Abstract

The co-orbiting satellites of the Gravity Recovery and Climate Experiment (GRACE) measure water mass change on the Arctic permafrost watershed regions is not due to surface snow water change. The seasonal loading-unloading of vegetation water content is storage into the North American watersheds (Muskett and Romanovsky, 2009). Changes in albedo due to the retreat of glaciers and changes in the distribution of wetlands and peatlands can also cause significant changes in the surface mass budget. GRACE data for the period 1999-2009 reveals a significant decrease in ground water storage in the Yukon and Mackenzie rivers, with a smaller decrease for the Lena river. This decrease in ground water storage is consistent with warming of the Arctic ground thermal state (Romanovsky and Osterkamp, 2000). The effect is largest near the coast and in the discontinuous permafrost zone of the watersheds. The increase in taliks in the discontinuous permafrost zone of the watersheds, and the decrease of permafrost lateral extent and development of new open water bodies are indications of increased thawing. Groundwater storage change is estimated by integrating ground water mass changes from GRACE and high resolution geoid models as part of the U.S. national effort to advance the Gravity Recovery and Climate Experiment (GRACE) for monitoring and understanding ground water storage changes. GRACE data on groundwater storage changes reveals a response to water mass loading changes from changes in albedo, changes in snow water equivalent, and changes in vegetation water content. The GRACE data is consistent with increased warming of the ground thermal state and the ongoing retreat of the permafrost from increased thawing of talik and increases in the extent of wetlands and peatlands.