reproduced the daily channel discharge for most rainfall events in both calibration and validation year. At the typhoon event in 2017, however, model overestimated the observed runoff. This is partly because GeoWEPP is not a flood runoff model.
In calculation, sediment yield at the outlet occurred during middle to large storm events. However,

sediment production during small events was not well reproduced, though SS load at the small rainfall event was small for annual total load. Since sediment production process may depend on the scale of the rainfall event, we should set the another soil erodibility to reproduce the sediment production for the small rainfall events.
Sediment production mainly occurred at the channel section. In hillslope section, soil loss area was limited near the channel section. This implies that RCs in most forested areas is immobile due to the low soil erodibility in the forested area. However, once vegetation at the forest floor and surface organic matter were removed by the inappropriate forest management, RCs mobility in the catchment would increase.

キーワード：放射性セシウム、懸濁態、土壌侵食、GeoWEPP
Keywords: radioactive cesium, particulate form, soil erosion, GeoWEPP

