Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

AHW019-P05 Room: Convention Hall Time: May 25 17:15-18:45

A model for estimating the transport soil particle and Cs-137 loss based on the selective transport model

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Desertification because of overgrazing in semi-arid areas has been a serious problem, and leads to considerable increase in runoff and nutrients. In semi-arid areas, which are often subject to high levels of land degradation, rates of sediment and nutrient losses are highest where shrub species dominate (Parsons et al., 1996; Schlesinger et al., 1999). In the southern America, over the past 1 50 years, a shift in dominance of shrub species over grass species has occurred, and rainfall-simulation conducted in southern Arizona by Parsons et al., 1996 shows much more erosion rates in shrubland than grassland.
Although Cs-137 has been used for estimating the erosion rates in various environments, Diffusion and Migration Model (He and Walling, 1996) which estimates soil erosion rates from the Cs-137 inventory is just one dimensional model which assumes eroded soil will immediately flow out from the transect. However, interrill erosion is known to be a main process in semi-arid grassland, so eroded soil should stay in the studied transect. Parsons et al., 2004 developed the transport distance model in which smaller particle transported through longer distance than the coarse sediment. Since, strong affinity of Cs-137 to fine soil particle has been studied (He and Walling, 19 96), a completely new and novel understanding of the sediment transport and Cs-137 behavior will be available if combining the transport distance model and the size affinity of Cs-137. Therefore, the purpose of our study is to investigate the relationship between erosion rates and the Cs-137 loss, and the effect of the difference in particle size on the Cs-137 loss considering erosion and deposition processes based on the transport distance model.
Process of erosion was assumed as detachment by rainfall impact and deposition by flow energy occurred in grass and shrub hillslope which was 10 m long, 1 m wide, 10 % slope. Detachment and deposition were simulated at 0.1 m slopelength intervals. Original soil was set in a matrix of 50 % 0.1 mm, 10 % 0.5 mm, 20 % 1.0 mm, and 20 % 2.0 mm. Net erosion rates can be estimated by subtracting deposition rate from detachment rate. Precipitation and runoff data in Walnut Gulch Experimental Watershed as input value for my model were obtained at Southwest Watershed Research Center website (http://www.tucson.ars.ag.gov/dap). Runoff depth was calculated using data derived from rainfall simulator experiment in Walnut Gulch Experimental Watershed by Parsons et al., (1996b). Detachment rate was calculated from equation by Morgan et al., (1998), which requires runoff depth, precipitation and detachability estimated from Posen & Savat (1981) data. Deposition probability for each particle size was estimated from the median transport distance using the experimental data set by rainfall simulator by Parsons et al., (1998). Erosion rate in the range from 0.1 mm to 2.0 mm of particle size was computed by multiplying detachment rate and deposition probability. Cs-137 detachment rate and deposition rate were estimated with Cs-137 concentration profile. Finally, the Cs-137 loss was estimated by subtracting Cs-137 deposition rate from Cs-137 detachment rate.
Erosion rates of 0.1 mm are found to be greater than that of 1.0 mm. However, the maximum of the Cs-137 loss of 0.1 mm is significantly greater than that of 1.0 mm. These results suggest a possibility of overestimating erosion rates using Cs-137 model in interrill erosion areas where the

fine sediment particle is dominant over surface materials. The model can evaluate the erosion rates and desertification processes.

Keywords: Cs-137, soil erosion, transport distance, interrill erosion