



Mass changes of Garabashi glacier, Central Caucasus derived from glaciological observations and remote sensing data over the past 20 years.

Stanislav Kutuzov (1), Gennady Nosenko (1), Oksana Rorotaeva (1), Stanislav Nikitin (1), Abdullah Kerimov (2), Akhmat Kerimov (2), Luydmila Tarasova (1), Nelly Elagina (1), and Etienne Berthier (3)

(1) Institute of Geography Russian Academy of Sciences, Moscow, Russia, (2) Center of Geography research Kabardino-Balkaryan scientific center RAS, Nalchik, Russia, (3) Laboratoire d'Etudes en Géophysique et Océanographie Spatiales, Centre National de la Recherche Scientifique (LEGOS – CNRS, UMR5566), Université de Toulouse, 31400 Toulouse, France

The ice-covered Europe's largest volcanic massif Elbrus (5,642 m) is a unique object for studying the reaction of mountain glaciers to climate changes. Elbrus glacial system contains more than 10% of the total ice volume in the Greater Caucasus.

Garabashi glacier was the subject of glaciological studies of the Institute of Geography RAS, Moscow starting in the 1982. Since 1984 the data on its balance state had been regularly published in WGMS bulletins. The components of the glacier mass balance are determined annually by direct measurements.

In recent years the mass balance values were strongly negative, the glacier loses mass faster than during the entire period of direct observations. Over the last 20 years since 1997 the cumulative mass balance reached -12.4 m. w.e. The average annual mass balance was -0.6 m. w.e. The rate of mass loss has further increased and almost doubled in recent decade (2007-2017) compare to 1997-2007 reaching -0.79 m w.e. In recent years firn accumulation fields at altitudes of 3800-4000 m have melted almost completely. Glacier retreated 280 m on average over the 20 years and its surface area reduced by 0.5 km².

Mass balance measurements were compared with the geodetic mass balance changes. Two high resolution DEMs were used: 1997 DEM completed by the Moscow State University from the aerial photography and the Pléiades stereo-pair of 2017. The average surface lowering over the entire glacier was -6 m, with the maximum of 40 m at glacier tongue.

Mass balance observations at Garabashi glacier show that warming over recent decades has led to unprecedented mass loss of Elbrus glaciers despite its high elevation position.

The Pléiades stereo-pair used in this study was provided by the Pléiades Glacier Observatory initiative of the French Space Agency (CNES)

This study was supported by the Russian Foundation for basic research grant 18-05-00838.