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Thermal impact of a small alas-valley river in a continuous permafrost area - insights and issues raised from a field monitoring Site in Syrdakh (Central Yakutia)

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Lakes are probably the most prominent surface water bodies in continuous permafrost areas. As a consequence, they are also the most studied features in these regions (e.g. Fedorov et al. 2014). They are indeed of great interest, not only for local populations that use the water resource they represent both in winter and summer, but also from a climatic point of view as they can be a specific source of green-house gases due to the relatively warmer environment they create, especially associated with their taliks (thawed zone surrounded by permafrost located beneath large enough lakes). From a hydrogeological perspective, such taliks can form complex groundwater networks, thus possibly connecting sub-permafrost groundwater with surface water in the present context of climate change. On the other hand, rivers, another important feature of permafrost landscapes providing similar challenges, have drawn less attention so that only a few studies focus on river interactions with permafrost (e.g. Costard et al. 2014, Grenier et al. 2013). However, the processes of heat transfer at stake between river and permafrost strongly differ from lake systems for several reasons. The geometries differ, the river water flow and thermal regimes and interactions with the lateral slopes (valley) are specific. Of particular importance is the fact that the water, in the case of rivers, is in motion leading to specific heat exchange phenomena between water and soil. (Roux et al., accepted) addressed this issue recently by means of an experimental study in a cold room and associated numerical simulations.

The present study focuses on a real river-permafrost system with its full natural complexity. A small alas-valley in the vicinity of Yakutsk (Central Yakutia, Siberia) was chosen. Monitoring was started in October 2012 to study the thermal and hydrological interactions between a river and its underground in this continuous permafrost environment. Thermal sensors were installed inside the river, in the atmosphere and into boreholes in the permafrost, at different locations and various distances from the river and the upstream lake. Hydrological information was collected as well (e.g. water temperature, electrical conductivity, pH and isotopic profiles; river flow rates). Soil properties were studied in pits (e.g. thermal conductivity, soil humidity and temperature measurements). More recently GPR studies were conducted along river profiles complementing the dataset.

This new study site is introduced and the major results are presented as well as the main issues raised and future perspectives.