



Circumpolar patterns of ground-fast lake ice and landscape development

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Shallow lakes in the Arctic are often associated with thermokarst processes which are characteristic for permafrost environments. They partially or completely freeze-up during winter time what can be observed from space using Synthetic Aperture Radar (SAR) data. Spatial patterns of ground-fast and floating ice relate to geomorphological and hydrological processes, but no circumpolar account of this phenomenon is currently available due to challenges when dealing with the varying observation geometry typical for SAR. An approach using ENVISAT ASAR Wide Swath data (approximately 120 m resolution) has been developed supported by bathymetric measurements in Siberia and eventually applied across the entire Arctic for late winter 2008. In total about 2 Million lake objects have been analyzed considering the boundaries of the Last Glacial Maximum, permafrost zones and soil organic carbon content.

Distinct patterns of ground-fast lake ice fraction can be found across the Arctic. Clusters of variable fractions of ground-fast ice occur especially in Yedoma regions of Eastern Siberia and Alaska. This reflects the nature of thaw lake dynamics. Analyses of lake depth measurements from several sites (Alaskan North Slope, Richards Island in Canada, Yamal Peninsula and Lena Delta) suggest that the used method yields the potential to utilize ground-fast lake ice information over larger areas with respect to landscape development, but results need to be treated with care, specifically for larger lakes and along river courses.

A combination of general lake features and ground-fast ice fraction may lead to an advanced understanding of landscape patterns and development. Ground-fast ice fraction information may support to some extent the identification of landscape units, for example areas of adjacent lakes with similar patterns (terraces) or areas with mixed ground-fast fractions which indicate different lake development stages.

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