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Temporal variations of dissolved chemical fluxes carried by Siberian rivers (Kochechum river and Nizhnyaya Tunguska river, Central Siberia)

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High latitude areas consist in atypical hydrological systems where the presence of permafrost strongly constrains water fluxes. Moreover, these regions are characterized by a very contrasted hydrological year punctuated by an intense spring flood in May/June. This study aims to work out how these features influence the temporal pattern of chemical element migration in boreal environments and, for this purpose, major and trace element concentrations as well as Sr and U isotopic ratios were analyzed in the dissolved load of two Siberian rivers regularly sampled over two hydrological cycles (2005-2007), Nizhnyaya Tunguska and Kochechum rivers.
Our results combining major and trace element data together with Sr and U isotope ratios show that the chemical composition of river waters over the year can be overall explained in terms of mixing between deep underground brines and suprapermafrost flows. Deep underground waters appear to be the main chemical contributors to large rivers during winter, their contribution depending strongly on the depth and on the continuous nature of the permafrost, while surface waters significantly impact the budget of chemical elements during spring flood and summer periods. At spring flood, the surface flux comes from the leaching of shallow organic soil levels whereas in summer it comes mainly from subsurface layers where the characteristics of the dissolved chemical load is controlled by water-rock interactions within mineral soil. Both surface and subsurface fluxes carry a significant colloidal component that affects the mobilization of insoluble elements and result especially in very high concentrations in chemical species such as DOC, Fe, Al, REE or Th during flood periods. These major temporal variations in the intensity and in the nature of dissolved geochemical fluxes have to be considered in order to establish reliable chemical budgets in boreal watersheds.