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Observed changes in water temperature and ice dynamics at selected lakes of Russia in the past decades

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The potential impacts of climate variability and change on lake hydrology are complex, especially as lakes are an important freshwater resource. The eight largest lakes of Russia contain about 96% of water resources of all lakes over Russia territory. Lakes Ladoga, Onega, Chudsko-Pskovskoe and Ilmen are the largest fresh water lakes of European territory of Russia. The catchment area of Lake Ladoga includes catchments of two other Lakes – Onega and Ilmen. The world's deepest and oldest Lake Baikal is among the four larget lakes of the Asian part of Russia including Lakes Lakes Khanka, Taimyr and closed brackishwater Lake Chany.Variations in air temperature, precipitation, and other meteorological parameters cause direct changes in the hydrological regime of lakes, such as: water level, thermal characteristics, ice events and ice thickness as well as hydrochemical and hydrobiological regimes and the entire lakes ecosystem. However, the response of the individual lakes and lake basins to these changes will depend on the magnitude and nature of regional climate change including peculiarities of the atmospheric circulation manifestation and the specific geomorphologic characteristics of the lakes. The study was based on the data of ice observations on the largest lakes of European Russia (Lakes Ladoga, Onega and Ilmen) and Lakes Baikal, Taimyr and Khanka in the Asian Russia. Observation period varies from 40 years for the Lake Taimyr to 118–116 years for Lakes Ladoga and Onega. Temporal trends have been discovered towards changes in the duration of the complete ice cover and maximum ice thickness on the background of a long-term variability. All observed characteristics of water temperature regime demonstrate the response to changes in air temperature over lakes basins. Mean monthly water temperature increased in Lakes Chany and Baikal by 0.5°C/decade and by 0.3°C/decade in the mentioned lakes of European part of Russia. Water temperature change directly affects lake ice dynamics. This has important implications for aquatic ecosystems' sustainable development and activities on lakes. Maximal ice cover thickness had the most pronounced response to climate warming in winter time during the last decades. All studied lakes exhibited the tendency of reduced ice cover thickness after 1980 by 5-10 cm. The mentioned lakes in the European Russian territory and Lake Baikal show the tendencies to decrease in duration of ice coverage by 10-15 days mainly because of earlier date of ice cover break-up.