

Characteristics and recent dynamics of thermo-erosional features in small catchments of Arctic Siberia

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Abstract

Thermal erosion is a prominent type of permafrost degradation that can lead to rapid changes in ice-rich permafrost landscapes. The process and its resulting landforms such as thermo-erosional gullies are reported to become increasingly active and widespread. (Re-)Activation of thermal erosion impacts the hydrological regime of affected landscapes and alters the biogeochemical composition of associated surface waters. Our study aims at assessing current rates and mechanisms of thermal erosion in small ice-rich permafrost catchments of Arctic Siberia. We investigated thermo-erosional features in three different areas in and around the Lena River Delta that represent differing geomorphological, lithological and geocryological settings. We used a combination of field measurements, remote sensing methods including tacheometry, DGPS, and UAV surveys and subsequent GIS analyses to 1) quantify the morphometry of thermo-erosional landforms, 2) quantify the spatial extent of current thermo-erosional activity, and 3) quantify areal changes in activation and stabilization of thermal erosion over recent years to decades. Further data on snow depth and distribution in the gullies and valleys as well as hydrological and hydrochemical data of the associated streams aided the interpretation of observed spatial differences in thermal erosion rates and the development of active versus stabilized zones as well as their impacts on headwaters.