

Kazakhstan: glaciers and geopolitics

Stephan Harrison

The consequences of climate change are making themselves felt in the public consciousness in dramatic ways. In Europe, the floods of 2002 and the heatwave of 2003 that killed at least 20,000 people are just two recent examples. But climate change has the potential to affect human society in subtler and less visible ways that can have the effect of destabilising economies and unsettling political relationships. This point is well illustrated by focusing on the evidence for recent climate change, and its likely future effects, in central Asia.

One of the anticipated outcomes of global warming is the reduction of mountain ice cover and permafrost now underway in almost all mountain regions. In much of central Asia, glaciers and ice-rich permafrost serve as water towers by providing a continuous supply of fresh water to the lowlands and thereby allowing economic activity to take place. Their recession over the past few decades in response to global climate change is striking.

This is well seen in the mountains of the northern Tian Shan range in Kazakhstan. Here glacier retreat affects the nature of the natural hazards in the populated valleys and the lowland piedmont zone. More widely, it has potential geopolitical implications.

Mountain regions fringing the arid zones of central Asia are facing increasing demand for water resources and tourism-leisure activities. These pressures are particularly acute in Kazakhstan, which (outside Russia) is the largest and most economically developed of the former Soviet republics, with extensive and important mineral resources.

The city and hinterland of Almaty, located in the highly-populated piedmont zone of the Zailiisky Alatau mountains in the northern Tian Shan region of Kazakhstan, form the economic powerhouse of the country: 20% of the country's industrial production, 30% of its agricultural production and 17% of its population are located here.

The area draws its water supply from two main sources. The first is from the trans-boundary Ili river which rises in the mountains of northwest China and flows westwards into southern Kazakhstan. The second, and only local and reliable supply of water for the city, comes from the glaciated Bolshaya and Malaya Almatinka drainage basins lying thirty kilometres south of Almaty. Like many glaciated mountain regions, these valleys are prone to experience severe flooding, avalanches and catastrophic debris flows that disrupt transport and utility infrastructure and endanger human activity.

Environmental records from the region include detailed glacier monitoring from the late 19th century, a wide range of climate parameters collected since 1879 in the Malaya Almatinka valley, and the frequency and character of avalanche and rock glacier activity over the past forty years. This data set makes clear that climate change is having an impact in the region, something confirmed by an analysis of the meteorological data and the response of mountain glaciers.

Mean annual air temperatures from 1936-98 show that there was a significant rise in air temperatures from the 1980s; these are now about 0.2–0.25 degrees Centigrade above the long-term trend. In the mountains, mean annual air temperatures from the Bolshaya Almatinskoye lake show a 0.8 degree rise over this period, slightly higher than the 0.6 degree rise in global mean surface temperatures over the past century reported in the 2001 IPCC report.

Glaciers and climate change

In the mountains of the northern Tian Shan range, 416 glaciers have been monitored over the last fifty years, and it is also clear that they are melting very rapidly, losing about 0.7% of their mass per year between 1955-2000. Over this time the glaciers reduced their total surface area from 272 to 201 square kilometres. The most studied of these is the Tuyuksu glacier, thirty kilometres south of Almaty. This small valley glacier is some five kilometres in length and 4 square kilometres in area. It has been monitored since the 1870s, making Tuyuksu's records one of the longest continuous glaciological data sets in the world and of considerable interest to glacial modellers and climatologists.

Mass balance data describes the balance between inputs to the glacier system (mainly in the form of snowfall and ice from avalanches) and outputs (mainly as a result of melting). Whether the mass balance of a glacier is positive or negative therefore defines its "health" and allows us to describe quantitatively whether the glacier is gaining or losing mass.

The data for the Tuyuksu glacier show that mass balance was mostly positive between the end of the 19th century to the first two decades of the 20th century. However, from the middle of the 20th century there was a shift to mostly negative mass balances. Whilst such trends are clearly of special interest to scientists, they also warn of profound changes which

may affect the livelihoods of millions of people in central Asia.

Water politics

Around 75-80% of river runoff in the region is derived from glaciers and permafrost, and with glacier recession the water supply is threatened, and with it the farming economy. Water supply problems also have the potential to destabilise the political situation in the region since many of the rivers are trans-boundary; glaciers in one state feed rivers supplying water in another.

For instance, China has produced plans to abstract water from the Ili river to develop its industrial capacity in Xinjiang province. It is clear that China's plans to abstract up to 40% of the water from the Irtysh and Ili river basins will exacerbate water supply problems to Lake Balkash and the Kapshagay reservoir, both of which supply Almaty. Sustainable water resource use cannot therefore be achieved without a high level of political agreement and the threat of conflicts over water supply remains.

Moreover, glacier recession has created two further natural hazards. First, the retreat of glaciers has uncovered huge amounts of unconsolidated glacial debris now choking main and tributary valleys. During periods of heavy rain, these are remobilised and form destructive debris flows that travel rapidly down valley into the southern suburbs of Almaty.

Second, and even more dangerously, recent glacier retreat has led to the development of glacial lakes dammed by unstable moraines. These lakes drain catastrophically and the subsequent debris flows pose a significant natural hazard to the city. One of the most powerful recent debris flows to affect the northern valleys of the Tian Shan occurred in July 1973 in the Malaya Almatinka valley. This deposited 4 million cubic metres of debris into the large dam and storage reservoir above Almaty.

Large sums of money need to be diverted to pay for engineering solutions to these hazards, representing a significant additional economic cost from climate change.

Too serious to ignore

The case of Kazakhstan reveals two things: how intimately related are climate, landscape, political and economic systems; and that assessing the risks from future climate change is about more than producing

flood hazard maps or knowing where sea-level rises will affect coastlines.

The evidence of climate change at a global scale from small remote glaciers such as those in southern Kazakhstan is invaluable as the records cannot have been contaminated by urban heat islands. Since the vast majority of glaciers in this region of central Asia are in recession, we can be confident that there is strong evidence for contemporary climate change in this region.

More widely, climate change has the potential to disrupt the context within which economic and political decision-making operate. Few non-scientists recognise the extreme rapidity with which climate can alter, and the non-linear and dynamic nature of the climate system. Politicians have consistently failed to listen to the warnings or take them seriously. This means that climate change is likely to have some very unpleasant surprises in store for us.

This article appears as part of [openDemocracy's](#) online debate on the politics of climate change. The debate was developed in partnership with the British Council as part of their ZeroCarbonCity initiative – a two year global campaign to raise awareness and stimulate debate around the challenges of climate change

Stephan Harrison is a geomorphologist, specialising in landscape responses to climate change, at Exeter University and Oxford University. He has worked in the mountains of central Asia, Patagonia, central Europe and northern Scandinavia on climate change issues.

Copyright © [Stephan Harrison](#), 21-04-2005. Published by [openDemocracy Ltd](#). Permission is granted to reproduce this article for personal, non-commercial use only. In order to circulate internally or use this material for teaching or other commercial purposes you will need to obtain an institutional subscription. Reproduction of this article is by arrangement only. [openDemocracy](#) articles are available for syndication. For institutional subscriptions, syndication and press inquiries, please call +44 (0) 207 608 2000.
