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# Isotopic separation of snowmelt runoff during an artificial rain-on-snow event

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Rain-on-snow events are common phenomenon in the climate conditions of central Europe, mainly during the spring snowmelt period. These events can cause serious floods in areas with seasonal snow. The snowpack hit by rain is able to store a fraction of rain water, but runoff caused by additional snowmelt also increases. Assessment of the rainwater ratio contributing to the outflow from the snowpack is therefore critical for discharge modelling.
A rainfall simulator and water enriched by deuterium were used for the study of rainwater behaviour during an artificial rain-on-snow event. An area of 1 $m^2$ of the snow sample, which was 1.2 m deep, consisting of ripped coarse-grained snow, was sprayed during the experiment with deuterium enriched water. The outflow from the snowpack was measured and samples of outflow water were collected. The isotopic content of deuterium was further analyzed from these samples by means of laser spectroscopy for the purpose of hydrograph separation. The concentration of deuterium in snow before and after the experiment was also investigated.
The deuterium enriched water above the natural concentration of deuterium in snowpack was detected in the outflow in $7^{th}$ minute from start of spraying, but the significant increase of deuterium concentration in outflow was observed in $19^{th}$ minute. The isotopic hydrograph separation estimated, that deuterium enriched rainwater became the major part (> 50% volumetric) of the outflow in $28^{th}$ minute. The culmination of the outflow (1.23 l $min^{-1}$) as well as deuterium enriched rainwater fraction (63.5%) in it occurred in $63^{th}$ minute, i.e. right after the end of spraying. In total, 72.7 l of deuterium enriched water was sprayed on the snowpack in 62 minutes. Total volume of outflow (after 12.3 hours) water was 97.4 l, which contained 48.3 l of deuterium enriched water (i.e. 49.6 %) and 49.1 l (50.4 %) of the melted snowpack. The volume of 24.4 l of deuterium enriched spray-water was stored in the snowpack. The increased total output v. input of the water volume was caused by the warmer spray-water induced snowmelt also connecting separated liquid layers in the snowpack within the process of infiltration and drainage.

Key words: deuterium tracer, rainfall simulator, snowmelt