Application of tritium-tracer and stable isotopes in the Chikuma River basin, Japan

*Maksym Gusyev[1], Yoshito Kikumori[1], Masatoshi Denda[2], Hide Toda[3], Maki Tsujimura[4], Koichi Sakakibara[3], Uwe Morgenstern[5], Michael Kilgour Stewart[5]

1. International Centre for Water Hazard Risk Management (ICHARM), Public Works Research Institute (PWRI), Japan, 2. River Restoration Team, Public Works Research Institute (PWRI), Japan, 3. Department of Environmental Sciences, Shinshu University, Japan, 4. Graduate School of Life and Environmental Sciences, University of Tsukuba, Japan, 5. GNS Science, New Zealand

Application of tritium-tracer in river water can provide useful information of groundwater residence times and pollutant transport dynamics in the subsurface. As a part of water molecule, tritium undergoes β-decay with a half-life of 12.32 years and tritium concentrations analyzed with ultra-low level precision measurement may give unique estimate of mean residence times (MRTs) with one river water sample of baseflows in Japanese headwater catchments (Gusyev et al., 2016). In the Chikuma River basin, 12 river water samples were collected during winter baseflow conditions in December 2017 at altitudes between 465 and 919 m above sea level (msl) to establish tritium-tracer MRTs in headwater catchments situated upstream of Ueda city (Figure 1). To characterize deep groundwater MRTs, one sample was collected from 1000 m deep wellbore, which is situated at elevation of 421 msl and screened from 600 to 1000 m below ground, and this groundwater is used for domestic drinking water supply and bathing at the Bingushi hot spring of Sakaki city. In each sampled location, in-situ measurements (e.g. water temperature, pH, dissolved oxygen, conductivity, turbidity (TDS), etc.) were conducted with YSI Pro DSS and 1L water samples were collected for tritium analysis with low-level liquid scintillation counting at GNS Science tritium laboratory, New Zealand. For the characterization of water pollution sources, 5L water samples were collected for analysis of nitrogen (^{15}N) and carbon (^{13}C) stable isotopes attached to sediments and 0.06L water samples for analysis of oxygen (^{18}O) and hydrogen (^{2}H) stable isotopes as well as ion chromatography chemistry. These tritium-tracers MRTs and stable isotopes provide essential information of regional and local groundwater and pollution dynamics and will be used for the long-term investigation of the of the Chikuma River main channel to develop guidelines for maintaining healthy aquatic community and productive river ecosystem.
References:

Gusyev M.A., Morgenstern U., Stewart M.K., Yamazaki Y., Kashiwaya K., Nishihara T., Kuribayashi D., Sawano H. and Y. Iwami (2016). Application of tritium in precipitation and baseflow in Japan: a case study of groundwater transit times and storage in Hokkaido watersheds. *Hydrol. Earth Syst. Sci.*, 20, 1-16, doi:10.5194/hess-20-1-2016

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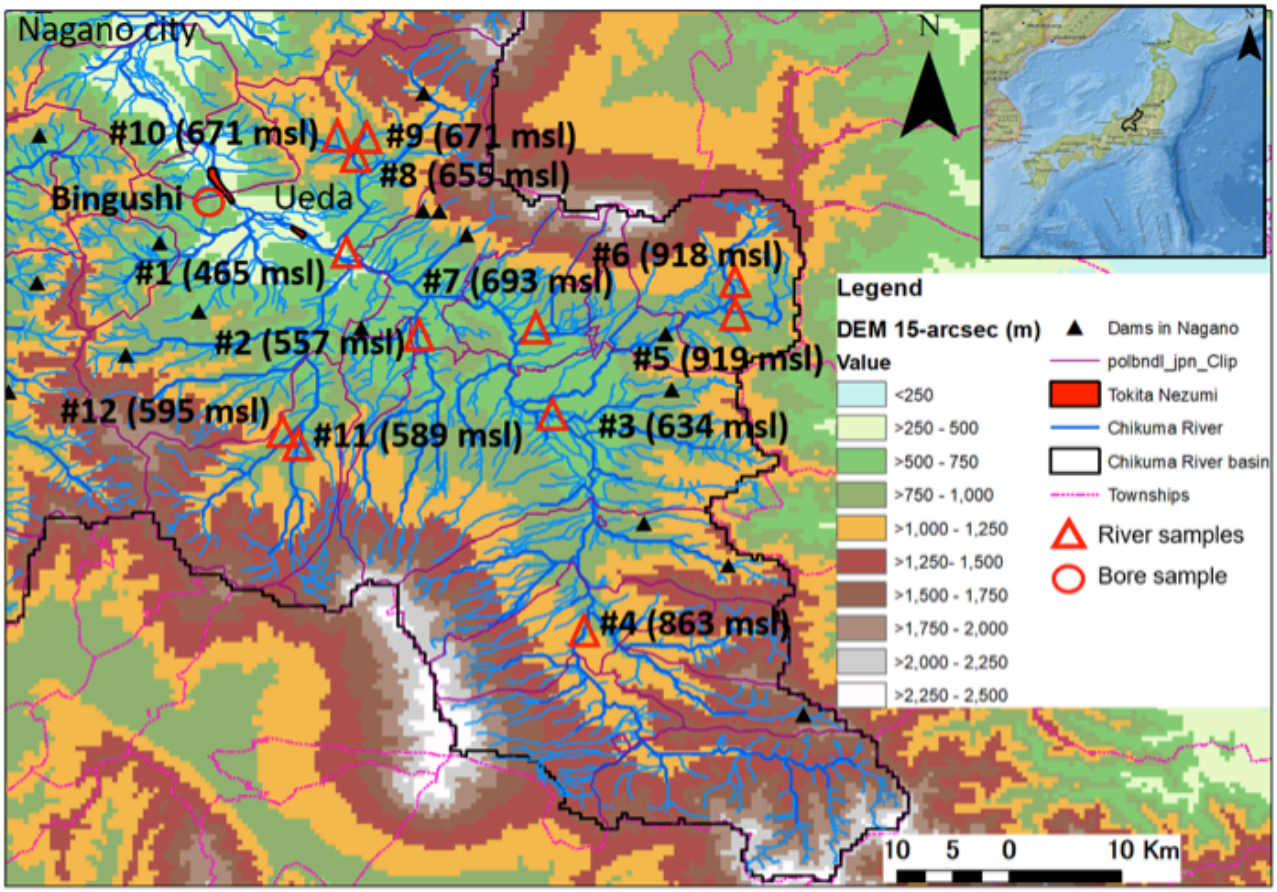

Figure 1. Sampled 12 river water and 1 wellbore locations in the Chikuma River basin, Japan.