



Effect of Soil Frost on Snow-melt runoff Generation: Stable Isotope Study in Drained Peatlands

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In this study, we analysed stable isotopes and water quality of runoff water collected daily from two different peatland drainage areas with automated samplers from March 2012 to October 2012, located in Northern Finland. In addition we collected weekly snow samples for stable isotope analysis. Our primary aim was to find out how different land use types, i) peat extraction area and ii) peatland forestry, are affecting the flow paths and runoff water quality during the snow melt period.

Results show that there is a clear difference in $\delta O18$ signal between these systems. The peatland forestry area is located at groundwater dominated area which can be seen as a flat line when $\delta O18$ values of all samples are plotted. Samples taken at the peat extraction area show a clear response to the snowmelt event. Most likely this difference is caused by different soil frost conditions. Quantity of the groundwater at the forestry area prevents the soil from freezing during winter, therefore water originating from melting snow is able to infiltrate to the peat soil and push pre-event water into the drainage system. This observation is also visible in water quality of runoff water as high peak in colour during the snow melt period. Contrary, the peat extraction area behaves in opposite way. Melting water from snow is not able to infiltrate to ditches but instead will rapidly move on the frozen soil surface as a Hortonian overland flow. Because the soil is frozen, moving water is not able to leach humic substances from soil layers or erode particulate matter from the soil surface.

These observations can be used to develop water quality protection policies for drained peatland areas. In Northern areas, where freezing of soil during winter is common it is not crucial to emphasize water protection during spring snowmelt, as frozen soil helps to maintain the runoff water quality at reasonable levels. In the areas where ground frost is rarer the impact of purifying runoff water in spring thaw will be more beneficial for the receiving water bodies.