

Glacier change in the Altai Mountains, Siberia, Russia

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Introduction

- The observed warming of climate results in enhanced glacier melt throughout the world. Glacier retreat has been documented for many regions, but glaciers of Siberia remain under-reported.
- In this project we are studying the Altai Mountains on the border between Russia, China, and Mongolia.
- In the study region, glaciers have lost 20% of their area between 1952 and 2004.
- Small glaciers may disappear in the Altai Mountains by the end of the 21st century.



Fig. 1 Location of the Altai Mountains on the border between Russia, China, and Mongolia

Study area

The Altai Mountains are the main centre of glaciation in Siberia accommodating about 1500 glaciers (~900 km²).

The climate of the area is strongly continental: winter temperatures are very low while summers are warm.

Glaciers melt in June-August. There is little precipitation in winter due to the low temperatures and snow accumulation season coincides with melt season.

Climatic warming and glacier retreat

257 glaciers with a combined area of 253 km² were mapped on the 2004 ASTER image (Fig. 3, 4).

Glaciers have lost 20% of their area between 1952 and 2004 and the number of glaciers has increased from 257 to 238 due to their fragmentation (Fig. 4).

The summer temperatures have been increasing at the local weather (e.g. Akkem and Kara-Tyurek) stations since 1985 at 0.10 - 0.13°C a⁻¹ with no compensating change in precipitation (Fig. 5).

The future climate projections indicate that temperatures will continue to increase resulting in the enhanced melt of glaciers.

Annual precipitation will change little. Moreover, rainfalls rather than snowfalls will become more frequent between spring and autumn and less snow will accumulate on glaciers in these season.

Under these conditions, small glaciers may disappear in the Altai Mountains by the end of the 21st century.

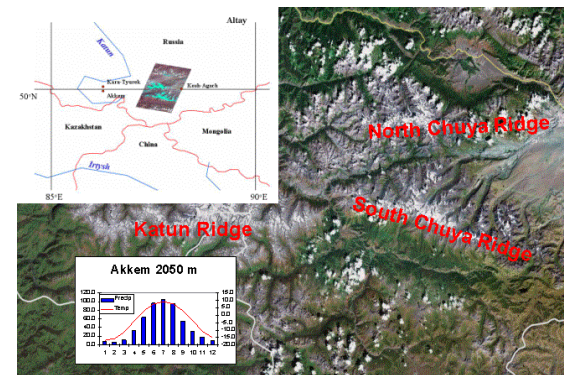


Fig. 2. The study area.

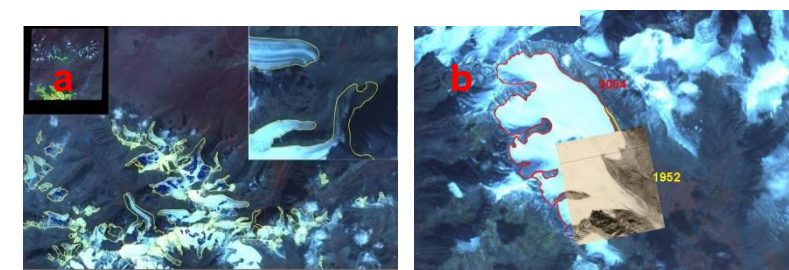


Fig. 3 Mapping glaciers on (a) ASTER 2004 image and (b) using 1952 aerial photograph

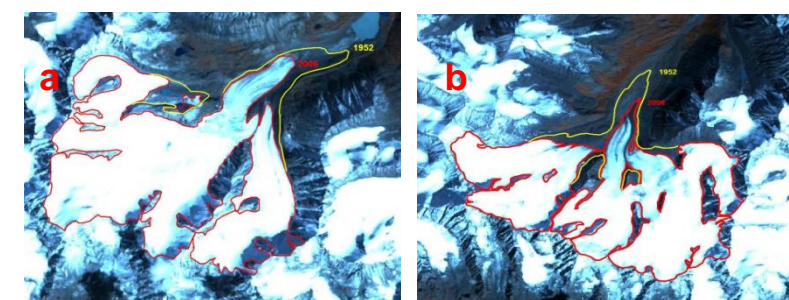


Fig. 4 Retreat & fragmentation of (a) Sofyiskiy and (b) Taldurinskyi Glaciers

Data and methods

ASTER imagery from 10/09/2004 (Fig. 2-4) was used to map the extent of glaciers. The extent of glaciers in the mid-20th century was mapped from aerial photographs of 1952. Climate records were obtained from the regional weather stations, e.g. Akkem and Kara-Tyurek stations (Fig. 2).

Future climate change projections have been derived using PRECIS modelling system based on HadRM3 regional climate model with 25 km resolution.

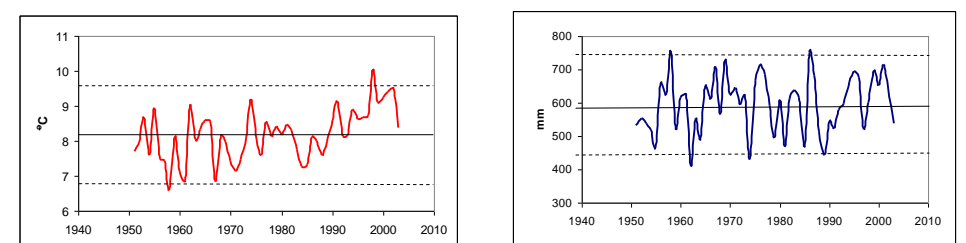


Fig. 5. Time series of July-August air temperature and annual precipitation at Akkem station. Solid black lines show long-term averages; dashed lines show $\pm 2\sigma$.

Future climate projections

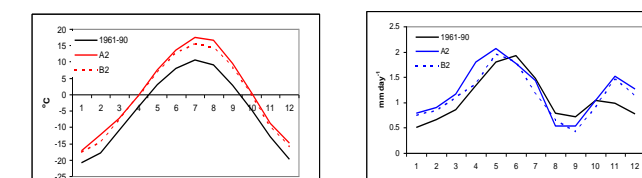


Fig. 9. The 1960-1991 and 2071-2100 temperature and precipitation as projected by PRECIS

The summer air temperatures are projected to increase by 6-7°C and 3-5°C under the A2 and B2 group of scenarios respectively. A 10% increase in annual precipitation per 1°C of warming is required if glaciers are to remain stable under the warming climate.

The projected change in precipitation will not be sufficient to compensate for the projected warming in the Altai and enhanced glacier melt implying further glacier retreat.

Find out more...

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