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Sediment yield and transportation in a humid forest plantation catchment through various scale field monitoring and FRN analysis

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Sediment yield and soil erosion in forest floors of monoculture Hinoki (Japanses cypress: Chamaecyparis obtusa) forest has been noted and is believe to be a serious problem in Japan. Because Hinoki stands was overstocked and canopy coverage remained high, understory vegetation failed to develop. In addition, leaf litter of Hinoki is easily transported by rain splash and overland flow because foliage readily fragments. Therefore, variable amount of mineral soil are typically exposed. Under such conditions, rain splash, soil surface sealing (or crusting), and resultant overland flow may promote soil surface erosion. However, very few studies examined occurrence of soil surface erosion on hillslopes and sediment transport from hillslopes to channel ways. A nested monitoring network from hillslope plots to catchments was established in a 0.33 ha catchment of Shikoku, Japan. Catchment was covered by 40 yrs-old unmanaged Hinoki forest with sparse understory vegetation. We installed 27 splash cups and 3 runoff plots (0.5 m x 2 m) for assessing overland flow and soil surface erosion on hillslopes. Runoff responses and sediment yields at outlets of sub-catchments were monitored by 5 parshall flumes and two turbidity sensors. Suspended sediment in channels was collected using a time-integrated suspended sediment sampler. FRN (Cs-137, Pb-210ex) of suspended sediment and soil samples at various locations within the catchment was analyzed by a gamma-ray spectrometer. Stable isotope of runoff water during storm events was also analyzed for estimating overland flow contribution on catchment storm runoff. Amount of splash erosion significantly correlated to rainfall intensity, especially 1-hour maximum precipitation. Overland flow generation on

hillslopes was very responsive to rainfall and the runoff rate was typical high during the initial stages of rainfall events. Suspended sediment concentration in the small tributary increased prior to increases in discharge and appeared to correspond to overland flow generation. Therefore, peaks of suspended sediment concentrations were typically bimodal: one was prior to increases in runoff volume; and the other was prior to discharge peak. Mixing model based on FRN analysis showed that 40-50% of suspended sediment was originated from forest floor. Hydrological separation using stable isotope suggested significant contribution of overland flow on catchment storm runoff. Our findings demonstrated that various pathways of connectivity from hillslope sediment sources to channels were developed with respect to rainfall intensity and overland flow generation. Such connectivity produced unique responses of sediment transport in forested catchments.