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Water and element fluxes in an experimental watershed in a permafrost-dominated, forested area of Central Siberia: insights from geochemical observations and thermo-hydrological modeling

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The biogeochemical transfers in the catchment of the Kulingdakan stream, which is a small tributary of the Kochechum river in the Yenisei basin, have been studied for more than a decade. Measurements of the chemical composition of the waters in the stream and in the other compartments of the watershed, such as mineral soil or litter horizons for instance, have been done. Along with these hydrogeochemical observations, characterizations of the chemical compositions of the constituents of the compartments themselves have been performed. The vegetation cover properties, heterogeneity and elemental composition have also been carefully assessed. This knowledge (e.g.: [1], [2]) allowed to build a conceptual hydrological scheme of the water fluxes in this Kulingdakan catchment, characterized by a strong impact of active layer dynamics. The main feature of this hydrological scheme is the high variability along slopes aspect, as summarized in Orgogozo et al. (2014) [3]. This conceptual scheme has then been investigated by cryohydrogeological numerical modeling [4]. The numerical study confirms the transfer mechanisms inferred by the biogeochemical studies, and allows to point out more precisely the impact on the fluxes of matter of the vegetation cover and especially of the dynamics of transfer processes within the root layers. The impact of evapotranspiration on water fluxes is studied numerically, which highlights a strong sensitivity to the variability of rooting depth and corresponding evapotranspiration at the slopes of different aspects in the catchment. On the basis of these results the potential evolution of the fluxes of water and elements from the slopes to the stream in the Kulingdakan watershed under climate change is briefly discussed using a substituting space-for-time approach (e.g.: [5]).

[1] Bagard M-L et al. Geochimica et Cosmochimica Acta. 2013;114:169-187. [2] Viers J et al. Biogeochemistry. 2013;113:435-449. [3] Orgogozo L et al. in 'Permafrost: Distribution, Composition and Impacts on Infrastructure and Ecosystems', ed. Pokrovksy OS, Nova Publishers. 2014:153-172. [4] Orgogozo L et al. Permafrost Periglac. Accepted. [5] Kirpotin SN et al. Int J Environ Stud. 2018;75(3): 385-394.