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Two kinds of effects for storm-runoff mitigation and the role of forest

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Flattening of a rainfall waveform into a runoff waveform is derived from the fluctuating of water storage in a catchment. However, because a catchment consists of plural flow components with different time scales, an allocation of rainwater into these components and an effect of water storage fluctuation within each component both have different influences on the hydrograph response.

In a mountainous topography due to a high tectonic activity like Japan, the time scale is approximately divided into two: storm- and baseflow components. When the allocation of rainwater to stormflow is smaller, the weight of baseflow is larger and the storm hydrograph is more flattened. If the allocation is the same, the hydrograph is more flattened for a storm flow component with a larger fluctuation of water storage.

If the stormflow component consists of two or more sub-components, the rainwater allocation to each of them would give a similar influence on the storm hydrograph to that for the allocation to the storm- and baseflow components. This assumption is reflected to Takasao's runoff model where the saturation overland flow may occur where the A layer is saturated, Nevertheless, the author has not obtained a result that the flow is transited to a component with a shorter time scale predicted by Takasao's model.

Hillslope hydrology suggests that stormflow is yielded by saturated subsurface flow within a soil layer including preferential pathways and that this system is robust for a large scale storm. This robustness is created through soil layer development accompanied with the both developments of tree-root system and preferential pathways contributing to the stability of soil layer against the landslide initiation on a steep slope.

Although the rainwater allocation is mainly controlled by the geology unrelated to forest, the effect of water storage fluctuation within a soil layer supported by the root system is robust for large storm events. This is the most important role of forest in the storm-runoff mitigation.

Keywords: forest influences, hillslope hydrology, rainfall runoff response, stormflow mitigation, subsurface flow, Takasao's runoff model