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Eastern Eurasian and Western North American Permafrost Groundwater Storage Changes from GRACE and High-Resolution Geoid Models

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Climate-change driven affects in the northern hemisphere have potential for wide reaching changes in surface energy balance and ecosystem stability. Observations from the Gravity Recovery and Climate Experiment (GRACE) mission from August 2002 through 2009 and high-resolution geoid model difference from 1999 through 2009, corrected for solid-earth effects, have shown that groundwater storage is changing. Groundwater storage is increasing in watersheds underlain by continuous permafrost: Lena, Yenisei and Arctic coastal plain of Alaska, U.S.A., and Yukon Territory, Canada. The Ob' watershed underlain by nonpermafrost is stable, i.e. no change in its groundwater storage over the observation period. Groundwater storage is decreasing in watersheds underlain by discontinuous permafrost: Mackenzie and Yukon in western North America. We hypothesize that the groundwater storage changes are linked to the development of closed taliks (unfrozen material acting as aquifers) and degradation of permafrost in the continuous permafrost zone and decrease of permafrost lateral extent and development of new open taliks in the discontinuous permafrost zone of the watersheds. The increase in taliks in the continuous and discontinuous permafrost zones may be linked with changes occurring beneath thaw bogs, ponds, lakes and riverbeds.