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Catchment characterization: regression analysis on the influences of precipitation, geology and land use on flow duration curves in Japan

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Hydrological science seeks to establish catchment classification system for better understanding hydrological responses of catchments in a holistic manner. However, the hydrological response in a catchment scale shows much variety of differences among catchments in spite of overall similarities due to self-organizing nature of a catchment land-forming processes. The inter-catchment differences are mainly caused by catchment heterogeneities due to the climatic, geomorphologic, geologic, and land use characteristics. Therefore, understanding their characteristics on flow regime is of great importance for the fundamental catchment classification system as well as practical water resources management and fluvial ecosystem conservation.

In this presentation, flow duration curves in 101 large river basins in Japan are analyzed by using a simple regression model. The regression model is a power-law model of Shreve's link magnitude with taking into account the effects of precipitation, geology and land use conditions within river basins. The high model predictability for flow discharge estimation on the duration curve is confirmed by using discharge observation data of the 101 large river basins, excluding extreme conditions of both floods and droughts. The results of regression analysis indicate that the effect of precipitation on flow duration curve becomes obvious for high flow discharges, while that of land use, in particular, urban and agricultural land uses, is apparent for low flow discharges. As for the geology, which shows large influences on the whole range of the flow duration curve, the contribution of both volcanic rocks in Tertiary period and sedimentary rocks in Cenozoic era is apparent for high flow discharges, while that of volcanic rocks in Quaternary period becomes obvious for low flow discharges. Values of a modified runoff coefficient, which takes into account the above-mentioned effects of precipitation, geology and land use conditions within river basins, show that their distribution in Japan seems to be grouped into several categories.