Summary

Changes in glaciers and ice caps provide some of the clearest evidence of climate change, and as such they constitute key variables for early detection strategies in global climate-related observations. These changes have impacts on global sea level fluctuations, the regional to local natural hazard situation, as well as on societies dependent on glacier meltwater. Internationally coordinated collection and publication of standardised information about ongoing glacier changes was initiated back in 1894. The compiled data sets on the global distribution and changes in glaciers and ice caps provide the backbone of the numerous scientific publications on the latest findings about surface ice on land. Since the very beginning, the compiled data has been published by the *World Glacier Monitoring Service* and its predecessor organisations. However, the corresponding data tables, formats and meta-data are mainly of use to specialists.

It is in order to fill the gaps in access to glacier data and related background information that this publication aims to provide an illustrated global view of the available data sets related to glaciers and ice caps, their distribution around the globe, and the changes that have occurred since the maximum extents of the so-called Little Ice Age (LIA).

International glacier monitoring has produced a range of unprecedented data compilations including some 36 000 length change observations and roughly 3 400 mass balance measurements for approximately 1 800 and 230 glaciers, respectively. The observation series are drawn from around the globe; however, there is a strong bias towards the Northern Hemisphere and Europe. A first attempt to compile a world glacier inventory was made in the 1970s based mainly on aerial photographs and maps. It has resulted to date in a detailed inventory of more than 100 000 glaciers covering an area of about 240 000 km^2 and in preliminary estimates, for the remaining ice cover of some 445 000 km^2 for the second half of the 20th century. This inventory task continues through the present day, based mainly on satellite images.

The moraines formed towards the end of the Little Ice Age, between the 17th and the second half of the 19th century, are prominent features of the landscape, and mark Holocene glacier maximum extents in many mountain ranges around the globe. From these positions, glaciers worldwide have been shrinking significantly, with strong glacier retreats in the 1940s, stable or growing conditions around the 1920s and 1970s, and again increasing rates of ice loss since the mid 1980s. However, on a time scale of decades, glaciers in various mountain ranges have shown intermittent re-advances. When looking at individual fluctuation series, one finds a high rate of variability and sometimes widely contrasting behaviour of neighbouring ice bodies.

In the current scenarios of climate change, the ongoing trend of worldwide and rapid, if not accelerating, glacier shrinkage on the century time scale is most likely of a non-periodic nature, and may lead to the deglaciation of large parts of many mountain ranges in the coming decades. Such rapid environmental changes require that the international glacier monitoring efforts make use of the swiftly developing new technologies, such as remote sensing and geo-informatics, and relate them to the more traditional field observations, in order to better face the challenges of the 21st century.

Fig. 0.1a—b Recession of Morteratsch Glacier, Switzerland, between 1985 and 2007. Source: J. Alean, *SwissEduc* (www.swisseduc.ch) / *Glaciers online* (www.glaciers-online.net).