

## Changes of permafrost thawing determined from long-term streamflow measurements of the Lena River, Eastern Siberia

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Permafrost has been reported to be degrading at increasing rates over wide areas in northern regions of Eurasia and North America; the evidence has come mainly from in situ observations in the soil profile, which have limited spatial and invariably limited temporal coverage. Herein two types of methods are proposed to relate low river flows (or baseflows) during the open water season with the rate of increase of the active groundwater layer thickness resulting from permafrost thawing at the scale of the upstream river basin. The methods are tested with data from four gaging stations within the Lena River basin in Eastern Siberia, one in the Upper Lena basin, and three in two of its tributaries, namely the Olyokma and the Aldan basins. The different results are mutually consistent and suggest, that over the 1950-2008 period the active layer depth has been increasing at average rates roughly of the order of 0.3 to 1 cm a<sup>-1</sup> in the areas with discontinuous permafrost and at average rates about half as large in colder more eastern areas with continuous permafrost. These rates have not been steady but have been increasing; thus it appears that in the earlier years over the period 1950-1970, some large regions have not been undergoing permafrost thawing and probably even accretion, whereas from the 1990's onward large areas have experienced average thawing rates as large as 2 cm a<sup>-1</sup> and some, especially those with continuous permafrost, even larger.

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