Current state and dynamics of glaciers in the Mountains of Northwest Inner Asia

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The mountains of Northwest Inner Asia have traditionally been a subject of special interest to geographers of St.Petersburg State University. The region is characterized by arid climate, existence of modern glaciation centers and sparse growth of forest cover. One of the key sites is Tavan Bogd Mountains with the largest valley glaciers of the entire Altai region. This mountain massif is located at the junction of the Russian and Mongolian Altai ranges on the border of Russia, Mongolia and China. The glaciers of Tavan Bogd are concerned with formation of the main river in western Mongolia - Khovd river related to the endorheic basin of Grate Lakes Depression. Khovd river plays a critical part in the water supply of submontane desert steppe plains of this region. Current state and dynamics over the past decades of the Tavan Bogd glaciers are investigated on the basis of results obtained in 2013–2015 field glaciological, meteorological and dendrochronological observations as well as remote sensing data acquired from satellites. Ground-based geodetic survey and aerial survey from unmanned aircraft system (UAS) allowed generating high-resolution orthomosaics and DEMs of the glaciers.
This study examined 39 glaciers with a debris-free glacier area of 68 sq.km in the Tsagaan-Gol River basin and 41 glaciers with an area of 31 sq.km in the Tsagaan-Us River basin. The areas of the main glaciers were not much changed since 1989, while the glacier tongue regression was fixed. The total glacier area decreased approximately by 4.5 % (3.2 sq.km) in the Tsagaan-Gol basin and by 6.9 % (2.3 sq.km) in the Tsagaan-Us basin from 1989 to 2013. Kozlov Glacier was retreating at an average rate of 34 m/year between 2001 and 2014. Potanin Glacier was retreating slowly between 1989 and 2001 at an average rate of 5–10 m/year and more active between 2001 and 2014 at an average rate of 28 m/year. On the base of the 2005–2014 weather station data, ablation observations and equilibrium line monitoring the glaciological and climatological characteristics such as temperature lapse rate, ablation–accumulation and precipitation values at equilibrium line altitude were calculated. Ablation–accumulation value amounts to 110 g/sq.cm at mean summer temperature on the equilibrium line of 1°C. These calculations give us an opportunity to pass on to glacioclimatic modelling and mass balance estimations.
Instrumental measurements in this region in general overtake no more than last 50 years. Using the dendrochronological data from 479 living trees of *Larix sibirica* collected on the 38 sites in the Tuva Mountains and Mongolian Altai two regional chronologies were obtained. They reflect growth conditions on the upper (UTL) and lower (LTL) tree lines. Strong statistical signal (R=0.73) allowed receiving reconstruction of June-July air temperature since 1715 year. LTL chronology has strong connection with hydrological records (R=0.65). A May-June streamflow of Buyant river since 1474 year was reconstructed. We detected trends and cyclicity (11-year solar cycle, 30–35 year Bruckner cycle and others) in tree-ring growth and reconstructions.

Keywords: glacier fluctuations, glacioclimatic modelling, dendrochronological reconstructions, Altai region, Tavan Bogd Mountains

