



## **Long-term open-water season stream temperature variations and changes over Lena River Basin in Siberia**

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This study systematically analyzes long-term (1950–1992) stream temperature records for the major sub-basins within the Lena River watershed in order to describe water temperature regimes over the various parts of the Lena watershed and document significant stream temperature changes induced by reservoir regulation, and by natural variations/changes. The results show that the open water season can be divided into three consecutive stages—increasing temperature stage in the early open water season, stable temperature stage in the mid-warm season, and decreasing temperature stage in the late open water season. Temperature conditions are similar over the Aldan and Upper Lena regions. However, stream temperatures at the Lena basin outlet are up to 8 °C lower than those over the southern sub-basins. This suggests that the latitudinal difference in climatic variables, such as air temperature, might be the major control on stream temperature regime. Results also demonstrate that the reservoir regulation has a strong influence on the regional water temperature regime and change in the regulated subbasin.

Reservoir regulation has increased (decreased) the downstream water temperatures in the Vilui valley during the early (mid) open water season. Trend analyses show consistent warming trends across the entire Lena River basin in the early open water season. This may indicate a response to earlier snowmelt over the Lena River watershed. Trend results also demonstrate that the Aldan tributary, without much human impact, experiences warming (cooling) trends in the first (second) half of the open water season, leading to a stream temperature regime shift toward early open water

season. The upper Lena River has warming (cooling) trends in the early (mid-late) open water season. Over the regulated Vilui tributary, however, stream temperatures have significantly increased in the early and late parts of the warm season due to combined effects of natural changes and reservoir regulation. Over the Lena basin as a whole, strong positive correlations have been found between the basin mean monthly air and water temperatures during the warm season. Increasing water temperatures were observed during the early and mid-June. Because of stream temperature increase in this peak flow period, the Lena River heat flux has gone up

by 23% in June. This may have considerable impact on the thermal conditions of the Laptev Sea in the early summer season.