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Year-to-year variations of snowmelt runoff in the Kurahone watershed on the Kawakami forest, University of Tsukuba

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Sensing the change of snowmelt runoff is one of important issues for understanding the impacts of climate change because water resources associated with winter precipitation are expected to be altered in future. Observations on small watersheds on headwaters can be useful for studying the impacts of climate change on hydrological cycle due to its exquisite sensibilities to environmental changes. Comprehensions of year-to-year variations in snowmelt runoff in headwater small watersheds can offer feasible implications for establishing countermeasures. This study presents observation results of water discharge in springtime in 1991, 1997, 1998 and 2012 on a headwater small watershed, the Kurahone watershed in Kawakami forest of University of Tsukuba. The Kurahone watershed is a forested small watershed (38.8 ha) locates on the Kawakami village, Nagano prefecture. Its altitude ranges from 1410 m to 1790 m and snow cover can be found during winter. Water discharge was observed with 90 degree V-notch weir. Meteorological data were monitored at a meteorological observation station in Kawakami forest. Precipitation data in 1991, 1997 and 1998 were estimated by regression equations obtained based on the relationship between Nobeyama AMeDAS and the station in Kawakami forest during 2002 to 2010 because of lacks of data during winter. Total specific discharge during winter and springtime seasons (December to May) in 1991, 1997, 1998 and 2012 were 470 mm, 324 mm, 661 mm and 511 mm, respectively. Total precipitation during springtime (March to May) in 1991, 1997, 1998 and 2012 were 357 mm, 265 mm, 465 mm and 342 mm, respectively. The average air temperature during winter and springtime seasons (December to May) in 1991, 1997, 1998 and 2012 were -1.9 degree C, 0.4 degree C, 1.8 degree C and -0.2 degree C. The maximum daily discharge in 1991, 1997, 1998 and 2012 were observed 25th on March, 6th on April, 15th on April and 5th on March. Integrating these results, the intensities of snowmelt were proportional to the amounts of winter precipitation and there were no clear evidence that forward shift of snowmelt was caused by increase of air temperature. Comparing of hourly discharge data, gradual increase and decrease of discharge, continuing approximately one month, were found in other years, whereas rapid increases and decreases of discharge were found in six times during March to May in 2012. These results suggest that rainfall could have controlled snowmelt runoff more strictly in 2012 than in other three years. These results suggest that changes of rainfall properties in springtime could result in changes of snowmelt runoff in headwaters in recent years.

Keywords: climate change, Kawakami forest, small forested watershed, snowmelt runoff