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Seasonal change of residence time in spring water and groundwater at a mountainous headwater catchment

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Determination of water age in headwater is important to consider water pathway, source and storage in the catchment. Previous studies showed that groundwater residence time changes seasonally. These studies reported that mean residence time of water in dry season tends to be longer than that in rainy season, and it becomes shorter as precipitation and discharge amount increases. However, there are few studies to clarify factors causing seasonal change in mean residence time in spring water and groundwater based on observed data. Therefore, this study aims to reveal the relationship between mean residence time and groundwater flow system using SFconcentration in spring and 10 minutes interval hydrological data such as discharge volume, groundwater level and precipitation amount in a headwater catchment in Fukushima, Japan.

The SF_6 concentration data in spring water observed from April 2015 to November 2016 shows the mean residence time of springs ranged from zero to 14 years. We also observed a clear negative correlation between discharge rate and residence time in the spring. The residence time in shallow groundwater in rainy season was younger as compared with that in low rainfall period. Therefore, the shallow groundwater with young residence time seems to contribute to the spring in rainy season, causing shorter residence time. Additionally, the residence time of groundwater ranged from 3 to 5 years even in low rainfall period. The residence time in high groundwater table level in ridge was older as compared with that in low groundwater table level. These suggest that the contribution of groundwater with older age in the ridge becomes dominant in the low discharge.