A new approach to estimate evaporation of canopy interception using stable isotope of water

*Shigeki Murakami[1], Shohei Hattori[2], Ryu Uemura[3]

1. Tohkamachi Experimental Station, Forestry and Forest Products Research Institute, 2. School of Materials and Chemical Technology, Tokyo Institute of Technology, 3. Faculty of Science, Department of Chemistry, Biology, and Marine Science, University of the Ryukyus

Evaporation of canopy interception CI, accounts for around 20% of gross rainfall PG. However, it is strange that CI is proportional to PG on an hourly basis during rainfall (e.g. Murakami, 2006, J. Hydrol.; Saito et al., 2013, J. Hydrol.). To understand the mechanism of canopy interception we estimated evaporation of wet canopy surface EW using stable isotope of water.
Murakami and Toba (2013, Hydrol. Res. Lett.) measured CI in a plastic Christmas tree stand placed on a 180-cm square tray that was set outside under natural rainfall. We used the same system to measure PG and net rainfall PN to calculate CI (= PG - PN) using water balance. Manual sampling of gross and net rainwater was also conducted on an hourly basis. EW was estimated based on the difference of d18O (or d2H) values in gross and net rainwater using fractionation factor, and the results were compared with CI. In a rain event we focused on, PG and PN (runoff from the tray) were 28.0 mm and 22.7 mm, respectively, with CI of 5.3 mm (18.9% of PG). The d18O (or d2H) value in net rainfall was higher than that in gross rainfall because of fractionation by EW. Calculated EW by the values of d18O was 5.2% of PG on average. We tried to reproduce the results using a tank model (Yoshida et al., 1993, J. Japan Soc. Hydrol & Water Resour.). Firstly, evaporation rate is assumed to be constant, 20% of PG and the calculated PN was 23.1 mm, i.e. CI was 4.9 mm (17.5% of PG). Secondly, retaining the parameter of the model, we calculated PN based on hourly surface evaporation derived from the d18O values. The simulated PN was 25.6 mm that means CI was only 2.4 mm (8.6% of PG).
The difference between the two methods can be explained by rapid evaporation of micro-droplets produced by splash after rain impacts the canopy (Murakami, 2006). We will present the results using d2H data at the session.
This work was supported by JSPS KAKENHI Grant Number JP15H40250.

Keywords: Canopy interception, Splash, Stable isotope of water

