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Water balance in the Antarctic lakes

Elena Shevnina
Finnish Meteorological Institute, Polar Meteorology, Helsinki, Finland (elena.shevnina@fmi.fi)

Antarctica keeps great volume of water on Earth. Its cold, dry and windy climate leads peculiar balance of water in various phases (solid, liquid and gas), and it is sensitive to warming. Increase of near surface temperature enhances water transition from solid to liquid phase (melting) as well as to gas (evaporation). The melted water is accumulated in a population of glacial lakes. These water bodies are located inside glaciers (subglacial type), over their surface (supraglacial type) or contacted glaciers (proglacial or epiglacial type). The glacial lakes are connected by a network of ephemeral streams. This hydrological network is typical in a lowest zone of Antarctic ice sheet, where the melting is substantial in the continental mass balance.

Water cycle in the glacial lakes differs with their type, and various processes drive water transport in the glacial lakes. In this study, the water balance equation method was applied to evaluate the volume of water accumulated in the glacial lakes. The water balance equation was written separately for the lakes of the epiglacial and supraglacial types. We used the observations by the long-term monitoring network, the data collected by the remote sensing, and the in-situ measurements gathered in field campaigns in the evaluations of the volume of lakes, the evaporation over a lake surface, and the inflow/outflow runoff. The components were evaluated for the epiglacial lakes located in the the Shirmacher, the Larsemann Hills and the Thala Hills oases (East Antarctica).

The lake volume was evaluated from the lake surface area and depth measured withing last 10 years. The results show that since late 1980s, the lake volume has increased on many epiglacial lakes located not only in the coastal oases but also in the continental interior. The results suggest that the evaporation in among a key components of the water balance of the glacial lakes located in the Antarctica. In the polar region, the role of the evaporation is traditionally underestimated due to lack of the observations with precise measuring techniques. The results of the study contribute with the QAntarctica with the dataset on the actual physiography of the glacial lakes in Antarctica. This study is supported by the Academy of Finland (contract number 304345) with the logistic support of the national programs on the Antarctic research.