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# A comparison of flow characteristics of forested watersheds with different climates and catchment sizes

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## INTRODUCTION

Transport of water in a mountainous watershed affects water balance and flow regimes as well as movement of sediment, nutrients, and chemicals in head water areas. Watershed experiments including those employing paired catchments have long been utilized to infer effects of forest on water balance and flow regimes in a mountainous watershed. Quite a number of studies reported how water balance and flow varies with changes in forest conditions such as deforestation, afforestation, tree growth, forest fire, diseases, land use conversion. However, extents of effects of forest conditions relative to other factors such as climates and catchment sizes are still in question. As such, this study aimed to infer how variations in climates and catchment sizes can affect flow characteristics of forest watersheds.

## STUDY SITES AND METHODS

This study compared flow characteristics of Forest Experimental Watersheds (Jozankei, Kamabuchi, Takaragawa, Tatsunokuchi-yama, Sarukawa; hereafter referred to as JZK, KMB, TKR, TKY, and SRK, respectively) of Forestry and Forest Products Research Institute (FFPRI) of Japan. Notable features of these experimental watersheds are that they covers a wide variety of climatic conditions and that catchment sizes vary widely with the smallest catchment of KMB No.3 (1.5 ha, 172-244 m) up to the largest catchment of TKR Honryu (1906 ha, 816-1945 m). Daily discharge from each catchment during 10 years from 1991 through 2000 (Abe et al., 2010; Goto et al., 2005; Hosoda et al., 1999; Hosoda and Murakami, 2006, 2007; Shimizu et al., 2008) were used. Daily discharge averaged over the first, middle, and last ten-days of each month was calculated together with annual averages.

## RESULTS AND DISCUSSION

Because calculation of 10-days mean daily discharge (hereafter, referred to as q10) smoothes out individual storm response, discharge would maximize during snowmelt seasons for watersheds with heavy snow in winter such as JZK, KMB, and TKR. A peak of q10 hydrographs appears during the last 10-days of April in JZK and during the first 10 days of April in KMB. While variations in the timing of the peak amongst catchments within the same watershed were small for JZK and KMB, considerable variations in both timing and rate of the peak of q10 were observed in TRK with more delayed and higher peak for the larger catchment. This indicates that a larger catchment includes higher places receiving more precipitation and its larger relief would disperse the timing of snowmelt due to altitudinal gradient of air temperature. Also, even during the periods of Bai-u and typhoon seasons, q10 is higher for the larger catchment in TKR, suggesting that more rainfall would precipitate in the higher part of the watershed.

For watersheds without substantial snow such as TKY and SRK, discharge maximized during Bai-u seasons, while the peaks in SRK is much larger by four or five times than those in TKY.

Annual mean of daily discharge is largest for Honryu catchment in TKR, followed by 3 catchments in KMB, 3 catchments in SRK, Shozawa and No.1 catchments in TKR, 2 catchments in JZK, and 2 catchments in TKY. Higher averages in KMB over those in SRK despite of an inverse relationship in annual precipitation suggests that differences in evapotranspiration overwhelmed differences in precipitation. Except for the largest Honryu catchment in TKR, the order of annual mean daily discharge suggests that in terms of water balance inter-watershed variations is larger than intra-watershed variations unless a catchment size varies significantly.

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