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Historical and recent glacier variations in the Karakoram Mountains

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Recent glacier dynamics in the subtropical mountain range of the Karakoram Mountains were surveyed on the base of field observations carried out in the period of 1992 – 2006 on over 40 glaciers. Historical documents, such as photographs and travel reports, as well as air and satellite images have been included in the compilation, in order to provide an overview on the trend of glacier dynamics in the 20^{th} century. Further indicators for glacier fluctuations are the formation of ice-dammed lakes, which have mainly been formed by advances of tributary glaciers into the trunk valley.

The Karakoram is one of the most heavily glaciated regions outside of the polar regions with valley glaciers reaching up to 72 km in length. Even though a considerable part of the Karakoram glaciers have shown signs of glacier retreat, most of the longer glaciers ($>$ 45 km), such as the Baltoro, Batura, Khurdopin glaciers have been rather stagnant in the last century. Even some of the clean-type glaciers ("Blankeisgletscher"), such as the Yazghil and the Barpu glaciers, did not retreat significantly. However, many glaciers have mainly shrinked by downwasting rather than by ice-frontal recession. At the same time a lot of glaciers, in particular the purely avalanche-fed glaciers, have shown considerable high amounts of vertical changes of the glacier surface. The Karakoram glaciers are accompanied by lateral moraine complexes over several decakilometers in length. Therefore observations from the lateroglacial environments and their morphodynamics will be presented. The Great Lateral Moraine (GLM), mainly attributed to the Little Ice Age, is even today overtopped by glacier thickening in the middle and lower parts of the glaciers.

The Karakoram is well known for glacier surges, such as the Hassanabad and Kutiah glaciers, which supposed to have advanced about 10 km in only a few months in histor-

ical times. In the 1990s, glacier advances have as well been reported from this mountain area. Such catastrophic advances have been mainly confined to medium sized glaciers. However, it must be considered that sudden advances of tributary glaciers have another genetic background than surges of trunk glacier tongues.

Glacier fluctuations have received increasingly more attention using them as indicators for climate change. The reactions of the individual glaciers on climate change in the 20^{th} century differ considerably in respect to time-scale. In the whole, the dynamic of the Karakoram glaciers proves to be rather different from the neighbouring mountain ranges, such as the Pamir, Himalayas and Tienshan, which are characterized by a general glacier retreat. It might be assumed that especially the longer Karakoram glaciers will react delayed to a global temperature warming. Moreover, topographical factors play a major role in glacier fluctuations. Therefore advancing and retreating glaciers occur in adjacent valleys – a phenomenon which is also rather common in other mountain ranges. Regular observations on individual glaciers are still not available for the Karakoram and especially the surging glaciers have been mostly visited only once. However, some of the more obvious glacier dynamics is not climatically controlled but rather a result of the individual topographical setting of the glacial catchment areas. Therefore it needs a careful selection of glaciers when using them as climatic indicators.