【Grant-in-Aid for Scientific Research(S)】
Integrated Science and Innovative Science (New multidisciplinary fields)

Title of Project : Prediction of catchment runoff changes based on elucidating a nested structure consisting of the developments of topography, soil and vegetation

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Research Area : Natural hazards, Hydrology
Keyword : Forest influences, Hillslope hydrology, Land slide, Prediction in ungauged basins

【Purpose and Background of the Research】

A difficulty of predicting runoff characteristics from catchment properties such as geology. topography, soil and vegetation is caused by their heterogeneous spatial distributions. The regularities are derived from a nested structure of developments with different time scales: topography is evolved due to orogenic movement and erosion, soil development is repeated through landslide occurrences, and plants have a life cycle. Revealing the nested structure must be a key for evaluating an effect of catchment properties on the runoff prediction.

This study challenges a unique simulation for a recurrence process consisting of landslide and soil development supported by roots. We aim at an assessment of runoff buffering potential of forest through a new parameterization of catchment properties into runoff models.

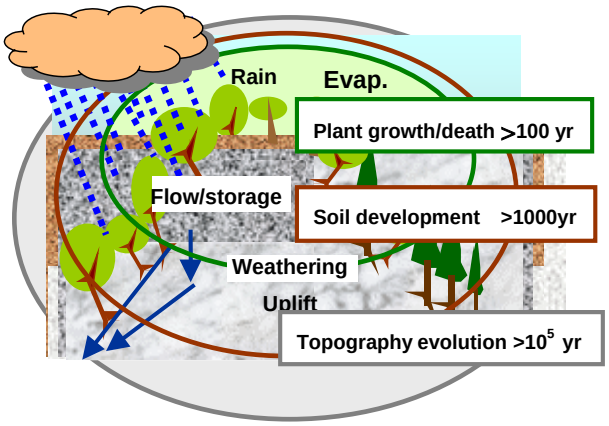

Fig. 1. Nested structure with various time

【Research Methods】

Effects of geology, weathering and land uplift velocity on catchment topography are first assessed by a simulation of topography evolution. Dependencies of runoff characteristics on the complicated underground structure are investigated through hydrometric observations and tracing tests using water quality and stable isotope. Root slope reinforcement effects are evaluated by field experiments. Field investigations are also conducted to know the history of landslide occurrences and the estimation of soil age.

A simulation model for a long-term cycle including many landslides and soil development processes is established based on the findings above, and simulation results and runoff characteristics produced from this catchment are examined against the field investigations to parameterize catchment properties in a runoff model.

Runoff characteristics in various small catchments in Japan and Asia are characterized and findings derived deductively from the above simulations are validated through them.

【Expected Research Achievements and Scientific Significance】

This study contributes to applications of process understandings obtained from hillslope hydrology to runoff-prediction implementations and to an IHAS activity for prediction in ungauged basins (PUB). A new paradigm in hydrology may be created by innovating a concept of nested structure to runoff studies.

【Publications Relevant to the Project】

Tani M.: Analysis of runoff–storage relationships to evaluate the runoff-buffering potential of a sloping permeable domain. Journal of Hydrology 360: 132-146, 2008.

Tani M., Fujimoto M., Katsuyama M. et al. : Predicting the dependencies of rainfall-runoff responses on human forest disturbances with soil loss based on the runoff mechanisms in granitic and sedimentary-rock mountains. Hydrological Processes, 2011 (in press).

【Term of Project】 FY2011-2015

【Budget Allocation】 122,900 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.bluemoon.kais.kyoto-u.ac.jp/start-jp.html