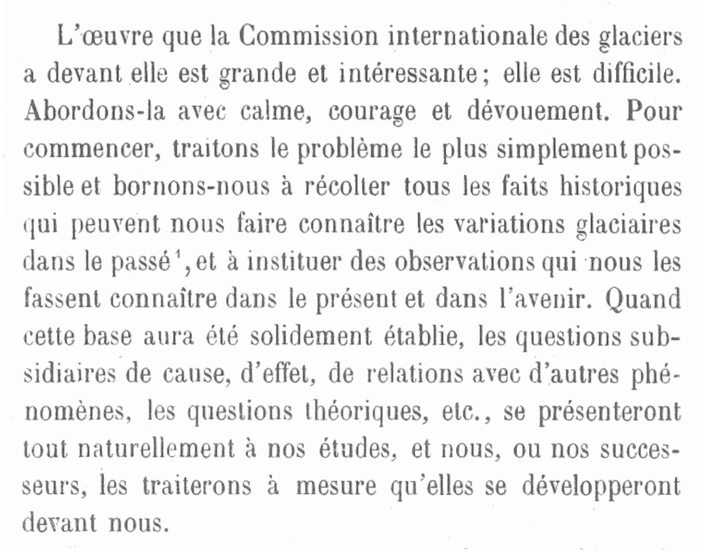
Global Glacier Changes: facts and figures

UNEP

wgms
World Glacier Monitoring Service

Contents

Excerpt from the introductory discourse of
“Les Variations périodiques des Glaciers” by Forel (1895).



L’œuvre que la Commission internationale des glaciers a devant elle est grande et intéressante ; elle est difficile. Abordons-la avec calme, courage et dévouement. Pour commencer, traitons le problème le plus simplement possible et bornons-nous à récolter tous les faits historiques qui peuvent nous faire connaître les variations glaciaires dans le passé[1], et à instituer des observations qui nous les fassent connaître dans le présent et dans l’avenir. Quand cette base aura été solidement établie, les questions subsidiaires de cause, d’effet, de relations avec d’autres phénomènes, les questions théoriques, etc., se présenteront tout naturellement à nos études, et nous, ou nos successeurs, les traiterons à mesure qu’elles se développeront devant nous.

Foreword by UNEP Executive Director

Climate change is now clearly at the top of the world’s agenda. This momentum was generated in large part by the *Intergovernmental Panel on Climate Change* (IPCC), which made clear that climate change is already happening and accelerating. As a result of the remarkable efforts of last year, the international community is armed with a powerful combination of authoritative and compelling science, a far-reaching and rising tide of public concern, and powerful declarations of political will voiced at the Bali *Climate Change Conference* held in December 2007.

The *United Nations Development Programme* (UNDP) *2007/2008 Human Development Report* highlighted the devastating effects climate change is already having on the poorest and most vulnerable, making the achievement of the *Millennium Development Goals* more challenging. UNEP’s flagship *Global Environment Outlook* report (GEO-4), published in October 2007, concludes that: “Tackling climate change globally will demand political will and leadership, and strong stakeholder engagement. Adaptation to the changes expected is now a global priority. Improved monitoring is needed, and it is urgent to enhance our scientific understanding of the potential tipping points beyond which reversibility is not assured.”

Glaciers are a critical component of the earth’ system and the current accelerated melting and retreat of glaciers have severe impacts on the environment and human well-being, including vegetation patterns, economic livelihoods, natural disasters, and the water and energy supply. Monitoring glacier changes and providing scientifically-sound, consistent and illustrative facts and figures on glaciers are therefore critical functions in today’s world. Glaciers and ice caps are now also one of the *Essential Climate Variables*, a set of core variables in support of the work of organizations such as the *United Nations Framework Convention on Climate Change* (UNFCCC) and the IPCC.

Under the auspices of the *International Council for Science* (FAGS/ICSU), the *International Union of Geodesy and Geophysics* (IACS/IUGG), the *United Nations Educational, Scientific and Cultural Organisation* (UNESCO), the *World Meteorological Organisation* (WMO), and the UNEP, the *World Glacier Monitoring Service* (WGMS) collects and compiles the basic glacier data from all parts of the world and provides information on the state and trends of glaciers in almost all mountain regions. The current publication follows the *Global Outlook for Ice and Snow* that was published by UNEP at the occasion of *World Environment Day* 2007 and complements regular reports by WGMS on *Fluctuations of Glaciers* and *Glacier Mass Balances*. It presents basic information on a range of glaciers and ice caps throughout the world in a concise and illustrative format, serving as a miniature atlas on global glacier changes for a wide range of audiences.

UNEP commends the work of WGMS and partners on this very important global issue and is grateful to all those who contributed to this current comprehensive and illustrative publication on the dramatic changes affecting so many glaciers in so many parts of the world.

Achim Steiner
United Nations Under-Secretary-General and
Executive Director, United Nations Environment Programme

Foreword by WGMS Director

In 2006, a new record annual mass loss was measured on the reference glaciers under observation, whose mass balance has been recorded since the late 1940s as part of internationally coordinated glacier observation programmes. The average annual melting rate of mountain glaciers appears to have doubled after the turn of the millennium in comparison with the already accelerated melting rates observed in the two decades before. The previous record loss in the year 1998 has already been exceeded three times, i.e., in the years 2003, 2004 and 2006, with the losses in 2004 and 2006 being almost twice as high as the previous 1998 record loss. Glaciers and ice caps are indeed key indicators and unique demonstration objects of ongoing climate change. Their shrinkage and, in many cases, even complete disappearance leaves no doubt about the fact that the climate is changing at a global scale and at a fast if not accelerating rate. Anyone can see the changes in glacier extent and understand the basic physical principle of snow and ice melting as temperatures continue to rise: as the glaciers and ice caps on earth grow smaller, the energy content in the climate system and in the environment on which we depend becomes greater.

The task of scientific glacier monitoring networks is to coordinate the worldwide collection of standardised data in order to quantify the rate of change, to compare its magnitude with the range of variability during the pre-industrial times of the Holocene period, to validate projections of possible future climate change based on general circulation and regional climate models, and to anticipate and assess impacts on the environment, the economy and on society. By looking at glaciers or what is left of them, future generations will be able to discern clearly which climate scenario is being played out at the present time. The consequences of snow and ice disappearance for landscape characteristics and natural hazards in high mountain areas will be felt at local to regional scales, while the changes in the water cycle will also affect continental-scale water supply and global-scale sea levels. The degree of glacier vanishing indeed reflects the increasing distance from dynamic equilibrium conditions of the climate system.

Glaciers and ice caps constitute *Essential Climate Variables* (ECV) within the *Global Climate Observing System* (GCOS) and its terrestrial component, the *Global Terrestrial Observing System* (GTOS), as related to the *United Nations Framework Convention on Climate Change* (UNFCCC). The corresponding *Global Terrestrial Network for Glaciers* (GTN-G) is run by the *World Glacier Monitoring Service* (WGMS) at the *University of Zurich*, Switzerland, in cooperation with the *National Snow and Ice Data Center* (NSIDC) at Boulder, Colorado, and the *Global Land Ice Measurement from Space* (GLIMS) initiative. The collected data form the basis for international assessments such as IPCC, or UNEP's recent *Global Outlook for Ice and Snow*. They are frequently analysed and discussed at scientific conferences and in related publications.

It is the task and responsibility of the WGMS to collect and disseminate standardised data on glacier changes worldwide. The standards are documented in the periodical WGMS publications (*Fluctuations of Glaciers* at 5-yearly intervals and the biennial *Glacier Mass Balance Bulletin*) as well as by the corresponding forms and requests for data submission through the national correspondents and principal investigators. The present publication aims at providing a commented and illustrated overview of the distribution and development of glaciers and ice caps based on the currently available database and selected satellite imagery. It was compiled in collaboration with the WGMS network of national correspondents and principal investigators and reviewed by regional glacier experts.

Our sincere thanks go to all the colleagues and friends who generously provided materials, ideas and expertise. It is with their help and with the support of the sponsoring agencies at national and international levels that the glacier community has been able to build up, for more than a century now, a unique treasury of information on the fluctuations in space and time of glaciers and ice caps on earth.

Wilfried Haeberli
Director, World Glacier Monitoring Service

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.

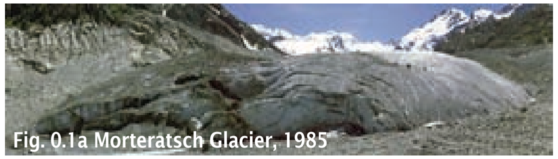


Fig. 0.1a Morteratsch Glacier, 1985

Fig. 0.1b Morteratsch Glacier, 2007

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).

1 Introduction

Glaciers, ice caps and continental ice sheets cover some ten per cent of the earth's land surface at the present time, whereas during the ice ages, they covered about three times this amount (Paterson 1994, Benn and Evans 1998). The present ice cover corresponds to about three-quarter of the world's total freshwater resources (Reinwarth and Stäblein 1972). If all land ice melted away, the sea level would rise by almost 65 m, with the ice sheets of Antarctica and Greenland contributing about 57 and 7 metres, respectively, and all other glaciers and ice caps roughly half a metre to this rise (IPCC 2007). Glaciers are an inherent component of the culture, landscape, and environment in high mountain and polar regions. They represent a unique source of freshwater for agricultural, industrial and domestic use, an important economic component of tourism and hydro-electric power production, yet they can also constitute a serious natural hazard. Because they are close to the melting point they react strongly to climate change, and thereby provide some of the clearest evidence of climate change and are essential variables within global climate-related monitoring programmes (GCOS 2004).

The cryosphere, derived from the Greek word *kryo* for cold, consists of snow, river and lake ice, sea ice, glaciers and ice caps, ice shelves and ice sheets, and frozen ground (Fig. 1.1). The different cryospheric components can be categorised in a) seasonal and perennial ice, b) surface and subsurface ice c) ice in the sea, in rivers, in lakes and on land. When referring to perennial surface ice on land, one usually differentiates between ice sheets, ice shelves, glaciers and ice caps (Box 1.1). There are fundamental differences in time-scales and processes involved between the different components of the perennial surface-ice on land. Due to the large volumes and areas, the two continental ice sheets actively influence the global climate over time scales of months to millennia. Glaciers and ice caps, with their smaller volumes and areas, react to climatic forcing at typical time scales from years to centuries. The focus of the present publication is on glaciers and ice caps. Good overviews on the state of knowledge concerning all cryospheric components can be found in IGOS (2007), IPCC (2007) and UNEP (2007).

Box 1.1 Perennial surface ice on land

Ice sheet: a mass of land ice of continental size, and thick enough to cover the underlying bedrock topography. Its shape is mainly determined by the dynamics of its outward flow. There are only two continental ice sheets in the modern world, on Greenland and Antarctica; during glacial periods there were others.

Ice shelf: a thick, floating slab of freshwater ice extending from the coast, nourished by land ice. Nearly all ice shelves are located in Antarctica.

Glacier: a mass of surface-ice on land which flows downhill under gravity and is constrained by internal stress and friction at the base and sides. In general, a glacier is formed and maintained by accumulation of snow at high altitudes, balanced by melting at low altitudes or discharge into lakes or the sea.

Ice cap: dome-shaped ice mass with radial flow, usually covering the underlying topography.

Note that drawing a distinction between ice sheets on one hand, and glaciers and ice caps on the other, is in accordance with the definition of the *Essential Climate Variables* as put forth by GCOS (2004). The term 'glacier' is used in this context as a synonym for different types of surface land ice masses including outlet glaciers, valley glaciers, mountain glaciers and glacierets.

Sources: WGMS 1989, WGMS 2005a,b, IPCC 2007, UNEP 2007.

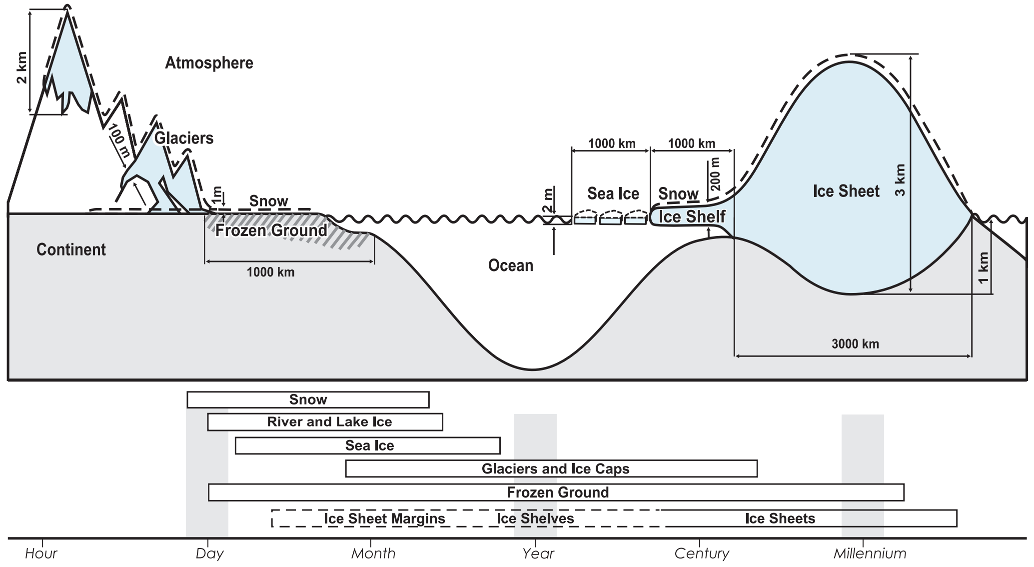


Fig. 1.1 Components of the cryosphere and their typical time scales. Source: Fig. 4.1 of IPCC (2007).

Internationally coordinated glacier monitoring was initiated already as early as 1894 (Box 1.2). To the present day, the active international compilation and publication of standardised glacier data has resulted in unprecedented data sets on the distribution and changes of glaciers and ice caps. These data derived from field measurements and remote sensing provide a fundamental basis for the scientific studies which constitute the present state of knowledge on glacier changes in time and space. Usually, scientific articles report on the methods and main results of glacier investigations. The raw data and meta-data are compiled, published in standardised formats and made readily available in printed and digital form by the World Glacier Monitoring Service (WGMS) and its cooperation partners. These are the US National Snow and Ice Data Center (NSIDC), which is one of the World Data Centers for Glaciology, and the Global Land Ice Measurements from Space (GLIMS) initiative. So far, a status report on the World Glacier Inventory (WGI) was published in 1989 (WGMS 1989) whereas detailed information on glacier fluctuations has been compiled every five years (WGMS 2008, and earlier volumes) and on glacier mass balance every other year (WGMS 2007, and earlier volumes). With the exception of the latter, these products present the data in tabular form with related meta-data, usually comprehensible to specialists.

The aim of this publication is to provide an illustrated global view of (a) the available data basis related to the monitoring of glaciers and ice caps, (b) their worldwide distribution, and (c) their changes since the maximum extents of the Little Ice Age (LIA).

Box 1.2 International glacier monitoring

Worldwide collection of information about ongoing glacier changes was initiated in 1894 with the foundation of the *Commission Internationale des Glaciers* at the *6th International Geological Congress* in Zurich, Switzerland. Today, the *World Glacier Monitoring Service* (WGMS) continues the collection and publication of standardised information on distribution and ongoing changes in glaciers and ice caps. The WGMS is a service of the *International Association of the Cryospheric Sciences* of the *International Union of Geodesy and Geophysics* (IACS, IUGG) and the *Federation of Astronomical and Geophysical Data Analysis Services* of the *International Council for Science* (FAGS, ICSU) and maintains a network of local investigators and national correspondents in all the countries involved in glacier monitoring. In cooperation with the *US National Snow and Ice Data Center* (NSIDC) in Boulder and the *Global Land Ice Measurements from Space* (GLIMS) initiative, the WGMS is in charge of the *Global Terrestrial Network for Glaciers* (GTN-G) within the *Global Climate/Terrestrial Observing System* (GCOS/GTOS). GTN-G aims to combine (a) field observations with remotely sensed data, (b) process understanding with global coverage, and (c) traditional measurements with new technologies by using an integrated and multi-level monitoring strategy.

More information on the history of international glacier monitoring is found in Haeberli (2007). The GTN-G monitoring strategy is discussed in detail in Haeberli et al. (2000) and Haeberli (2004), with updates on the present state in the biennial GTOS reports (GTOS 2006, GTOS 2008), and illustrated using the example of the European Alps in Haeberli et al. (2007).

Federation of Astronomical and Geophysical Data Analysis Services: www.icsu-fags.org
Global Land Ice Measurements from Space: www.glims.org
Global Terrestrial Network for Glaciers: www.fao.org/gtos/gt-netGLA.html
Global Climate Observing System: www.wmo.ch/pages/prog/gcos/
Global Terrestrial Observing System: www.fao.org/gtos/
International Association of Cryospheric Sciences: www.cryosphericsciences.org
United Nations Environment Programme: www.unep.org
United Nations Educational, Scientific and Cultural Organization: www.unesco.org
US National Snow and Ice Data Center: www.nsidc.org
World Glacier Monitoring Service: www.wgms.ch
World Meteorological Organization: www.wmo.ch

2 Glaciers and climate

Glaciers generally form where snow deposited during the cold/humid season does not entirely melt during warm/dry times. Temperate glaciers not influenced by thick debris cover, calving or surge instabilities are recognised as being among the best climate indicators as their reaction or change provide a signal that is easily understandable to a wider public.

Fig. 2.1 Franz-Josef Glacier, New Zealand, is a temperate valley glacier in a maritime climate descending into rain forest. Source: M. Hambrey, *SwissEduc* (www.swisseduc.ch).

Glaciers form where snow is deposited during the cold/humid season and does not entirely melt during warm/dry periods. This seasonal snow gradually densifies and transforms into perennial firn and finally, after the interconnecting air passages between the grains are closed off, into ice (Paterson 1994). The ice from such accumulation areas then flows under the influence of its own weight and the local slopes down to lower altitudes, where it melts again (ablation areas). Accumulation and ablation areas are separated by the equilibrium line, where the balance between gain and loss of mass is exactly zero. Glacier distribution is thus primarily a function of mean annual air temperature and annual precipitation sums modified by the terrain which influences, for example, the amount of incoming net radiation or the accumulation pattern.

In humid-maritime regions, the equilibrium line is at (relatively) low altitude with warm temperatures and long melting seasons, because of the large amount of ablation required to eliminate thick snow layers (Shumskii 1964, Haeberli and Burn 2002). 'Temperate' glaciers with firn and ice at melting temperature dominate these landscapes. Such ice bodies, with relatively rapid flow, exhibit a high mass turnover and react strongly to atmospheric warming by enhanced melt and runoff. Features of this type are the Patagonian Icefields and the ice caps of Iceland, as well as the glaciers of the western Cordillera of North America, the western mountains of New Zealand (Fig. 2.1) and Norway. The lower parts of such maritime-temperate glaciers may extend into forested valleys, where summer warmth and winter snow accumulation prevent development of permafrost. In contrast, under dry-continental conditions, such as in parts of Antarctica (Fig. 2.2), northern Alaska, Arctic Canada, subarctic Russia, parts of the Andes near the Atacama desert, and in many Central Asian mountain chains, the equilibrium line may be at (relatively) high elevation with cold temperatures and short melting seasons. In such regions, glaciers lying far above the tree line can have polythermal as well as cold firn/ice well below melting temperature, also a low mass turnover, and are often surrounded by permafrost (Shumskii 1964).

The reaction of a glacier to a climatic change involves a complex chain of processes (Nye 1960, Meier 1984). Changes in atmospheric conditions (solar radiation, air temperature, precipitation, wind, cloudiness, etc.) influence the mass and energy balance at the glacier surface (see Kuhn 1981, Oerlemans 2001). Air temperature thereby plays a predominant role as it is related to the long-wave radiation balance, turbulent heat exchange and solid/liquid precipitation. Over time periods of years to several decades, cumulative changes in mass balance cause volume and thickness changes, which in turn affect the flow of ice via altered internal deformation and basal sliding. This dynamic reaction finally leads to glacier length changes, the advance or retreat of glacier tongues. In short, the advance or retreat of glacier tongues (i.e., the 'horizontal' length change) constitutes an indirect, delayed and filtered but also enhanced and easily observed signal of climatic change, whereas the glacier mass balance (i.e., the 'vertical' thickness change) is a more direct and undelayed signal of annual atmospheric conditions (Haeberli 1998).

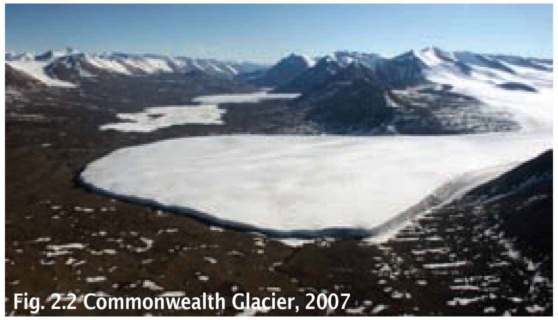


Fig. 2.2 Commonwealth Glacier, Taylor Valley, Antarctica, is a cold glacier in a continental climate (10 January 2007). In the background Canada Glacier and frozen Lake Fryxell are shown. Source: D. Stumm, *University of Otago*, New Zealand.

The described complication involved with the dynamic response disappears if the time interval analysed is sufficiently long, i.e., longer than it takes a glacier to complete its adjustment to a climatic change (Jóhannesson et al. 1989, Haeberli and Hoelzle 1995). Cumulative length and mass change can be directly compared over such extended time periods of decades (Hoelzle et al. 2003). Different behaviours are encountered at heavily debris-covered glaciers with reduced melting and strongly limited 'retreat', glaciers ending in deep water bodies causing enhanced melting and calving, and glaciers periodically undergoing mechanical instability and rapid advance ('surge') after extended periods of stagnation and recovery. Glaciers (those not affected by these special conditions) are recognised to be among the best indicators within global climate related monitoring (Box 2.1). They gradually convert a small change in climate, such as a temperature change of 0.1°C per decade over a longer time period, into a pronounced length change of several hundred metres or even kilometres.

Box 2.1 Glaciers as climate indicator

Glacier changes are recognised as high-confident climate indicator and as a valuable element in early detection strategies within the international climate monitoring programmes (GCOS 2004, GTOS 2008). Fluctuations of a glacier, which are not influenced by thick debris covers, calving or surge instabilities, are a reaction to climatic forcing. Thereby, the glacier length change (i.e., the advance or retreat) is the indirect, delayed, filtered but also enhanced signal to a change in climate, whereas the glacier mass balance (i.e., the change in thickness/volume) is the direct and un-delayed response to the annual atmospheric conditions (Haeberli and Hoelzle 1995). The mass balance variability of glaciers is well correlated over distances of several hundred kilometres and with air temperature (Lliboutry 1974, Schöner et al. 2000, Greene 2005). However, the glacier mass balance change provides an integrative climatic signal and the quantitative attribution of the forcing to individual meteorological parameters is not straight forward. The energy and mass balance at the glacier surface is influenced by changes in atmospheric conditions (e.g., solar radiation, air temperature, precipitation, wind, cloudiness). Air temperature thereby plays a predominant role as it is related to the radiation balance, turbulent heat exchange and solid/liquid precipitation ratio (Kuhn 1981, Ohmura 2001). The climatic sensitivity of a glacier not only depends on regional climate variability but also on local topographic effects and the distribution of the glacier area with elevation, which can result in two adjacent glaciers featuring different specific mass balance responses (Kuhn et al., 1985). As a consequence, the glacier sensitivity to a climatic change is much related to the climate regime in which the ice is located. The mass balance of temperate glaciers in the mid-latitudes is mainly dependent on winter precipitation, summer temperature and summer snow falls (temporally reducing the melt due to the increased albedo; Kuhn et al. 1999). In contrast, the glaciers in the low-latitudes, where ablation occurs throughout the year and multiple accumulation seasons exist, are strongly influenced by variations in atmospheric moisture content which affects incoming solar radiation, precipitation and albedo, atmospheric longwave emission, and sublimation (Wagnon et al. 2001, Kaser and Osmaston 2002). In the Himalaya, influenced by the monsoon, most of the accumulation and ablation occurs during the summer (Ageta and Fujita 1996, Fujita and Ageta 2000). Cold glaciers in high altitude and the polar regions can receive accumulation in any season (Chinn 1985). As described in the text, strongly diverse mass balance characteristics also exist between glaciers under dry-continental conditions and in maritime regions. As a consequence, analytical or numerical modelling is needed to quantify the above mentioned topographic effects as well as to attribute the glacier mass changes to individual meteorological or climate parameters (e.g., Kuhn 1981, Oerlemans 2001). Modelling is further needed in combination with measured and reconstructed glacier front variations, to compare the present mass changes with the (pre-) industrial variability (e.g. Haeberli and Holzhauser 2003).

3 Global distribution of glaciers and ice caps

A first attempt to compile a world glacier inventory started in the 1970s based mainly on aerial photographs and maps. Up to now, it resulted in a detailed inventory of more than 100 000 glaciers covering an area of about 240 000 km², and in preliminary estimates for the remaining ice cover of some 445 000 km². Today the task of inventorying glaciers worldwide is continued for the most part based on satellite images.

The need for a worldwide inventory of existing perennial ice and snow masses was first considered during the *International Hydrological Decade* declared by UNESCO for the period of 1965–1974 (Hoelzle and Trindler 1998, UNESCO 1970). The *Temporal Technical Secretariat for the World Glacier Inventory* (TTS/WGI) was established in 1975 to prepare guidelines for the compilation of such an inventory and to collect available data sets from different countries (WGMS 1989). These tasks were continued by its successor organisation, the WGMS, after 1986. In 1989, a status report on the WGI was published including detailed information on about 67 000 glaciers covering some 180 000 km² and preliminary estimates for the other glacierised regions, both based on aerial photographs, maps, and satellite images (WGMS 1989). The detailed inventory includes tabular information about geographic location, area, length, orientation, elevation and classification of morphological type (a selection of different types is shown in Figures 3.2–3.5, and more in the other chapters) and moraines, which are related to the geographical coordinates of glacier label points. Due to the different data sources, the entries of the WGI do not refer to one specific year but can be viewed as a snapshot of the glacier distribution around the 1960s. The average map year is 1964 with a standard deviation of eleven years, and a time range from 1901 to 1993. In 1998, the WGMS and the NSIDC agreed to work together, pooled their data sources and made the inventory available online in 1999 via the NSIDC website (Box 3.1). Since then, several plausibility checks, subsequent data corrections and updates of the inventory have been carried out, including updates and new data sets from the former Soviet Union and China. At present the database contains information for over 100 000 glaciers throughout the world with an overall area of about 240 000 km² (NSIDC 2008). This corresponds to about half of the total number and roughly one-third of the global ice cover of glaciers and ice caps, which are estimated at 160 000 and 685 000 km², respectively, by Dyurgerov and Meier (2005) based mainly on the WGI (WGMS 1989) and additional estimates from the literature.

In 1995, the GLIMS initiative was launched, in close collaboration with the NSIDC and the WGMS, to continue the inventorying task with space-borne sensors as a logical extension of the WGI and storing the full complement of the WGMS-defined glacier characteristics (see Kääb et al. 2002, Bishop et al. 2004, Kargel et al. 2005). GLIMS is designed to monitor the world's glaciers primarily using data from optical satellite instruments, such as the *Advanced Spaceborne Thermal Emission and reflection Radiometer* (ASTER), an instrument that is required on board of Terra satellite (Box 3.2). A geographic infor-

Box 3.1 Online data access to the WGI and GLIMS databases

The ***World Glacier Inventory* (WGI)** currently has detailed information on over 100 000 glaciers throughout the world. Parameters within the inventory include coordinates (latitude and longitude) per glacier, together with tabular information about geographic location, area, length, orientation and elevation, as well as classifications of morphological type and moraines. The entire database can be searched by entering attributes and geographical location. The data sets thus selected or the entire database can be downloaded via the websites of the NSIDC, the WGMS, or of the *GLIMS glacier database.*

The ***GLIMS Glacier Database*** stores some 62 000 digital glacier outlines together with tabular information such as glacier area, length and elevation. The database can be queried using a text or mapping search interface. Glacier outlines with the related information can be downloaded from the GLIMS website in several formats used by geographic information system software products.

WGI at NSIDC: http://nsidc.org/data/glacier_inventory/index.html
WGI at WGMS: http://www.wgms.ch/wgi.html
GLIMS Glacier Database: http://glims.colorado.edu/glacierdata/

Box 3.2 ASTER satellite images

Satellite data are an important resource for global-scale glacier monitoring. They enable the observation of land ice masses over large spatial scales using a globally uniform set of data and methods, and independent of monitoring obstacles on the ground such as access problems and financial limitations on institutional levels. On the other hand, space-aided glacier monitoring relies on a small number of space agencies, the financial resources and political willingness of which are thus crucial for the maintenance of the monitoring system. Typical glaciological parameters that can be observed from space are glacier areas and their changes over time, snow lines, glacier topography and glacier thickness changes, and glacier flow and its changes over time (Kääb 2005).

The satellite images in this publication were taken by the *US/Japan Advanced Thermal Emission and Reflection Radiometer* (ASTER) onboard the *NASA Terra* spacecraft. They were acquired within the *Global Land Ice Measurements from Space* (GLIMS) initiative and obtained through the *US Geological Survey/NASA EOS* data gateway. The ASTER sensor includes two spectral bands in the visible range (green and red), one band in the near-infrared, six bands in the short-wave infrared, and five bands in the thermal infrared. The most important bands for glaciological applications are the visible, near- and short-wave infrared bands (Fig. 3.1 a–d). They allow for automatic mapping of ice and snow areas. This technique exploits the large difference in ice and snow reflectivity between the visible, near- and short-wave infrared spectrum, and enables the fast compilation of a large number of glacier outlines and their changes over time. In addition to the above-mentioned nadir bands, ASTER has also a back-looking stereo sensor that, together with the corresponding nadir image, allows for the photogrammetric computation of glacier topography and its changes over time (Kääb 2005).

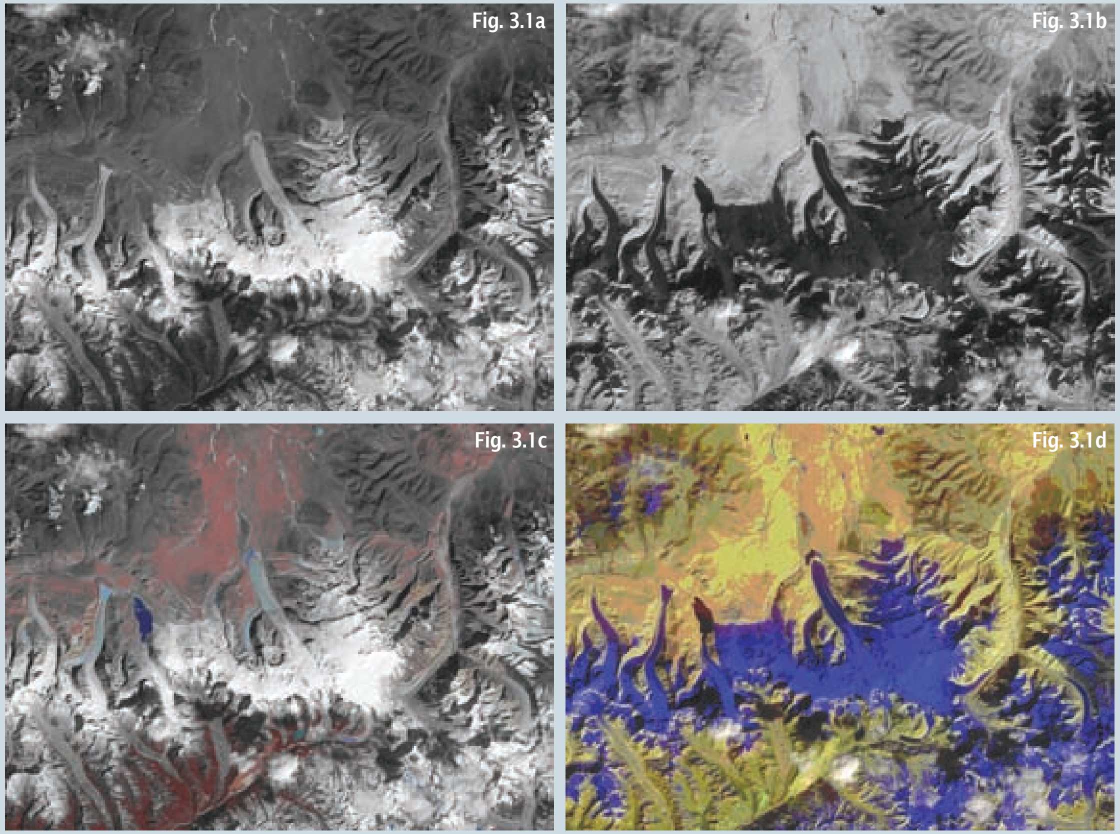


Fig. 3.1 a–d Glaciers in Bhutan, Himalayas (57x42 km): a) green ASTER band, b) shortwave-infrared, c) colour composite of the green, red and near-infrared bands, and d) colour composite of red, near-infrared and short-wave infrared bands.

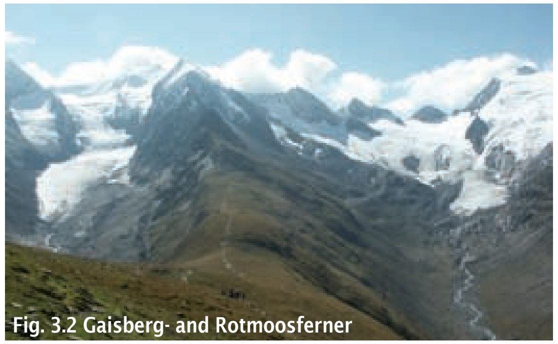


Fig. 3.2 Gaisberg- and Rotmoosferner


Fig. 3.3 Piedmont glaciers

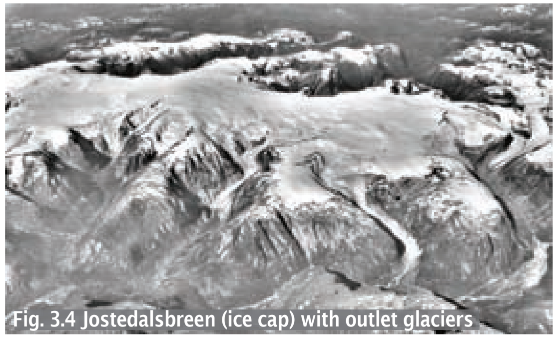


Fig. 3.4 Jostedalsbreen (ice cap) with outlet glaciers


Fig. 3.5 Balfour Glacier

mation system, including database and web interfaces, has been designed and implemented at the NSIDC in order to host and distribute the information from the WGI and the new GLIMS databases (Raup et al. 2007). In addition to the point information of the WGI, the GLIMS database now contains digital outlines on over 62 000 glaciers (status as of May, 2008). A global overview of the distribution of glaciers and ice caps as well as available datasets is given in Figure 3.6. New projects, such as the *International Polar Year* (IPY; www.ipy.org) and the *GlobGlacier* project, a data user element activity within the *European Space Agency* (Volden 2007), aim at making a major contribution to the current WGMS and GLIMS databases.

At first glance it might be surprising to find that after more than three decades of cryosphere observation from space (see IGOS 2007) there is still no complete detailed inventory of the world's glaciers and ice caps. Glacier mapping techniques from threshold ratio satellite images have been developed and automated to a high degree (Paul et al. 2002). However, fully automated inventorying of individual glaciers is hampered by challenges encountered with topographic shadowing effects, debris-covered and calving glaciers, clouds and snow separation as well as with the location of ice divides. A high quality inventory of glaciers and ice caps from both aerial photographs and satellite images still needs to be operated by a well-trained glaciologist. Empirical values of completed glacier inventories based on satellite images (e.g., Paul and Kääb 2005), indicate average operation times of five minutes per glacier for the semi-automatic detection of ice outlines as well as manual correction of errors due to shading and debris cover, and another five minutes per glacier for the delineation of individual glacier catchments, neither including the compilation of useful satellite images nor the rectification and restoration of the scenes (see Lillesand and Kiefer 1994).

The latest assessment report of IPCC (2007) quotes the total area of land ice and corresponding potential sea level rise at 510 000–540 000 km^2 and at 150–370 mm, respectively (Table 3.1). These estimates – as noted in IPCC (2007) – do not include ice bodies around the ice sheets in Greenland and Antarctica. Preliminary rough estimates of the ice cover of glaciers and ice caps, surrounding the continental ice sheets, are 70 000 km^2 in Greenland based on Weidick and Morris (1998) and ranges between 70 000 km^2 (Weidick and Morris 1998) and 169 000 km^2 (Shumsky 1969) for Antarctica. Hence the values indicated in the table (Table 3.1) of the IPCC report (2007), represent minimum values of the global area of glaciers and ice caps as well as their potential contribution to sea level rise.

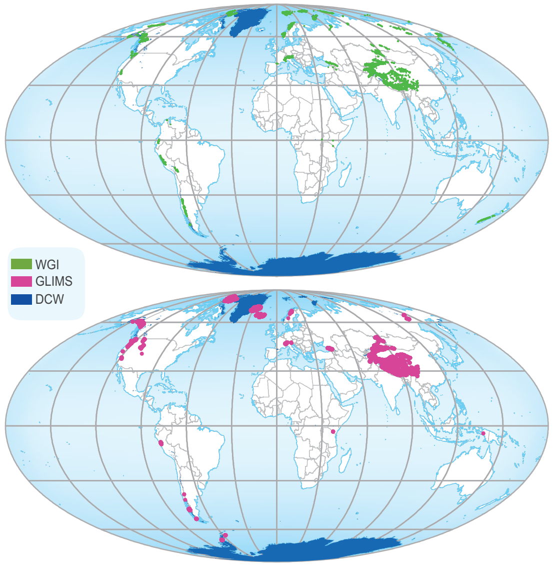


Fig. 3.6 Global glacier inventories

Table 3.1 Ice sheets, ice shelves, glaciers and ice caps

Cryospheric Component	Area (mio km^2)	Ice volume (mio km^3)	Potential sea level rise (m) [e]
Glaciers and ice caps			
- smallest estimate [a]	0.51	0.05	0.15
- largest estimate [b]	0.54	0.13	0.37
Ice shelves [c]	1.50	0.70	~0
Ice sheets			
- Greenland [d]	1.7	2.9	7.3
- Antarctica [c]	12.3	24.7	56.6

Notes:
[a] Ohmura (2004); glaciers and ice caps surrounding Greenland and Antarctica are excluded; [b] Dyurgerov and Meier (2005); glaciers and ice caps surrounding Greenland and Antarctica are excluded; [c] Lythe et al. (2001); [d] Bamber et al. (2001); [e] Assuming an oceanic area of 3.62 × 100 mio km^2, an ice density of 917 kg/m^3, a seawater density of 1 028 kg/m^3, and seawater replacing grounded ice below sea level.

Source: IPCC (2007), Table 4.1

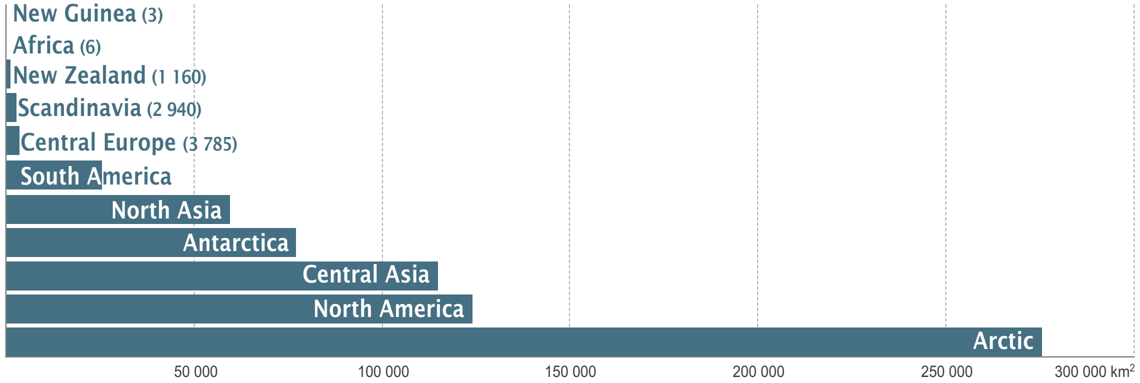


Fig. 3.7 Regional overview of the distribution of glaciers and ice caps

Fig. 3.2 Gaisbergferner (left) and Rotmoosferner (right), Austria (July 2002). These typical valley glaciers were connected during the last ice age (transfluence zone in the centre of the photograph). Source: I. Roer, *University of Zurich*, Switzerland.

Fig. 3.3 Piedmont glaciers in southern Axel Heiberg Island, Canadian Arctic. Aerial photograph (1977). Source: J. Alean, *SwissEduc* (www.swisseduc.ch) / *Glaciers online* (www.glaciers-online.net).

Fig. 3.4 Jostedalsbreen, Norway, is a typical ice cap with several outlet glaciers, e.g., Nigardsbreen in the centre of the aerial photography of 1982. Source: Photo of unknown photographer provided by the archive of the *Norwegian Water Resources and Energy Directorate* (NVE).

Fig. 3.5 Debris-covered tongue of Balfour Glacier, New Zealand. Source: M. Hoelzle, *University of Zurich*, Switzerland.

Fig. 3.6 Worldwide distribution of perennial surface ice on land. The map shows the approximate distribution of glaciers, ice caps and the two ice sheets from ESRI's Digital Chart of the World (DCW), overlaid by the point layer of the *World Glacier Inventory* (WGI) and the polygons of the *Global Land Ice Measurements from Space* (GLIMS) databases (status June 2008).

Fig. 3.7 Regional overview of the distribution of glaciers and ice caps. Source: Dyurgerov and Meier (2005).

Table 3.1 Area, volume and sea level equivalent of glaciers and ice caps, ice shelves and the two continental ice sheets as given in the latest report of the Intergovernmental Panel on Climate Change. The values for glaciers and ice caps denote the smallest and largest estimates, excluding the ice bodies surrounding the ice sheets on Greenland and Antarctica. Source: IPCC (2007), Table 4.1

4 Glacier fluctuation series

The internationally coordinated collection of information on glacier changes has resulted in unprecedented compilations of data including some 36 000 length change observations and roughly 3 400 mass balance measurements for about 1 800 and 230 glaciers, respectively. The observation series are located around the globe, with a bias towards the Northern Hemisphere and in particular Europe.

Since the very beginning of the internationally coordinated glacier monitoring activities in 1894, the collected data on glacier fluctuations has been published in written reports. The Swiss limnologist François-Alphonse Forel started the periodical publishing of the *Rapports sur les variations périodiques des glaciers* (Forel 1895) on behalf of the then established *Commission Internationale des Glaciers*, which later developed into the *International Commission on Snow and Ice*, and in 2007 into the *International Association of Cryospheric Sciences* (see Radok 1997, Jones 2008). Up to 1961, the data compilations constituting the main source of glacier length change (Box 4.1) data worldwide were published in French, Italian, German, and English; since 1967, all publications appear in English (Haeberli 1998). The first reports contain mainly qualitative observations, with the exception of the glaciers in the Alps and Scandinavia, which have been well documented by quantitative measurements right from the start (Forel and Du Pasquier 1896, 1897; Richter 1898, 1899, 1900; Finsterwalder and Muret 1901, 1902, 1903; Reid and Muret 1904, 1905, 1906; Brückner and Muret 1908, 1909, 1910, 1911; Rabot and Muret 1911, 1912, 1913; Rabot and Mercanton 1913; Hamberg and Mercanton 1914). After the First World War, Mercanton edited the publications which appeared less frequently (Mercanton 1930, 1934, 1936, 1948, 1952, 1954, 1958, 1961). Starting with 1967, the data have been published in five-yearly intervals under the Fluctuations of Glaciers series, first by the *Permanent Service on the Fluctuations of Glaciers* (PSFG 1967, 1973, 1977, 1985) and, after the merger of the PSFG with the *Temporal Technical Secretariat* (TTS)/WGI in 1986, by the WGMS (1988, 1993a, 1998, 2005a, 2008). In 1945, annual mass balance measurements (Box 4.2) over an entire glacier with the direct glaciological method (cf. Østrem and Brugman 1991), based on an extensive net of ablation stakes, snow pits and snow probing, were initiated on Storglaciären, Sweden (Holmlund and Jansson 2005). This new type of data has been included, together with detailed meta-data in tabular form, in the *Fluctuations of Glaciers* series since the very first volume (PSFG 1967). As a consequence of the rising interest in and in order to accelerate the access to the glacier mass balance information, preliminary values on the specific annual mass balance as well as on the equilibrium line altitude and the accumulation area ratio have been published in the bi-annual *Glacier Mass Balance Bulletin* (WGMS 1991, 1993b, 1994, 1996, 1999, 2001, 2003, 2005b,

Box 4.1 Measurement of glacier length changes

The basic principle behind the measurement of horizontal changes in the position of the glacier terminus is very simple and was already illustrated in the *Instruction pour l'observation des variations des glaciers* by Forel (1895).

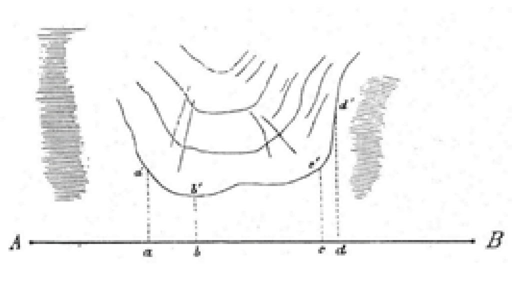


Fig. 4.1 Front position measurement (Forel 1895)

The distance and direction from fixed positions in the glacier forefield (such as landmarks, cairns and boulders) to the ice front are measured in metres and compared to the values of the previous year(s). Historically the measurements have been carried out using tape and compass, and over the past years increasingly by means of universal surveying instruments and global positioning systems. Ideally the cumulative annual length change measurements of a glacier are compared with decadal length changes as derived from aerial photographs or satellite images.

Fig. 4.2 Length change measurement at Steinlimmi Glacier

Fig. 4.1 Sketch explaining the measurement of the glacier front position as published by Forel (1895).

Fig. 4.2 Length change measurement at Steinlimmi Glacier, Switzerland. An investigator determines the direction from a marked boulder in the forefield to the glacier terminus. Source: S. Kappeler, Switzerland.

Fig. 4.3 Drilling of an ablation stake

Fig. 4.3 Drilling of an ablation stake. Source: D. Vonder Mühll, *University of Zurich*, Switzerland.

Fig. 4.4 Accumulation measurements in a snow pit. Source: M. Hoelzle, *University of Zurich*, Switzerland.

Box 4.2 Measurement of glacier mass balance

The WGMS collects and publishes mass balance data of glaciers and ice caps from direct glaciological and geodetic methods. The direct glaciological method is based on field measurements of the change in glacier surface elevation between two dates at a network of ablation stakes, snow pits and snow probings. The differences in elevation, i.e. gain or loss, are multiplied by (measured or estimated) density of snow, firn or ice to units in metre water equivalent (m w.e.) and then interpolated over the entire glacier by a set of methods. The mass change calculated in this way corresponds to the total meltwater runoff in cubic m w.e. of the measurement period. Division of the total mass change by the glacier area yields the specific glacier mass balance which corresponds to the mean glacier thickness change in m w.e. and can be compared directly between different glaciers. The measurement and calculation of glacier mass balance contains various sources of systematic and random errors and uncertainties (see Gerbaux et al. 2005 and references therein). This requires checking against the independent geodetic methods which derive decadal volume changes from repeated mapping of the glacier topography.

Detailed explanations on how to measure glacier mass balance are found in the manuals of Østrem and Stanley (1969), Østrem and Brugman (1991), and Kaser et al. (2003).

Fig. 4.4 Accumulation measurements in a snow pit

2007). Based on an agreement with the Terrestrial Observation Panel for Climate of GCOS/GTOS, preliminary glacier mass balance results have been made available annually on the WGMS website since 1999, as of one year after the end of the measurement period.

In 1989, an initial attempt was made to set up a glaciological database with the data collected and published in the WGI and in the *Fluctuations of Glaciers* series as well as those compiled from the literature (Hoelzle and Trindler 1998, Hoelzle et al. 2003). Nowadays, all data is available digitally, either directly from the website or on email request (Box 4.3). Online meta-data browsers provide an overview of the location of glaciers with available data and corresponding attributes. Table 4.1 gives an overview of the number of length change and mass balance series carried out in 11 macro-regions (see Fig. 6.0.1). Global maps of available length change and mass balance data series are given in Figures 4.6 and 4.7, respectively. A temporal overview of the reported fluctuation data is shown in Figure 4.8.

Box 4.3 Submission and request for glacier fluctuation data

The WGMS regularly collects data on changes in glacier length, area, thickness and volume for publication in the *Fluctuations of Glaciers* and the *Glacier Mass Balance Bulletin* series. Corresponding calls-for-data are sent out through the national correspondents of WGMS who organise the collection and submission of the glacier data in line with the WGMS standards. Apart from the official calls-for-data, the WGMS welcomes any information on glacier changes that is submitted according to the standards described in the submission guidelines on the WGMS website. All data hosted by the WGMS is available on request in digital form and at no charge. In addition to the review of collected data sets presented here, online meta-data browsers on the WGMS website provide updated overviews of the available information.

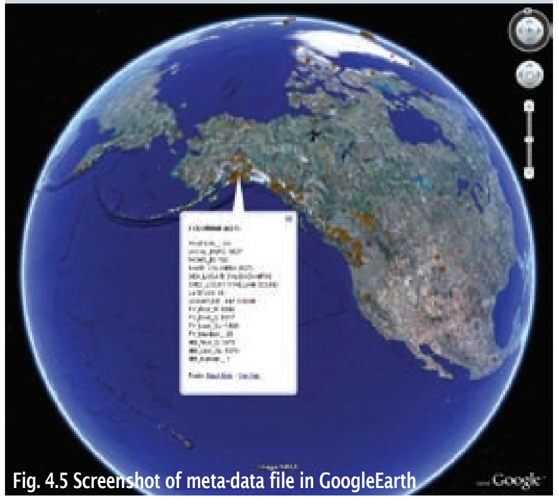


Fig. 4.5 Screenshot of meta-data file in GoogleEarth

Fig. 4.5 Screenshot of meta-data file in GoogleEarth. Meta-data file with information about available glacier fluctuation data displayed in Google Earth application.

Table 4.1 Global and regional overview of the available length change and mass balance observations

Macroregion	Area	FRONT VARIATION								MASS BALANCE						
		NoSer	NoSer 21th	First RY	First SY	Last SY	AvTR	AvNo Obs	SerDens	NoSer	NoRef Ser	NoSer 21st	First SY	Last SY	AvNo Obs	Ser Dens
New Guinea	3	3	0	1936	1941	1990	46.3	4.7	1000.0	0	0	0				0.0
Africa	6	14	11	1893	1899	2004	71.4	6.1	2333.3	1	0	0	1979	1996	18.0	166.7
New Zealand	1160	99	70	1879	1892	2005	14.4	6.2	85.3	3	0	1	1959	2005	2.7	2.6
Scandinavia	2940	67	45	1896	1899	2005	53.2	30.2	22.8	39	8	23	1946	2005	16.3	13.3
Central Europe	3785	764	417	1730	1815	2005	65.1	35.3	201.8	43	10	29	1948	2005	19.6	11.4
South America	25500	160	49	1830	1888	2005	36.4	4.1	6.3	11	1	9	1976	2005	8.1	0.4
Northern Asia	59600	24	11	1833	1895	2005	55.2	14.1	0.4	14	3	5	1962	2005	13.5	0.2
Antarctica	77000	48	7	1882	1883	2004	30.4	2.8	0.6	1	0	1	2002	2005	4.0	0.0
Central Asia	114800	310	16	1850	1893	2005	21.5	4.5	2.7	35	2	6	1957	2005	13.1	0.3
North America	124000	221	15	1720	1885	2005	36.9	5.2	1.8	45	4	24	1953	2005	15.8	0.4
Arctic	275500	93	49	1840	1886	2005	52.4	30.5	0.3	34	2	20	1960	2005	12.6	0.1
Worldwide	684294	1803	690	1720	1815	2005	46.7	20.1	2.6	226	30	118	1946	2005	15.0	0.3

Notes:
NoSer: number of series; NoSer21th: number of series with last survey after 1999; FirstRY: first reference year; FirstSY: first survey year; LastSY: last survey year; AvTR: average time range per series; AvNoObs: average number of observations per series; SerDens: number of series per 1 000 square kilometre; NoRefSer: number of 'reference' mass balance series with continuous measurements since 1976.

Table 4.1 Global and regional overview of the distribution of glaciers and ice caps as well as of reported length change and mass balance observation series. Source: Macroregions and ice cover areas (in sq km) after Dyurgerov and Meier (2005); information on glacier fluctuations from WGMS.

Length change measurements have been reported to WGMS from 1 803 glaciers worldwide, including a total 36 240 observations. At the global level, the average measurement series covers a time range of 47 years with 20 observations. Of all the glacier tongues observed, 85 per cent are located on the northern hemisphere and 42 per cent in Central Europe. On the global average, there are between two and three glaciers with available length change data per 1 000 km^2 of glacierised area. Highest observation densities are found in Central Europe with over 200 series per 1 000 km^2, followed by New Zealand (85 series per 1 000 km^2), Scandinavia (23 series per 1 000 km^2), and South America (three series per 1 000 km^2). The other macro-regions do have less dense observation networks with fewer than three series per 1 000 km^2. The virtual high observation densities in Africa and New Guinea are due to the minimal ice area in these regions. Earliest field observations of glacier length changes started in the late 19th century and often extended with measured distances from the glacier termini to the LIA moraines. The best temporal observation coverage is again found in Central Europe with an average time range of 65 years and a mean of 35 observations per data series, and in Scandinavia with 53 years and 30 observations. The length change data from the Arctic amount also to a mean of over 30 observations per series, which is mainly thanks to the long-term programmes reported from Iceland, whereas the corresponding numbers from the Canadian Arctic and Greenland are much lower. The 24 series from Northern Asia on average comprise 14 measurements. The temporal observation density is rather limited in other macro-regions with an average of six or fewer observations per series. A striking feature is the breakdown of the field monitoring network towards the end of the 20th century in North America as well as in Central Asia. A general cause for this interruption is not easy to provide, as each glacier observation series has its own history and is often strongly linked to the activity and situation of its investigators. However, the dissolution of the former Soviet Union might at least partly explain the situation in Asia. In North America the reasons are rather to be found in budget cuts, retirement of dedicated investigators and maybe in the belief that remote sensing can replace the field measurements.

Initial surface mass balance measurements at individual stakes were already carried out on a few glaciers around the beginning of the 20th century, e.g., on Rhone (1885), Clariden (1912), Silvretta (1915) and Aletsch (1921) in Switzerland (Huss et al. 2008). Most of these series have some lengthy data gaps, with the exception of the continuous measurement series at two stakes in the accumulation area of Claridenfirn (Müller and Kappenberger 1991, Ohmura et al. 2007). Mass balance measurements on entire glaciers have been carried out since after the Second World War, with first data available from Scandinavia (Storglaciären, SE) in 1946, Plattalva (CH) and Limmern (CH) in 1948, Storbreen (NO) and Sarennes (FR) in 1949, South Cascade (US), Hintereis (AT), Kesselwand (AT) and Lemon Creek (US) in 1953, and others following later. For the period 1946–2005 there are 3 383 annual mass balance results from 226 glaciers available through the WGMS. The highest observation density is once more found in Scandinavia and Central Europe with 13 and 11 observation series per 1 000 km^2, respectively, and a total of 39 and 43 glaciers under observation. North America has the most reported series (45) overall. In Central Asia and the Arctic, mass balance programmes were carried out on 36 and 35 glaciers, respectively. Mass balance observations from South America have been available since 1976 with recent data reported from nine glaciers. Globally, there is an average of 15 observation years per data series, with 39 glaciers having more than 30 years of measurements. From the 226 available data series, 118 provide information from the 21st century, and there are only 30 'reference' glaciers with continuous measurements since 1976. Additional information related to mass balance data, such as seasonal balances, equilibrium line altitudes and accumulation area ratio are also available for many of these.

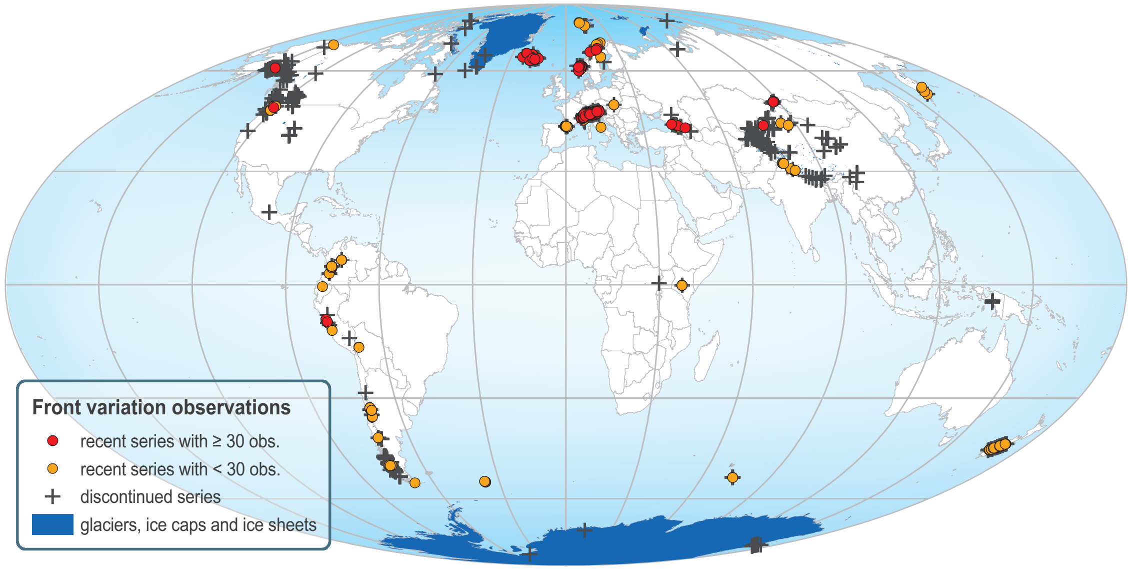


Fig. 4.6 Worldwide length change observations

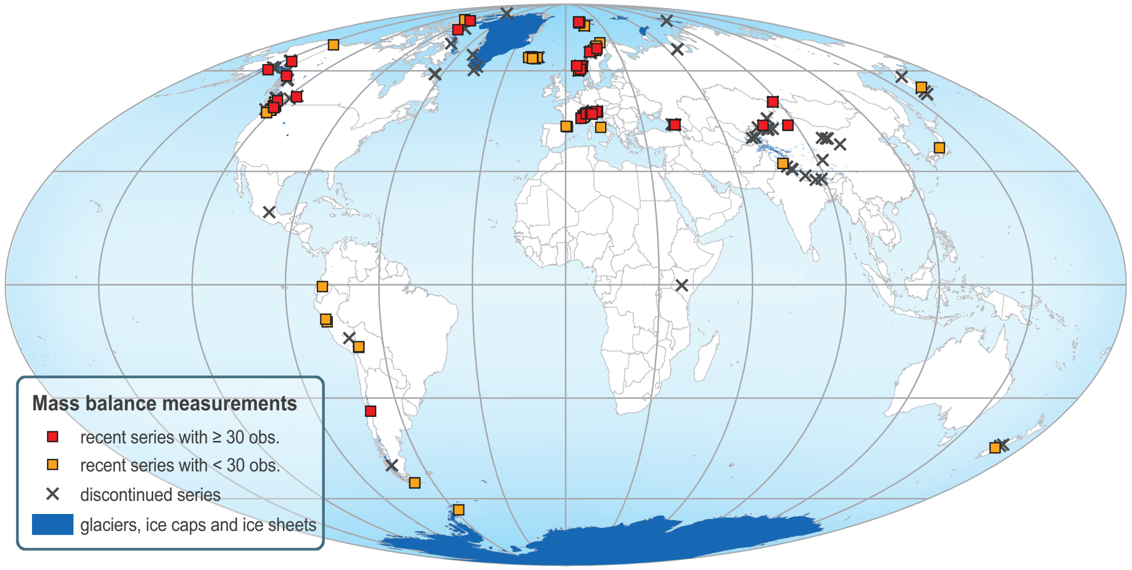


Fig. 4.7 Worldwide mass balance measurements

* * *

Fig. 4.6 Worldwide length change observations. The map shows the location of glaciers with reported information on length changes. Data series with surveys after 1999 are plotted as red and orange circles when having more or equal and less than 30 observations, respectively. The locations of observation series which were discontinued before 2000 are shown as black crosses. Data source: glacier information from WGMS; country outlines and surface ice on land cover from *ESRI's Digital Chart of the World*.

Fig. 4.7 Worldwide mass balance measurements. The map shows the location of ice bodies with reported measurements of the glacier mass balance. Data series with surveys after 1999 are plotted as red and orange squares when having more or equal and less than 30 observation years, respectively. The locations of observation series discontinued before 2000 are shown as black crosses. Data source: glacier information from WGMS; country outlines and surface ice on land cover from *ESRI's Digital Chart of the World*.

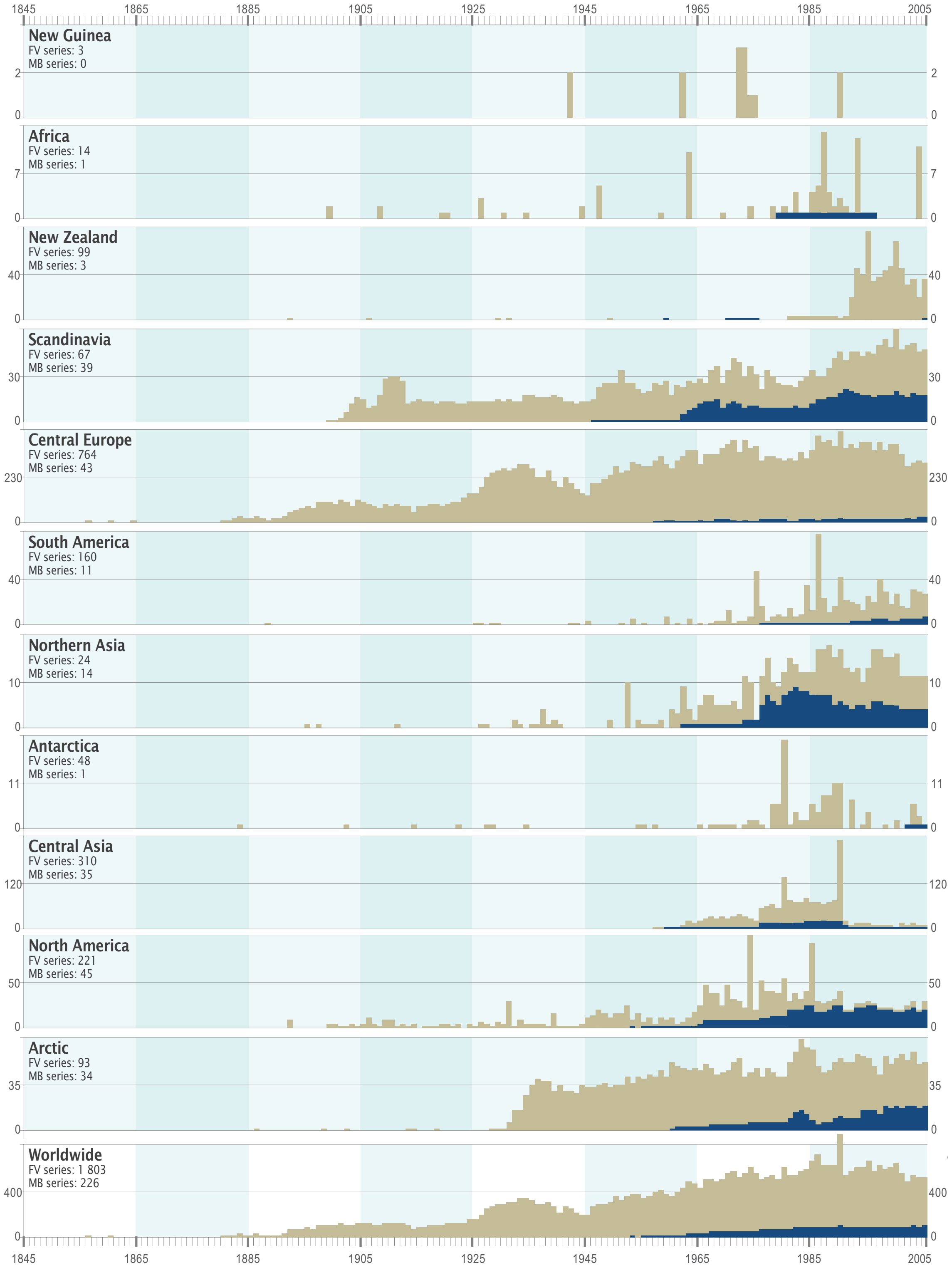


Fig. 4.8 Length change and mass balance surveys - Temporal overview on the number of reported length change (light brown bars) and mass balance surveys (dark blue bars). Note that the scaling of the number of observations on the y-axis changes between the regions. The total number of length change (FV) and mass balance (MB) series are listed below the name of the region. Source: Data from WGMS.

5 Global glacier changes

The moraines from the Little Ice Age mark maximum Holocene glacier extents in many mountain ranges. From these positions, glaciers around the world show a centennial trend of ice wastage which has been accelerating since the mid 1980s. On a decadal time scale, glaciers in various regions have shown intermittent re-advances.

At the peak of the last ice age about 21 000 years ago, about one-third of the land on earth was covered by ice (Paterson 1994, Benn and Evans 1998). Glacier fluctuations can be reconstructed back to that time using a variety of scientific methods. General warming during the transition from the Late Glacial period (between the Late Glacial Maximum and about 10 000 years ago) to the early Holocene (about 10 000 to 6 000 years ago) led to a drastic general ice retreat with intermittent periods of re-advances (Maisch et al. 2000, Solomina et al. 2008). About 11 000 to 10 000 years ago, the pronounced warming reduced the glaciers in most mountain ranges to extents comparable with conditions at the end of the 20th century (Grove 2004). Northern Europe and western North America were still influenced by the remnants of the great ice sheets and the major retreat was delayed until about 6 000 to 4 000 years ago (Solomina et al. 2008). During the Holocene (the past 10 000 years) there were periods of glacier advances on a centennial time scale, peaking in the late Holocene in the Northern Hemisphere and in the early Holocene in the Southern Hemisphere (Koch and Clague 2006). Glaciers in the tropics were rather small or even absent in the early to mid Holocene and gradually re-advanced from about 4 000 years ago (Abbott et al. 2003). Also in Scandinavia, glaciers seem to have largely disappeared during that time (Nesje et al. 2008). The moraines that were formed during the LIA (early 14th to mid 19th century) mark a Holocene maximum extent of glaciers in many regions of the world (Grove 2004, Solomina et al. 2007). However, the timing of these last maximum states is not really synchronous around the globe, but extends from the 17th to the second half of the 19th century. A detailed review of LIA glacier maximum extents around the globe is provided by Grove (2004).

Length change measurements have been available since the late 19th century (Fig. 5.1). These observations show a general glacier recession from the positions of the LIA moraines worldwide. The overall retreat of the glacier termini is commonly measured in kilometres for larger glaciers, and hundreds of metres for smaller glaciers (Hoelzle et al. 2003). Within this general trend, strong glacier retreat was observed in the 1920s and 1940s, followed by stable or advancing conditions around the 1970s, and again drastic glacier retreats after the mid 1980s. On shorter timescales, deviations from these global trends are found in many regions. Looking at the individual data series, one finds a high variability in glacier fluctuations. Large, flat valley glaciers with centennial response times are too long to react dynamically to decadal mass variations, but exhibit a continuous retreat from their LIA moraines, while medium-sized steeper glaciers reacted with re-advances to intermittent wetter and cooler periods. Small cirque glaciers are able to react in a much more direct manner to annual mass changes. Their length changes exhibit a high interannual variability. Surge-type glaciers (Box 5.1) have extreme advances on the short term, followed by a rapid decay of the glacier tongue after the event (Kamb et al. 1985, Kamb 1987). The length change of glaciers calving into a lake or into the sea (Box 5.2) is strongly controlled by the relation between ice velocity and calving rates, as influenced primarily by water depth (Benn et al. 2007). Once they lose contact with their end moraines, such glaciers have to retreat into shallow waters or onto land before being able to advance again on a new frontal moraine. Heavy debris cover acts as an insulator of the glacier ice which, hence, becomes decoupled from climatic changes (Box 5.3). Glaciers in contact with lakes (Box 5.4) or volcanoes (Box 5.5) can feature peculiar behaviours, and be hazardous in populated areas. From the large variety of glacier types and their different sensitivities and reactions to climatic changes it becomes evident that the signal derived from a set of length change series depends strongly on the chosen observation sites. Climate related analysis will have to select the data series of glaciers not influenced by thick debris cover, calving or surge instabilities. Furthermore such studies have to consider the whole spectrum of glacier response characteristics in order to obtain optimal information on secular, decadal and annual developments and its causes (Box 5.6).

Mass balance measurements on entire glaciers have been available for the past six decades. Glacier mass

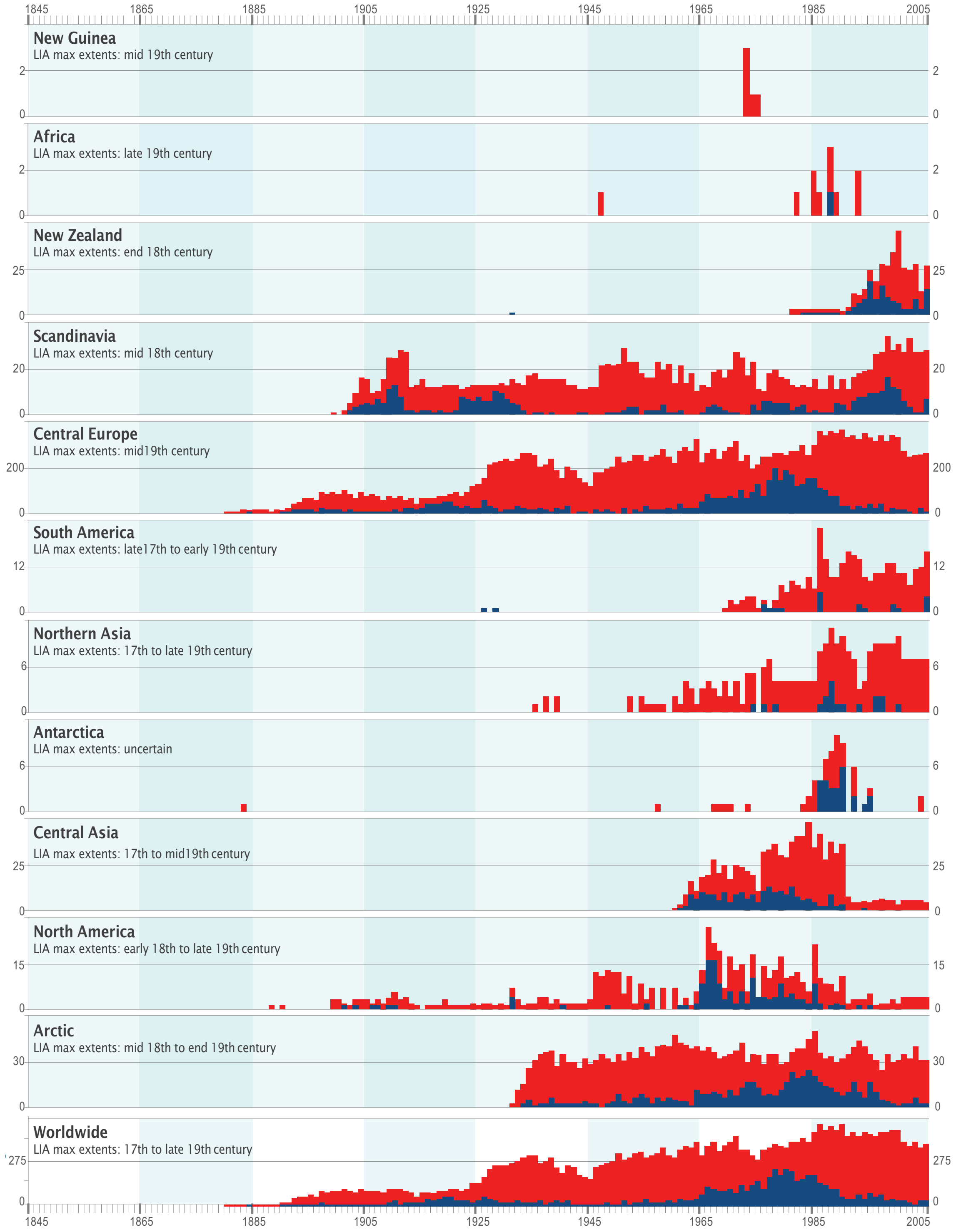


Fig. 5.1 Glacier length changes - Temporal overview on short-term glacier length changes. The number of advancing (blue) and retreating (red) glaciers are plotted as stacked columns in the corresponding survey year. This figure shows 30 420 length change observations with a time range of less than 4 years (between survey and reference year). This corresponds to almost 85 per cent of the reported data which in addition include observations covering a longer time scale and/or stationary conditions. The time period of glacier LIA maximum extents is given according to the regional information in Chapter 6. Note that the scaling of the number of glaciers on the y-axis changes between the regions. Source: figure based on data analysis by R. Prinz, *University of Innsbruck*, Austria; data from WGMS.

Box 5.1 Surging glaciers

Glacier surges are short-term, often periodic, events where a glacier suddenly begins to flow with velocities up to 100 times faster than normal and substantially advances expressed in kilometres per month (Benn and Evans 1998). Typically, the surge starts in the upper part and propagates in a wave down the glacier. The basal motion seems to be restricted to a thin layer at the ice/bed interface. During and after the surge, the glacier surface is characterised by deep crevasses and jagged pinnacles. Most of the glaciers indicating surge behaviour are found in Svalbard, Arctic Islands and Alaska, but some have also been reported from Patagonia and Central Asia. The mechanisms of glacier surges are widely discussed and still not understood completely. In any case, the drainage system underneath and within the glacier seems to play a key role in surge cycles. Lingle and Fatland (2003) investigated temperate glacier surges and suggest that the fundamental driving force is englacial storage of water, combined with gravity-driven movement of stored water to the bed. When crossing a certain threshold, the drainage system collapses and forces failure of the subglacial till – or, alternatively, widespread and rapid basal sliding – and thus initiates the surge (Lingle and Fatland 2003).


Fig 5.2 Variegated Glacier

change is a direct, undelayed reaction to atmospheric conditions. The specific mass balance can be compared directly between different glaciers. This makes it easier to establish a link to climate data, as compared to length changes. However, the limited number of long-term observations – only 30 'reference' glaciers have continuous data series since 1976 – renders global analysis much more complicated. As a consequence

Box 5.2. Calving glaciers

Calving glaciers typically terminate into a lake or the ocean, and in the latter case are also known as tidewater glaciers. Calving occurs when pieces of glacier ice break off and fall into the water. Calving is the most efficient way for these glaciers to lose ice. For the world's oceans, the gain of water by melting of icebergs plays an important role (Van der Veen 1996). Most of the tidewater glaciers are found in high latitudes such as on Svalbard, in Alaska, on the Arctic- and Antarctic Islands. In Patagonia or New Zealand many glaciers calve into lakes. In Alaska a few large calving glaciers are currently in the process of increasing in volume and advance, in strong contrast to the majority of glaciers in that region (Molnia 2007). Hubbard Glacier, at the head of Disenchantment Bay near Yakutat, is one of these advancing glaciers and is the largest calving glacier on the North American continent. Its advance began shortly before 1895 and has periodically been newsworthy, for example, when it blocked the entrance to Russell Fiord, creating a 60 km long glacier-dammed lake, once in 1986 and again in 2002 (Trabant et al. 2002). The accumulation area of Hubbard Glacier is 95 per cent of the entire glacier area and, like the other advancing glaciers, is far from being in equilibrium with climate on the positive mass balance side. The sometimes catastrophic retreat of calving glaciers after losing contact with their frontal moraine and the related production of huge icebergs can threaten nearby ship passages, as in the case of Columbia Glacier in the Chugach Mountains of Alaska (Molnia 2007). While fluctuations of land-based glaciers are generally driven by climate forcing, the behaviour of calving glaciers is often dominated by the calving processes where water depth plays an important role.


Fig. 5.3 Perito Moreno

Fig. 5.2 Variegated Glacier, Alaska, during a surge (photograph taken in 1983). Source: J. Alean, *SwissEduc* (www.swisseduc.ch) / *Glaciers online* (www.glaciers-online.net).
Fig. 5.3 Perito Moreno, Argentina, is a prime example of a calving glacier (photograph taken in December 2005). Source: J. Nötzli, *University of Zurich*, Switzerland.
Fig. 5.4 a—b Luana, Bhutan Himalayas (17 x 13 km). Details from a Landsat image of 1990 (left) and an ASTER image of 2001 (right). Most of the lakes have increased in area between 1990 and 2001, either due to retreat of the calving front, or from growing and connecting supra- and pro-glacial ponds. On October 7, 1994, the lake to the right of the images, Lugge Tsho, burst out and caused a major flood (see deposits in the valley (circle)). Source: A. Kääb, *University of Oslo*, Norway.
Fig. 5.5 High angle view of Mount St. Helens' crater, USA, with new dome and glacier (photograph taken on September 21, 2005). Source: J. Ewert, J. Vallance, *US Geological Survey*.

Box 5.3 Debris-covered glaciers

Debris-covered glaciers occur in every mountain chain with ice-free steep slopes, but are particularly common in the Himalaya, Alaska and New Zealand. In general, the debris appears on the glacier surface below the equilibrium line by medial moraines converging downglacier and forming a continuous debris cover, or by rock falls from the surrounding slopes. A general increase in debris cover over time was observed in Central Asia by several studies (e.g. Ageta et al. 2000, Shroder et al. 2006). The debris cover partially or completely masks the ablation zone of a glacier and therefore significantly influences the energy balance. It also partially controls the ablation rate and the discharge of melt water (Nakawo et al. 2000). When melting, the glaciers waste down or back where they have clean ice, while changes in the debris-covered part are significantly smaller. Therefore, the behaviour of heavily debris-covered glaciers – such as Imja Glacier in the Himalaya or Tasman Glacier in New Zealand – are limited in terms of their use as climatic indicators.

Box 5.4 Lake formation and glacier lake outburst floods

Lakes can form underneath (subglacial-), within (englacial-), on top of (supraglacial-) or in front of (proglacial) a glacier. The lake formation process can occur permanently, periodicly or infrequently. Their formation and also their draining are in most cases controlled by changes in the glacial drainage system (Benn and Evans, 1998). Thus, lake drainage occurs slowly or in a catastrophic manner when a certain threshold is crossed. Other processes such as earthquakes, subglacial volcanic eruptions and rock avalanches or debris flows reaching the lake may cause breaching of ice or moraine dams and lead to sudden glacier lake outburst floods (Kääb et al. 2006). Parallel to the worldwide glacier retreat, numerous glacier lakes have been forming at a rapid rate – especially on the surface of debris-covered glaciers (e.g. in the Himalaya) (Reynolds 2000). Therefore, the number of hazardous glaciers, where outburst floods endangers human life and resources, is rising.

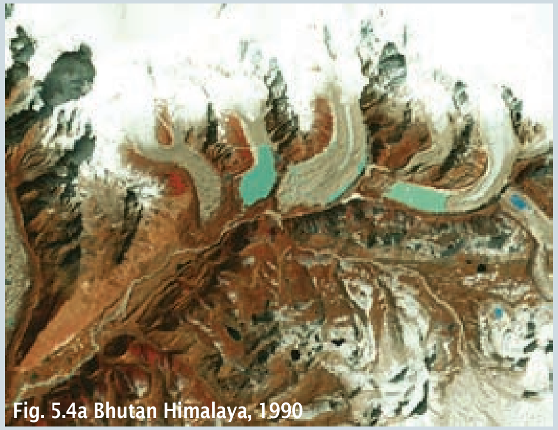


Fig. 5.4a Bhutan Himalaya, 1990


Fig. 5.4b Bhutan Himalaya, 2001

Box 5.5 Glaciers and Volcanoes

Active volcanoes are typically associated with the boundaries of tectonic plates and often reach sufficient heights to sustain the occurrence of glaciers, even in tropical climates. The concurrence of glaciers and volcanoes occurs noticeably in South America (e.g., Nevado del Ruiz), in Mexico (e.g., Popocatépetl), in North America (e.g., Mt. St. Helens) and in Iceland (e.g., Hofsjøkull). Geothermal activity beneath a glacier can strongly enhance the glacier motion, as investigated on Vatnajøkull ice cap in Iceland (Björnsson et al. 2001). More intense processes like volcanic eruptions or pyroclastic flows directly influence the glacier by melting of the ice. The meltwater can trigger catastrophic floods or lahars when incorporating ice and debris from the volcano's flanks. Such an event occurred on Nevado del Ruiz Volcano in Colombia in 1985, where pyroclastic flows caused surface melting of 10 per cent of the ice cap, leading to floods and lahars which claimed at least 25 000 lives (Naranjo et al. 1986). For this reason, glacier-covered volcanoes pose a very serious potential hazard in populated areas (Huggel et al. 2007).


Fig. 5.5 Mount Saint Helens

Box 5.6 Causes of global glacier changes

The reasons for the cyclical nature of the ice ages, so-called Milankovitch cycles, with dominant periods of 23 000, 41 000, 100 000 and 400 000 years (Milankovitch 1930), are mainly to be found in the variation of the earth rotational parameters. Further influences include the variability of solar activity, the latitudinal position of the earth's continents, the chemical composition of the atmosphere, the internal dynamics of the climate system, as well as volcanic eruptions and impacts of meteorites of extreme dimensions (Imbrie and Imbrie 1979, Ruddiman 2000). The overall glacier retreat after the Last Glacial Maximum and extending to the early Holocene is very much in line with the global warming (Solomina et al. 2008). The major glacier re-advances around 8 200 years ago were related possibly to a change in the thermohaline circulation of the ocean in the North Atlantic and North Pacific, and a subsequent cooling, due to the outburst of the Lake Agassiz on the North American continent (Solomina et al. 2008). By contrast, the gradual re-advance of tropical glaciers from their small extents, or even absence, in the early to mid Holocene was probably a result of increasing humidity (Abbott et al. 2003). The periods of simultaneous glacier advances around the world, peaking in the late Holocene in the Northern Hemisphere and in the early Holocene in the Southern Hemisphere, as well as the glacier maximum extents towards the end of the LIA are attributed to changes in solar irradiance, in dependence on the sun's activity and the earth's orbit, and also to the effects of volcanic eruption, internal dynamics of the climate system (Grove 2004, Solanki et al. 2004, Koch and Clague 2006) and possible initial large-scale anthropogenic changes in land use (Ruddiman 2003).

The overall shrinking of glaciers and ice caps since their LIA maximum extents is well correlated with the increase in global mean air temperature of about 0.75 °C since the mid 19th century, which is most likely man-induced since the second half of the 20th century (IPCC 2007). On decadal or regional scales, changes in snow accumulation may have dominated glacier response in maritime climates (IPCC 2007). As such, the onset of the post LIA retreat and the later periods of intermittent re-advances in the European Alps are attributed to changes in winter precipitation rather than temperature (Vincent et al. 2005, Zemp et al. 2007b). Increased precipitation is also seen as the main reason for the glacier advances in the early 18th century and the 1990s in Norway (Andreassen et al. 2005), in the 1990s in New Zealand (Chinn et al. 2005), and for the 20th century advances and/or thickening of some glaciers in central Karakoram (Hewitt 2005). Such glacier changes are striking features in photo comparisons as shown in Figures 0.1, 5.6, 5.7 and 7.1.

The period in which glaciers were close to steady state or even advancing, which occurred worldwide around the 1970s, might be explained, at least in part by diminished incoming solar radiation due to the increase of atmospheric pollution after the mid 20th century (Wild et al. 2007). Recent studies have shown that the atmosphere cleared up again in the mid 1980s, probably as a result of the implementation of industrial filters and the breakdown of industry in the former Soviet Union, which increased the amount of incoming solar radiation and, as such, of glacier melting (Ohmura 2006, Padma Kumari et al. 2007). Analyses of mass balance data have shown a moderate increase in mean winter accumulation and a substantially increased low-altitude summer melting (Ohmura 2004, Dyurgerov and Meier 2005, Greene 2005). This is consistent with the observed increase in the mass turnover rate which is derived from field measurements in the Northen Hemisphere (Dyurgerov and Dwyer 2000) and remote sensing studies in Alaska (Arendt et al. 2002), the Canadian Arctic Archipelago (Abdalati et al. 2004) and Patagonia (Rignot et al. 2003).

In addition to climate changes on the global level, altered atmospheric circulation patterns can have a great impact on the glacier behaviour of entire mountain ranges. Examples are the accelerated glacier retreat in continental USA and southwest Canada which are attributed to a shift in atmospheric circulation in approximately 1976/77 (Bitz et al. 1999, McCabe et al. 2000), the mass balance variations of glaciers in the tropical Andes which are strongly influenced by the El Niño-Southern Oscillation (ENSO; Wagnon et al. 2001, Francou et al. 2004, Sicart et al. 2005), and the North Atlantic Oscillation that has an effect on glaciers in the European Alps and Scandinavia (Schöner et al. 2000, Nesje et al. 2000).


Fig. 5.6a 1989
b 1995
c 2001
d 2007


Fig. 5.7.a Peyto Glacier, 1966


Fig. 5.7.b Peyto Glacier, 2001

there are three main approaches to calculating global average mass balances which are independent of climate, hydrology or climate indicator data. These are by (i) using the (arithmetic) mean value of the few continuous measurement series, (ii) averaging the moving sample of all available data series, and (iii) using regionally weighted samples (cf. Kaser et al. 2006). However, when cumulated over the past six decades, the results of these approaches are consistent. The global averages (i, ii, iii) reveal strong ice losses in the first decade after the start of the measurements in 1946, slowing down in the second decade (1956–65), followed by a moderate mass loss between 1966 and 1985, and a subsequent acceleration of ice loss until present (Fig. 5.8 a—f). The mean of the 30 continuous 'reference' series yields an annual mass loss of 0.58 m water equivalent (m w.e.) for the decade 1996–2005, which is more than twice the loss rate of the previous decade (1986–95: 0.25 m w.e.), and over four times the rate for the period 1976–85 (0.14 m w.e.).

Overall, the cumulative average ice loss over the past six decades exceeds 20 m w.e. (Fig. 5.9), which is a dramatic ice wasting when compared to the global average ice thickness, which is estimated (by dividing estimated volume by area) to be between 100 m (IPCC 2007) and about 180 m (Ohmura, personal comm.). The average ice loss over that period of about 0.35 m w.e. per year exceeds the loss rates reconstructed from worldwide cumulative length changes for the time since the LIA (see Hoelzle et al. 2003) and is of the same order of magnitude as characteristic long-term mass changes during the past 2 000 years in the Alps (Haeberli and Holzhauser 2003). Based on the mass balance measurements, the annual contribution of glaciers and ice caps to the sea level rise is to be estimated at one-third of a millimetre between 1961 and 1990, with a doubling of this rate in the period from 1991 to 2004 (Kaser et al. 2006), and passing the one millimetre per year limit for the period 2000 to 2006. However, these values are to be considered first order estimates due to the rather small number of mass balance observations and their probably limited representativeness for the entire surface ice on land, outside the continental ice sheets. The vast ice loss over the past decades has already led to the splitting or disintegration of many glaciers within the observation network, e.g., Lower Curtis and Columbia 2057 (US), Chacaltaya (BO), Carèser (IT), Lewis (KE), Urumqihe (CN), and presents one of the major challenges for glacier monitoring in the 21st century (Paul et al. 2007). The massive downwasting of many glaciers over the past two decades, rather than dynamic retreat, has decoupled the glaciers horizontal extent (i.e. length, area) from current climate, so that glacier length or area change has definitely become a diminished climate indicator of non-linear behaviour. Under the present climate change scenarios (IPCC 2007), the ongoing trend of global and rapid, if not accelerating, glacier shrinkage on the century time scale is of non-periodic nature and may lead to the deglaciation of large parts of many mountain ranges in the coming decades (e.g., Zemp et al. 2006, Nesje et al. 2008).

For a temperate glacier, a step-change in climatic conditions would cause an initial mass balance change followed by a return to zero values, due to the glacier's adaptation of its size (surface area) to the new climate

Fig. 5.6 a—d Advance and retreat of Briksdalsbreen, an outlet glacier of Jostedalsbreen, Norway, in a photo series of the years 1989, 1995, 2001 and 2007. Source: S. Winkler, *University of Würzburg*, Germany.

Fig. 5.7 a—b Retreat of Peyto Glacier, Canadian Rockies, between 1966 and 2001. Source: W.E.S. Henoch and M.N. Demuth, Canada.

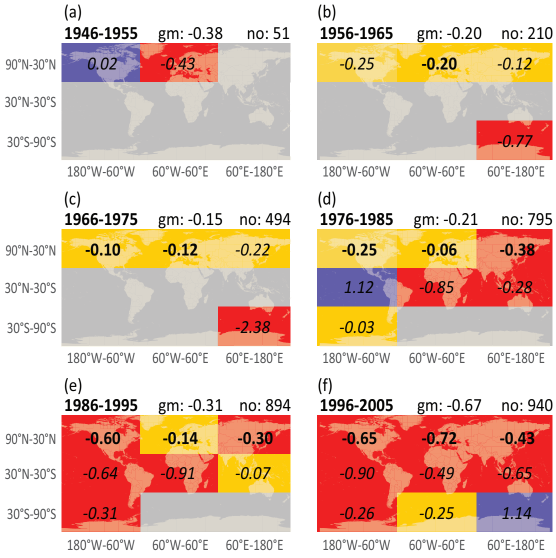


Fig. 5.8 Spatio-temporal overview on glacier mass changes

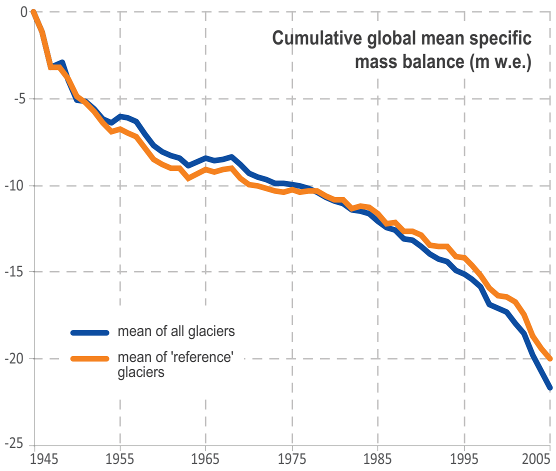


Fig. 5.9 Cumulative specific mass balance

(Jóhannesson et al. 1989). The observed trend of increasingly negative mass balance over reducing glacier surface areas thus leaves no doubt about the ongoing climatic forcing resulting from the change in climate and possible enhancement mechanisms such as mass balance / altitude feedback, altered turbulent and long-wave radiation fluxes due to the size and existence of rock outcrops or changes in the surface albedo (Paul et al. 2007). The specific mass balance data can be directly compared between different glaciers of any size and elevation range. The data series provide a combined hydrological and climatic signal. Runoff can be calculated by multiplying the specific mass balance with the corresponding glacier area, whereas a climatic interpretation needs to consider the geometric changes. In order to derive a real climate signal, it is required to relate the mass changes to a reference extent of the glacier (Elsberg et al. 2001, WGMS 2007 and earlier issues).

The numerous length change series together with the positions of moraines from the LIA provide a good qualitative overview on the global and regional glacier changes; while the mass balance series provide quantitative measures of the ice loss since the late 1940s. However, the about 230 glacier mass balance series are less representative for the changes in the global ice cover. Many regions with large ice cover are strongly underrepresented in the data set or are even lacking in observations. Data from south of 30° N has only been reported since 1976. As a consequence, the field measurements with a high temporal resolution but limited in spatial coverage should be complemented by remotely-sensed decadal area and volume change assessment in order to obtain a representative view of the climate change impact on the glacierisation. Examples for such integrative analysis for entire mountain ranges are given by Molnia (2007) for Alaska, by Casassa et al. (2007) on the Andean glaciers, by Kaser and Osmaston (2002) for tropical glaciers, by Andreassen et al. (2005) for Norway, by Zemp et al. (2007b) for the European Alps, by Kotlyakov et al. (2006) for Russia, and by Chinn (2001) and Hoelzle et al. (2007) for New Zealand, as well as by Hoelzle et al. (2003), Grove (2004), Zemp et al. (2007a) and USGS (in prep.) for a global overview.

Fig. 5.8 a—f Spatio-temporal overview on glacier mass changes. The average annual mass balance for nine sectors of the globe are shown for the decades (a) 1946–55, (b) 1956–65, (c) 1966–75, (d) 1976–85, (e) 1986–95, and (f) 1996–2005. Sectors with measurements are coloured according to the mean annual specific mass balance in metre w.e. with positive balances in blue, ice losses up to 0.25 m w.e. in orange and above that in red; sectors without data in grey. Average decadal mass balance values based on less than 100 observations (marked in italics) are less representative for the entire sector. For each decade, the global mean (gm) annual mass balance in m w.e. and the number of observations (no) are indicated. Source: Data from WGMS.

Fig. 5.9 The cumulative specific mass balance curves are shown for the mean of all glaciers and 30 'reference' glaciers with (almost) continuous series since 1976. Source: Data from WGMS.

6 Regional glacier changes

The following sections provide an overview on the glacier changes after the Little Ice Age (LIA) in eleven glacierised macroregions (Fig. 6.0.1). Sections 6.1-6.11 are ordered according to the extent of the glacier cover in the macroregions (see Table 4.1). A classification of the world's glaciers and ice caps into geographical macroregions is based on the purpose of the particular investigation as well as on the spatial resolution of the data set and, hence, is somewhat arbitrary. The regional attributions, names and ice cover information used in this publication are based on Dyurgerov and Meier (2005). Each section includes a brief statistic of the glacier fluctuation data as reported to the WGMS. The sections summarise the characteristics of the mountain ranges and its ice covers, followed by a brief discussion of the available fluctuation series, the timing of the LIA maximum extents and the subsequent regional glacier changes based on the available field series and some key publications. Selected long-term length change and mass balance series are plotted as cumulative graphs. A complete overview of the data series reported to, and available from, the WGMS as well as a list of the National Correspondents are given in the Appendix. Detailed information on the Principal Investigators and Sponsoring Agencies of the reported data is published in the *Fluctuations of Glaciers* series (WGMS 2008, and earlier volumes). In order to provide an impression of the glacier characteristics, false-colour satellite images from ASTER, including close-up to interesting glaciological features, as well as terrestrial, oblique aerial photographs are shown for each region.

Figure 6.0.1 gives an overview of the distribution of the global ice cover and indicates the location of the eleven macroregions. Figure 6.0.2 a–f details the available fluctuation series (WGMS glacier data) and those presented in the following regional sections 6.1 to 6.11. Note that the two-digit country code assigned to the glaciers in the following sections and the appendix table is given according to the information submitted to the WGMS and as such might not correspond to present political territories.

Fig. 6.0.1 The selected eleven glacierised macroregions.
Details on the mountain ranges, its glacier covers and changes are presented in detail in the sections 6.1 – 6.11. Source: glacier outlines from *ESRI's Digital Chart of the World* (DCW).

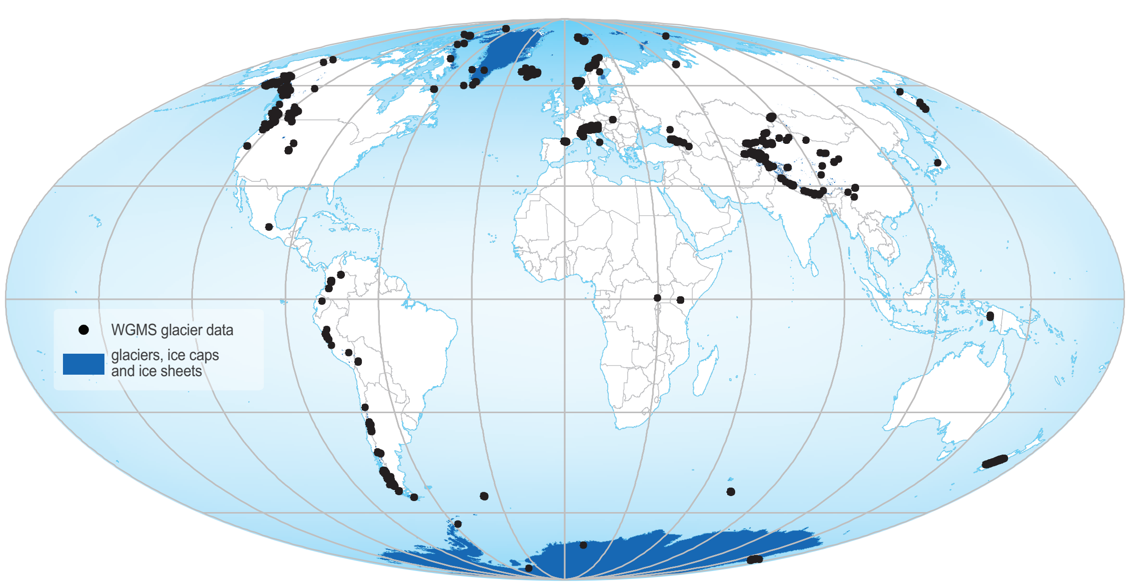


Fig. 6.0.2a WGMS glacier data

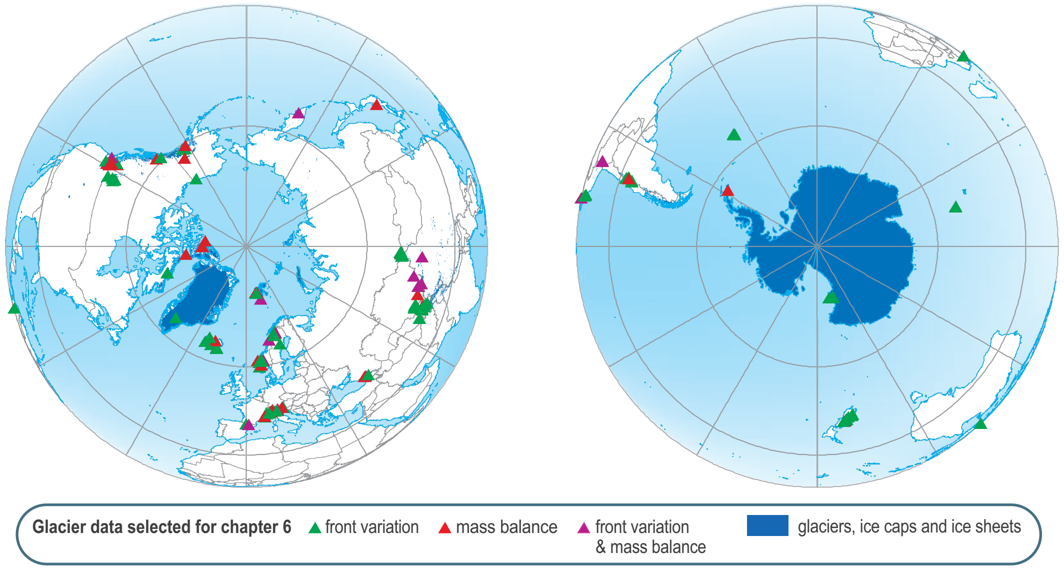


Fig. 6.0.2b—c Selected front variation and mass balance data

Fig. 6.0.2 Global distribution of glaciers, ice caps and ice sheets are shown with (a) the available fluctuations data and (b-f) selected mass balance and front variation series shown in sections 6.1-11. Sources: glacier outlines from *ESRI's Digital Chart of the World* (DCW), fluctuation series from WGMS.

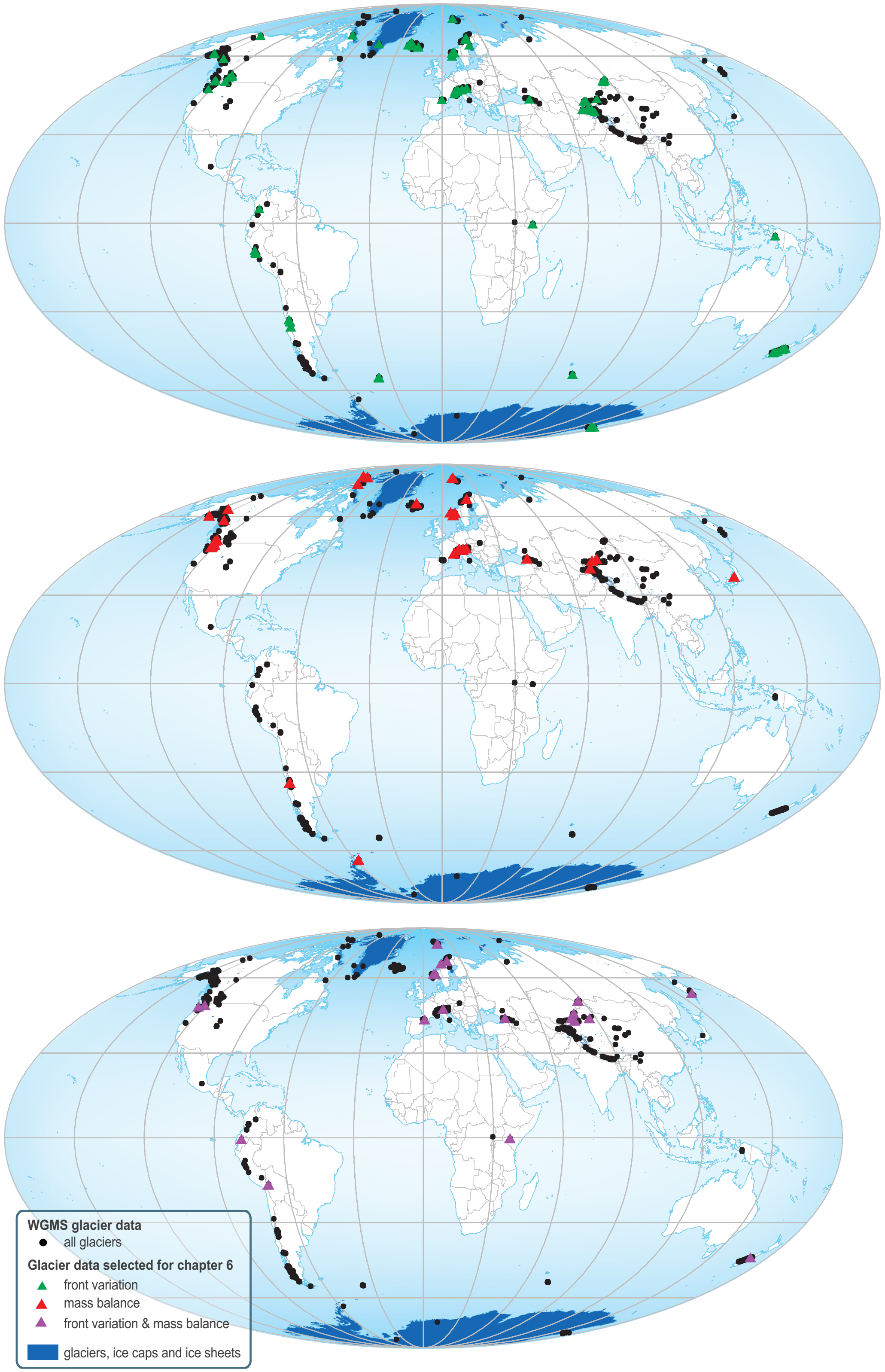
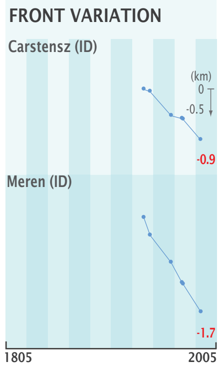


Fig. 6.4d—f Selected front variation and mass balance series

6.1 New Guinea

The few glaciers of Papua (formerly Irian Jaya, Indonesia) and Papua New Guinea are located on the peaks of the great Cordillera of the island of New Guinea. Direct observations are sparse, but historical documents, aerial photographs and satellite images offer insight into the historical glacier changes.



The only tropical glaciers of Asia are located on the mountains of New Guinea. In the 20th century glaciers were found on Puncak Mandala (Juliana 4 640 m asl), Ngga Pilimsit (Idenburg 4 717 m asl) and Puncak Jaya (Carstenz 5 030 m asl), three peaks in Papua, Indonesia, located in the western part of the great Cordillera of New Guinea (Grove 2004). A small ice cap existed on Puncak Trikora (Wilhelmina 4 730 m asl) in Papua New Guinea (Grove 2004). The LIA maximum extent was reached in the mid 19th century (Allison and Peterson 1976).

Regular series of direct measurements of front variation or mass balance are not available. The glacier changes have been traced from information on glacier extents derived from historical records, dated cairns erected during several expeditions, aerial photographs, satellite images as well as from some in-situ measurements carried out during Australian expeditions in the 1970s (Allison and Peterson, 1989). Most observations focused on the glaciers on Puncak Jaya, namely the North Wall Firn; two valley glaciers, Meren and Carstenz; and the Southwall Hanging Glacier. All have undergone extensive retreat since the LIA maximum extent (Peterson et al. 1973) reducing the entire Puncak Jaya ice cover from almost 20 km^2 around 1850 to less than 3 km^2 in 2002, with highest retreat rates around 1940 and in the early 1970s (Klein and Kincaid 2006). All ice masses except some on Puncak Jaya have now disappeared. The isolated ice caps vanished from Puncak Trikora between 1939 and 1962; from Ngga Pilimsit between 1983 and 2003 (Klein and Kincaid, 2006); and from Puncak Mandala between 1989 and 2003 (Klein and Kincaid, 2008). The larger Meren Glacier on Puncak Jaya melted away between 1992 and 2000 (Klein and Kincaid, 2006).


Fig. 6.1.1 Punca Jaya

Fig. 6.1.1 Oblique aerial photograph looking east at Northwall Firn, Meren Glacier and Carstensz Glacier (left to right) on Puncak Jaya. Source: Photograph of 1936 by J.J. Dozy, provided by the *United States Geological Survey* (Allison and Peterson 1989).

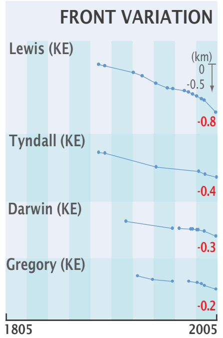
Ice covered area (km^2):	3
Front variation	
number of series:	3
average number of observations:	5
average time length (years):	46
Mass balance	
number of series:	0
average number of observations:	0

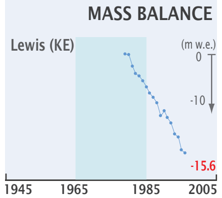
6.2 Africa

The few tropical ice bodies in East Africa are located on Ruwenzori, Mount Kenya and Kilimanjaro. Their recession since the late 19th century has been well documented.

African glaciers are found near the equator in East Africa, situated on three mountains: Ruwenzori (5,109 m asl), Mount Kenya (5 199 m asl) and Kilimanjaro (5 895 m asl), of which the latter are volcanoes (Grove 2004). The glaciers are situated in the tropical climate zone. The processes governing accumulation and ablation are thus different from mid-latitude or polar climates. The glaciers reached their LIA maximum extents towards the late 19th century (Hastenrath 2001).


Fig. 6.2.2 Lewis Glacier





Glaciological studies on Ruwenzori, Mount Kenya and Kilimanjaro have a long history and are summarised in Hastenrath (1984, 2005), Kaser and Osmaston (2002), and Cullen et al. (2006). Several front variation series document the glacier changes on Mount Kenya where also the only African mass balance measurements were carried out on Lewis Glacier between 1978 and 1996 (Hastenrath 2005).

The ice cover on Ruwenzori has retreated continuously since the late 19th century, became strongly fragmented and on some peaks has completely vanished (Kaser and Osmaston 2002). The ice bodies on Kilimanjaro have shrunk continuously from about 20 km^2 just before 1880 to about 2.5 km^2 in 2003 (Cullen et al. 2006). The plateau glaciers thereby showed a linear retreat, whereas the glaciers on the slopes of the mountain had higher loss rates in the first half of the 20th century. Front variation measurements and repeated mapping provide documentation of the century-long history of glacier recession on Mount Kenya, with eight (out of 18) glaciers vanishing in the 20th century (Hastenrath 2005). The ice volume of Lewis Glacier decreased from about 7.7 km^3 in 1978 to about 0.3 km^3 in 2004 (Hastenrath and Polzin 2004) with an average thickness loss of almost one metre ice per year.


Fig. 6.2.1.a Mount Kilimanjaro, 1950

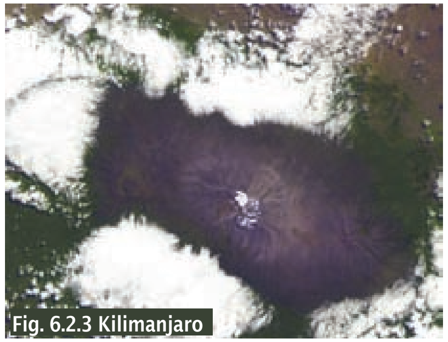


Fig. 6.2.3 Kilimanjaro

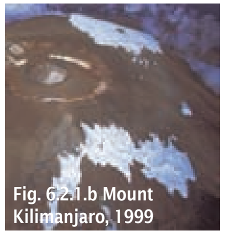


Fig. 6.2.1.b Mount Kilimanjaro, 1999

Ice covered area (km^2):	6
Front variation	
number of series:	14
average number of observations:	6
average time length (years):	71
Mass balance	
number of series:	1
average number of observations:	18

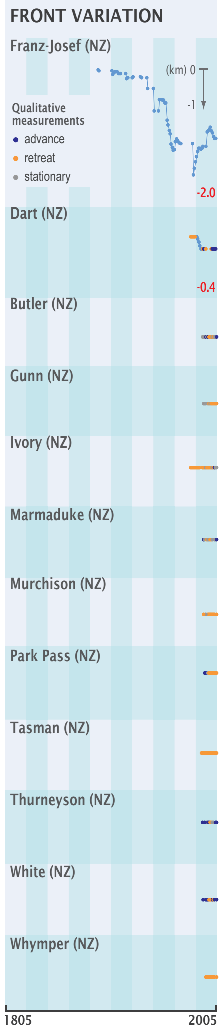
Fig. 6.2.1 a—b Mount Kilimanjaro, Tanzania, northern icefield. Source: Upper photograph taken in the early 1950s by J. West, lower photograph taken in 1999 by J. Jafferji.

Fig. 6.2.2 Lewis Glacier, Mount Kenya, in the mid 1990s. Source: S. Ardito.

Fig. 6.2.3 Mount Kilimanjaro, Tanzania. Space view of the glaciers around the crater (center) and typical surrounding clouds. Source: ASTER satellite image (50 x 45 km), 19 August 2004.

6.3 New Zealand

Most glaciers are situated along the Southern Alps, with a few more on Mount Ruapehu Volcano on the Northern Island. The country has a long tradition of glacier observation; however, the majority of the available data series are of qualitative type and start in the 1980s.



The topography of New Zealand is characterised by evidence of the collision of the Indio-Australian Plate with the Pacific Plate and the resulting tectonic uplift, seismic activity and volcanism. Apart from a few glaciers on Mount Ruapehu Volcano on the North Island, the majority of glaciers are located along the Southern Alps spanning the length of the South Island between 42° and 46° south. Their climatic regime is characterised by high precipitation with extreme gradients. Annual average values amount to 4500 mm on the west side (Whataroa) of the Alps and maximum values of up to 15 000 mm (Chinn 1979, Griffiths and McSaveney 1983, Tomlinson and Sansom 1994). Mount Cook is the highest peak at 3 754 m asl. Below its flank, the Tasman Glacier – the largest glacier in New Zealand – is located. In total, the inventory of 1978 reported 3 144 glaciers covering an area of about 1 160 km² with an estimated total ice volume of about 53 km³ at that time (Chinn 2001). Glacier runoff is used for irrigation east of the main divide of the Southern Island and for hydro-electric power production, which accounts for over two-thirds of the nation's total generating outputs.


Fig. 6.3.1 Franz-Josef Glacier

Fig. 6.3.1 Oblique aerial photograph showing the west coast of the South Island with Franz-Josef Glacier and Mount Cook (photograph taken on March 27, 2006). Source: M. Hoelzle, *University of Zurich*, Switzerland.

The LIA maximum extent of New Zealand's glaciers occurred towards the end of the 18th century, with only minor retreats until the end of the 19th century (Gellatly et al. 1988, Anderson 2003, Winkler 2004). New Zealand has a long tradition of glacier observation going as far back as the 19th century and focusing on glacier front variations. The most comprehensive series is a detailed history of frontal positions of the Franz-Josef Glacier with the first survey made in 1893 (Harper 1894, Anderson and Mackintosh 2006).

However, the majority of the data series start in the 1980s and provide qualitative data only (advance, retreat, stationary). Glacier extents have been mapped for an inventory in 1978 (Chinn 1996), revealing an overall retreat from the moraines of the LIA extents. Since 1977 annual end-of-summer snowline surveys have been carried out by taking aerial photographs of 50 glaciers (Chinn et al. 2005). Limited mass balance data are available from two glaciers only, the Tasman and Ivory. Most recently a new mass balance monitoring program has been started with on-site support by the WGMS on Brewster Glacier.

Overall, New Zealand's glaciers lost between one-quarter (Chinn 1996) and almost half of their area (Hoelzle et al. 2007) between the timing of their LIA maximum extents and the 1970s. After the mid 1980s many glaciers on the west coast have gained mass and advanced noticeably. Since the beginning of the 21st century, the number of retreating glaciers has increased again. A net ice volume loss between 1977 and 2005 of about 11 per cent has been reported in a recent study (Chinn pers. comm.). This mass loss was attributed mainly to the downwasting of the 12 largest glaciers and the minor contributions from their calving into lakes, as well as from negative mass balances of smaller glaciers.

Ice covered area (km²): 1 160

Front variation	
number of series:	99
average number of observations:	6
average time length (years):	14

Mass balance	
number of series:	3
average number of observations:	3

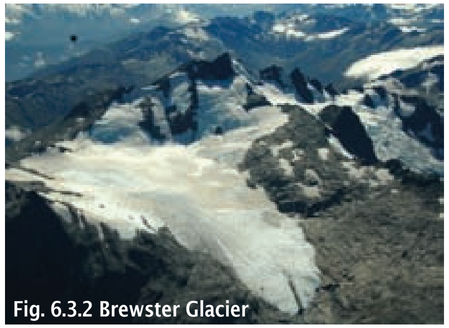
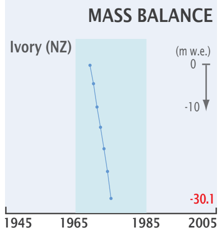


Fig. 6.3.2 Brewster Glacier

Fig. 6.3.2 Brewster Glacier (on left) with almost no accumulation area. The oblique aerial photograph was taken during the end-of-summer snowline survey on 14 March, 2008. Source: A. Willsman (NIWA), as part of *New Zealand Foundation of Research, Science and Technology* contract C01X0701.



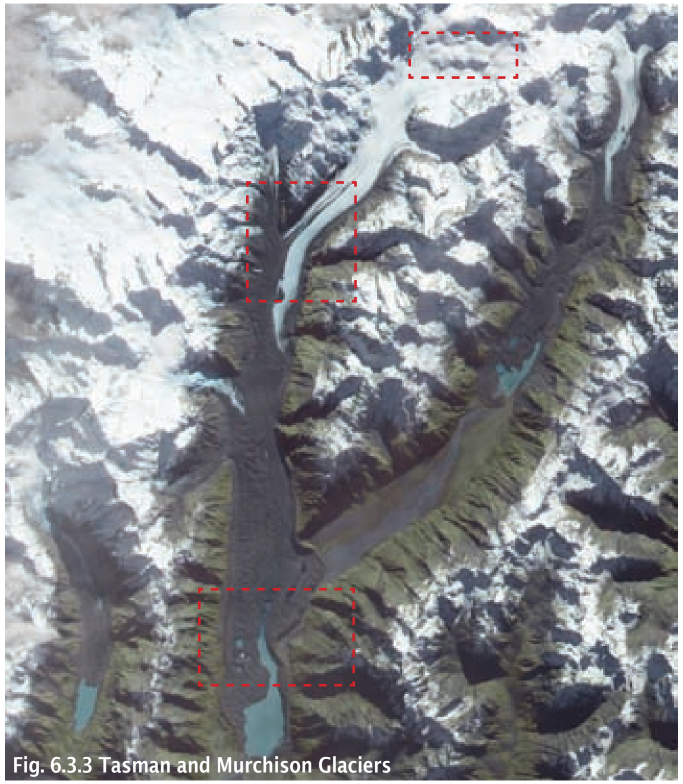


Fig. 6.3.3 Tasman and Murchison Glaciers

Fig. 6.3.3 Tasman (left) and Murchison (right) Glaciers region. Source: ASTER satellite image (23 x 31 km) and close-ups, 29 April 2000.


Fig. 6.3.3a

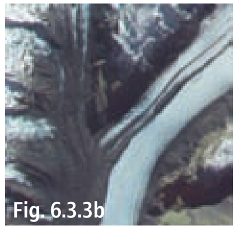


Fig. 6.3.3b

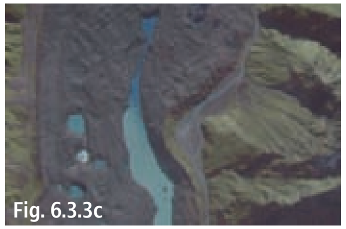
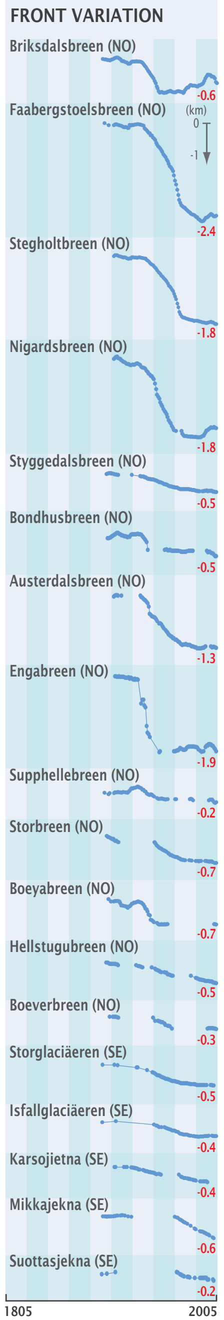


Fig. 6.3.3c

6.4 Scandinavia

The majority of the ice on the Scandinavian Peninsula is located in southern Norway. Some glaciers and ice caps are also found in northern Norway and the Swedish Kebnekaise mountains. Scandinavia is one of the regions with the most and longest reported observation series.



The Scandinavian Peninsula is located between 60° and 71° north. Galdehøpiggen (2469 m asl) in southern Norway is the highest peak on the Peninsula, and Kebnekaise (2104 m asl) is the highest summit in northern Sweden. Due to the combination of high latitude and the moisture from the North Atlantic, many glaciers and ice caps developed, mainly in Norway, all within 180 km of the west coast (Grove 2004). The greater part of the ice cover is concentrated in southern Norway, namely in Folgefonna, Hardangerjøkulen, Breeheimen, Jotunheimen, and Jostedalsbreen, which is the largest ice cap of mainland Europe (Østrem et al. 1988, 1993). In northern Norway there are the Okstindan and Svartisen ice caps, glaciers in Lyngen and Skjomen (Østrem et al. 1973), as well as in the adjacent Kebnekaise region in Sweden (Holmlund and Jansson 2005). The relevance of glaciers and their changes to the lives of the Scandinavian people is reflected in the extensive observation record. Farms and farmland buried by ice, resettlements and reduced taxes due to the Little Ice Age glacier advances are reported in historical documents (Grove 2004). In today's Norway, 15 per cent of the used runoff comes from glacierised basins and 98 per cent of the electricity is generated by hydropower production (Andreassen et al. 2005).


Fig. 6.4.1 Nigardsbreen

After having probably disappeared in the early/mid Holocene (Nesje et al. 2008), most of the Scandinavian glaciers and ice caps reached their maximum extent in the mid-18th century (Grove 2004). Blomsterskardsbreen, the southern outlet glacier of Folgefonna, is one of the exceptions, reaching its maximum extent at the beginning of the 20th century (Grove 2004). Annual front variation measurements began in Norway and Sweden at the turn to the 19th century. Several glaciers have been observed on a regular basis for more than a century. A total of over 60 Scandinavian front variation series are available. Storglaciären in Sweden provides the longest existing mass balance record for an entire glacier with continuous seasonal measurements since 1946. Mass balance measurements in Norway started at Storbreen (Jotunheimen) in 1949. Overall mass balance measurements have been reported from 39 glaciers, with 8 continuous series since 1970.

After their enlarged state in the 18th century and the minor retreat trend with small frontal oscillations up until the late 19th century, Scandinavian glaciers experienced a general recession during the 20th century with intermittent periods of re-advances around 1910 and 1930, in the second half of the 1970s, and around 1990; the last advance stopped at the beginning of the 21st century (Grove 2004, Andreassen et al. 2005). Local precipitation variances superimposed on these generally coherent patterns, cause variations to occur on individual glaciers. The maritime glaciers (e.g. Hardangerjøkulen, Nigardsbreen, Ålfotbreen, Engabreen) with large annual mass turnover started to gain mass after the early 1960s, whereas the more continental glaciers (e.g. Storglaciären, Gråsubreen, Hellstugubreen, Storbreen) continued their ice loss. Since 2001 all monitored glaciers have experienced a distinct mass deficit (Andreassen et al. 2005).

Fig. 6.4.1 View toward the proglacial lake and the tongue of Nigardsbreen, Norway, Jostedalsbreen Ice Cap in the background (photograph taken in July 2005). Source: I. Roer, *University of Zurich*, Switzerland.

Fig. 6.4.2 Tarfala research station in the Kebnekaise region (Sweden), with Isfallsglaciären in the background (photograph taken in August 2007). Source: P. Jansson, *University of Stockholm*, Sweden.

Fig. 6.4.3 Svartisen Ice Caps, Norway, with Engabreen outlet glacier to the middle left. Source: ASTER satellite image (35x21 km) and close-ups, 11 August 2006.

Ice covered area (km²):	2 940

Front variation	
number of series:	65
average number of observations:	30
average time length (years):	53

Mass balance	
number of series:	39
average number of observations:	16

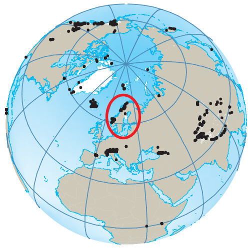
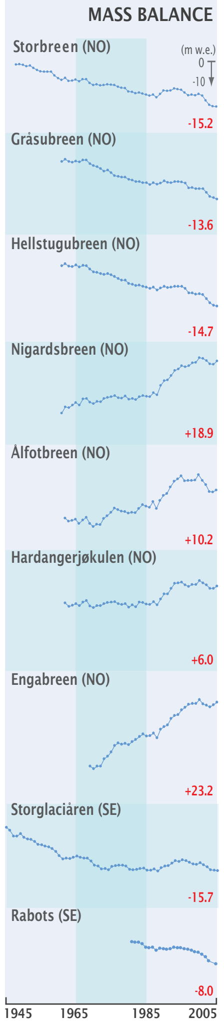



Fig. 6.4.2 Kebnekaise region



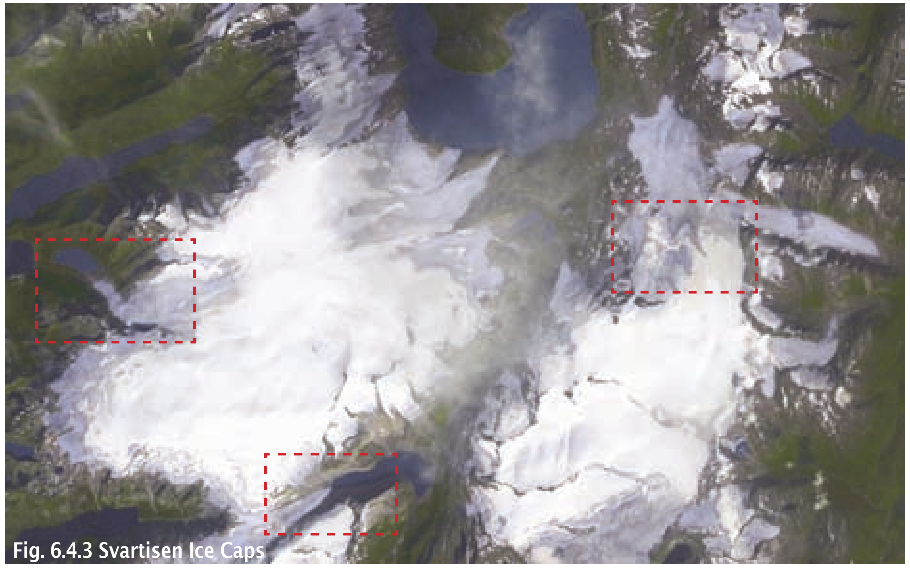


Fig. 6.4.3 Svartisen Ice Caps


Fig. 6.4.3a

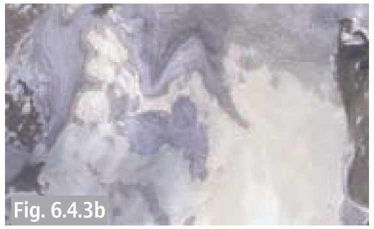


Fig. 6.4.3b


Fig. 6.4.3c

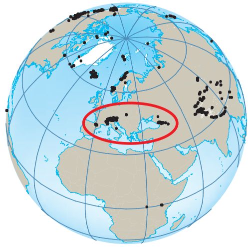
6.5 Central Europe

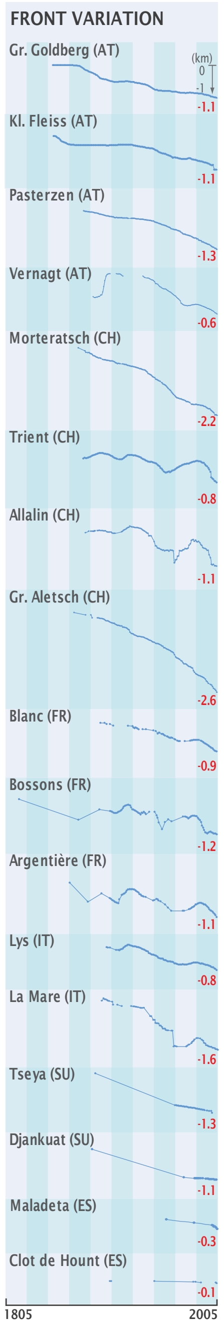
Glaciers are found in the European Alps, the Pyrenees, and the Caucasus Mountains. Central Europe has the greatest number available of length change and mass balance measurements, with many long-term data series.

Ice covered area (km²):	3 785

Front variation	
number of series:	764
average number of observations:	35
average time length (years):	65

Mass balance	
number of series:	43
average number of observations:	20





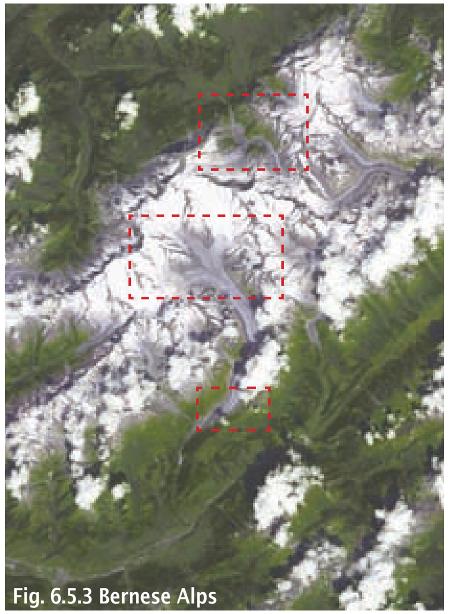
In Central Europe, almost two-thirds of the perennial surface ice cover is located in the Alps with Aletsch Glacier as their greatest valley glacier. The Alps represent the 'water tower' of Europe and form the watershed of the Mediterranean Sea, the North Sea/North Atlantic Ocean, and the Black Sea. The highest peak is Mont Blanc, at 4 808 m asl, near the Italian-French border. About one-third of the region's ice cover is represented by glaciers in the Caucasus Mountains which are situated between the Black Sea and the Caspian Sea. Most glaciers are located in the northern part known as the Ciscaucasus with Mount Elbrus (5 642 m asl) considered as the highest peak in Europe. Some smaller glaciers are found in the Pyrenees – a mountain range in southwest Europe. It extends from the Bay of Biscay to the Mediterranean Sea. The glaciers are situated in the Maladeta massif in Spain with the highest peak of the Pyrenees, Pico d'Aneto (3 404 m asl), and around the peak Vignemale (3 298 m asl) in France. A few more perennial ice fields are found e.g. in the Appennin, Italy, as well as in Slovenia and Poland. In the densely populated Alps, glaciers are a unique resource of freshwater for domestic, agricultural, and industrial use, an important economic component of tourism and hydro-electric power production, but also a source of natural hazards. One of the largest historical glacier disasters occurred in 2002 in North Ossetia, in the Caucasus. An ice-rock avalanche in the Kazbek region resulting from a slope failure sheared off almost the entire Kolka Glacier and devastated the Genaldon valley, causing the death of about 140 people (Huggel et al. 2005).

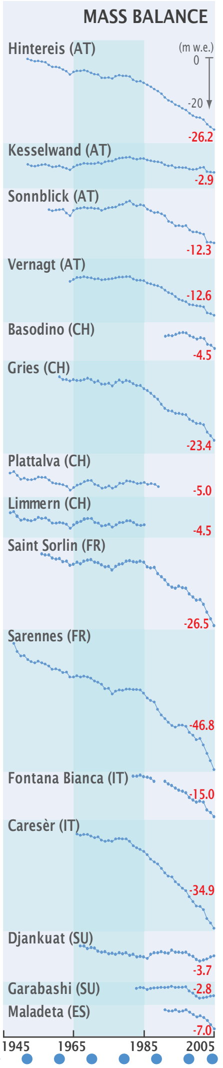
Fig. 6.5.1 Aerial view toward the Maladeta Massif, Spain, with Pico d'Aneto (left), Aneto Glacier (center) as well as Maladeta Glacier (right) from September 2002. Source: M. Arenillas, *Ingeniería 75*, Spain.

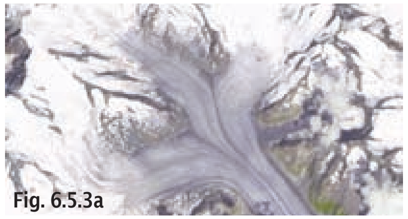
In the Alps as well as in the Pyrenees and in the Caucasus most glaciers reached their LIA maximum towards mid 19th century (Gross 1987, Maisch et al. 2000, Grove 2004). Annual observations of glacier front variations started in the second half of the 19th century in Austria, Switzerland, France and Italy resulting in more than 680 data series, distributed over the entire Alpine mountain range. There are over 40 front variation series available for the Caucasus, mostly starting in the 2nd half of the 20th century and a few going back to the 1930s. There are two glaciers in the Pyrenees with length change data, one starting in the 1980s and a second one covering the 20th century, though with a few observation points. Mass balance measurements started in 1949 in the Alps, in 1968 in the Caucasus, and in 1992 on Maladeta Glacier in the Pyrenees. Overall mass balance data is available for 43 glaciers, with 10 continuous series since 1968.

Fig. 6.5.2 Mount Elbrus, seen from the north (photograph taken in September 2007). Source: A. Kääb, *University of Oslo*, Norway.

The front variations show a general trend of glacier retreat over the past 150 years with intermittent Alpine glacier re-advances in the 1890s, 1920s, and 1970–1980s (Patzelt 1985, Pelfini and Smiraglia 1988, Zemp et al. 2007b). The Alpine glacier cover is estimated to have diminished by about 35 per cent from 1850 to the 1970s and another 22 per cent by 2000 (Paul et al. 2004, Zemp et al. 2007b). Mass balance measurements show an accelerated ice loss after 1980 (Vincent 2002, Huss et al. 2008) culminating in an annual loss of 5 to 10 per cent of the remaining ice volume in the extraordinarily warm year of 2003 (Zemp et al. 2005). In the Caucasus, glacier retreat since the end of the LIA is also widespread, with a certain amount of mass gain in the late 1980s and the early years of the 21st century. The recent retreat was associated with an increase in debris cover and glacier lake development (Stokes et al. 2007). Since the first half of the 19th century, about two-thirds of the ice cover was lost in the Pyrenees with a marked glacier shrinking after 1980 (Chueca et al. 2005).







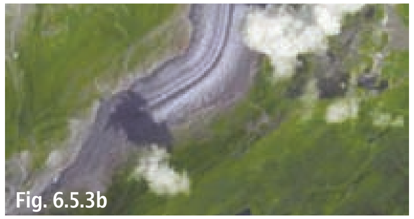


Fig. 6.5.3 Bernese Alps with Grosser Aletsch Glacier in the center, Swiss Alps. Source: ASTER satellite image (32 x 44 km) and close-ups, 21 July 2006.

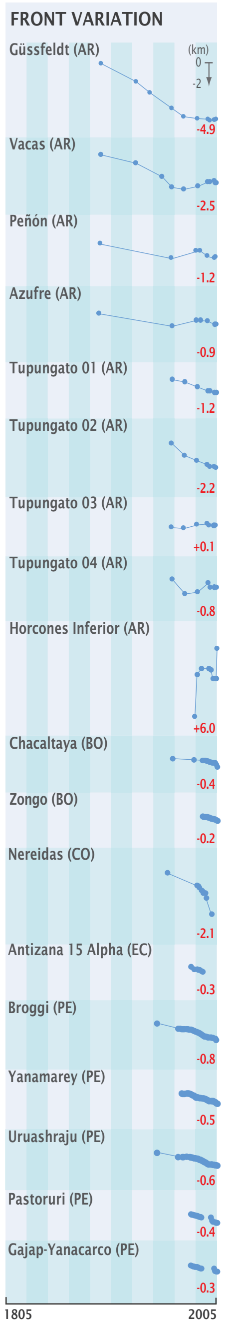
6.6 South America

Glaciers are widespread along the Andes from the tropical ice bodies in the north to the Patagonian Icefields and the Tierra del Fuego in the south. The available fluctuation series cover the time period since the 1960s.

Ice covered area (km²):	25 500

Front variation	
number of series:	160
average number of observations:	4
average time length (years):	36

Mass balance	
number of series:	11
average number of observations:	8



The Andes, stretching over 7 000 km, is the world's longest continental mountain range and a distinct feature of South America, forming a continuous chain of mountains in a north-south direction along the entire west coast. In the north-central portion of South America the Andes are divided into several ridges which span some hundred km in width, whereas to the south the Andes form a narrower and more concentrated chain. The highest peak is the Aconcagua (6 962 m asl), situated in Argentina close to the border with Chile. The climate of the Andes varies greatly depending on latitude, altitude and proximity to the sea. This is found for example in the snowline altitude, which is at 4 500 – 4 800 m asl in the tropical Andes of Ecuador, Colombia, Venezuela, and northern Peru, rises to 5 000–6 500 m asl in the Atacama desert (northern Chile), then descends to 4 500 m asl on Aconcagua at 32° S, 2 000 m asl at 40° S, 650–1 000 m asl at 50° S, and only 300 m asl at 55° S (Troll 1973).

Approximate glacier areas for tropical South America are: 1.8 km² for Venezuela, 87 km² for Colombia, 90 km² for Ecuador, 1 780 km² for Peru and 534 km² for Bolivia (Kaser and Osmaston 2002). By far the largest ice cover at about 23 000 km² is found in Chile and Argentina, with more than 85 per cent located in the Northern and Southern Patagonian Icefields and in the Cordillera Darwin Icefield in Tierra del Fuego (Naruse 2006). Glaciers in South America are critically important as a water resource for domestic, agricultural and industrial uses, particularly in equatorial, tropical and subtropical latitudes (Casassa et al. 2007). Andean glaciers also pose a natural hazard, for example, in the form of lahars related to volcanic eruptions, rock/ice avalanches, debris flows and glacier floods related to gravity, climatic processes and ice dynamics (Casassa et al. 2007).

In the southern Andes, most glaciers reached their LIA maximum between the late 17th and early 19th centuries (Villalba 1994). The Peruvian glaciers were in advanced positions in the 1870s, followed by a rapid retreat (Grove 2004). Of the available in-situ mass balance measurements from the Andes only a dozen cover more than a decade, with earliest observations starting at the end of the 1960s. Mass balance is currently being measured on 28 glaciers from which eleven series have been reported. Long-term series comes from Echaurren Norte in central Chile with more than 30 years of continuous mass balance measurements, as well as from Zongo and Chacaltaya in Bolivia (14 years), and Antizana 15 Alpha in Ecuador (11 years). The observations thus include the glacier shrinkage of the past decades. There have been a few cases of surging glaciers, the most recent being Horcones Inferior in Argentina, with two major surge events starting in 1984 and in 2004 (Milana 2007). The small number of available data series indicates the problems encountered when conducting such measurements under difficult logistical conditions and with unreliable financial support (Casassa et al. 2007). Except for a few cases in Patagonia and Tierra del Fuego, glaciers in South America have shown a general retreat and wasting since the LIA maximum extent with an enhanced retreat trend in recent decades (Casassa et al. 2007).

The Northern Patagonian Icefield lost about 3.4 per cent (140 km²) of its area between 1942 and 2001, whereby the frontal tongues of calving glaciers were observed to be an important source of recession and area change (Rivera et al. 2007). Thinning rates of up to 30 m/y have been observed recently in the Southern Patagonian Icefield, with a relevant contribution to sea level rise (Rignot et al. 2003).


Fig. 6.6.1 Glaciarised volcanoes in Colombia

Fig. 6.6.1 Glacierised volcanoes in Colombia. The view to the north shows the active volcanos Nevado del Tolima (foreground) and Nevado del Ruiz (background, right) as well as the the inactive Santa Isabel (background, center). The photograph was taken in 2002. Source: J. Ramírez Cadena, *INGEOMINAS*, Colombia.

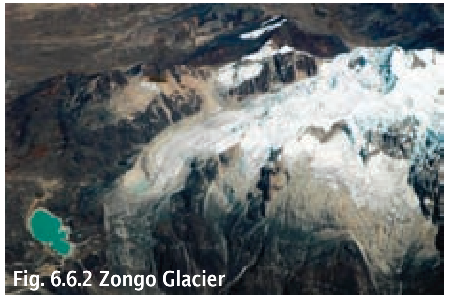
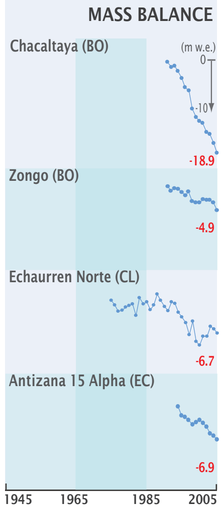


Fig. 6.6.2 Zongo Glacier

Fig. 6.6.2 Zongo Glacier and downstream hydroelectric power station located north-east of La Paz city, Bolivia. Photograph taken in July 2006. Source: B. Francou, *IRD*, Bolivia.



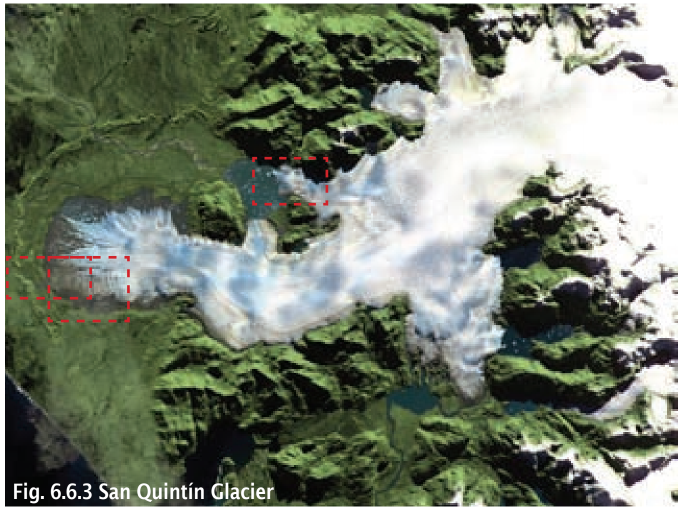


Fig. 6.6.3 San Quintín Glacier


Fig. 6.6.3.a


Fig. 6.6.3.b

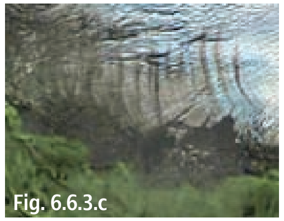


Fig. 6.6.3.c

Fig. 6.6.3 San Quintín Glacier, Northern Patagonian Icefield. Source: ASTER satellite image in artificial natural colors (35 x 28 km) and close-ups, 2 May 2000.

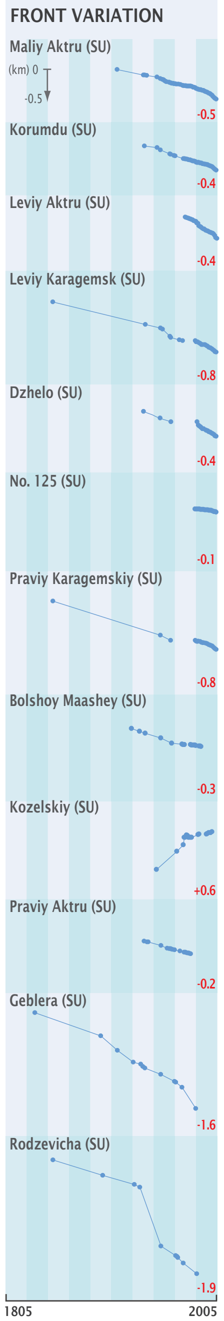
6.7 Northern Asia

The majority of land surface ice in Northern Asia is located on the East Arctic Islands such as Novaya Zemlya, Severnaya Zemlya and Franz Josef Land, as well as distributed in the mountain ranges from the Ural to the Altay, in the east Siberian mountains and Kamchatka. The available data series are sparse and most of the few measurements were discontinued in latter decades of the 20th century.

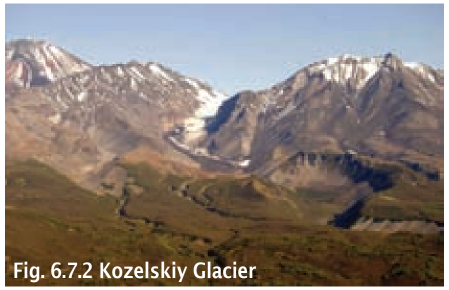
Ice covered area (km^2): 59 600

Front variation	
number of series:	24
average number of observations:	14
average time length (years):	55

Mass balance	
number of series:	14
average number of observations:	14

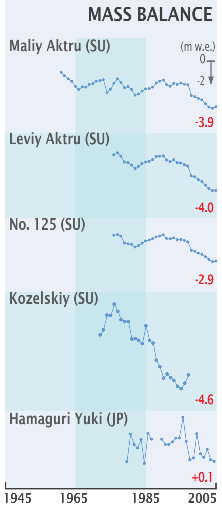


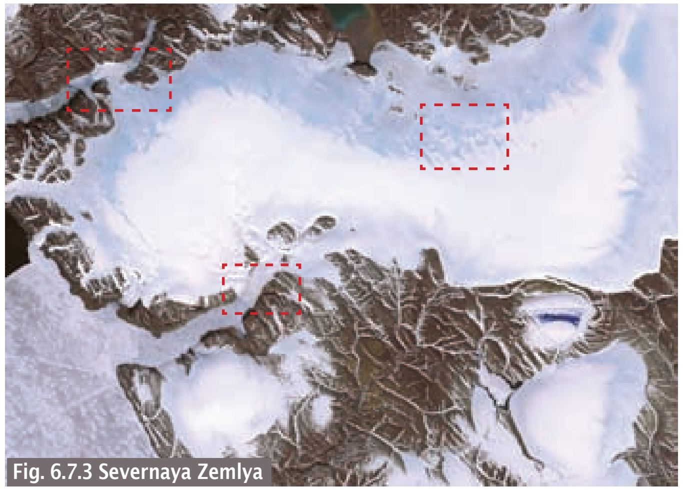
Most of the glacier ice in Northern Asia is concentrated on the East Arctic Islands (total ice cover of about 56 000 km^2) such as Novaya Zemlya (23 645 km^2), Severnaya Zemlya (18 325 km^2) and Franz Josef Land (13 735 km^2). In addition, glaciers occur in the mountain ranges from the Ural to the Altay, and Kamchatka with a total area of about 3 500 km^2 (Dyurgerov and Meier 2005). The glaciers on the East Arctic Islands are not well investigated due to their remote location in the Barents and Kara Sea. They are very much influenced by the extent of sea ice and the North Atlantic oscillations, and some of them are tidewater glaciers. Dated moraines suggest LIA maxima around or after 1300 for some glaciers, and the late 19th century for others on Novaya Zemlya (Zeeberg and Forman 2001). The Altay extends over about 2 100 km from Kazakhstan, China, Russia to Mongolia, reaching its highest elevation of 4 506 m asl on Belukha Mountain in the Russian Altay. Until recently, investigations in the Altay failed to disclose evidence of early LIA advances (Kotlyakov et al. 1991). New studies based on lichenometry indicate extended glacier states in the late 14th and mid 19th century (Solomina 2000). The east Siberian Mountains, such as Cherskiy Range, Suntar-Khayata, and Kodar Mountains, show only small amounts of glacier ice and the knowledge on these glaciers is limited. Gurney et al. (2008) mapped more than 80 glaciers in the Buordakh Massif, in the Cherskiy Range (northeast Siberia), a region with a total glacierised area of about 70 km^2. The LIA maximum extents have also been delineated and have been dated to 1550–1850 AD (Gurney et al. 2008). The topography of Kamchatka is characterised by numerous volcanoes with heights up to 5 000 m asl. Therefore, some of the glaciers are strongly influenced by volcanic activities. Here, the maximum stage of the LIA was reached in the mid to late 19th century (Grove 2004), with advances of similar magnitudes in the 17th, 18th century (Solomina 2000).



The few available fluctuation series mainly come from the Russian Altay, with half a dozen front variation series covering the entire 20th century and three continuous mass balance series extending back to 1977, from Leviy Aktru and No. 125 (Vodopadniy), and to 1962 from Maliy Aktru. Some information is available from Kamchatka with front variation and mass balance measurements from 1948–2000 and 1973–1997, respectively, and a few short-term series from the Northern Ural and Severnaya Zemlya. Most of the observation series were discontinued at the end of the 20th century. A particular challenge in this region, as well as in parts of Central Asia, has been the breakdown of the Soviet system in 1989 and the related loss in expertise in and capacities for glacier monitoring. In Japan, mass balance measurements have been carried out since 1981 on Hamaguri Yuki, a perennial snow patch at 2 750 m asl in the Tateyama Mountain, Central Japan (Higuchi et al. 1980).

In the Arctic islands a slight reduction in the glacierised area by little more than one per cent over the past 50 years has been found (Kotlyakov et al. 2006). Tidewater calving glaciers in north Novaya Zemlya underwent a rapid retreat in the first half of the 20th century, half of them being stable during 1952 to 1964, with a more moderate retreat occurring up to 1993 (Zeeberg and Forman 2001). A study based on satellite images shows that from 40 outlet glaciers on north Novaya Zemlya, 36 retreated and only four advanced between 1990 and 2000 (Kouraev et al. 2008). Russian studies show that in the Urals, some glaciers have disappeared completely, while in the Altay, glaciers have been shrinking continuously since the mid 19th century (Kotlyakov et al. 2006) accelerating from seven per cent ice loss between 1952 and 1998 to four per cent between 1998 and 2006 (Shahgedanova et al. 2008). Comparisons with Landsat satellite images of 2003 have shown that the glacier extent of Suntar-Khayata has diminished by 19 per cent since 1945, and in the Cherskiy Range by 28 per cent since 1970 (Ananicheva 2006). On average, the scale of glacier shrinkage was much smaller in continental Siberia than in central Asia and along the Pacific margins (Solomina 2000). On Kamchatka both retreats and advances have occurred on glaciers influenced by volcanoes, whereas a general retreat was found on glaciers located in the coastal area (Kotlyakov et al. 2006).





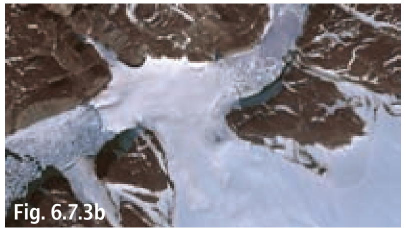


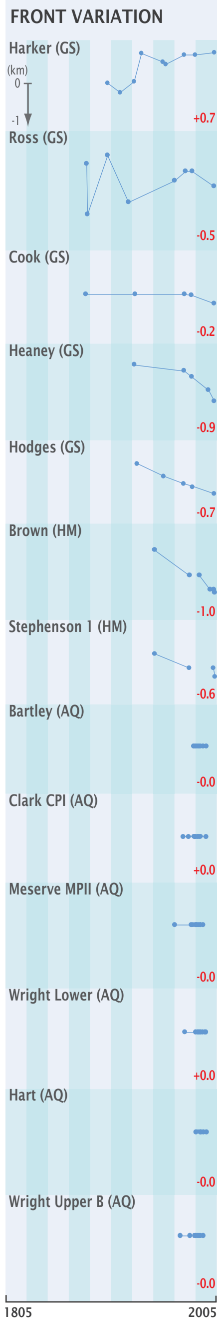
Fig. 6.7.1 Maliy Aktru Glacier located in the Russian Altay (photograph taken in July 2007). Source: W. Hagg, *LMU Munich*, Germany.

Fig. 6.7.2 Kozelskiy Glacier on Kamchatka in September 2007. Source: A.G. Manevich, *Russian Academy of Sciences*.

Fig. 6.7.3 Ice caps on Severnaya Zemlya, Russian Arctic. ASTER satellite image (63 x 47 km) and close-ups, 19 August 2003.

6.8 Antarctica

Mainly due to the remoteness and the immense size of the ice masses, little is known about the distribution and changes in the large number of glaciers and ice caps around the continental ice sheet in Antarctica and on the Subantarctic Islands.



The vast majority of glaciers and ice caps in the Antarctica are located on the Antarctic Peninsula and around the Antarctic Ice Sheet, with an overall estimated area ranging from 70 000 km^2 (Dyurgerov and Meier 2005) to 169 000 km^2 (Shumsky 1969). This large uncertainty results from the difficulty to differentiate clearly between the various glaciers and ice caps, and the ice bodies closely linked to the continental ice sheet. Weidick and Morris (1998) describe three categories of local glaciers outside the ice sheet: coastal glaciers, ice streams which are discrete dynamic units attached to the ice sheet, and isolated ice caps. Coastal local glaciers are most obvious in the McMurdo Dry Valleys within Victoria Land and on the Antarctic Peninsula. The latter is covered by a long, relatively narrow and thin ice field nourishing valley glaciers, which cut through the coastal mountains and terminate in ice cliffs at sea level. Ice streams range from smaller ones on the southern part of the Antarctic Peninsula to larger ones flowing from the central Antarctic Plateau down to the Ross or Filchner-Ronne ice shelves. Examples of the third type are the ice rises on the Larsen and Filchner-Ronne ice shelves. Berkner Island, the largest ice rise in the world, is located on the latter (Swithinbank 1988). Evidence of the timing of LIA glacier maxima south of the Antarctic Circle (66˚ 30’ S) is sparse due to the lack of organic material for dating (Grove 2004).

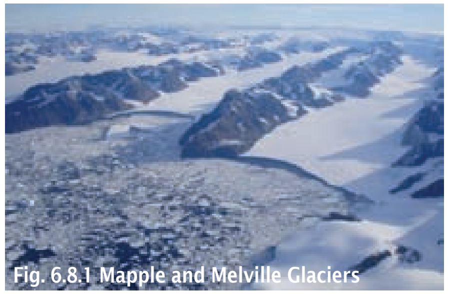


Fig. 6.8.1 Mapple and Melville Glaciers

In addition to Antarctica, glaciers and ice caps are situated on Subantarctic Islands such as the South Shetland Islands, South Georgia, Heard Island and Kerguelen, with a total estimated ice cover of roughly 7 000 km^2 (Dyurgerov and Meier 2005). On the South Shetland Islands, at least ten glacial events were found to have occurred between 1240 and 1991 (Birkenmajer 1998, Clapperton 1990). South Georgia is located about 1 400 km east-southeast of the Falkland / Malvinas Islands. More than half of it is ice covered, with most of the glaciers extending to the sea (Clapperton et al. 1989a, b). Clapperton et al. (1989a, b) described LIA advances beginning after the late 13th century and culminating in the 18th, 19th and 20th centuries. Heard Island is situated in the Southern Indian Ocean, 1 650 km north of the Antarctic continent. The island is characterised by two volcanoes; the larger and still active one, Big Ben, reaching 2 750 m asl. Some 21 glaciers are identified on the volcanic cone (Ruddell 2006); typically, they widen and steepen toward the sea, and terminate in ice cliffs (Grove, 2004). A total of 70 per cent of the island is ice covered (Ruddell 2006, Thost and Truffer 2008).

Fig. 6.8.1 Oblique aerial photograph with Antarctic Peninsula plateau in the background (March 11, 2007). From north to south (right-left) the Mapple and Melville Glaciers, which are calving at present into the Larsen B embayment. Both glaciers nourished formerly the Larsen B ice shelf, which collapsed within a few weeks in February–March 2002, during the warmest summer ever recorded in the region. Source: P. Skvarca, *Instituto Antártico Argentino*.

Fig. 6.8.2 Wright Lower Glacier with Lake Brownworth, Dry Valleys in Antarctica (January 14, 2007). The Wright Lower Glacier is fed from the Wilson-Piedmont Glacier. The Onyx River dewaters from Lake Brownworth into the drainless Lake Vanda. The nunatak is called King Pin (820 m) and at the far back Mt Erebus (3794 m), the most southern active volcano, is visible. Source: D. Stumm, *University of Otago*, New Zealand.

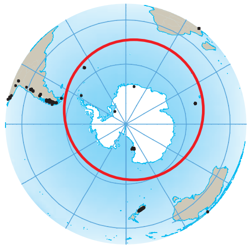
Ice covered area (km^2):	77 000

Front variation

number of series:	48
average number of observations:	3
average time length (years):	30

Mass balance

number of series:	1
average number of observations:	4



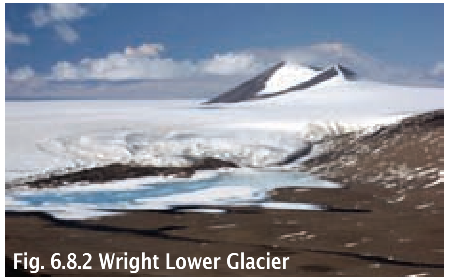
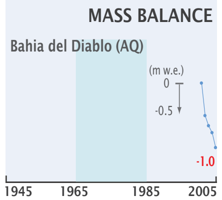


Fig. 6.8.2 Wright Lower Glacier

A number of front variation series as derived from expedition reports, aerial photographs and satellite images are available from the Dry Valleys in Antarctica extending back to the 1960s, as well as from South Georgia, back to the late 19th century, and from Heard Island back to 1947. In summer 1999–2000, a detailed mass balance monitoring program was initiated on Glaciar Bahía del Diablo, a glacier on Vega Island, at the northeastern side of the Antarctic Peninsula (Skvarca and De Angelis 2003, Skvarca et al. 2004). Additional reconstructions and measurements are reported in the literature, e.g. from Kerguelen (e.g., Frenot et al. 1993) and South Shetland Islands (e.g., Hall 2007), with no data having been reported to the WGMS.

Cook et al. (2005) mapped 244 glaciers on the Antarctic Peninsula and adjacent islands, most of them terminating in the sea. Their analyses of aerial photographs and satellite images showed that 87 per cent of the glaciers have retreated over the last six decades. A general glacier recession trend of different spatial pattern on the Antarctic Peninsula was previously reported by Rau et al. (2004), who investigated the ice-front changes north of 70˚ S over the period 1986–2002. Large retreat and thinning rates over the past two decades have been reported from glaciers terminating on land on Vega and James Ross Islands, as well as strong glacier acceleration, surges and retreats subsequent to the collapse of the Larsen Ice Shelf A and B sections (De Angelis and Skvarca 2003, Rott et al. 2002, Skvarca and De Angelis 2003). Glaciers on South Georgia receded overall by varying amounts from their more advanced positions in the 19th century, with large tidewater glaciers showing a more variable behavior and remaining in relatively advanced positions until the 1980s. Since then, however, most glaciers have receded; some of these retreats have been dramatic and a number of small mountain glaciers are about to disappear (Gordon et al. 2008). According to expedition records, little or no change occurred on glaciers at Heard Island during the first decades of the 20th century (Grove 2004). However, in the second half, recession of glaciers has been widespread. A recent study yields a reduction in the overall ice extent of about 29 per cent from 1947 to 2003 (Thost and Truffer 2008), interrupted by a re-advance of some glaciers in the 1960s (Radok and Watts 1975).



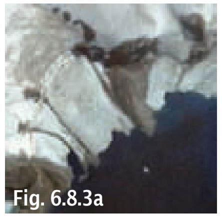


Fig. 6.8.3a

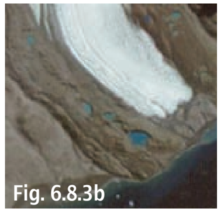


Fig. 6.8.3b

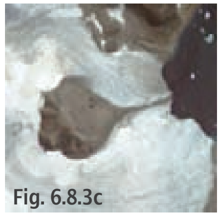


Fig. 6.8.3c

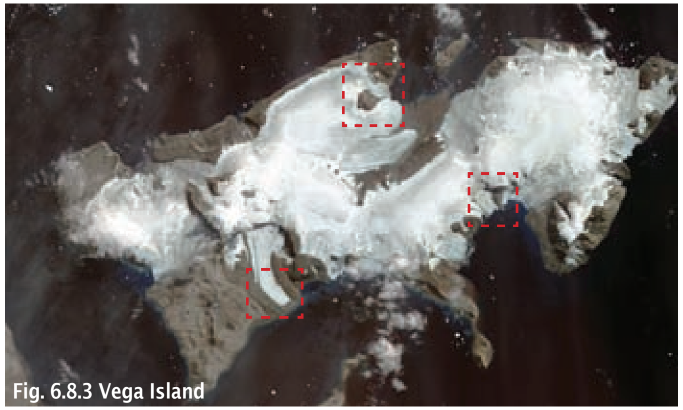
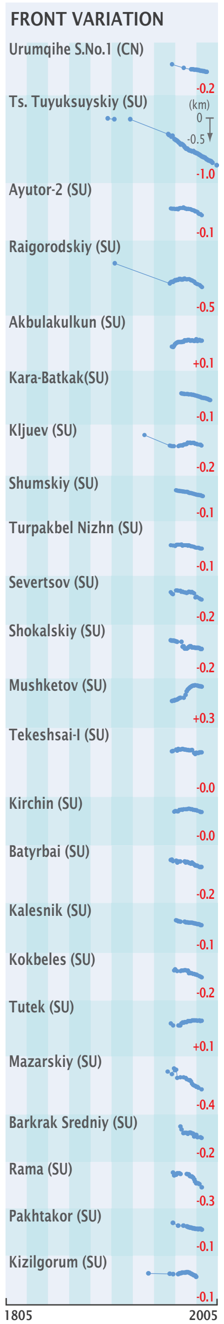


Fig. 6.8.3 Vega Island

Fig. 6.8.3 Bahía del Diablo on Vega Island, at the northeastern side of the Antarctic Peninsula. Source: ASTER satellite image (37 x 20 km) and close-ups, 27 January 2006.

6.9 Central Asia

The main mountain range of Central Asia is the Himalaya and its adjacent mountain ranges such as Karakoram, Tien Shan, Kunlun Shan and Pamir. The sum of its glacierised area corresponds to about one sixth of the global ice cover of glaciers and ice caps. The available observations are distributed well over the region but continuous long-term fluctuations series are sparse.



Central Asia with an estimated total ice cover of 114 800 km^2 has as its dominant mountain range the Himalaya, where most of the glaciers occur (33 050 km^2) and its adjacent mountain ranges (with corresponding ice areas): Karakoram (16 600 km^2), Tien Shan (15 417 km^2), Kunlun Shan (12 260 km^2) and Pamir (12 260 km^2) mountains (Dyurgerov and Meier 2005). The Himalaya is the highest mountain range of the world and extends from the Nanga Parbat (8 126 m asl) in the NW over 2 500 km to the Namcha Barwa (7 782 m asl) in the SE with a north-south extent of 180 km (Burga et al. 2004). The climate, and the precipitation in particular, is characterised by the influence of the South Asian monsoon in summer and the mid-latitude westerlies in winter. In Central Asia, glacier degradation is accompanied by increasing debris cover on many glacier termini and the formation of glacier lakes (Ageta et al. 2000). Such lakes, sometimes also dammed due to glacier surges (Kotlyakov et al. 2008), have the potential to threaten downstream areas with outburst floods (Wessels et al. 2002). The mountain ranges of Central Asia function as water towers for millions of people. Glacier runoff thereby is an important freshwater resource in arid regions as well as during the dry seasons in monsoonal affected regions (Barnett et al. 2005).


Fig. 6.9.1 Ts. Tuyuksuyskiy Glacier

The LIA is considered to have lasted until the mid or late 19th century in most regions (Grove 2004) with glacier maximum extents occurring between the 17th and mid 19th century (Solomina 1996, Su and Shi 2002, Kutuzov 2005). The available 310 front variation series are distributed over most of the region, and the first observations started early in the 20th century. About 10 per cent of the series extend back to the first half of the 20th century but only 24 data series, located in Pamir and Tien Shan, consist of more than 15 observation series. Unfortunately, 90 per cent of the observations series were discontinued before 1991 and only about a dozen series have reported information in the 21st century. The distribution of mass balance series in space and time shows a similar pattern. Just six (out of 35) series consist of more than 15 observation years and only two of them, Ts. Tuyuksuyskiy (Kazakh Tien Shan) and Urumqihe South No.1 (Chinese Tien Shan) are still surveyed every year. As in Northern Asia, the breakdown of the Soviet System in 1989 might partly explain the breakdown of the observation network in the 1990s. Within Central Asia, the Himalaya is strongly underrepresented in terms of front variation and mass balance observations, and most series are comparably short.


Fig. 6.9.2 Baltoro Glacier in the Karakoram

Fig. 6.9.1 Tsentralniy Tuyuksuyskiy, Kazakh Tien Shan, in September 2003. Source: V.P. Blagoveshchenskiy.

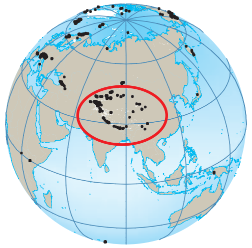
Fig. 6.9.2 Panoramic view with direction NNE to the confluence of the Godwin Austen Glacier, flowing south from K2 (8 611 m asl), with the Baltoro Glacier in the Karakoram. Source: C. Mayer, *Commission for Glaciology of the Bavarian Academy of Sciences.*

Fig. 6.9.3 Himalaya main ridge between Bhutan and Tibet. Source: ASTER satellite image (56 x 32 km) and close-ups, 20 January 2001.

Ice covered area (km^2):	114 800

Front variation	
number of series:	310
average number of observations:	5
average time length (years):	22

Mass balance	
number of series:	35
average number of observations:	13



Regional studies based on remote sensing data help to provide a better overview on the recent changes in the Central Asian ice cover. Glacier retreat was dominant in the 20th century, except for a decade or two around 1970, when some glaciers gained mass and even reacted with re-advances of a few hundred metres. After 1980 ice loss and glacier retreat was dominant again. In Bhutan, Eastern Himalaya, an eight per cent glacier area loss was observed between 1963 and 1993 (Karma et al. 2003). Berthier et al. (2007) used remote sensing data to investigate glacier thickness changes in the Himachal Pradesh, Western Himalaya. They found an annual ice thickness loss of about 0.8 m w.e. per year between 1999 and 2004 – about twice the long-term rate of the period 1977–1999. In China, the overall glacier area loss is estimated at about 20 per cent since the maximum extent in the 17th century (Su and Shi 2002). The area loss since the 1960s is estimated to about 6 per cent, and is more pronounced in the Chinese Himalaya, Qilian Mountains and Tien Shan, but with rather small recessions in the hinterland of the Tibetan plateau (Li et al. in press). Over the 20th century, glacier area is estimated to have decreased by 25–35 per cent in the Tien Shan (Podrezov et al. 2002, Kutuzov 2005, Narama et al. 2006, Bolch 2007), by 30–35 per cent in the Pamirs (Yablokov 2006), and by more than 50 per cent in northern Afghanistan (Yablokov 2006).

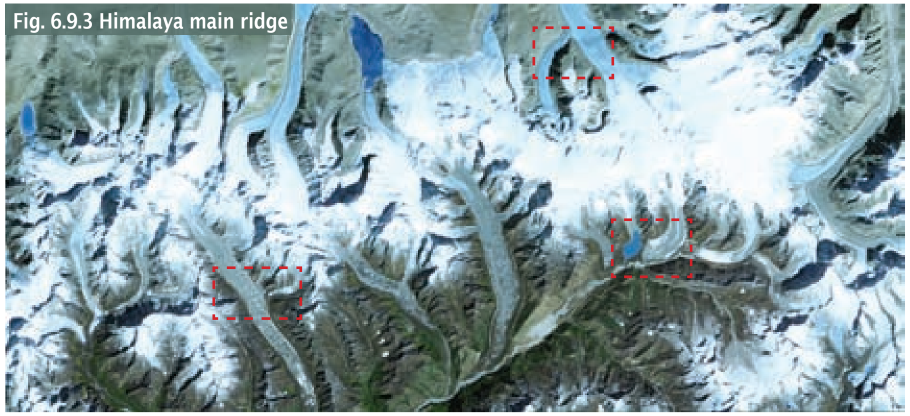


Fig. 6.9.3 Himalaya main ridge

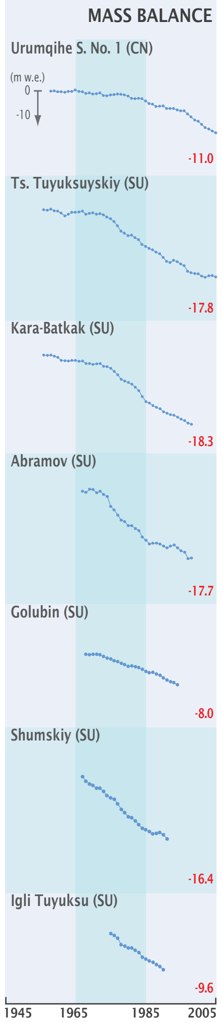



Fig. 6.9.3a

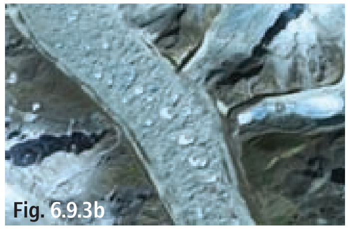


Fig. 6.9.3b

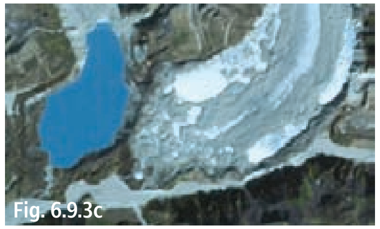


Fig. 6.9.3c

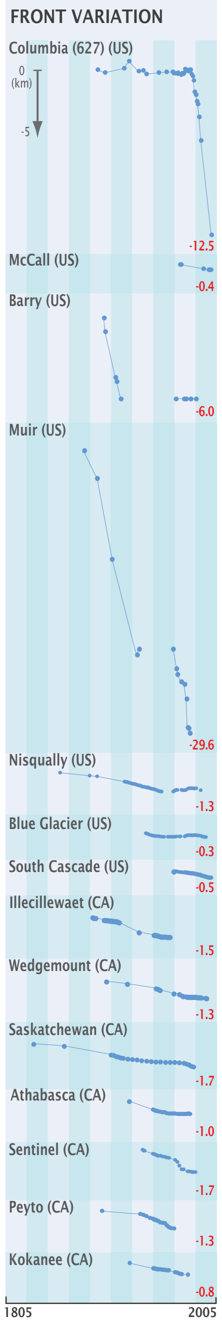
6.10 North America

North American glaciers are located on mountains in the west of the continent from Alaska down to the Canadian and US Rockies, and on volcanoes in Mexico. A lot of the length change observations were discontinued at the end of the 20th century, but there still are several long-term mass balance series.

Ice covered area (km^2): 124 000

Front variation	
number of series:	221
average number of observations:	5
average time length (years):	37

Mass balance	
number of series:	45
average number of observations:	16



Most of the mountain ranges in North America are found on the west of the continent, parallel to the coastline. Prominent are the "Rocky Mountains", which spread over more than 3 000 km from the Mexican border through the United States and into Canada and eastern Alaska. To the north they extend into the Alaska Range and the Brooks Range. The highest peak of the continent is Mount McKinley / Denali (6 193 m asl), which is situated in the Alaska Range. Glaciers and ice fields in the region presented here cover almost as much area as in the Canadian Archipelago (see section 6.11 Arctic Islands) with about 75 000 km^2 in Alaska and about 49 000 km^2 in the conterminous USA and western Canada. In the latter, glaciers are situated in the Rocky Mountains and Interior Ranges, and along the coast of the Pacific Ocean, where they are in some regions continuous with Alaskan Glaciers (Williams and Ferrigno 2002). In general, the climate of the mountain ranges shows strong variations depending on latitude, altitude and proximity to the sea. Therefore, the glaciers in the south are much smaller and occur at higher elevations than in the higher latitudes, where some glaciers extend down to the shore. In Mexico, small glaciers occur on the peaks of three volcanoes, namely on Pico de Orizaba, Iztaccíhuatl, and Popocatépetl (White 2002).

In conterminous USA and Canada glaciers reached their LIA maximum extent in the mid to late 19th century (Kaufmann et al. 2004). In Alaska, the LIA maxima were attained at various times; for the northeast Brooks Range it was the late 15th century, and for the Kenai Mountains, the mid 17th century (Grove 2004). However, most of the Alaskan glaciers reached the LIA maximum extent between the early 18th and late 19th centuries (Molnia 2007). Although several dozen front variation observations exist for the 20th century, most of the series were discontinued in the 1980s or 1990s. Half of the 45 reported mass balance series cover ten or more measurement years. Among these there are seven with 39 or more years of observations, including for example Peyto Glacier in the Canadian Rockies, Place and South Cascade Glacier in the Cascade Mountains, as well as Lemon Creek, Gulkana and Wolverine Glacier in Alaska, with some extending as far back as the early 1950s. Half of the mass balance series were not continued into the 21st century.

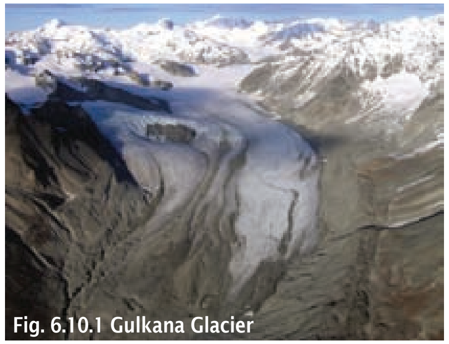


Fig. 6.10.1 Gulkana Glacier

Fig. 6.10.1 Gulkana Glacier in the Alaska Range, USA. Photograph was taken October 5, 2003. Source: R. March, *United States Geological Survey.*

Fig. 6.10.2 South Cascade Glacier in the Canadian Rockies. Photograph was taken in 2001. Source: M.N. Demuth, *Natural Resources Canada.*

Fig. 6.10.3 Section of Kenai Mountains, Alaska, USA, with Wolverine Glacier to the middle bottom. Source: ASTER satellite image (37 x 48 km) and close-ups, 8 September 2005.

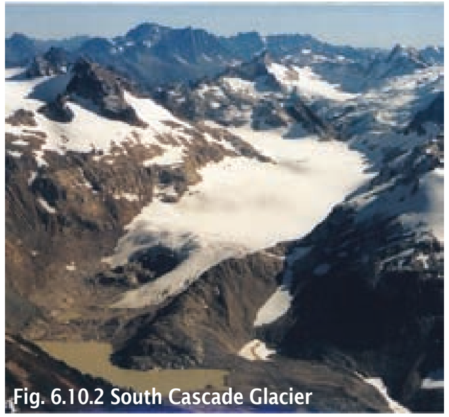


Fig. 6.10.2 South Cascade Glacier

The glacier observations show a general retreat after the LIA maximum, particularly at lower elevations and southern latitudes (Molnia 2007), which slowed down somewhat between the 1950s and 1970s (La Chapelle 1960) and accelerated again after the 1970s. Distinct exceptions to this overall trend are found in the fluctuations of certain tidewater glaciers such as Muir (Saint Elias Mountains), Columbia 627 (Chugach Mountains), or Taku Glacier (Alaskan Panhandle). Mass balance measurements show strong accelerating ice losses since the mid 1970s (Demuth and Keller 2006, Josberg et al. 2007, Moore and Demuth 2001) which was confirmed by remote sensing studies in Alaska and Canada (Arendt et al. 2002, Demuth et al. 2008, Larsen et al. 2007). In the Western Cordillera of the Rocky Mountains the glacier area loss since the LIA is estimated at about 25 per cent (Fountain et al. 2006, Luckman 2000, Luckman 2006). Small glacier diminution appears to be a distinct feature of the past century and a half of ice observation in some regions (Canadian Rocky Mountain eastern slopes: Demuth et al. 2008; North Cascades: Granshaw and Fountain 2006). It is recognised in both instances however, that topographic controls and glacier dynamics can be the source of significant local and regional variability (e.g., DeBeer and Sharp 2007).

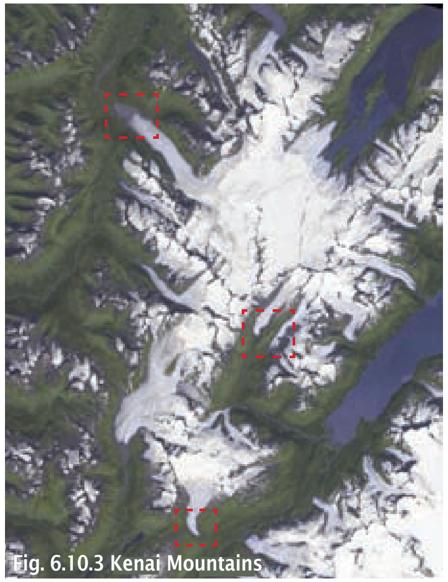


Fig. 6.10.3 Kenai Mountains

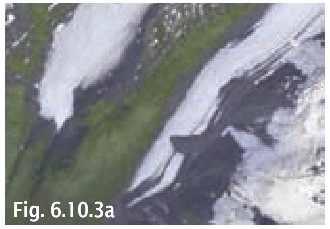
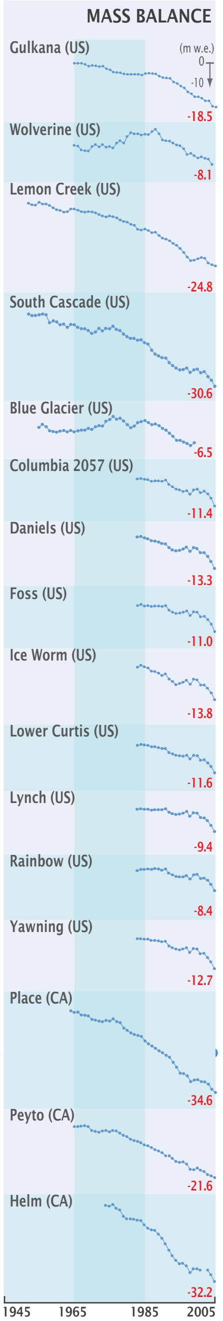


Fig. 6.10.3a

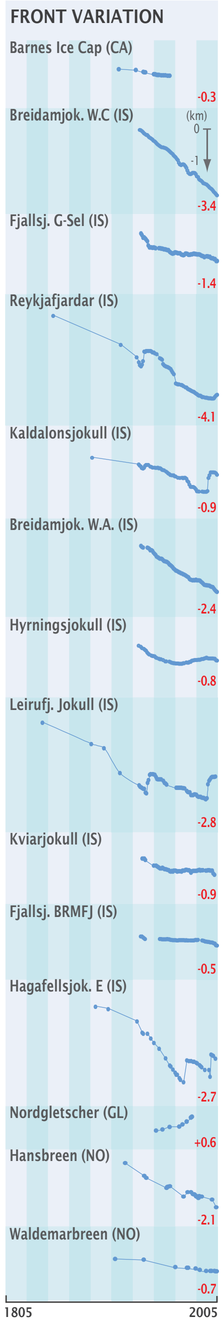

Fig. 6.10.3b


Fig. 6.10.3c



6.11 Arctic Islands

Glaciers and ice caps are found on the Canadian Arctic Archipelago and around the Greenland Ice Sheet, as well as on the West Arctic Islands, Iceland, and Svalbard. The majority of the fluctuation measurements have been reported from the latter two regions.



The Arctic Islands consist of Greenland, the Canadian Arctic Archipelago to the west, Iceland, Svalbard and the West Arctic Islands, as well as the East Arctic Islands (see section Northern Asia) to the east. More than half of the area covered by glaciers and ice caps (~ 150 000 km²) is located on the Canadian Arctic Archipelago, which is a group of more than 36 000 islands (e.g. Baffin, Devon, Ellesmere, and Axel Heiberg Island), and another quarter is found around the Greenland ice sheet. Iceland is located on the Mid-Atlantic Ridge, the boundary of the European and the American plates, with its ice cover dominated by six large ice caps, with Vatnajökull as the largest. The Svalbard Archipelago is situated in the Arctic Ocean north of mainland Europe. Its topography is more than half covered by ice, and is characterized by plateau mountains and fjords. The climate and as such the fluctuations of glaciers and ice caps of the Arctic Islands are very much influenced by the extent and distribution of sea ice which in turn depends on ocean current and on the Arctic and North Atlantic Oscillations. The large variability in ice thickness of Arctic glaciers and ice caps as well as different ice temperatures is expected to result in different responses to climatic changes. In addition, some of the rapid glacier advances might have been related to volcanic activities (in Iceland), glacier surges or calving processes rather than to climatic events.

The timing of the LIA maximum extent of glaciers and ice caps differs between the regions. It is estimated to the mid 18th century for Iceland and the end of the 19th century for the Canadian Arctic Archipelago (Grove 2004). The few investigations from Greenland indicate that many glaciers and ice caps (e.g. on Disko Island) reached their maximum extents before the 19th century (Weidick 1968). In the LIA the glaciers on Svalbard were close to their late Holocene maximum extent and remained there until the onset of the 20th century (Svendsen and Mangerud 1997).

Iceland and the western part of Svalbard are quite well represented in glacier observation series. Front variation series span most of the 20th century. Continuous mass balance measurements are available since the end of the 1960s from Svalbard (Austre Brøggerbreen, Midtre Lovénbreen) and since 1988 from Iceland (Hofsjökull North). Available fluctuation series from glaciers and ice caps of Greenland and the Canadian Arctic Archipelago are sparse and most of them were interrupted in the 20th century. The only long-term mass balance series, starting in the early 1960s, are available from White and Baby Glacier (Axel Heiberg Island), as well as from the Devon Ice Cap (Koerner 2005). Archaeological findings, historical documents, trim lines together with the fragmentary measurement series, give evidence of a general retreating trend of the Arctic glaciers and ice caps since the time when of their LIA extent which slowed down somewhat during the middle of the 20th century (Dowdeswell et al. 1997, Grove 2004, ACIA 2005). Glaciers on Cumberland Peninsula, Baffin Island, yield an area loss of 10–20 per cent between the LIA maximum extent and 2000 (Paul and Kääb 2005). However, there are several regional or glacier specific variations found in this overall trend such as the mass gain of Kongsvegen (Svalbard) in the early 1990s (Hagen et al. 2003) and periods of glacier retreat (1930–1960, after 1990) and advance (1970–1985) in Iceland (Sigurdsson et al. 2007).


Fig. 6.11.1 Waldemarbreen

Fig. 6.11.1 Waldemarbreen in the western part of Svalbard (summer of 2006). Source: I. Sobota, *Nicolaus Copernicus University*, Poland.


Fig. 6.11.2 Hofsjökull

Fig. 6.11.2 The Hofsjökull Ice Cap, Iceland. Source: ASTER satellite image (50 x 51 km), 13 August 2003.

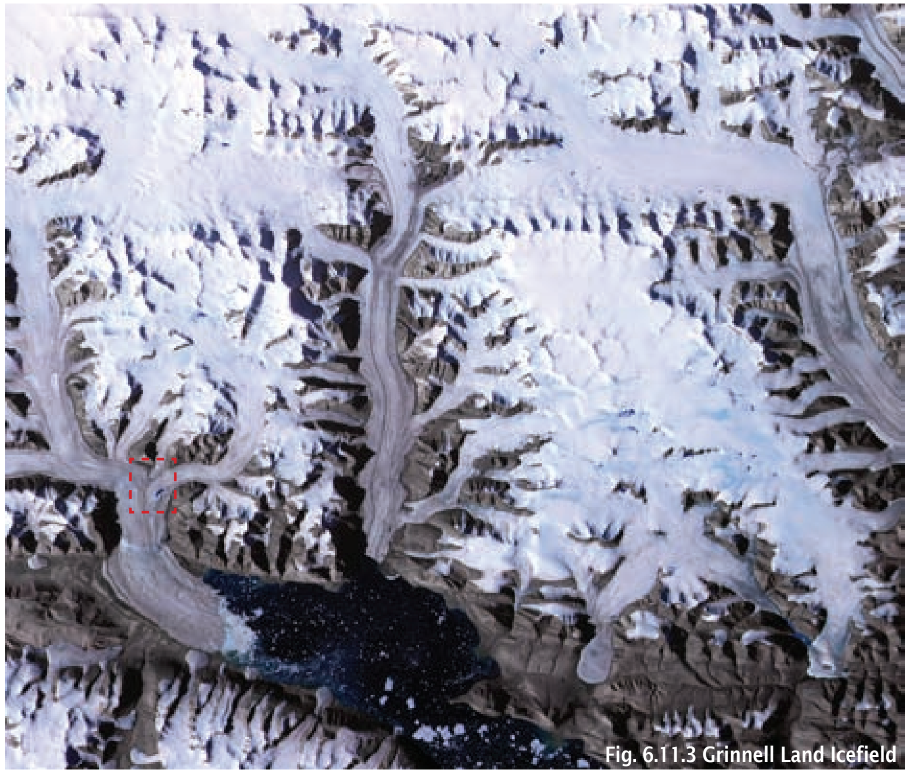


Fig. 6.11.3 Grinnell Land Icefield

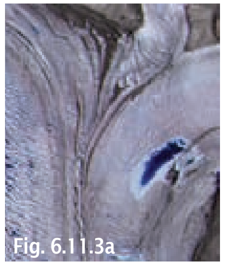


Fig. 6.11.3a

Fig. 6.11.3 Glaciers draining the Grinnell Land Icefield on Ellesmere Island, Canadian Arctic. Source: ASTER satellite image (62 x 61 km) and close-up, 31 July 2000.

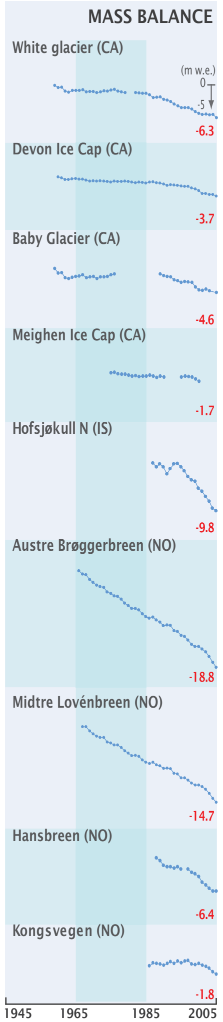
Ice covered area (km^2): 275 500

Front variation

number of series:	93
average number of observations:	31
average time length (years):	52

Mass balance

number of series:	34
average number of observations:	13



7 Conclusions

The internationally coordinated collection of information about ongoing glacier changes since 1894 and the efforts towards the compilation of a world glacier inventory have resulted in unprecedented data sets. Several generations of glaciologists around the world have contributed with their data to the present state of knowledge. For the second half of the 20th century, preliminary estimates of the global distribution of glaciers and ice caps covering some 685 000 km², are available, including detailed information on about 100 000 glaciers, and digital outlines for about 62 000 glaciers. The database on glacier fluctuations includes 36 240 length change observations from 1803 glaciers as far back as the late 19th century, as well as about 3 400 annual mass balance measurements from 226 glaciers covering the past six decades. All data is digitally made available by the WGMS and its cooperation partners, the NSIDC and the GLIMS initiative.

The glacier moraines formed during the end of the LIA, between the 17th and the second half of the 19th century, mark Holocene maximum extents of glaciers in most of the world‘s mountain ranges. From these positions, glaciers around the globe have been shrinking significantly, with strong glacier retreats in the 1940s, stable or growing conditions around the 1970s, and again increasing rates of ice loss since the mid 1980s. On a shorter time scale, glaciers in various mountain ranges have shown intermittent re-advances. Looking at individual fluctuation series, a high variability and sometimes contradictory behaviour of neighbouring ice bodies are found which can be explained by the different glacier characteristics. The early mass balance measurements indicate strong ice losses as early as the 1940s and 1950s, followed by a moderate ice loss between 1966 and 1985, and accelerating ice losses until present. The global average annual mass loss of more than half a metre water equivalent during the decade of 1996 to 2005 represents twice the ice loss of the previous decade (1986–95) and over four times the rate of the decade from 1976 to 1985. Prominent periods of regional mass gains are found in the Alps in the late 1970s and early 1980s and in coastal Scandinavia and New Zealand in the 1990s. Under current IPCC climate scenarios, the ongoing trend of worldwide and rapid, if not accelerating, glacier shrinkage on the century time scale is most likely to be of a non-periodic nature, and may lead to the deglaciation of large parts of many mountain ranges by the end of the 21st century.

In view of the incompleteness of the detailed inventory of glaciers and ice caps and the spatio-temporal bias of the available fluctuation series towards the Northern Hemisphere and Europe, it is of critical importance that glacier monitoring in the 21st century:

- continues long-term fluctuation series (i.e., length change and mass balance) in combination with decadal determinations of volume/thickness and length changes from geodetic methods in order to verify the annual field observations,
- re-initiates interrupted long-term series in strategically important regions and strengthens the current monitoring network in the regions wich are currently sparsely covered (e.g. Tropics, South America, Asia, and the polar regions),
- integrates reconstructed glacier states and variations into the present monitoring system in order to extend the historical set of length change data and to put the measured glacier fluctuations of the last 150 years into context with glacier variations during the Holocene,
- replaces long-term monitoring series of vanishing glaciers with timely starting parallel observations on larger or higher-reaching glaciers,
- concentrates the extent of the field observation network mainly on (seasonal) mass balance measurements, because they are the most direct indication of glacier reaction to climate changes,
- makes use of decadal digital elevation model differencing, and similar techniques, to extend and understand the representativeness of the field measurements to/for the regional ice changes,
- completes a global glacier inventory, e.g., for the 1970s (cf. WGMS 1989),
- defines key regions, where the glacier cover is relevant to climate change, sea level rise, hydrological issues and natural hazards, and in which repeated detailed inventories assess glacier changes (e.g., from the trim lines of the LIA) around 2000, and of the coming decades, with respect to the global baseline inventory, and
- periodically re-evaluates the feasibility and relevance of the monitoring strategy and its implementation.

The potentially dramatic climate changes, as sketched for the 21st century by IPCC (2007) refer to glacier changes of historical dimensions with strong impacts on landscape evolution, fresh water supply, natural hazards and sea level changes. This requires that international glacier monitoring makes use of the rapidly developing new technologies (remote sensing and geo-informatics) and relate them to the more traditional field observations, in order to face the challenges of the 21st century.


Fig. 7.1a Muir Glacier, 1941


Fig. 7.1b Muir Glacier, 2004

Fig. 7.1a—b Photo comparison of Muir Glacier, Alaska, which is a typical tidewater glacier. The photo 7.1a was taken on 13 August 1941 by W. O. Field; the photo 7.1b was taken on 31 August 2004 by B. F. Molnia of the *United States Geological Survey*. Source: *US National Snow and Ice Data Center*.

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Appendix 1 National Correspondents of the WGMS

List of the national correspondents of the WGMS. A detailed list of the principle investigators of glaciers monitored within GTN-G as well as a list of the supporting agencies are given in the WGMS data publications (WGMS 2005a and earlier volumes).

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Appendix 2 Meta-data on available fluctuation data

Overview table on available length change (FV) and mass balance data series (MB) up to the year 2005. Notes: PU: political unit; PSFG: local PSFG key; WGMS ID: internal WGMS key; FirstRY: first reference year; FirstSY: first survey year; LastSY: last survey year; NoObs: number of observations.

Source: Data from WGMS. An update of this list in various digital formats is available on the WGMS website: www.wgms.ch/dataexp.html

PU	PSFG	NAME	WGMS ID	GENERAL LOCATION	SPECIFIC LOCATION	LATITUDE	LONGITUDE	FV FirstRY	FV FirstSY	FV LastSY	FV NoObs	MB FirstRY	MB LastSY	MB NoObs
AQ	27	ADAMS	885	DRY VALLEYS	MIERS VALLEY	-78.10	163.75	1988	1989	1990	2			
AQ		BAHIA DEL DIABLO	2665	ANTARCTIC PENINSULA	VEGA ISLAND	-63.82	-57.43					2002	2005	4
AQ	16	BARTLEY	893	DRY VALLEYS	WRIGHT VALLEY	-77.52	162.23	1983	1984	1995	9			
AQ	9	CANADA	877	DRY VALLEYS	TAYLOR VALLEY	-77.58	162.75	1972	1979	1979	1			
AQ	12	CLARK CPI	894	DRY VALLEYS	WRIGHT VALLEY	-77.42	162.33	1973	1978	1995	9			
AQ	10	COMMONWEALTH	878	DRY VALLEYS	TAYLOR VALLEY	-77.55	163.08	1972	1979	1979	1			
AQ	5	FINGER	873	DRY VALLEYS	TAYLOR VALLEY	-77.70	161.48	1973	1979	1979	1			
AQ	20	GOODSPEED	888	DRY VALLEYS	WRIGHT VALLEY	-77.42	162.38	1985	1986	1989	4			
AQ	19	HART	889	DRY VALLEYS	WRIGHT VALLEY	-77.50	162.35	1985	1986	1995	7			
AQ	3	HEIMDALL	890	DRY VALLEYS	WRIGHT VALLEY	-77.58	162.87	1984	1987	1992	4			
AQ		KALESNIKA	1434			-82.06	-41.41	1966	1967	1970	4			
AQ		KRASOVSKOGO	1079			-71.50	12.46	1965	1971	1973	2			
AQ	7	LA CROIX	875	DRY VALLEYS	TAYLOR VALLEY	-77.65	162.47	1972	1978	1978	1			
AQ	17	MESERVE MPII	892	DRY VALLEYS	WRIGHT VALLEY	-77.55	162.37	1965	1981	1992	9			
AQ	26	MIERS	886	DRY VALLEYS	MIERS VALLEY	-78.08	163.75	1988	1989	1990	2			
AQ	14	PACKARD	880	DRY VALLEYS	VICTORIA VALLEY	-77.33	162.13	1973	1978	1978	1			
AQ	4	SCHLATTER	872	DRY VALLEYS	TAYLOR VALLEY	-77.70	161.43	1973	1979	1979	1			
AQ	8	SUESS	876	DRY VALLEYS	TAYLOR VALLEY	-77.63	162.67	1972	1979	1979	1			
AQ	6	TAYLOR AN	874	DRY VALLEYS	TAYLOR VALLEY	-77.75	162.00	1972	1978	1978	1			
AQ	15	VICTORIA LOWER	881	DRY VALLEYS	VICTORIA VALLEY	-77.37	162.28	1973	1978	1990	2			
AQ	13	VICTORIA UPPER	879	DRY VALLEYS	VICTORIA VALLEY	-77.27	161.50	1972	1978	1992	5			
AQ	18	WRIGHT LOWER	891	DRY VALLEYS	WRIGHT VALLEY	-77.42	162.83	1975	1985	1995	8			
AQ	11	WRIGHT UPPER B	895	DRY VALLEYS	WRIGHT VALLEY	-77.55	166.50	1970	1979	1992	7			
AR	5003	ALERCE	1346			-41.48	-70.83	1944	1953	1975	4			
AR		AZUFRE	2851	CORDILLERA PRINCIPAL	PLANCHON-PETEROA	-35.17	-70.33	1894	1963	2005	6			
AR	5005	BONETE S	1348			-41.45	-71.00	1969	1970	1975	2			
AR	5002	CASTANO OVERO	918	PATAGON.ANDES	NAHUEL HUAPIN.	-41.18	-71.83	1944	1953	1983	5			
AR		DE LOS TRES	1675	PATAGONIA		-49.33	-73.00	1995	1996	2003	4	1996	1998	3
AR	5004	FRIAS	1347			-41.52	-70.82	1944	1953	1986	4			
AR	64	FRIAS	1661	PATAGONIA	S.PAT.ICEFIELD	-50.75	-75.08	1984	1986	1986	1			
AR		GUESSFELDT	2848	CORDILLERA FRONTAL	ACONCAGUA	-32.59	-70.03	1896	1929	2005	10			
AR	5006	HORCONES INFERIOR	919	CENTRAL ANDES	ACONCAGUA	-32.67	-70.00	1963	1976	2005	9			
AR	131	MARTIAL	917	ANDES FUEGUINOS	MONTES MARTIAL	-54.78	-68.42	1898	1943	2003	5	2001	2002	2
AR		MARTIAL ESTE	2000	ANDES FUEGUINOS	MONTES MARTIAL	-54.78	-68.40					2001	2005	5
AR	34	MORENO	920	PATAGONIA	S.PAT.ICEFIELD	-50.50	-73.12	1945	1970	1986	2			
AR		PENON	2850	CORDILLERA PRINCIPAL	PLANCHON-PETEROA	-35.27	-70.56	1896	1963	2005	6			
AR	5001	RIO MANSO	1345			-41.47	-70.80	1944	1953	1975	4			
AR		TUPUNGATO 01	2852	CORDILLERA PRINCIPAL	TUPUNGATO	-33.39	-69.73	1963	1975	2005	6			
AR		TUPUNGATO 02	2853	CORDILLERA PRINCIPAL	TUPUNGATO	-33.37	-69.75	1963	1975	2005	6			
AR		TUPUNGATO 03	2854	CORDILLERA PRINCIPAL	TUPUNGATO	-33.36	-69.75	1963	1975	2005	6			
AR		TUPUNGATO 04	2855	CORDILLERA PRINCIPAL	TUPUNGATO	-33.34	-69.74	1963	1975	2005	6			
AR	33	UPSALA	921	PATAGONIA	S.PAT.ICEFIELD	-50.00	-73.28	1945	1968	1990	8			
AR		VACAS	2849	CORDILLERA FRONTAL	ACONCAGUA	-32.65	-70.00	1896	1929	2005	10			
AT	229	AEU.PIRCHLKAR	504	EASTERN ALPS	OETZTALER ALPS	47.00	10.92	1982	1982	2004	23			
AT	321	ALP.KRAEUL F.	594	EASTERN ALPS	STUBAIER ALPEN	47.05	11.15	1975	1975	1994	19			
AT	307	ALPEINER F.	497	EASTERN ALPS	STUBAIER ALPEN	47.05	11.13	1848	1848	2004	86			
AT	304	BACHFALLEN F.	500	EASTERN ALPS	STUBAIER ALPEN	47.08	11.08	1892	1892	2005	65			
AT	702	BAERENKOPF K.	567	EASTERN ALPS	GLOCKNER GR.	47.13	12.72	1924	1915	2005	46			
AT	308	BERGLAS F.	496	EASTERN ALPS	STUBAIER ALPEN	47.07	11.12	1891	1892	2005	74			
AT	0105C	BIELTAL F E	1453			46.87	10.13	1968	1969	1978	10			
AT	0105B	BIELTAL F W	1452			46.87	10.13	1969	1970	2005	15			
AT	0105A	BIELTAL F.	481	EASTERN ALPS	SILVRETTA	46.88	10.13	1924	1924	2002	65			
AT		BIELTALFERNER MITTE	2674	EASTERN ALPS	STUBAIER ALPS	46.88	10.13	1996	1997	2005	9			
AT	0310B	BILDSTOECKL F.	603	EASTERN ALPS	STUBAIER ALPEN	47.00	11.10	1964	1969	1990	18			
AT	302	BOCKKOGEL F.	502	EASTERN ALPS	STUBAIER ALPEN	47.03	11.12	1892	1898	1994	43			
AT	727	BRENNKOGL K.	528	EASTERN ALPS	GROSSGLOCKNER G	47.10	12.80	1988	1988	2005	18			
AT	0310A	DAUNKOGEL F.	604	EASTERN ALPS	STUBAIER ALPEN	47.00	11.10	1891	1891	2005	89			
AT	220	DIEM F.	513	EASTERN ALPS	OETZTALER ALPEN	46.81	10.95	1871	1848	2005	100			
AT	509	DORFER K.	577	EASTERN ALPS	VENEDIGER GRUP.	47.10	12.33	1896	1891	2003	67			
AT	317	E.GRUEBL F.	597	EASTERN ALPS	STUBAIER ALPEN	46.98	11.23	1891	1892	1994	53			
AT	708	EISER K.	562	EASTERN ALPS	GLOCKNER GR.	47.15	12.68	1961	1955	1989	27			
AT	1301	EISKAR G.	1632	KARNISCHE ALPEN		46.62	12.90	1897	1920	2005	19			
AT	312	FERNAU F.	601	EASTERN ALPS	STUBAIER ALPEN	46.98	11.13	1890	1891	2004	85			
AT	0601B	FILLECK K.	476	EASTERN ALPS	GRANATSPITZ GR.	47.13	12.60					1964	1980	17
AT	320	FREIGER F.	595	EASTERN ALPS	STUBAIER ALPEN	46.97	11.20	1898	1899	2005	38			
AT	706	FREIWAND K.	564	EASTERN ALPS	GLOCKNER GR.	47.10	12.75	1928	1929	2005	54			
AT	507	FROSNITZ K.	579	EASTERN ALPS	VENEDIGER GRUP.	47.08	12.40	1891	1860	2005	66			
AT	722	FRUSCHNITZ K.	552	EASTERN ALPS	GLOCKNER GR.	47.08	12.67	1975	1974	1991	10			
AT	406	FURTSCHAGL K.	585	EASTERN ALPS	ZILLERTALER A.	47.00	11.77	1896	1897	2005	38			
AT	325	GAISKAR F.	530	EASTERN ALPS	STUBAI ALPS	46.97	11.12	1984	1984	2005	22			
AT	225	GAISSBERG F.	508	EASTERN ALPS	OETZTALER ALPEN	46.83	11.07	1859	1856	2005	111			
AT	202	GEPATSCH F.	522	EASTERN ALPS	OETZTALER ALPEN	46.85	10.77	1855	1856	2005	91			
AT	1201	GOESSNITZ K.	532	EASTERN ALPS	SCHOBER GROUP	46.97	12.75	1983	1983	2005	23			
AT	0802B	GR GOLDBERG KEE	1305			47.03	12.47	1849	1850	2005	156	2001	2005	5
AT	1101	GR.GOSAU G.	536	EASTERN ALPS	DACHSTEIN GR.	47.48	13.60	1877	1884	2005	67			
AT		GRANATSPITZ K.	2675	EASTERN ALPS	GRANATSPITZ GROUP	47.13	12.59	1970	1971	1994	21			
AT	313	GRAWAWAND FERNER	1308			47.11	11.16	1953	1957	1969	9			
AT	709	GRIESKOGL K.	561	EASTERN ALPS	GLOCKNER GR.	47.17	12.68	1955	1955	1989	33			
AT	1001	GROSSELEND K.	542	EASTERN ALPS	AUKOGEL GR.	47.03	13.32	1898	1900	2004	91			
AT	315	GRUENAU F.	599	EASTERN ALPS	STUBAIER ALPEN	46.98	11.20	1891	1892	2005	89			
AT	222	GURGLER F.	511	EASTERN ALPS	OETZTALER ALPEN	46.80	10.98	1896	1897	2005	67			
AT	210	GUSLAR F.	490	EASTERN ALPS	OETZTALER ALPEN	46.85	10.80	1899	1893	2005	92			
AT	504	HABACH KEES	1310			47.15	12.37	1924	1925	2003	26			
AT	1102	HALLSTAETTER G.	535	EASTERN ALPS	DACHSTEIN GR.	47.48	13.62	1847	1848	2005	81			
AT	209	HINTEREIS FERNER	491	EASTERN ALPS	OETZTALER ALPEN	46.80	10.77	1847	1848	2005	111	1953	2005	53
AT	1005	HOCHALM K.	538	EASTERN ALPS	AUKOGEL GR.	47.02	13.33	1898	1900	2005	82			
AT	208	HOCHJOCH F.	492	EASTERN ALPS	OETZTALER ALPEN	46.78	10.82	1890	1856	2005	100			
AT	309	HOCHMOOS F.	495	EASTERN ALPS	STUBAIER ALPEN	47.05	11.15	1946	1947	2003	41			
AT	724	HOFMANNS K.	550	EASTERN ALPS	GLOCKNER GR.	47.07	12.72	1937	1937	1991	13			
AT	1202	HORN K.(SCHOB.)	531	EASTERN ALPS	SCHOBER GROUP	46.97	12.77	1984	1984	2005	22			
AT	402	HORN K.(ZILLER)	589	EASTERN ALPS	ZILLERTALER A.	47.00	11.82	1881	1882	2005	105			
AT	203	HT.OELGRUBEN F.	521	EASTERN ALPS	OETZTALER ALPEN	46.89	10.77	1950	1951	1987	34			
AT	228	INN.PIRCHLKAR	505	EASTERN ALPS	OETZTALER ALPS	47.00	10.92	1982	1982	2005	24			
AT	106	JAMTAL F.	480	EASTERN ALPS	SILVRETTA	46.87	10.17	1892	1892	2005	93	1989	2005	17
AT	0602B	KA.TAUERN K. S	571	EASTERN ALPS	GRANATSPITZ GR.	47.12	12.60	1961	1962	1994	26			
AT	1003	KAELBERSPITZ K.	540	EASTERN ALPS	AUKOGEL GR.	47.03	13.28	1927	1927	2005	75			
AT		KALSER BAERENKOPF K.	2676	EASTERN ALPS	GRANATSPITZ GROUP	47.11	13.60	1970	1971	2005	33			
AT	207	KARLES F.	493	EASTERN ALPS	OETZTALER ALPEN	46.93	10.92	1950	1951	1998	48			
AT	701	KARLINGER K.	568	EASTERN ALPS	GLOCKNER GR.	47.13	12.70	1840	1860	2005	73			
AT	226	KESSELWAND FERNER	507	EASTERN ALPS	OETZTALER ALPEN	46.84	10.79	1894	1900	2005	73	1953	2005	53
AT	801	KL.FLEISS K.	547	EASTERN ALPS	SONNBLICK GR.	47.05	12.95	1850	1851	2005	155	2001	2005	5
AT	717	KLEINEISER K.	555	EASTERN ALPS	GLOCKNER GR.	47.15	12.67	1961	1963	2005	42			
AT	1002	KLEINELEND K.	541	EASTERN ALPS	AUKOGEL GR.	47.07	13.25	1898	1900	2005	88			
AT	803	KLEINER SONNBLICK KEES	1306			47.05	12.97	1924	1924	1979	19			
AT	703	KLOCKERIN K.	477	EASTERN ALPS	GLOCKNER GR.	47.15	12.73	1844	1846	1982	48			
AT	0102B	KLOSTERTALER M	485	EASTERN ALPS	SILVRETTA	46.87	10.07	1968	1969	2005	37			
AT	0102A	KLOSTERTALER N	486	EASTERN ALPS	SILVRETTA	46.87	10.07	1968	1969	2005	36	1998	1998	1
AT	0102C	KLOSTERTALER S	484	EASTERN ALPS	SILVRETTA	46.87	10.07	1924	1924	1994	66			
AT	0501A	KRIMMLER K.	584	EASTERN ALPS	VENEDIGER GRUP.	47.08	12.25	1896	1897	2005	74			
AT	0501B	KRIMMLER K. EAST	1309			47.08	12.25	1896	1897	2003	73			
AT		KRIMMLER K. MITTLERE ZUNGE	2677	EASTERN ALPS	VENEDIGER GROUP	47.08	12.27	1906	1906	1986	21			
AT	806	KRUML K.	527	EASTERN ALPS	SONNBLICK GROUP	47.08	12.93	1899	1900	1995	14			
AT	305	LAENGENTALER F.	499	EASTERN ALPS	STUBAIER ALPEN	47.08	11.10	1905	1905	2004	60			
AT	604	LANDECK K.	569	EASTERN ALPS	GRANATSPITZ GR.	47.13	12.58	1978	1978	2005	27			
AT	223	LANGTALER F.	510	EASTERN ALPS	OETZTALER ALPEN	46.79	11.02	1879	1846	2005	108	1963	1970	8
AT	721	LAPERWITZ K.	553	EASTERN ALPS	GLOCKNER GR.	47.10	12.65	1974	1974	1991	11			
AT	107	LARAIN F.	479	EASTERN ALPS	SILVRETTA	46.90	10.22	1928	1929	2003	54			
AT	306	LIESENSER F.	498	EASTERN ALPS	STUBAIER ALPEN	47.08	11.12	1905	1905	2004	63			
AT	101	LITZNERGL.	607	EASTERN ALPS	SILVRETTA	46.88	10.05	1932	1933	2005	73			
AT		LITZNERGL. SW	2678	EASTERN ALPS	SILVRETTA	46.88	10.04	1933	1934	1983	26			
AT	218	MARZELL F.	515	EASTERN ALPS	OETZTALER ALPEN	46.78	10.88	1870	1856	2005	107			
AT	714	MAURER K.(GLO.)	558	EASTERN ALPS	GLOCKNER GR.	47.18	12.68	1961	1896	2005	44			
AT	510	MAURER K.(VEN.)	576	EASTERN ALPS	VENEDIGER GRUP.	47.08	12.30	1896	1897	2003	60			
AT	206	MITTELBERG F.	494	EASTERN ALPS	OETZTALER ALPEN	46.92	10.90	1855	1856	1995	72			
AT	214	MITTERKAR F.	487	EASTERN ALPS	OETZTALER ALPEN	46.88	10.87	1891	1892	2005	101			
AT	227	MUTMAL F.	506	EASTERN ALPS	OETZTALER ALPEN	46.78	10.92	1968	1969	2005	35			
AT	217	NIEDERJOCH F.	516	EASTERN ALPS	OETZTALER ALPEN	46.78	10.87	1870	1883	2005	110			
AT	502	OBERSULZBACH K.	583	EASTERN ALPS	VENEDIGER GRUP.	47.11	12.29	1871	1815	2005	89			
AT	103	OCHSENTALERGL.	483	EASTERN ALPS	SILVRETTA	46.85	10.10	1850	1891	2005	85	1991	1999	9
AT	712	OEDENWINKEL K.	559	EASTERN ALPS	GLOCKNER GR.	47.11	12.65	1896	1897	2005	46			
AT	704	PASTERZEN K.	566	EASTERN ALPS	GLOCKNER GR.	47.10	12.70	1879	1880	2005	124	2005	2005	1
AT	324	PFAFFEN F.	591	EASTERN ALPS	STUBAI MONTAINS	46.96	11.14	1981	1981	2005	24			
AT	707	PFANDLSCHARTEN	563	EASTERN ALPS	GLOCKNER GR.	47.08	12.78	1884	1885	1992	47			
AT	213	PITZTALERJOECHL	1311			46.93	10.92	1959	1959	1971	8			
AT		PLESSNITZ K.	2679	EASTERN ALPS		47.15	13.43	1929	1930	1952	8			
AT	603	PRAEGRAT K.	570	EASTERN ALPS	GRANATSPITZ GR.	47.12	12.59	1961	1963	2005	35			
AT	212	RETTENBACH F.	488	EASTERN ALPS	OETZTALER ALPEN	46.93	10.93	1952	1889	2005	52			
AT	718	RIFFL K. N	554	EASTERN ALPS	GLOCKNER GR.	47.13	12.67	1961	1963	2002	34			
AT	0713A	RIFFLKAR KEES	606	EASTERN ALPS	GLOCKNER GR.	47.13	12.67	1968	1969	1991	19			
AT	215	ROFENKAR F.	518	EASTERN ALPS	OETZTALER ALPEN	46.88	10.88	1891	1892	2005	102			
AT		ROTER KNOPF K.	3297	EASTERN ALPS	SCHOBER GROUP	46.97	12.75	2002	2002	2005	4			
AT	224	ROTMOOS F.	509	EASTERN ALPS	OETZTALER ALPEN	46.82	11.05	1891	1847	2005	111			
AT	219	SCHALF F.	514	EASTERN ALPS	OETZTALER ALPEN	46.78	10.93	1924	1925	2005	76			
AT	108	SCHATTENSPITZ	526	EASTERN ALPS	SILVRETTA	46.88	10.08	1973	1974	1994	19			
AT	311	SCHAUFEL F.	602	EASTERN ALPS	STUBAIER ALPEN	46.98	11.12	1891	1912	2004	76			
AT	1103	SCHLADMINGER G.	534	EASTERN ALPS	DACHSTEIN GR.	47.47	13.63	1877	1884	2005	59			
AT	805	SCHLAPPEREBEN K.	544	EASTERN ALPS	SONNBLICK GROUP	47.02	13.02	1984	1984	1999	15			
AT	506	SCHLATEN K.	580	EASTERN ALPS	VENEDIGER GRUP.	47.11	12.38	1891	1857	2005	75			
AT	405	SCHLEGEIS K.	586	EASTERN ALPS	ZILLERTALER A.	46.98	11.77	1896	1897	2005	37			
AT	726	SCHMIEDINGER K.	548	EASTERN ALPS	GR.GLOCKNER GR.	47.18	12.68	1952	1952	2005	46			
AT	109	SCHNEEGLOCKEN	525	EASTERN ALPS	SILVRETTA	46.87	10.10	1973	1974	2005	32			
AT	1104	SCHNEELOCH G.	533	EASTERN ALPS	DACHSTEIN GR.	47.50	13.60	1903	1969	2005	32			

PU	PSFG	NAME	WGMS ID	GENERAL LOCATION	SPECIFIC LOCATION	LATITUDE	LONGITUDE	FV FirstRY	FV FirstSY	FV LastSY	FV NoObs	MB FirstRY	MB LastSY	MB NoObs
AT	407	SCHOENACH K.	529	EASTERN ALPS	ZILLERTALER A.	47.15	12.08	1903	1983	1989	6			
AT	303	SCHWARZENBERG F.	501	EASTERN ALPS	STUBAIER ALPEN	47.05	11.12	1890	1891	2005	67			
AT	403	SCHWARZENSTEIN	588	EASTERN ALPS	ZILLERTALER A.	47.02	11.85	1850	1882	2005	102			
AT	716	SCHWARZKARL K.	556	EASTERN ALPS	GLOCKNER GR.	47.17	12.67	1961	1963	2005	38			
AT	710	SCHWARZKOEPFL K.	560	EASTERN ALPS	GLOCKNER GR.	47.15	12.72	1955	1955	2005	48			
AT	204	SEXEGERTEN F.	520	EASTERN ALPS	OETZTALER ALPEN	46.90	10.80	1870	1883	2005	76			
AT		SIMILAUN F.	3296	EASTERN ALPS	OETZTALER ALPEN	46.78	10.88	2003	2003	2005	3			
AT	318	SIMMING F.	596	EASTERN ALPS	STUBAIER ALPEN	46.98	11.25	1891	1892	2005	78			
AT	511	SIMONY K.	575	EASTERN ALPS	VENEDIGER GRUP.	47.07	12.27	1896	1897	2005	71			
AT	0601A	SONNBLICK KEES	573	EASTERN ALPS	GRANATPITZ GR.	47.13	12.60	1960	1961	2005	45	1959	2005	47
AT	221	SPIEGEL F.	512	EASTERN ALPS	OETZTALER ALPEN	46.83	10.95	1891	1892	2005	104			
AT	0314A	SULZENAU F.	600	EASTERN ALPS	STUBAIER ALPEN	46.98	11.15	1850	1891	2005	89			
AT	301	SULZTAL F.	503	EASTERN ALPS	STUBAIER ALPEN	47.00	11.08	1895	1898	2005	67			
AT	205	TASCHACH F.	519	EASTERN ALPS	OETZTALER ALPEN	46.90	10.85	1856	1878	2005	85			
AT	0602A	TAUERN K.	572	EASTERN ALPS	GRANATSPITZ GR.	47.12	12.60	1968	1970	1990	20			
AT	216	TAUFKAR F.	517	EASTERN ALPS	OETZTALER ALPEN	46.88	10.90	1891	1892	2003	87			
AT	723	TEISCHNITZ K.	551	EASTERN ALPS	GLOCKNER GR.	47.07	12.68	1896	1897	1991	16			
AT	110	TOTENFELD	524	EASTERN ALPS	SILVRETTA	46.88	10.15	1976	1975	2005	29			
AT		TOTENKOPF K.	2680	EASTERN ALPS	GLOCKNER GROUP	47.13	12.66	1970	1971	2005	33			
AT	323	TRIEBENKARLAS F.	592	EASTERN ALPS	STUBAIER ALPEN	46.96	11.15	1978	1978	2005	26			
AT	901	UEBERGOSS.ALM	543	EASTERN ALPS	HOCHKOENIG	47.43	13.07	1871	1892	1992	52			
AT	512	UMBAL K.	574	EASTERN ALPS	VENEDIGER GRUP.	47.05	12.25	1896	1897	2005	73			
AT	0713B	UNT. RIFFL KEES	605	EASTERN ALPS	GLOCKNER GR.	47.13	12.67	1960	1961	2005	45			
AT	503	UNTERSULZBACH K.	582	EASTERN ALPS	VENEDIGER GRUP.	47.13	12.35	1896	1829	2005	74			
AT	719	VD.KASTEN K.	478	EASTERN ALPS	GLOCKNER GR.	47.10	12.64	1961	1963	1991	17			
AT	322	VERBORGENBERG F.	593	EASTERN ALPS	STUBAIER ALPEN	47.07	11.12	1977	1977	2005	28			
AT	104	VERMUNTGL.	482	EASTERN ALPS	SILVRETTA	46.85	10.13	1902	1903	2005	85	1991	1999	9
AT	211	VERNAGT FERNER	489	EASTERN ALPS	OETZTALER ALPEN	46.88	10.82	1888	1889	2005	114	1965	2005	41
AT	505	VILTRAGEN K.	581	EASTERN ALPS	VENEDIGER GRUP.	47.13	12.37	1891	1892	2005	71			
AT	316	W.GRUEBL F.	598	EASTERN ALPS	STUBAIER ALPEN	46.98	11.22	1891	1893	2003	57			
AT	1004	W.TRIPP K.	539	EASTERN ALPS	AUKOGEL GR.	47.02	13.32	1925	1928	2004	62			
AT	705	WASSERFALLWINKL	565	EASTERN ALPS	GLOCKNER GR.	47.12	12.72	1943	1944	2005	59			
AT	401	WAXEGG K.	590	EASTERN ALPS	ZILLERTALER A.	47.00	11.80	1881	1882	2005	99			
AT	201	WEISSEE F.	523	EASTERN ALPS	OETZTALER ALPEN	46.85	10.72	1894	1891	2005	85			
AT		WESTLICHER GRUEBLER F. W	2681	EASTERN ALPS	STUBAI	46.96	11.18	1974	1975	2003	27			
AT		WESTLICHES WURTEN K.	2682	EASTERN ALPS	SONNBLICK GROUP	47.03	13.00	1933	1934	1992	59			
AT	725	WIELINGER K.	549	EASTERN ALPS	GR.GLOCKNER GR.	47.15	12.75	1896	1897	2005	41			
AT	404	WILDGERLOS	587	EASTERN ALPS	ZILLERTALER A.	47.15	12.11	1972	1913	2005	34			
AT	1006	WINKL K.	537	EASTERN ALPS	AUKOGEL GR.	47.02	13.32	1920	1928	2004	62			
AT	715	WURFER K.	557	EASTERN ALPS	GLOCKNER GR.	47.17	12.68	1961	1963	1994	25			
AT	804	WURTEN K.	545	EASTERN ALPS	SONNBLICK GR.	47.04	13.01	1850	1851	2005	155	1983	2005	23
AT	508	ZETTALUNITZ K.	578	EASTERN ALPS	VENEDIGER GRUP.	47.08	12.38	1896	1897	2005	67			
BO	5180	CHACALTAYA	1505	TROPICAL ANDES	CORDILLERA REAL	-16.35	-68.12	1963	1983	2005	16	1992	2005	14
BO		CHARQUINI SUR	2667	TROPICAL ANDES	CORDILLERA REAL	-16.17	-68.09					2003	2005	3
BO	5150	ZONGO	1503	TROPICAL ANDES	CORDILLERA REAL	-16.25	-68.17	1991	1992	2005	14	1992	2005	14
CA	110	ABRAHAM	48	LABRADOR	TORNGAT MTS.	58.93	-63.53	1981	1982	1984	3	1982	1984	3
CA	133	ALEXANDER	32	COAST MOUNTAINS	ISKUT RIVER	57.10	-130.82					1979	1990	9
CA	148	ANDREI	34	COAST MOUNTAINS	ISKUT RIVER	56.93	-130.97	1978	1980	1990	7	1978	1990	10
CA	150	ANGEL	1419			52.68	-118.60	1945	1946	1946	1			
CA	170	APE	26	COAST MOUNTAINS	NOEICK RIVER	52.08	-126.22	1947	1951	1984	4			
CA	185	ASULKAN	1401			51.20	-117.20	1898	1899	1931	13			
CA	187	ATAVIST	25	COAST MOUNTAINS	NOEICK RIVER	51.13	-126.22	1900	1951	1984	4			
CA	190	ATHABASCA	7	ROCKY MOUNTAINS	COLUMBIA ICEF.	52.20	-117.25	1922	1945	1980	23			
CA	205	BABY GLACIER	1	NWT CANADA	AXEL HEIBERG	79.43	-90.97					1960	2005	31
CA	0210A	BARNES ICE CAP	38	NWT CANADA	BAFFIN ISLAND	69.75	-72.00					1976	1984	9
CA	0210B	BARNES ICE CAP	1435	NWT CANADA	BAFFIN ISLAND	69.75	-72.00	1923	1945	1958	10			
CA	0210C	BARNES ICE CAP	1436	NWT CANADA	BAFFIN ISLAND	69.75	-72.00	1912	1928	1960	15			
CA	234	BENCH	66	COAST MOUNTAINS	HOMATHKO RIVER	51.43	-124.92					1981	1990	8
CA	245	BERM	11	COAST MOUNTAINS	TOBA INLET BAS.	50.55	-123.98	1883	1947	1979	5			
CA	265	BOUNDARY	58	ROCKY MOUNTAINS	SASKATCHEWAN R.	52.20	-117.20	1983	1984	1985	2			
CA	275	BRIDGE	47	COAST MOUNTAINS	BRIDGE RIVER	50.82	-123.57					1981	1985	5
CA	290	BUGABOO	10	BRIT.COLUMBIA		50.72	-116.78	1964	1966	1978	7			
CA	310	CALTHA LAKE	40	COAST MOUNTAINS	LILLOOET BASIN	59.15	-122.28	1914	1951	1985	5			
CA	335	CLENDENNING	17	COAST MOUNTAINS	ELAHO BASIN	50.42	-123.90	1883	1947	1979	5			
CA	350	COLUMBIA CDN 35	1392			52.17	-117.28	1919	1924	1972	6			
CA	370	CRUSOE GLACIER	1410			79.43	-91.50	1959	1960	1962	3			
CA	431	DEVON ICE CAP	39	HIGH ARCTIC	DEVON ISLAND	75.42	-83.25					1961	2005	45
CA	480	DRUMMOND	1398			51.60	-116.58	1884	1906	1965	6			
CA	510	EAST CHABA	1421			52.20	-116.98	1927	1936	1936	1			
CA	575	ELKIN	62	COAST MOUNTAINS	TATLOW RANGE	51.37	-123.85	1951	1982	1982	1			
CA	560	EMERALD	56	BRIT.COLUMBIA	YOHO NAT.PARK	51.50	-116.53	1978	1979	1982	4			
CA	675	FLEUR D.NEIGES	20	COAST MOUNTAINS	SE GARIBALDI	49.85	-123.60	1895	1931	1978	7			
CA	685	FRANKLIN	1404			51.25	-125.22	1927	1931	1948	6			
CA	690	FRESHFIELD	1395			51.77	-115.77	1871	1902	1954	12			
CA	692	FRIENDLY	61	COAST MOUNTAINS	CHILCOTIN BASIN	51.05	-123.85	1951	1975	1982	2			
CA	698	FYLES	27	COAST MOUNTAINS	NOEICK RIVER	52.10	-126.23	1900	1954	1985	4			
CA	784	GRIFFIN	21	COAST MOUNTAINS	SE GARIBALDI	49.85	-122.63	1795	1886	1978	8			
CA	840	HAVOC	12	COAST MOUNTAINS	ELAHO BASIN	50.52	-123.88	1750	1893	1979	6			
CA	851	HECTOR	1397			51.60	-116.40	1904	1938	1965	3			
CA	855	HELM	45	COAST MOUNTAINS	GARIBALDI PARK	49.97	-123.00	1865	1935	1958	12	1975	2005	28
CA	875	HIDDEN	49	LABRADOR	TORNGAT MTS.	58.93	-63.55					1982	1984	3
CA	890	HOURGLASS	1407			51.03	-122.90	1951	1975	1975	1			
CA	940	ILLECILLEWAET	1400			51.23	-117.22	1887	1888	1960	29			
CA	1190	KOKANEE	23	BRIT.COLUMBIA	KOKANEE GLACIER	49.75	-117.13	1923	1945	1978	16			
CA	721	LAIKA GL + ICE	1413			75.88	-79.50					1975	1975	1
CA	720	LAIKA GLACIER	1412			75.88	-79.50	1959	1971	1971	1	1974	1975	2
CA	1335	MEIGHEN ICE CAP	16	CDN ARCTIC ARCH	MEIGHEN ISLAND	79.95	-99.13					1976	2000	19
CA	1350	MINARET	50	LABRADOR	TORNGAT MTS.	58.88	-63.68					1982	1984	3
CA	1402	NADAHINI	3	BRIT.COLUMBIA	DATLASAKA RANGE	59.73	-136.68	1964	1966	1978	7			
CA	1430	NEW MOON	5	HAZELTON MTNS.	BULKLEY RANGES	53.92	-127.77	1875	1946	1978	6			
CA	1465	NOEICK	28	COAST MOUNTAINS	NOEICK RIVERENE	52.10	-126.28	1900	1954	1978	2			
CA	1590	OVERLORD	43	COAST MOUNTAINS	GARIBALDI PARK	50.02	-122.83	1900	1928	1995	8			
CA	1640	PEYTO	57	ROCKY MOUNTAINS	WAPTA ICEFIELD	51.67	-116.53	1897	1933	1965	17	1966	2005	39
CA	1660	PLACE	41	COAST MOUNTAINS	BIRKEN B.C.	50.43	-122.60					1965	2005	41
CA	1690	PURGATORY	29	COAST MOUNTAINS	NOEICK RIVER	52.15	-126.37	1900	1947	1984	3			
CA	1815	RAM RIVER	1394	ROCKY MOUNTAINS	EASTERN SLOPES	51.85	-116.48					1966	1974	9
CA	1875	ROBSON	1418			53.15	-119.57	1908	1911	1953	5			
CA	1905	SASKATCHEWAN	8	ALBERTA	BANFF NAT.PARK	52.20	-117.13	1912	1925	1980	24			
CA	1911	SCOTT	1420			52.43	-118.58	1924	1953	1953	1			
CA	1915	SENTINEL	44	COAST MOUNTAINS	GARIBALDI PARK	49.90	-122.98	1935	1936	1985	23	1966	1989	23
CA	1958	SOUTHEAST LYELL	1393			51.92	-117.63	1919	1926	1953	3			
CA	1965	SPHINX	19	BRIT.COLUMBIA	GARIBALDI PROV.	49.92	-122.95	1968	1970	1978	3			
CA	1973	STAIRCASE	18	COAST MOUNTAINS	SE GARIBALDI	49.93	-122.60	1895	1931	1978	7			
CA	1983	SUPERGUKSOAK	51	LABRADOR	TORNGAT MTS	58.95	-63.78					1982	1984	3
CA	1986	SURF	13	COAST MOUNTAINS	ELAHO BASIN	50.50	-123.97	1893	1947	1979	6			
CA	1995	SYKORA	59	COAST MOUNTAINS	BRIDGE RIVER	50.87	-123.58					1976	1985	10
CA	2007	TATS	72	ST. ELIAS MTS.	ALSEK RANGES	59.68	-137.77					1989	1989	1
CA	2015	TCHAIKAZAN	60	COAST MOUNTAINS	CHILCOTIN RANGE	51.02	-123.78	1900	1951	1982	5			
CA	2025	TERRIFIC	15	COAST MOUNTAINS	TOBA INLET BAS.	50.43	-123.43	1883	1947	1979	7			
CA	2050	THOMPSON GLACIE	1411			79.47	-90.17	1960	1961	1977	11			
CA	2035	THUNDERCLAP	22	COAST MOUNTAINS	SE GARIBALDI	49.85	-122.65	1886	1931	1977	6			
CA	2040	TIEDEMANN	24	COAST MOUNTAINS	HOMATHKO RIVER	51.33	-125.05					1981	1990	7
CA	2070	TOBY	1403			50.23	-116.13	1915	1921	1929	4			
CA	2075	TSOLOSS	63	COAST MOUNTAINS	TATLOW RANGE	51.38	-123.87	1720	1900	1982	3			
CA	2220	VICTORIA	1399			51.38	-116.38	1898	1903	1966	14			
CA	2318	WARD H. I. RISE	53	ELLESMERE IS.	WARD HUNT IS.	83.12	-74.17					1981	1985	5
CA	2320	WARD H. I. SH.	52	ELLESMERE IS.	WARD HUNT IS.	83.08	-73.80					1981	1985	5
CA	2330	WAVE	14	COAST MOUNTAINS	ELAHO BASIN	50.48	-123.98	1947	1948	1979	5			
CA	2333	WEDGEMOUNT	42	COAST MOUNTAINS	GARIBALDI PARK	50.15	-122.78	1900	1920	1995	25			
CA	2340	WHITE	0	CDN ARCTIC ARCH	AXEL HEIBERG IS	79.45	-90.67	1959	1960	1977	11	1960	2005	43
CA	2380	WOOLSEY	1402			51.12	-118.62					1966	1974	9
CA	2520	YOHO	1396			51.60	-116.12	1901	1903	1931	16			
CA	2530	YURI	30	COAST MOUNTAINS	ISKUT RIVER	56.97	-130.68					1978	1990	10
CA	2605	ZAVISHA	46	COAST MOUNTAINS	BRIDGE RIVER	50.80	-123.42					1976	1985	10
CH	116	ALBIGNA	1674	EASTERN ALPS	ADDA BASIN	46.30	9.64	1855	1882	1991	7			
CH	11	ALLALIN	394	WESTERN ALPS	RHONE BASIN	46.05	7.93	1881	1884	2005	110			
CH	109	ALPETLI(KANDER)	439	WESTERN ALPS	AARE BASIN	46.48	7.80	1893	1894	2005	47			
CH	111	AMMERTEN	435	WESTERN ALPS	AARE BASIN	46.42	7.53	1969	1970	2005	35			
CH	27	AROLLA (BAS)	377	WESTERN ALPS	RHONE BASIN	45.98	7.50	1856	1886	2005	112			
CH	104	BASODINO	463	WESTERN ALPS	TESSIN BASIN	46.42	8.48	1893	1894	2005	87	1992	2005	14
CH	21	BELLA TOLA	383	WESTERN ALPS	RHONE BASIN	46.24	7.65	1945	1946	2005	56			
CH	77	BIFERTEN	422	WESTERN ALPS	LIMMAT BASIN	46.82	8.95	1883	1884	2005	69			
CH	107	BIS	388	WESTERN ALPS	RHONE BASIN	46.11	7.74	1900	1901	1996	27			
CH	64	BLUEMLISALP	436	WESTERN ALPS	AARE BASIN	46.50	7.77	1893	1894	2005	99			
CH	41	BOVEYRE	459	WESTERN ALPS	RHONE BASIN	45.97	7.26	1889	1890	2005	46			
CH	36	BRENEY	368	WESTERN ALPS	RHONE BASIN	45.97	7.42	1881	1882	2005	59			
CH	103	BRESCIANA	465	WESTERN ALPS	TESSIN BASIN	46.50	9.03	1896	1898	2005	78			
CH	20	BRUNEGG	384	WESTERN ALPS	RHONE BASIN	46.15	7.70	1934	1941	2005	64			
CH	72	BRUNNI	427	WESTERN ALPS	REUSS BASIN	46.73	8.78	1882	1883	2003	95			
CH	95	CALDERAS	403	EASTERN ALPS	INN BASIN	46.53	9.71	1920	1921	2005	57			
CH	99	CAMBRENA	399	EASTERN ALPS	ADDA BASIN	46.39	9.99	1888	1889	2005	52			
CH	119	CAVAGNOLI	464	WESTERN ALPS	TESSIN BASIN	46.45	8.48	1893	1894	2005	41			
CH	29	CHEILLON	375	WESTERN ALPS	RHONE BASIN	46.00	7.42	1924	1925	2005	76			
CH	38	CORBASSIERE	366	WESTERN ALPS	RHONE BASIN	45.98	7.30	1889	1890	2005	67			
CH	120	CORNO	468	WESTERN ALPS	TESSIN BASIN	46.45	8.38	1893	1895	2005	33			
CH	121	CROSLINA	1681	ALPS	TESSIN ALPS	46.43	8.73	1989	1990	2005	14			
CH	70	DAMMA	429	WESTERN ALPS	REUSS BASIN	46.63	8.45	1921	1922	2003	80			
CH	112	DUNGEL	1678	ALPS	BERNESE ALPS	46.37	7.37	1893	1894	2005	39			
CH	59	EIGER	442	WESTERN ALPS	AARE BASIN	46.57	7.98	1876	1883	2005	84			
CH	30	EN DARREY	374	WESTERN ALPS	RHONE BASIN	46.02	7.38	1880	1929	2005	69			
CH	13	FEE NORTH	392	WESTERN ALPS	RHONE BASIN	46.08	7.88	1883	1884	2005	97			
CH	25	FERPECLE	379	WESTERN ALPS	RHONE BASIN	46.02	7.58	1891	1892	2005	109			
CH	4	FIESCHER	471	WESTERN ALPS	RHONE BASIN	46.50	8.15	1891	1892	2001	109			
CH	16	FINDELEN	389	WESTERN ALPS	RHONE BASIN	46.00	7.87	1885	1886	2005	77	2005	2005	1
CH	75	FIRNALPELI	424	WESTERN ALPS	REUSS BASIN	46.78	8.47	1894	1895	2005	69			
CH	102	FORNO	396	EASTERN ALPS	ADDA BASIN	46.30	9.70	1833	1864	2005	107			
CH	61	GAMCHI	440	WESTERN ALPS	AARE BASIN	46.51	7.79	1883	1884	2005	99			
CH	52	GAULI	449	WESTERN ALPS	AARE BASIN	46.62	8.18	1882	1886	2005	53			
CH	113	GELTEN	1679	ALPS	BERNESE ALPS	46.35	7.33	1999	2003	2003	1			
CH	37	GIETRO	367	WESTERN ALPS	RHONE BASIN	46.00	7.38	1889	1890	2005	59			
CH	80	GLAERNISCH	418	WESTERN ALPS	LIMMAT BASIN	47.00	8.98	1923	1926	2005	56			
CH	14	GORNER	391	WESTERN ALPS	RHONE BASIN	45.97	7.80	1882	1883	2005	111			
CH	31	GRAND DESERT	373	WESTERN ALPS	RHONE BASIN	46.07	7.34	1892	1893	2005	104			
CH	45	GRAND PLAN NEVE	455	WESTERN ALPS	RHONE BASIN	46.25	7.15	1893	1894	2005	90			
CH	3	GRIES	359	WESTERN ALPS	RHONE BASIN	46.44	8.34	1847	1880	2005	48	1962	2005	44
CH	74	GRIESS(KLAUSEN)	425	WESTERN ALPS	REUSS BASIN	46.83	8.83	1929	1930	2005	69			
CH	76	GRIESSEN(OBWA.)	423	WESTERN ALPS	REUSS BASIN	46.85	8.50	1894	1895	2005	71			
CH	5	GROSSER ALETSCH	360	WESTERN ALPS	RHONE BASIN	46.50	8.03	1870	1881	2005	114	1976	1995	20
CH	73	HUEFI	426	WESTERN ALPS	REUSS BASIN	46.82	8.85	1882	1883	2005	113			
CH	7	KALTWASSER	363	WESTERN ALPS	RHONE BASIN	46.25	8.08	1891	1892	2005	100			

PU	PSFG	NAME	WGMS ID	GENERAL LOCATION	SPECIFIC LOCATION	LATITUDE	LONGITUDE	FV FirstRY	FV FirstSY	FV LastSY	FV NoObs	MB FirstRY	MB LastSY	MB NoObs
CH	68	KEHLEN	431	WESTERN ALPS	REUSS BASIN	46.68	8.42	1893	1894	2005	104			
CH	12	KESSJEN	393	WESTERN ALPS	RHONE BASIN	46.07	7.93	1928	1931	2005	58			
CH	63	LAEMMERN	437	WESTERN ALPS	AARE BASIN	46.40	7.55	1917	1919	2005	47			
CH	18	LANG	386	WESTERN ALPS	RHONE BASIN	46.46	7.93	1888	1889	2005	105			
CH	82	LAVAZ	416	WESTERN ALPS	RHEIN BASIN	46.63	8.93	1882	1886	2005	87			
CH	84	LENTA	414	WESTERN ALPS	RHEIN BASIN	46.51	9.04	1895	1897	2005	90			
CH	78	LIMMERN	421	WESTERN ALPS	LIMMAT BASIN	46.82	8.98	1885	1886	2005	41	1948	1985	38
CH	98	LISCHANA	400	EASTERN ALPS	INN BASIN	46.77	10.35	1895	1897	2005	84			
CH	46	MARTINETS	358	WESTERN ALPS	RHONE BASIN	46.22	7.10	1894	1895	1992	64			
CH	106	MITTELALETSCH	470	WESTERN ALPS	RHONE BASIN	46.45	8.03	1959	1960	1997	32			
CH	24	MOIRY	380	WESTERN ALPS	RHONE BASIN	46.08	7.60	1891	1892	2005	89			
CH	23	MOMING	381	WESTERN ALPS	RHONE BASIN	46.08	7.67	1879	1880	2001	74			
CH	35	MONT DURAND	369	WESTERN ALPS	RHONE BASIN	45.92	7.33	1890	1891	2005	58			
CH	32	MONT FORT	372	WESTERN ALPS	RHONE BASIN	46.08	7.32	1892	1893	2005	101			
CH	26	MONT MINE	378	WESTERN ALPS	RHONE BASIN	46.02	7.55	1956	1957	2005	45			
CH	94	MORTERATSCH	1673	EASTERN ALPS	INN BASIN	46.40	9.93	1874	1880	2005	118			
CH	2	MUTT	472	WESTERN ALPS	RHONE BASIN	46.55	8.42	1918	1919	2005	69			
CH	57	OB.GRINDELWALD	444	WESTERN ALPS	AARE BASIN	46.62	8.10	1879	1880	2001	98			
CH	50	OBERAAR	451	WESTERN ALPS	AARE BASIN	46.53	8.22	1858	1880	2001	74			
CH	6	OBERALETSCH	361	WESTERN ALPS	RHONE BASIN	46.42	7.97	1870	1881	2005	37			
CH	9	OFENTAL	469	WESTERN ALPS	RHONE BASIN	46.02	8.01	1922	1923	1996	51			
CH	34	OTEMMA	370	WESTERN ALPS	RHONE BASIN	45.95	7.45	1881	1882	2005	65			
CH	100	PALUE	398	EASTERN ALPS	ADDA BASIN	46.37	9.98	1885	1895	2004	72			
CH	44	PANEYROSSE	456	WESTERN ALPS	RHONE BASIN	46.27	7.17	1886	1887	2004	85			
CH	86	PARADIES	412	WESTERN ALPS	RHEIN BASIN	46.50	9.07	1873	1898	2005	95			
CH	101	PARADISINO	397	EASTERN ALPS	ADDA BASIN	46.42	10.11	1955	1956	2005	42			
CH	49	PIERREDAR	452	WESTERN ALPS	RHONE BASIN	46.32	7.18	1923	1924	1995	37			
CH	81	PIZOL	417	WESTERN ALPS	LIMMAT BASIN	46.97	9.40	1893	1894	2005	93			
CH	114	PLATTALVA	420	WESTERN ALPS	LIMMAT BASIN	46.83	8.98	1969	1970	2005	32	1948	1989	42
CH	88	PORCHABELLA	410	EASTERN ALPS	RHEIN BASIN	46.63	9.88	1893	1894	2005	98			
CH	48	PRAPIO	453	WESTERN ALPS	RHONE BASIN	46.32	7.20	1898	1899	2005	91			
CH	83	PUNTEGLIAS	415	WESTERN ALPS	RHEIN BASIN	46.79	8.95	1895	1897	2005	98			
CH	65	RAETZLI	434	WESTERN ALPS	AARE BASIN	46.38	7.52	1925	1928	2001	64			
CH	1	RHONE	473	WESTERN ALPS	RHONE BASIN	46.62	8.40	1879	1880	2005	124	1980	1983	4
CH	17	RIED	387	WESTERN ALPS	RHONE BASIN	46.13	7.85	1895	1896	2005	53			
CH	92	ROSEG	406	EASTERN ALPS	INN BASIN	46.38	9.84	1855	1881	2005	99			
CH	56	ROSENLAUI	445	WESTERN ALPS	AARE BASIN	46.65	8.15	1880	1882	1996	61			
CH	105	ROSSBODEN	462	WESTERN ALPS	TESSIN BASIN	46.18	8.01	1891	1892	2002	109			
CH	69	ROTFIRN NORD	430	WESTERN ALPS	REUSS BASIN	46.66	8.42	1956	1957	2005	47			
CH	42	SALEINA	458	WESTERN ALPS	RHONE BASIN	45.98	7.07	1878	1880	2005	112			
CH	67	SANKT ANNA	432	WESTERN ALPS	REUSS BASIN	46.60	8.60	1867	1882	2004	72			
CH	91	SARDONA	407	WESTERN ALPS	RHEIN BASIN	46.92	9.27	1895	1897	2005	92			
CH	115	SCALETTA	1680	ALPS		46.70	9.95	1998	1999	2005	6			
CH	62	SCHWARZ	438	WESTERN ALPS	AARE BASIN	46.42	7.67	1924	1925	2005	77			
CH	10	SCHWARZBERG	395	WESTERN ALPS	RHONE BASIN	46.02	7.93	1880	1909	2005	75			
CH	97	SESVENNA	401	EASTERN ALPS	INN BASIN	46.71	10.41	1956	1957	2004	45			
CH	47	SEX ROUGE	454	WESTERN ALPS	RHONE BASIN	46.33	7.21	1898	1899	2005	89			
CH	90	SILVRETTA	408	EASTERN ALPS	RHEIN BASIN	46.85	10.08	1956	1957	2005	46	1960	2005	46
CH	53	STEIN	448	WESTERN ALPS	AARE BASIN	46.70	8.43	1893	1894	2005	109			
CH	54	STEINLIMMI	447	WESTERN ALPS	AARE BASIN	46.70	8.40	1961	1962	2005	43			
CH	79	SULZ	419	WESTERN ALPS	LIMMAT BASIN	46.88	9.05	1912	1913	2005	70			
CH	87	SURETTA	411	EASTERN ALPS	RHEIN BASIN	46.52	9.38	1930	1931	2005	67			
CH	8	TAELLIBODEN	362	WESTERN ALPS	RHONE BASIN	46.00	7.99	1922	1923	1996	59			
CH	96	TIATSCHA	402	EASTERN ALPS	INN BASIN	46.83	10.09	1850	1894	2003	69			
CH	66	TIEFEN	433	WESTERN ALPS	REUSS BASIN	46.62	8.43	1922	1923	2005	76			
CH	43	TRIENT	457	WESTERN ALPS	RHONE BASIN	46.00	7.03	1879	1880	2005	125			
CH	55	TRIFT (GADMEN)	446	WESTERN ALPS	AARE BASIN	46.67	8.37	1891	1892	2005	41			
CH	33	TSANFLEURON	371	WESTERN ALPS	RHONE BASIN	46.32	7.23	1884	1885	2005	110			
CH	93	TSCHIERVA	405	EASTERN ALPS	INN BASIN	46.40	9.88	1934	1943	2005	59			
CH	60	TSCHINGEL	441	WESTERN ALPS	AARE BASIN	46.50	7.85	1893	1894	2005	56			
CH	40	TSEUDET	364	WESTERN ALPS	RHONE BASIN	45.90	7.25	1890	1891	2005	49			
CH	28	TSIDJIORE NOUVE	376	WESTERN ALPS	RHONE BASIN	46.00	7.45	1880	1882	2005	113			
CH	19	TURTMANN (WEST)	385	WESTERN ALPS	RHONE BASIN	46.13	7.68	1885	1886	2005	113			
CH	58	UNT.GRINDELWALD	443	WESTERN ALPS	AARE BASIN	46.58	8.09	1879	1880	2001	117			
CH	51	UNTERAAR	450	WESTERN ALPS	AARE BASIN	46.57	8.22	1876	1880	2001	111			
CH	118	VAL TORTA	466	WESTERN ALPS	TESSIN BASIN	46.47	8.53	1970	1971	2005	31			
CH	117	VALLEGGIA	467	WESTERN ALPS	TESSIN BASIN	46.47	8.51	1971	1973	2005	29			
CH	39	VALSOREY	365	WESTERN ALPS	RHONE BASIN	45.90	7.27	1889	1890	2005	107			
CH	89	VERSTANKLA	409	EASTERN ALPS	RHEIN BASIN	46.84	10.07	1926	1927	2005	69			
CH	85	VORAB	413	WESTERN ALPS	RHEIN BASIN	46.88	9.17	1882	1886	2005	81			
CH	71	WALLENBUR	428	WESTERN ALPS	REUSS BASIN	46.71	8.47	1893	1894	2005	99			
CH	22	ZINAL	382	WESTERN ALPS	RHONE BASIN	46.07	7.63	1891	1892	2005	111			
CH	15	ZMUTT	390	WESTERN ALPS	RHONE BASIN	46.00	7.63	1892	1893	1997	61			
CL	56	AMALIA	1653	PATAGONIA	S.PAT.ICEFIELD	-50.95	-73.75	1945	1975	1996	3			
CL	19	ARCO	1028	PATAGONIA	N.PAT.ICEFIELD	-47.28	-73.28	1945	1975	1990	3			
CL	55	ASIA	1652	PATAGONIA	S.PAT.ICEFIELD	-50.82	-73.73	1945	1984	1986	2			
CL	60	BALMACEDA	1657	PATAGONIA	S.PAT.ICEFIELD	-51.38	-73.30	1945	1984	1986	2			
CL	7	BENITO	1040	PATAGONIA	N.PAT.ICEFIELD	-47.03	-73.90	1945	1975	1990	3			
CL	37	BERNARDO	1634	PATAGONIA	S.PAT.ICEFIELD	-48.62	-73.93	1945	1976	1993	4			
CL	74	BLANCO CHICO	2011	LAKE DISTRICT		-41.15	-71.92	1961	1981	1997	3			
CL	32	BRUEGGEN	1014	PATAGONIA	S.PAT.ICEFIELD	-49.17	-74.00	1945	1976	1986	2			
CL	21	CACHET	1026	PATAGONIA	N.PAT.ICEFIELD	-47.10	-73.20	1945	1975	1990	3			
CL	53	CALVO	1650	PATAGONIA	S.PAT.ICEFIELD	-50.68	-73.35	1945	1984	1986	2			
CL	73	CASA PANGUE	2010	LAKE DISTRICT		-41.13	-71.87	1911	1945	2000	6			
CL	34	CERRO BLANCO	2013	PATAGONIA		-48.33	-72.25	1945	1975	1997	2			
CL	59	CHICO	2015	PATAGONIA		-49.00	-73.07	1945	1975	1996	3			
CL	71	CIPRESES	2008	CENTRAL ANDES		-34.55	-70.37	1860	1888	1997	4			
CL	20	COLONIA	1027	PATAGONIA	N.PAT.ICEFIELD	-47.25	-73.23	1945	1975	1990	3			
CL	63	DICKSON	1660	PATAGONIA	S.PAT.ICEFIELD	-50.78	-73.15	1901	1945	1998	5			
CL	0001B	ECHAURREN NORTE	1344	CENTRAL ANDES		-33.58	-70.13					1976	2005	30
CL	49	EUROPA	1646	PATAGONIA	S.PAT.ICEFIELD	-50.30	-73.87	1945	1981	1986	2			
CL	28	EXPLORADORES	1011	PATAGONIA	N.PAT.ICEFIELD	-46.50	-73.17	1945	1975	1990	3			
CL	26	FIERO	1021	PATAGONIA	N.PAT.ICEFIELD	-46.70	-73.20	1945	1975	1990	3			
CL	68	G30	2005	CENTRAL ANDES		-33.13	-70.13	1955	1997	1997	1			
CL	69	G32	2006	CENTRAL ANDES		-33.13	-70.12	1955	1997	1997	1			
CL	1016	GALERIA	2031			-52.79	-73.01	1984	1986	1998	2			
CL	1009	GCN09	2024			-52.75	-73.11	1984	1986	1998	2			
CL	1013	GCN13	2028			-52.76	-73.03	1984	1986	1998	2			
CL	1021	GCN22	2036			-52.83	-73.01	1942	1984	1998	3			
CL	1036	GCN37	2051			-52.89	-73.09	1984	1986	1998	2			
CL	1037	GCN38	2052			-52.87	-73.13	1984	1986	1998	2			
CL	1039	GCN40	2054			-52.84	-73.19	1942	1986	1998	2			
CL	1040	GCN41	2055			-52.82	-73.18	1942	1986	1998	2			
CL	1041	GCN42	2056			-52.81	-73.14	1942	1986	1998	2			
CL	40	GREVE	1637	PATAGONIA	S.PAT.ICEFIELD	-48.97	-73.92	1945	1976	1987	5			
CL	62	GREY	1659	PATAGONIA	S.PAT.ICEFIELD	-51.02	-73.20	1945	1967	1995	4			
CL	0001A	GROSSE	1044	PATAGONIA	N.PAT.ICEFIELD	-46.45	-73.30	1945	1975	1990	3			
CL	0004A	GUALAS N-TONGUE	1019	PATAGONIA	N.PAT.ICEFIELD	-46.55	-73.67	1945	1975	1990	3			
CL	0004B	GUALAS S-TONGUE	1020	PATAGONIA	N.PAT.ICEFIELD	-46.55	-73.67	1945	1975	1990	3			
CL	8	HPN 1	1039	PATAGONIA	N.PAT.ICEFIELD	-47.18	-73.87	1945	1975	1990	3			
CL	9	HPN 2	1038	PATAGONIA	N.PAT.ICEFIELD	-47.23	-73.90	1945	1975	1990	3			
CL	10	HPN 3	1037	PATAGONIA	N.PAT.ICEFIELD	-47.32	-73.92	1945	1975	1990	3			
CL	43	HPS12	1640	PATAGONIA	S.PAT.ICEFIELD	-49.68	-73.75	1981	1984	1986	2			
CL	45	HPS13	1642	PATAGONIA	S.PAT.ICEFIELD	-49.72	-73.67	1945	1984	1986	2			
CL	46	HPS15	1643	PATAGONIA	S.PAT.ICEFIELD	-49.80	-73.70	1945	1984	1986	2			
CL	47	HPS19	1644	PATAGONIA	S.PAT.ICEFIELD	-50.00	-73.92	1981	1986	1986	1			
CL	51	HPS28	1648	PATAGONIA	S.PAT.ICEFIELD	-50.42	-73.58	1945	1984	1986	2			
CL	52	HPS29	1649	PATAGONIA	S.PAT.ICEFIELD	-50.47	-73.60	1945	1984	1986	2			
CL	50	HPS31	1647	PATAGONIA	S.PAT.ICEFIELD	-50.60	-73.55	1945	1970	1984	2			
CL	54	HPS34	1651	PATAGONIA	S.PAT.ICEFIELD	-50.72	-73.53	1945	1984	1986	2			
CL	57	HPS38	1654	PATAGONIA	S.PAT.ICEFIELD	-51.05	-73.75	1945	1984	1986	2			
CL	58	HPS41	1655	PATAGONIA	S.PAT.ICEFIELD	-51.30	-73.57	1945	1984	1986	2			
CL	41	HPS8	1638	PATAGONIA	S.PAT.ICEFIELD	-49.03	-73.78	1945	1976	1986	4			
CL	42	HPS9	1639	PATAGONIA	S.PAT.ICEFIELD	-49.05	-73.80	1976	1979	1986	3			
CL	30	JORGE MONTT	1016	PATAGONIA	S.PAT.ICEFIELD	-48.33	-73.50	1945	1976	1986	2			
CL	64	JUNCAL NORTE	2001	CENTRAL ANDES		-33.03	-70.10	1955	1997	2000	2			
CL	65	JUNCAL SUR	2002	CENTRAL ANDES		-33.08	-70.10	1955	1997	1997	1			
CL	1019	LENGUA	2034			-52.81	-73.00	1942	1984	1998	3			
CL	25	LEONES	1022	PATAGONIA	N.PAT.ICEFIELD	-46.77	-73.22	1945	1975	1990	3			
CL	23	NEF	1024	PATAGONIA	N.PAT.ICEFIELD	-47.10	-73.18	1945	1975	1990	3			
CL	39	OCCIDENTAL	1636	PATAGONIA	S.PAT.ICEFIELD	-48.85	-74.23	1945	1976	1987	3			
CL	36	OFHIDRO	1633	PATAGONIA	S.PAT.ICEFIELD	-48.42	-73.85	1945	1976	1986	3			
CL	31	O'HIGGINS	1015	PATAGONIA	S.PAT.ICEFIELD	-48.92	-73.17	1945	1976	1986	2			
CL	67	OLIVARES BETA	2004	CENTRAL ANDES		-33.13	-70.18	1955	1997	1997	1			
CL	66	OLIVARES GAMA	2003	CENTRAL ANDES		-33.13	-70.17	1955	1997	1997	1			
CL	17	PARED NORTE	1030	PATAGONIA	N.PAT.ICEFIELD	-47.47	-73.25	1945	1975	1990	3			
CL	16	PARED SUR	1031	PATAGONIA	N.PAT.ICEFIELD	-47.45	-73.33	1945	1975	1990	3			
CL	48	PENGUIN	1645	PATAGONIA	S.PAT.ICEFIELD	-50.08	-73.92	1981	1986	1986	1			
CL	61	PINGO	1658	PATAGONIA	S.PAT.ICEFIELD	-51.03	-73.35	1945	1984	1986	2			
CL	44	PIO XI	1641	PATAGONIA	S.PAT.ICEFIELD	-49.22	-74.00	1830	1925	2000	15			
CL	15	PISCIS	1032	PATAGONIA	N.PAT.ICEFIELD	-47.45	-73.42	1945	1975	1990	3			
CL	0003A	REICHER NE	1018	PATAGONIA	N.PAT.ICEFIELD	-46.48	-73.58	1945	1975	1990	3			
CL	0003B	REICHER SW	1017	PATAGONIA	N.PAT.ICEFIELD	-46.48	-73.58	1945	1975	1990	3			
CL	70	RISOPATRON	2007	CENTRAL ANDES		-33.13	-70.08	1955	1997	1997	1			
CL	6	SAN QUINTIN	1041	PATAGONIA	N.PAT.ICEFIELD	-46.87	-74.08	1945	1975	1990	3			
CL	5	SAN RAFAEL	1042	PATAGONIA	N.PAT.ICEFIELD	-46.68	-73.85	1945	1975	1990	3			
CL	59	SNOWY	1656	PATAGONIA	S.PAT.ICEFIELD	-51.37	-73.57	1945	1984	1986	2			
CL	24	SOLER	1023	PATOGONIA	N.PAT.ICEFIELD	-46.90	-73.18	1945	1975	1990	3			
CL	11	STEFFEN	1036	PATAGONIA	N.PAT.ICEFIELD	-47.53	-73.70	1945	1975	1990	3			
CL	38	TEMPANO	1635	PATAGONIA	S.PAT.ICEFIELD	-48.73	-74.05	1945	1976	1986	3			
CL	55	TRINIDAD	2014	PATAGONIA		-49.42	-73.75	1945	1986	2000	3			
CL	29	TRONQUITOS	1010	NORTHERN CHILE	RIO COPIAPO	-28.53	-69.72	1955	1984	1996	2			
CL	35	TYNDALL	1013	PATAGONIA	S.PAT.ICEFIELD	-51.17	-73.33	1945	1975	1986	2			
CL	72	UNIVERSIDAD	2009	CENTRAL ANDES		-34.70	-70.33	1955	1997	1997	1			
CL	2	UNNAMED RC1	1043	PATAGONIA	N.PAT.ICEFIELD	-46.47	-73.38	1945	1975	1986	2			
CL	75	VERDE	2012	LAKE DISTRICT		-41.20	-71.83	1961	1981	1997	3			
CN	36	COLLIERY	859	KUNLUN MT.	GOLMUD RIVER	35.67	94.18	1969	1989	1989	1			
CN	28	DAGONGBA	841	HENGDUAN SHAN	CHANGJIANG	29.58	101.87	1981	1984	1990	2			
CN	34	GOZHA	861	KUNLUN MT.	GOZHA LAKE	35.27	81.08	1970	1987	1987	1			
CN	35	GULIYA	860	KUNLUN MT.	GOZHA LAKE	35.28	81.48	1970	1990	1990	1			
CN	31	HAILUOGOU	849	HENGDUAN SHAN	CHANGJIANG	29.58	101.93	1930	1966	1990	5			
CN	23	HALONG GL.	846	ANYEMAGEN SHAN	HUANGHE	36.75	99.50	1966	1981	1981	1			
CN	14	KALAGEYULE WUK.	866	TIAN SHAN	MUZHAERT BASIN	42.28	80.37	1964	1978	1978	1			
CN	15	KEGIKER	867	TIAN SHAN	AKSU BASIN	41.83	80.15	1973	1976	1976	1			
CN	4	LAOHUGOU	855	QILIAN SHAN	SHULEHE BASIN	39.43	96.55	1962	1976	1985	2	1976	1976	1
CN	25	LAPATE NO.48	844	TIAN SHAN	KUYTUN HE	43.72	84.48	1964	1981	1981	1			
CN	27	LAPATE NO.51	842	TIAN SHAN	KUYTUN HE	43.70	84.40	1964	1981	2005	7			
CN	26	LAPATE NO.53	843	TIAN SHAN	KUYTUN HE	43.72	84.40	1964	1981	1981	1			
CN	13	MUZHAERT	865	TIAN SHAN	MUZHAERT BASIN	42.30	80.02	1906	1959	1978	2			
CN	33	NAINUOGERU	847	HENGDUAN SHAN	LANCANG JIANG	28.45	98.72	1932	1959	1982	3			

PU	PSFG	NAME	WGMS ID	GENERAL LOCATION	SPECIFIC LOCATION	LATITUDE	LONGITUDE	FV FirstRY	FV FirstSY	FV LastSY	FV NoObs	MB FirstRY	MB LastSY	MB NoObs
CN	19	QIANGYONG	871	HIMALAYA	YARLUNGZANGBU R	28.85	90.23	1975	1979	1980	2			
CN	17	QIERGANBULAK	869	EASTERN PAMIR	MT.MUZTAGATA	38.23	75.10	1973	1979	1979	1			
CN	3	QIYI	856	QILIAN SHAN	BEIDAHE BASIN	39.23	97.90	1958	1975	1987	7	1976	1985	4
CN	11	QUNTAILAN	863	TIAN SHAN	TAILAN BASIN	41.97	80.12	1962	1973	1973	1			
CN	18	RONGBU	870	HIMALAYA	MT.QUMOLANGMA	28.07	86.95	1921	1966	1980	2			
CN	16	SAYIGAPEIR	868	TIAN SHAN	TAILAN BASIN	41.87	80.20	1942	1976	1976	1			
CN	1	SHUIGUANHE NO.4	857	QILIAN SHAN	SHIYANGHE BASIN	37.55	101.75	1976	1976	1984	4	1976	1977	2
CN	8	SIGONHE NO.4	838	TIAN SHAN	MT. BOGDA	43.83	88.33	1956	1972	1972	1			
CN	9	SIGONHE NO.5	862	TIAN SHAN	MT. BOGDA	43.82	88.32	1959	1961	1961	1			
CN	6	TUERGANGOU	854	TIAN SHAN	YIWU HE	43.10	94.35	1960	1965	1984	4			
CN	12	TUGEBIELIQI	864	TIAN SHAN	MUZHAERT BASIN	42.17	80.33	1959	1964	1976	2			
CN	1	URUMQIHE E-BR.	1511	TIAN SHAN	URUMQIRIVER	43.08	86.82	1995	1996	2005	10	1988	2005	18
CN	10	URUMQIHE S.NO.1	853	TIAN SHAN	URUMQI RIVER	43.08	86.82	1962	1973	1995	17	1959	2005	47
CN	2	URUMQIHE W-BR.	1512	TIAN SHAN	URUMQIRIVER	43.08	86.82	1995	1996	2005	10	1988	2005	18
CN	24	WEIGELE DANGXI.	845	ANYEMAGEN SHAN	HUANGHE	36.83	99.45	1966	1981	1981	1			
CN	38	XIAO DONGKZMADI	1510	TIBETAN PLATEAU	TANGGULA MTS.	33.17	92.13					1989	1993	5
CN	29	XIAOGONGBA	840	GONGGA SHAN	CHANGJIANG	29.60	101.85	1981	1984	1990	2			
CN	37	XIDATAN	858	KUNLUN MT.	GOLMUD RIVER	35.67	94.27	1969	1989	1989	1			
CN	2	YANGLONGHE NO.5	837	QILIAN SHAN	BEIDAHE BASIN	39.23	98.57	1956	1977	1977	1	1977	1979	3
CN	30	YANZIGOU	839	HENGDUAN SHAN	CHANGJIANG	29.63	101.88	1930	1966	1990	3			
CN	22	YIEHELONG GL.	850	ANYEMAGEN SHAN	HUANGHE	36.73	99.55	1966	1981	1981	1			
CN	32	YULONG	848	HENGDUAN SHAN	CHANGJIANG	27.12	100.20	1930	1982	1982	1			
CO	13	ALFOMBRALES	2692	CORDILL-CENTRAL	VOLCAN NEVADO DEL RUIZ	4.87	-75.33	1987	2000	2000	1			
CO	0013B	ALFOMBRALES E	2693	CORDILL-CENTRAL	VOLCAN NEVADO DEL RUIZ	4.87	-75.33	1945	1959	1987	4			
CO	0005B	AZUFRADO E	2696	CORDILL-CENTRAL	VOLCAN NEVADO DEL RUIZ	4.90	-75.32	1945	1959	1987	4			
CO	0005A	AZUFRADO W	2697	CORDILL-CENTRAL	VOLCAN NEVADO DEL RUIZ	4.90	-75.32	1945	1959	1987	4			
CO	32	CENTRAL	2713	CORDILL-CENTRAL	VOLCAN NEVADO DEL SANTA ISABEL	4.47	-75.22	1987	2000	2000	1			
CO		CERRO CON-CAVO (7)	2742	CORDILL-ORIENTAL	SIERRA NEVADA DE EL COCUY	6.45	-72.30	1986	1991	2004	4			
CO		CERRO CON-CAVO (8)	2743	CORDILL-ORIENTAL	SIERRA NEVADA DE EL COCUY	6.45	-72.30	1986	1991	2004	4			
CO		CERRO TOTI (B)	2744	CORDILL-ORIENTAL	SIERRA NEVADA DE EL COCUY	6.45	-72.30	1997	1998	1998	1			
CO		CERRO TOTI (C)	2745	CORDILL-ORIENTAL	SIERRA NEVADA DE EL COCUY	6.45	-72.30	1997	1998	1998	1			
CO		DESA S	2683	CORDILL-CENTRAL	VOLCAN NEVADO DEL HUILA	2.92	-76.05	1961	1989	1995	2			
CO		DESA SE	2684	CORDILL-CENTRAL	VOLCAN NEVADO DEL HUILA	2.92	-76.05	1961	1989	1995	2			
CO		DESA WSW	2685	CORDILL-CENTRAL	VOLCAN NEVADO DEL HUILA	2.92	-76.05	1961	1989	1995	2			
CO		EL MAYOR	2686	CORDILL-CENTRAL	VOLCAN NEVADO DEL HUILA	2.92	-76.05	1961	1965	1995	4			
CO		EL OSO	2687	CORDILL-CENTRAL	VOLCAN NEVADO DEL HUILA	2.92	-76.05	1961	1965	2000	4			
CO		EL VENADO	2688	CORDILL-CENTRAL	VOLCAN NEVADO DEL HUILA	2.92	-76.05	1961	1970	1995	2			
CO	3	GUALI	2700	CORDILL-CENTRAL	VOLCAN NEVADO DEL RUIZ	4.90	-75.33	1987	2000	2000	1			
CO		HOJALARGA 1	2758	CORDILL-ORIENTAL	SIERRA NEVADA DE EL COCUY	6.45	-72.30	1988	1991	1997	2			
CO	7	LA CABANA	2701	CORDILL-CENTRAL	VOLCAN NEVADO DEL RUIZ	4.90	-75.30	1959	1975	1987	3			
CO	33	LA CONEJERA	2721	CORDILL-CENTRAL	VOLCAN NEVADO DEL SANTA ISABEL	4.48	-75.22	1987	2000	2000	1			
CO	4	LA LISA	2702	CORDILL-CENTRAL	VOLCAN NEVADO DEL RUIZ	4.92	-75.32	1987	2000	2000	1			
CO	6	LA PLAZUELA	2705	CORDILL-CENTRAL	VOLCAN NEVADO DEL RUIZ	4.90	-75.30	1945	1959	1987	3			
CO	26	LAGUNA AZUL	2723	CORDILL-CENTRAL	VOLCAN NEVADO DEL SANTA ISABEL	4.47	-75.37	1987	2000	2000	1			
CO	8	LAGUNILLAS	2706	CORDILL-CENTRAL	VOLCAN NEVADO DEL RUIZ	4.88	-75.30	1945	1959	1987	4			
CO		LENGUA-SI 1	2727	CORDILL-CENTRAL	VOLCAN NEVADO DEL SANTA ISABEL	4.81	-75.37	1988	1989	1993	4			
CO		LENGUA-SI 2	2728	CORDILL-CENTRAL	VOLCAN NEVADO DEL SANTA ISABEL	4.82	-75.37	1988	1989	2003	7			
CO		LENGUA-SI 4CEN	2729	CORDILL-CENTRAL	VOLCAN NEVADO DEL SANTA ISABEL	4.82	-75.37	1990	1991	2001	5			
CO		LENGUA-SI 4DER	2730	CORDILL-CENTRAL	VOLCAN NEVADO DEL SANTA ISABEL	4.82	-75.37	1989	1989	2003	7			
CO		LENGUA-SI 4IZQ	2731	CORDILL-CENTRAL	VOLCAN NEVADO DEL SANTA ISABEL	4.81	-75.38	1991	1992	2004	9			
CO		LENGUA-SI 5	2732	CORDILL-CENTRAL	VOLCAN NEVADO DEL SANTA ISABEL	4.82	-75.37	1989	1990	1993	4			
CO		LENGUA-SI 6	2733	CORDILL-CENTRAL	VOLCAN NEVADO DEL SANTA ISABEL	4.82	-75.37	1989	1990	1996	5			
CO		LENGUA-SI 7	2734	CORDILL-CENTRAL	VOLCAN NEVADO DEL SANTA ISABEL	4.82	-75.37	1989	1990	1992	3			
CO		LENGUA-SI 8	2735	CORDILL-CENTRAL	VOLCAN NEVADO DEL SANTA ISABEL	4.82	-75.37	1989	1990	2003	7			
CO		LENGUA-SI 8DER	2736	CORDILL-CENTRAL	VOLCAN NEVADO DEL SANTA ISABEL	4.82	-75.37	1988	1990	1993	4			
CO		LENGUA-SI N	2737	CORDILL-CENTRAL	VOLCAN NEVADO DEL SANTA ISABEL	4.82	-75.37	2001	2002	2004	3			
CO		LENGUA-SI PNORTE	2738	CORDILL-CENTRAL	VOLCAN NEVADO DEL SANTA ISABEL	4.82	-75.34	2001	2003	2004	2			
CO	9	LEONERA ALTA	2707	CORDILL-CENTRAL	VOLCAN NEVADO DEL RUIZ	4.88	-75.30	1945	1959	1987	4			
CO	2	MOLINOS	2708	CORDILL-CENTRAL	VOLCAN NEVADO DEL RUIZ	4.90	-75.33	1987	2000	2000	1			
CO	14	NEREIDAS	2709	CORDILL-CENTRAL	VOLCAN NEVADO DEL RUIZ	4.88	-75.33	1958	1986	2000	10			
CO		PA3	2767	CORDILL-ORIENTAL	SIERRA NEVADA DE EL COCUY	6.45	-72.30	1986	1988	2004	5			
CO		PAB	2768	CORDILL-ORIENTAL	SIERRA NEVADA DE EL COCUY	6.45	-72.30	1991	1997	2004	3			
CO		PASO BELLAVISTA (A)	2769	CORDILL-ORIENTAL	SIERRA NEVADA DE EL COCUY	6.45	-72.30	1997	1998	2004	2			
CO		PULPITO DEL DIABLO	2776	CORDILL-ORIENTAL	SIERRA NEVADA DE EL COCUY	6.45	-72.30	1986	1988	2004	5			
CO		SECTOR NORTE	2690	CORDILL-CENTRAL	VOLCAN NEVADO DEL HUILA	2.92	-76.05	1961	1989	1995	2			
CO	12	TRIDENTE	2711	CORDILL-CENTRAL	VOLCAN NEVADO DEL RUIZ	4.88	-75.32	1987	2000	2000	1			
DE	3	HOELLENTAL	348	EASTERN ALPS	BAVARIAN ALPS	47.42	10.99	1896	1897	1900	4			
DE	1	SCHNEEFERNER N	346	EASTERN ALPS	BAVARIAN ALPS	47.41	10.97					1963	1968	6
EC	1	ANTIZANA15ALPHA	1624	E. CORDILLERA	RIO ANTIZANA B.	-0.47	-78.15	1994	1995	2005	11	1995	2005	11
ES	9010	ALBA	967	PYRENEES SOUTH	ANETO-MALADETA	42.66	0.62	1983	1990	2000	2			
ES	9030	ANETO	943	PYRENEES SOUTH	ANETO-MALADETA	42.63	0.65	1946	1957	2005	6			
ES	1030	BALAITUS SE	954	PYRENEES SOUTH	BALAITUS	42.83	-0.28	1946	1957	2000	4			
ES	9040	BARRANCS	941	PYRENEES SOUTH	ANETO-MALADETA	42.63	0.67	1946	1957	2005	5			
ES	1020	BRECHA LATOUR	953	PYRENEES SOUTH	BALAITUS	42.83	-0.28	1946	1957	2000	4			
ES	3010	CLOT DE HOUNT	960	PYRENEES SOUTH	VINEMAL	42.78	-0.15	1904	1905	2005	6			
ES	9080	CORONAS	970	PYRENEES SOUTH	ANETO-MALADETA	42.63	0.63	1946	1957	2005	6			
ES	0907A	CREGUENA N	969	PYRENEES SOUTH	ANETO-MALADETA	42.63	0.63	1946	1957	2000	4			
ES	0907B	CREGUENA S	971	PYRENEES SOUTH	ANETO-MALADETA	42.63	0.63	1946	1957	2000	4			
ES	2020	INFIERNO E	957	PYRENEES SOUTH	INFIERNO	42.78	-0.25	1946	1957	2005	6			
ES	0201A	INFIERNO W	955	PYRENEES SOUTH	INFIERNO	42.78	-0.25	1946	1957	2005	5			
ES	0201B	INFIERNO WW	956	PYRENEES SOUTH	INFIERNO	42.78	-0.25	1946	1957	2000	4			
ES	7020	LA PAUL	948	PYRENEES SOUTH	POSETS	42.65	0.43	1957	1983	2005	4			
ES	1010	LAS FRONDELLAS	952	PYRENEES SOUTH	BALAITUS	42.83	-0.28	1985	1957	2005	5			
ES	8010	LITEROLA	951	PYRENEES SOUTH	PERDIGUERO	42.70	0.53	1985	1990	1990	1			
ES	7010	LLARDANA	947	PYRENEES SOUTH	POSETS	42.65	0.43	1957	1983	2005	5			
ES	9090	LLOSAS	939	PYRENEES SOUTH	ANETO-MALADETA	42.63	0.65	1946	1957	2000	4			
ES	7040	LOS GEMELOS	950	PYRENEES SOUTH	POSETS	42.48	0.43	1957	1983	2005	4			
ES	9020	MALADETA	942	PYRENEES SOUTH	ANETO-MALADETA	42.65	0.64	1957	1983	2005	8	1992	2005	14
ES	5010	MARBORECILINDRO	964	PYRENEES SOUTH	PERDIDO	42.68	0.02	1983	1990	2005	3			
ES	0302B	MONFERRAT	962	PYRENEES SOUTH	VINEMAL	42.77	-0.13	1985	1990	1990	1			
ES	0502B	PERDIDO INF	966	PYRENEES SOUTH	PERDIDO	42.67	0.05	1983	1990	2005	4			
ES	0502A	PERDIDO SUP	965	PYRENEES SOUTH	PERDIDO	42.67	0.05	1983	1990	2005	4			
ES	7030	POSETS	949	PYRENEES SOUTH	POSETS	42.65	0.43	1957	1983	2005	4			
ES	2040	PUNTA ZARRA	959	PYRENEES SOUTH	INFIERNO	42.83	-0.23	1946	1957	2005	5			
ES	6010	ROBINERA	946	PYRENEES SOUTH	LA MUNIA	42.70	0.14	1985	1990	1990	1			
ES	9060	SALENCAS	940	PYRENEES SOUTH	ANETO-MALADETA	42.62	0.68	1946	1957	2000	4			
ES	5030	SOUM RAMOND SE	944	PYRENEES SOUTH	PERDIDO	42.67	0.05	1985	1990	1990	1			
ES	5040	SOUM RAMOND SW	945	PYRENEES SOUTH	PERDIDO	42.67	0.03	1985	1990	1990	1			
ES	4010	TAILLON	963	PYRENEES SOUTH	TAILLON	42.70	-0.05	1893	1906	1990	4			
ES	0302A	TAPOU	961	PYRENEES SOUTH	VINEMAL	42.77	-0.13	1983	1990	2000	2			
ES	9050	TEMPESTADES	968	PYRENEES SOUTH	ANETO-MALADETA	42.63	0.68	1946	1957	2005	6			
FR	2	ARGENTIERE	354	WESTERN ALPS	MONT BLANC AREA	45.95	6.98	1866	1883	2005	79	1976	2005	10
FR	32	BARD	2324			45.18	6.93	1927	1928	1966	3			
FR	6	BIONNASSAY	1313	WESTERN ALPS	MONT BLANC AREA	45.85	6.81	1904	1905	1973	36			
FR	31	BLANC	351	WESTERN ALPS	EGRINS AREA	44.94	6.39	1895	1899	2005	54			
FR	4	BOSSONS	355	WESTERN ALPS	MONT BLANC AREA	45.88	6.86	1818	1874	2005	84			
FR	9	GEBROULAZ	352	WESTERN ALPS	VANOISE AREA	45.30	6.63	1907	1908	2005	49	2001	2005	5
FR	34	LAMET	2326			45.24	6.99	1959	1960	1967	5			
FR	3	MER DE GLACE	353	WESTERN ALPS	MONT BLANC AREA	45.88	6.93	1825	1866	2005	59			
FR		OSSOUE	2867	PYRENEES	CENTRAL PYRENEES	42.77	-0.14	2000	2001	2005	5	2002	2005	4
FR	15	SAINT SORLIN	356	WESTERN ALPS	GRANDES ROUSSES	45.17	6.15	1909	1923	2005	42	1957	2005	49
FR	29	SARENNES	357	WESTERN ALPS	GRANDES ROUSSES	45.14	6.14	1905	1906	1935	4	1949	2005	57
FR	5	TACONNAZ	1312	WESTERN ALPS	MONT BLANC AREA	45.87	6.84	1921	1922	1973	25			
FR	1	TOUR	1315	WESTERN ALPS	MONT BLANC AREA	45.99	6.99	1818	1878	1973	44			
FR	7	TRE LA TETE	1314	WESTERN ALPS	MONT BLANC AREA	45.79	6.79	1730	1864	1973	19			
GL	4	AMITSULOQ ISKA.	232	SW GREENLAND	TASERSIAQ	60.10	-50.22	1981	1981	1981	1			
GL	6	EQ.KANGIGD.SER.	241	S GREENLAND	NARSSARSSUAQ A.	61.33	-45.80	1955	1967	1980	3			
GL	5	NARSSAQ BRAE	233	S GREENLAND	NARSSAQ AREA	60.25	-45.92					1981	1983	3
GL	2	NORDBOGLETSCHER	234	S GREENLAND	NARSSARSSUAQ A.	61.42	-45.38	1942	1953	1981	3			
GL	8	NORDGLETSCHER	236	S GREENLAND	NARSSARSSUAQ A.	65.45	-45.13	1947	1953	1981	7			
GL	9	QAPIARFIUP SER.	238	SW GREENLAND	SUKKERTOPPEN	65.60	-52.13					1981	1985	5
GL	1	VALHALTINDEGL.	240	S GREENLAND	NARSSARSSUAQ A.	61.43	-45.35					1979	1983	5
GS		COOK	2870	SOUTH GEORGIA	ST ANDREWS BAY	-54.48	-36.20	1882	1928	2003	4			
GS		HARKER	2868	SOUTH GEORGIA	MORAINE FJORD	-54.37	-36.53	1902	1914	2003	8			
GS		HEANEY	2871	SOUTH GEORGIA	ST ANDREWS BAY	-54.45	-36.27	1928	1975	2003	4			
GS		HODGES	2872	SOUTH GEORGIA	THATCHER PENINSULA	-54.27	-36.54	1930	1955	2003	4			
GS		ROSS	2869	SOUTH GEORGIA	ROYAL BAY	-54.56	-36.18	1882	1883	2003	7			
HM	1350	ALLISON	2902	HEARD ISLAND	BIG BEN	-53.08	73.40	1947	1980	1980	1			
HM	1020	ANZAC PEAK	2914	HEARD ISLAND		-53.00	73.32	1947	1980	1980	1			
HM	105	BAUDISSIN	2874	HEARD ISLAND	BIG BEN	-53.04	73.44	1947	1980	1980	1			
HM	111	BROWN	2886	HEARD ISLAND	BIG BEN	-53.08	73.64	1947	1980	2004	3			
HM	1130	CHALLENGER	2876	HEARD ISLAND	BIG BEN	-53.03	73.48	1947	1980	1980	1			
HM		COMPTON	3324	HEARD ISLAND	BIG BEN	-53.06	73.60	1947	1980	1980	1			
HM	112	COMPTON 1	2883	HEARD ISLAND	BIG BEN	-53.07	73.62	1947	1980	1980	1			
HM		DOWNES	3325	HEARD ISLAND	BIG BEN	-53.02	73.53	1947	1980	1980	1			
HM	1150	DOWNES 1	2879	HEARD ISLAND	BIG BEN	-53.02	73.53	1947	1980	1980	1			
HM	1170	EALEY 1	2881	HEARD ISLAND	BIG BEN	-53.02	73.56	1947	1980	1980	1			
HM		EALY	3326	HEARD ISLAND	BIG BEN	-53.02	73.57	1947	1980	1980	1			
HM	0113A	JACKA	2905	HEARD ISLAND	LAURENS PENINSULA	-53.00	73.33	1947	1980	1980	1			
HM	1140	MARY-POWELL	2878	HEARD ISLAND	BIG BEN	-53.03	73.50	1947	1980	1980	1			
HM	1010	MT DIXON	2916	HEARD ISLAND		-53.00	73.30	1947	1980	1980	1			
HM	1040	MT OLSEN	2917	HEARD ISLAND		-53.02	73.35	1947	1980	1980	1			
HM	1120	NARES	2875	HEARD ISLAND	BIG BEN	-53.04	73.47	1947	1980	1980	1			
HM		STEPHENSON	3327	HEARD ISLAND	BIG BEN	-53.11	73.65	1947	1980	1980	1			
HM	110	STEPHENSON 1	2888	HEARD ISLAND	BIG BEN	-53.11	73.69	1947	1980	2004	3			
HM	106	VAHSEL	2903	HEARD ISLAND	BIG BEN	-53.06	73.40	1947	1980	1980	1			
HM		WINSTON	3328	HEARD ISLAND	BIG BEN	-53.13	73.62	1947	1980	1980	1			
HM	109	WINSTON 1	2891	HEARD ISLAND	BIG BEN	-53.13	73.63	1947	1980	1980	1			
ID	4	CARSTENSZ	1051	IRAN JAYA		-4.10	137.17	1936	1942	1990	6			
ID	3	MEREN	1050	IRAN JAYA		-4.08	137.17	1936	1942	1990	6			
ID	1	NORTHWALL FIRN	1070			-4.60	137.15	1942	1972	1973	2			
IN		ADI KAILASH	3051	UTTARANCHAL	RAMGANGA	30.33	80.64	1962	2002	2002	1			
IN		BEAS KUND	3053	HIMACHAL PRADESH	BEAS	32.34	77.08	1963	2003	2003	1			
IN		BHAGIRATHI KHARAK	3050	UTTARANCHAL	VISHNUGANGA	30.79	79.30		2001	2001	1			
IN	2522	CHANGMEKHANGPU	1045	HIMALAYA	TISTA BASIN	27.95	88.68	1980	1981	1987	7	1981	1986	6
IN		CHHOTA SHIGRI	2921	WESTERN HIMALAYA	PIR PANJAL RANGE	32.20	77.50					2003	2005	3
IN		CHIPA	3048	UTTARANCHAL	DHAULIGANGA	30.18	80.50	1961	2001	2001	1			
IN	191	DUNAGIRI	1047	CHAMOLI U.P.	DHAULIGANGA	30.55	79.90	1984	1986	1990	5	1986	1990	5
IN		GI.NO.30	3052	HIMACHAL PRADESH	BEAS	32.26	77.34	1963	2003	2003	1			
IN		HAMTAH	3044	HIMACHAL PRADESH	CHANDRA	32.24	77.37	2000	2001	2005	5	2001	2005	5
IN		JHULANG (KHARSA)	3046	UTTARANCHAL	DHAULIGANGA	30.36	80.40	1912	2001	2001	1			
IN		JOBRI	3054	HIMACHAL PRADESH	BEAS	32.21	77.35	1963	2003	2003	1			
IN		MEOLA	3047	UTTARANCHAL	DHAULIGANGA	30.21	80.46	1912	2001	2001	1			
IN		NIKARCHU	3049	UTTARANCHAL	KUTHIYANKTI	30.29	80.65	1962	2002	2002	1			
IN		PINDARI	3045	UTTARANCHAL	PINDAR	30.30	80.01		2001	2001	1			
IN		SARA UMGA	3055	HIMACHAL PRADESH	PARVATI	32.16	77.55	1963	2004	2004	1			
IN	84	SHAUNE GARANG	1048	KINNAUR H.P.	BASPA VALLEY	31.28	78.33	1985	1986	1989	4	1982	1990	9
IN	4	TIPRA BANK	1049	CHAMOLI UP	VAL. OF FLOWERS	30.73	79.68					1986	1988	3
IN	2432	ZEMU	1046	HIMALAYA	TISTA BASIN	27.70	88.22	1980	1981	1987	7			
IS	304	BAEGISARJ0KULL	3059	N-ICELAND	TROELLASKAGI	65.50	-18.40	1939	1957	1977	2			

PU	PSFG	NAME	WGMS ID	GENERAL LOCATION	SPECIFIC LOCATION	LATITUDE	LONGITUDE	FV FirstRY	FV FirstSY	FV LastSY	FV NoObs	MB FirstRY	MB LastSY	MB NoObs
IS	1527	BIRNUDALSJOKULL	3060			64.25	-15.97	1935	1936	1972	29			
IS		BLAGNIPUJOKULL	3130	CENTRAL-ICELAND	Hofsjökull	64.72	-19.13	1997	1998	2005	8			
IS	1126A	BREIDAMJOK.E.A	3061	SE-ICELAND	VATNAJOKULL	64.22	-16.33	1932	1935	1991	56			
IS	1126B	BREIDAMJOK.E.B	3062	SE ICELAND	VATNAJOKULL	64.22	-16.33	1936	1937	2002	53	1998	2005	7
IS	1125A	BREIDAMJOK.W.A	3063	SE-ICELAND	VATNAJOKULL	64.17	-16.47	1933	1934	2005	67			
IS	1125B	BREIDAMJOK.W.B	3064	SE ICELAND	VATNAJOEKULL	64.17	-16.47	1933	1934	1984	30			
IS	1125C	BREIDAMJOK.W.C	3065	SE ICELAND	VATNAJOKULL	64.17	-16.47	1932	1933	2005	72			
IS	1427	BROKARJOKULL	3066			64.25	-16.55	1935	1936	1994	45			
IS	2400	BRUARJOKULL	3067	E-ICELAND	VATNAJOKULL	64.67	-16.17	1963	1964	1988	4	1994	2005	11
IS	2600	DYNGJUJOKULL	3068	CENTRAL NORTHERN ICELAND		64.67	-17.00					1994	2005	4
IS	2300	EYJABAKKAJOKULL	3069	E-ICELAND	VATNAJOKULL	64.65	-15.58	1971	1972	1985	13	1994	2005	11
IS	1627	EYVINDSTUNGNAK	3070			63.00	-20.00	1935	1936	1972	33			
IS	1021	FALLJOKULL	3071	SE-ICELAND	VATNAJOKULL	63.98	-16.75	1957	1958	2005	46			
IS	1024B	FJALLS.FITJAR	3072	SE ICELAND	VATNAJOKULL	64.03	-16.52	1935	1936	2003	67			
IS	1024A	FJALLSJ. BRMFJ	3073	SE ICELAND	VATNAJOEKULL	64.03	-16.52	1933	1934	2005	57			
IS	1024C	FJALLSJ.G-SEL	3074	SE-ICELAND	VATNAJOEKULL	64.03	-16.52	1933	1934	2005	69			
IS	1930D	FLAAJ E146	3075			64.33	-15.13	1934	1935	1982	39			
IS	1930C	FLAAJ E148	3076			64.33	-15.13	1905	1931	2000	46			
IS	1930B	FLAAJ E150	3077			64.33	-15.13	1934	1935	1994	44			
IS	1930A	FLAAJOKULL	3078			64.33	-15.13	1970	1971	2001	7			
IS		GEITLANDSJOKULL	3128	WEST-ICELAND	Langjökull	64.67	-20.53	2002	2003	2005	3			
IS	112	GIGJOKULL	3079	S-ICELAND	EYJAFJALLAJ.	63.65	-19.62	1930	1934	2005	38			
IS	103	GLJUFURARJOKULL	3080	N-ICELAND	TROELLASKAGI	65.72	-18.67	1932	1933	2005	43			
IS	306	HAGAFELLSJOK.E	3081	CENTRAL-ICELAND	LANGJOKULL	64.57	-20.22	1890	1902	2003	33			
IS	204	HAGAFELLSJOK.W	3082	CENTRAL-ICELAND	LANGJOKULL	64.57	-20.40	1970	1972	2003	12			
IS	117	HALSJOKULL	3083			65.87	-18.47	1990	1991	1993	3			
IS	1829B	HEINABERGSJ H	3084			64.30	-15.02	1904	1930	1995	39			
IS	1829A	HEINABERGSJOEKU	3085			64.30	-15.02	1904	1930	1995	41			
IS		HEINABERGSJOKULL	3135	SE ICELAND	Vatnajökull	64.29	-15.67	1967	1990	2004	13			
IS	2132	HOFFELLSJ.E	3086	SE-ICELAND	VATNAJOEKULL	64.48	-15.57	1930	1932	1990	47			
IS	2031	HOFFELLSJ.W	3087	SE-ICELAND	VATNAJOKULL	64.48	-15.57	1905	1931	1998	44			
IS	0510B	HOFSJOKULL E	3088	CENTRAL ICELAND	HOFSJOKULL	64.80	-18.58					1989	2005	17
IS	0510A	HOFSJOKULL N	3089	CENTRAL ICELAND	HOFSJOKULL	64.95	-18.92	1983	1984	1990	6	1988	2005	18
IS	0510C	HOFSJOKULL SW	3090	CENTRAL ICELAND	HOFSJOKULL	64.72	-19.05					1990	2005	16
IS	923	HRUTARJOKULL	3091	SE-ICELAND	VATNAJOKULL	64.02	-16.53	1947	1948	2005	55			
IS	100	HYRNINGSJOKULL	3092	WEST-ICELAND	SNAEFELLSJ.	64.80	-23.77	1931	1933	2005	65			
IS	201	JOKULHALS	3093	WEST-ICELAND	SNAEFELLSJOEKUL	64.82	-23.75	1934	1935	1990	42			
IS	7	JOKULKROKUR	3094	CENTRAL-ICELAND	LANGJOKULL	64.80	-19.73	1933	1936	2003	24			
IS	102	KALDALONSJOKULL	3095	NW-ICELAND	DRANGAJOKULL	66.13	-22.27	1887	1931	2005	68			
IS		KIRKJUJOKULL	3129	CENTRAL-ICELAND	Langjökull	64.70	-19.83	1997	1998	2005	8			
IS	2700	KOELDUKVISLARJ.	3096			64.58	-17.83					1995	2005	10
IS		KOTLUJOKULL	3132	S-ICELAND	Mýrdalsjökull	63.55	-18.84	1993	1993	2005	5			
IS	2500	KVERKJOKULL	3097	SE-ICELAND	VATNAJOKULL	64.68	-16.63	1963	1971	2000	19			
IS	822	KVIARJOKULL	3098	SE-ICELAND	VATNAJOKULL	63.97	-16.57	1934	1935	2005	61			
IS		KVISLAJOKULL	3131	CENTRAL-ICELAND	Hofsjökull	64.85	19.16	2002	2003	2005	3			
IS	409	LAMBAHRAUNSJOEK	3099			64.97	-17.78	1950	1955	1982	5			
IS		LANGJOKULL SOUTHERN DOME	3101			64.62	-20.30					1997	2005	9
IS	200	LEIRUFJ.JOKULL	3102	NW-ICELAND	DRANGAJOKULL	66.18	-22.38	1840	1886	2003	65			
IS	108	LODMUNDARLOEKUL	3103			64.67	-19.47	1932	1936	2005	26			
IS	318	MORSARJOKULL	3104	SE-ICELAND	VATNAJOKULL	64.12	-16.88	1932	1935	2004	68			
IS	0311A	MULAJOKULL S.	3105	CENTRAL ICELAND	HOFSJOKULL	64.67	-18.72	1932	1935	2004	56			
IS	0311B	MULAJOKULL W	3106	CENTRAL-ICELAND	HOFSJOEKULL	64.67	-18.72	1937	1938	1995	48			
IS	210	NAUTHAGAJOKULL	3107	CENTRAL-ICELAND	HOFSJOKULL	64.67	-18.77	1932	1935	2005	60			
IS	114	OLDUFELLSJOKULL	3108	S-ICELAND	MYRDALSJOEKULL	63.73	-18.92	1961	1967	2005	16			
IS	300	REYKJAFJARDARJ.	3109	NW-ICELAND	DRANGAJOKULL	66.18	-22.20	1850	1914	2005	69			
IS		RJUPNABREKKUJOKULL	3136	CENTRAL NORTHERN ICELAND	Vatnajökull	64.72	-17.57	1998	2001	2005	5			
IS	530	SATUJOKULL	3110			64.92	-18.83	1990	1991	2004	11			
IS	0015A	SIDUJOK.E M175	3111	SE ICELAND	VATNAJOEKULL	64.18	-17.88	1933	1934	1995	24			
IS	0015B	SIDUJOK.E M177	3112	SE-ICELAND	VATNAJOEKULL	64.18	-17.88	1933	1934	2003	29			
IS	419	SKAFTAFELLSJ.	3113	SE ICELAND	VATNAJOKULL	64.08	-16.80	1932	1934	2000	66			
IS	1728B	SKALAFELLSJ E	3114			64.28	-14.98	1970	1971	1972	2			
IS	1728A	SKALAFELLSJOKUL	3115			64.28	-14.98	1934	1935	2005	45			
IS	0117A	SKEIDARARJ. E1	3116	SE-ICELAND	VATNAJOKULL	64.22	-17.22	1950	1951	2005	55			
IS	0117B	SKEIDARARJ. E2	3117	SE ICELAND	VATNAJOKULL	64.22	-17.22	1904	1932	2005	46			
IS	0117C	SKEIDARARJ. E3	3118	SE ICELAND	VATNAJOKULL	64.22	-17.22	1904	1932	2005	70			
IS	116	SKEIDARARJ. W	3119	SE-ICELAND	VATNAJOKULL	64.22	-17.22	1904	1932	2005	69			
IS		SKEIDARARJOKULL M	3134	SE ICELAND	Vatnajökull	64.00	-17.27	1990	1991	2005	10			
IS		SLETTJOKULL	3133	S-ICELAND	Mýrdalsjökull	63.77	-19.22	2001	2002	2004	3			
IS	0113B	SOLHEIMAJ E	3120	S-ICELAND	MYRDALSJOEKULL	63.58	-19.28	1930	1931	1995	62			
IS	0113C	SOLHEIMAJ J	3121	S-ICELAND	MYRDALSJOEKULL	63.58	-19.28	1930	1932	1995	58			
IS	0113A	SOLHEIMAJOK. W	3122	S-ICELAND	MYRDALSJOKULL	63.58	-19.28	1930	1931	2005	70			
IS	0520B	SVINAFELLSJ S	3123	SE ICELAND	VATNAJOKULL	64.03	-16.75	1904	1932	1995	63			
IS	0520A	SVINAFELLSJ.	3124	SE ICELAND	VATNAJOKULL	64.03	-16.75	1950	1951	2005	54			
IS	1940	THRANDARJOKULL	3125	EASTERN ICELAND		64.70	-14.88					1994	1996	3
IS	2214	TUNGNAARJOKULL	3126	CENTRAL-ICELAND	VATNAJOKULL	64.32	-18.07	1944	1946	2005	50	1994	2005	9
IS	721	VIRKISJOKULL	3127	SE-ICELAND	VATNAJOKULL	64.00	-16.75	1932	1933	2005	63			
IT	609	ADAMÈ	2562			46.14	10.53	1952	1953	1995	3			
IT	29	AGNELLO MER.	684	WESTERN ALPS	DORA RIPARIA BA	45.15	6.90	1915	1927	2005	50			
IT	210	AGUILLES DE TRELATETE MER.	1215			45.78	6.80	1931	1975	1975	1			
IT	730	ALTA (VEDRETTA)	632	CENTRAL ALPS	ADIGE BASIN	46.46	10.68	1923	1924	2005	39			
IT	559	ALTO DI REDORTA	2551			46.06	9.98	1932	1953	1993	6			
IT	661	AMBIEZ	2574			46.15	10.87	1944	1945	1955	8			
IT	644	AMOLA	638	CENTRAL ALPS	SARCA BASIN	46.20	10.72	1948	1949	2005	54			
IT	336	ANDOLLA SETT.	617	WESTERN ALPS	TICINO BASIN	46.10	8.04	1979	1981	2001	19			
IT	967	ANTELAO INFERIORE (OCC.)	642	EASTERN ALPS	PIAVE BASIN	46.45	12.27	1933	1952	2005	28			
IT	966	ANTELAO SUP.	643	EASTERN ALPS	PIAVE BASIN	46.45	12.27	1935	1952	2005	26			
IT	138	AOUILLE	1239			45.52	7.15	1971	1972	2005	6			
IT	200	ARGUEREY MER.	1253			45.70	6.84	1930	1953	2000	16			
IT	201	ARGUEREY SETT.	1254			45.70	6.83	1930	1953	2000	18			
IT	338	AURONA	616	WESTERN ALPS	TICINO BASIN	46.26	8.09	1961	1962	2005	24			
IT	583	AVIO CENTRALE D	1145			46.16	10.48	1952	1953	1977	12			
IT	591	AVIOLO	2557			46.18	10.44	1976	1977	1993	4			
IT	779	BARBADORSO (FONTANA OR.)	1130			46.80	10.70	1926	1927	1981	39			
IT	778	BARBADORSO DI DENTRO	658	CENTRAL ALPS	ADIGE BASIN	46.81	10.72	1935	1936	1999	36			
IT	64	BASEI	611	WESTERN ALPS	ORCO BASIN	45.48	7.12	1960	1961	2005	27			
IT	363	BASODINO OCC.	1180			46.41	8.47	1962	1963	1977	7			
IT	166	BASSAC	1247			45.52	7.05	1937	1973	1973	1			
IT	124	BELLEFACE	1281			45.60	7.25	1970	1975	1975	1			
IT	325	BELVEDERE (MACUGNAGA)	618	WESTERN ALPS	TICINO BASIN	45.95	7.91	1921	1922	2005	73			
IT	206	BERIO BLANC	1258			45.76	6.90	1952	1973	1998	12			
IT	36	BERTA	1295			45.23	7.14	1951	1975	1975	1			
IT	40	BESSANESE	1297			45.30	7.12	1946	1947	2005	44			
IT	360	BLINDENHORN SUP.	1179			46.42	8.31	1962	1963	1999	11			
IT	342	BOCCARECCIO	1175			46.30	8.20	1962	1963	1986	9			
IT	533	BONDONE BASSO DE	1137			46.09	10.06	1970	1974	1974	1			
IT	311	BORS	2453			45.89	7.87	1922	1923	1999	22			
IT	652	BRENTEI	2571			46.18	10.90	1945	1946	1977	19			
IT	219	BRENVA	615	WESTERN ALPS	DORA BALTEA BAS	45.83	6.90	1924	1925	2004	64			
IT	69	BREUIL (O BROGLI)	1260			45.48	7.23	1961	1962	1999	8			
IT	202	BREUIL MER.	1255			45.72	6.82	1930	1953	2000	17			
IT	203	BREUIL SETT.	1256			45.73	6.82	1930	1953	2000	19			
IT	216	BROUILLARD	608	WESTERN ALPS	DORA BALTEA B.	45.81	6.87	1946	1947	1979	27			
IT	243	BY	2422			45.92	7.29	1926	1927	1944	18			
IT	689	CADINI	2581			46.38	10.61	1925	1926	1946	6			
IT	12	CADREGHE	2330			44.67	7.09	1984	1985	1993	6			
IT	1006	CALDERONE	1107			42.47	13.62	1946	1947	2005	24	2001	2005	5
IT	579	CALOTTA	1144			46.20	10.51	1969	1970	1975	5			
IT	489	CAMOSCI	2522			46.49	10.52	1926	1928	1950	8			
IT	361	CAMOSCI (SIEDEL)	630	WESTERN ALPS	TICINO BASIN	46.45	8.36	1925	1928	1988	22			
IT	488	CAMPO (MERID.)	2521			46.49	10.49	1927	1940	1951	8			
IT	997	CAMPO SETT.	1106			46.42	10.11	1942	1949	2000	28			
IT	985	CANIN OCC.	680	EASTERN ALPS	TAGLIAMENTO	46.36	13.44	1920	1921	1994	38			
IT	984	CANIN OR.	640	EASTERN ALPS	TAGLIAMENTO BAS	46.37	13.45	1920	1921	1999	38			
IT	61	CAPRA	1304			45.45	7.12	1927	1928	2000	29			
IT	469	CARDONNE OCC. (PIAZZI OCC.)	626	CENTRAL ALPS	ADDA BASIN	46.42	10.25	1950	1951	1990	30			
IT	468	CARDONNE OR. (PIAZZI CENTR.)	1189			46.42	10.32	1931	1932	1998	41			
IT	632	CARE ALTO OR.	1148			46.11	10.61	1952	1953	2001	23			
IT	701	CARESER	635	CENTRAL ALPS	ADIGE BASIN	46.45	10.70	1897	1898	2005	37	1967	2005	39
IT	60	CARRO OCCIDENT.	2358			45.43	7.12	1959	1961	1991	8			
IT	59	CARRO ORIENT.	2357			45.43	7.15	1927	1928	1994	17			
IT	435	CASPOGGIO	628	CENTRAL ALPS	ADDA BASIN	46.34	9.91	1926	1927	2005	57			
IT	410	CASSANDRA OCC.	1184			46.26	9.75	1896	1897	1995	24			
IT	411	CASSANDRA OR.	1185			46.26	9.76	1926	1927	2001	27			
IT	494	CASTELLI OCC.	1163			46.45	10.54	1925	1929	2001	25			
IT	493	CASTELLI OR.	1162			46.45	10.55	1925	1928	2001	27			
IT	299	CASTORE	1208			45.92	7.79	1914	1915	1975	35			
IT	702	CAVAION	1126			46.42	10.72	1923	1925	1975	20			
IT	503	CEDEC	1165			46.45	10.60	1925	1926	1975	30			
IT	859	CENTRALE DEL LAGO	2627			46.83	11.09	1927	1928	1944	17			
IT	825	CEPPO	2625			46.74	11.00	1926	1927	1975	18			
IT	510	CERENA	1169			46.40	10.55	1925	1926	1976	14			
IT	285	CERVINO	1203			45.97	7.66	1926	1927	1998	46			
IT	731	CEVEDALE FORCOLA	663	CENTRAL ALPS	ADIGE BASIN	46.45	10.65	1898	1899	2001	45			
IT	732	CEVEDALE PRINCIPALE	662	CENTRAL ALPS	ADIGE BASIN	46.46	10.63	1897	1899	2005	50			
IT	181	CHATEAU BLANC	1251			45.65	7.02	1961	1962	1999	7			
IT	276	CHATEAU DES DAMES	1198			45.92	7.58	1972	1975	1992	6			
IT	267	CHAVACOUR	1194			45.88	7.54	1964	1965	1975	4			
IT	204	CHAVANNES	1257			45.74	6.82	1936	1952	2004	28			
IT	282	CHERILLON	1200			45.96	7.62	1925	1926	1996	52			
IT	5	CIAFRAION (GELAS OR.)	1290			44.12	7.38	1926	1927	1974	41			
IT	43	CIAMARELLA	1298			45.33	7.13	1927	1928	2001	28			
IT	272	CIAN ROISETTA	1195			45.89	7.68	1963	1964	1999	13			
IT	81	CIARDONEY	1264	WESTERN ALPS	GRAN PARADISO	45.52	7.40	1971	1973	2005	23	1992	2005	14
IT	424	CIMA DI ROSSO ORIENT.	2508			46.31	9.73	1926	1927	1995	20			
IT	842	CIMA FIAMMANTE OCC.	685	CENTRAL ALPS	ADIGE BASIN	46.74	11.04	1972	1973	1974	2			
IT	736	CIMA MADRICCIO	2602			46.49	10.63	1926	1927	1944	18			
IT	501	CIME DEI FORNI	2530			46.45	10.55	1927	1928	1949	7			
IT	1	CLAPIER	1286			44.11	7.42	1923	1924	1999	52			
IT	257	COL COLLON	1233			45.94	7.53	1932	1933	1974	7			
IT	83	COL DEI BECCHI	1265			45.49	7.33	1974	1975	1975	1			
IT	223	COL DEL GIGANTE	1221			45.84	6.93	1966	1973	1973	1			
IT	0506A	COL DELLA MARE I	1167			46.43	10.61	1923	1925	2001	40			
IT	215	COL DU MIAGE	1217			45.80	6.84	1970	1971	1975	4			
IT	927	COLLALTO	647	EASTERN ALPS	ADIGE BASIN	46.93	12.15	1972	1974	2005	26			
IT	273	COLLE VALCOURNE (CIGNANA)	1196			45.88	7.54	1941	1942	1992	5			
IT	42	COLLERIN D'ARNAS	2349			45.32	7.12	1972	1973	2001	13			
IT	22	COOLIDGE INF.	1292			44.65	7.13	1963	1967	1988	6			
IT	20	COOLIDGESUPER.	2338			44.68	7.09	1972	1973	2000	5			
IT	409	CORNA ROSSA	1183			46.26	9.74	1959	1960	1974	13			
IT	646	CORNISELLO MER.	1151	CENTRAL ALPS	PO BASIN	46.22	10.68	1927	1928	2003	36			

PU	PSFG	NAME	WGMS ID	GENERAL LOCATION	SPECIFIC LOCATION	LATITUDE	LONGITUDE	FV FirstRY	FV FirstSY	FV LastSY	FV NoObs	MB FirstRY	MB LastSY	MB NoObs
IT	603	CORNO DI SALARNO	2560			46.14	10.50	1995	1996	2001	6			
IT	355	COSTONE	1177			46.40	8.35	1962	1963	1971	8			
IT	109	COUPE DE MONEY	1271			45.53	7.38	1926	1927	2001	46			
IT	482	CRAPINELLIN (CRISTALLO D.)	1157			46.50	10.45	1939	1975	1975	1			
IT	963	CRESTA BIANCA	1117			46.58	12.20	1951	1952	1993	26			
IT	937	CRISTALLO	644	EASTERN ALPS	ADIGE BASIN	46.58	12.21	1923	1927	1998	38			
IT	956	CRISTALLO - ZUITA	2642			46.38	12.05	1950	1951	1964	13			
IT	485	CRISTALLO CENTR.	1159			46.49	10.42	1900	1901	1975	13			
IT	484	CRISTALLO OR.	1158			46.49	10.43	1923	1927	1975	11			
IT	838	CRODA DEL CAVAL	1115			46.70	10.99	1927	1958	1990	6			
IT	828	CRODA ROSSA	654	CENTRAL ALPS	ADIGE BASIN	46.73	10.98	1972	1973	2004	19			
IT	655	CROZZON DI BRENTA	1153			46.16	10.87	1934	1935	1976	21			
IT	8	DE CESSOLE	2329			44.18	7.30	1926	1927	1947	17			
IT	344	DELLA ROSSA	2475			46.33	8.23	1975	1976	1997	6			
IT	419	DISGRAZIA	2503			46.28	9.74	1925	1926	2001	37			
IT	214	DOMES DE MIAGE	1216			45.82	6.81	1969	1970	1971	2			
IT	474	DOSDE CENTR.	1191			46.39	10.20	1931	1932	1975	20			
IT	475	DOSDE OCC.	1192			46.39	10.20	1931	1932	1993	31			
IT	473	DOSDE OR.	625	CENTRAL ALPS	ADDA BASIN	46.39	10.22	1931	1932	2001	49			
IT	512	DOSEGU	668	CENTRAL ALPS	ADDA BASIN	46.37	10.55	1925	1926	2005	58			
IT	275	DRAGONE	1197			45.90	7.55	1972	1975	1989	5			
IT	23	DUE DITA	2340			44.68	7.08	1984	1985	1995	8			
IT	113	DZASSET	2372			45.54	7.27	1995	1996	2001	6			
IT	140	ENTRELOR SETT.	2377			45.53	7.15	1986	1988	1999	5			
IT	220	ENTREVES	2416			45.84	6.94	1949	1950	1959	5			
IT	208	ESTELLETTE	1259			45.77	6.82	1931	1953	2000	29			
IT	256	EVEQUE	1232			45.96	7.50	1972	1973	1974	2			
IT	635	FARGORIDA	2563			46.15	10.60	1949	1950	1960	7			
IT	439	FELLARIA OCC.	627	CENTRAL ALPS	ADDA BASIN	46.35	9.92	1890	1898	2005	62			
IT	146	FOND OCCID.	2380			45.48	7.07	1985	1986	2001	14			
IT	145	FOND OR.	1243			45.47	7.08	1962	1963	2001	21			
IT	713	FONTANA BIANCA	1507	CENTRAL ALPS	ADIGE BASIN	46.48	10.77	1925	1926	1993	38	1983	2005	22
IT	780	FONTANA OCC.	657	CENTRAL ALPS	ADIGE BASIN	46.80	10.69	1926	1927	1993	48			
IT	0496A	FORÀ ORIENT.	2525			46.45	10.51	1925	1926	1957	8			
IT	286	FORCA	1204			45.97	7.66	1946	1947	1993	33			
IT	507	FORNI	670	CENTRAL ALPS	ADDA BASIN	46.40	10.59	1969	1970	2005	30			
IT	349	FORNO	2478			46.38	8.33	1927	1928	1998	5			
IT	823	FOSSA OR.	655	CENTRAL ALPS	ADIGE BASIN	46.75	11.02	1927	1958	1990	8			
IT	27	FOURNEAUX	1294			45.11	6.84	1891	1905	2001	35			
IT	950	FRADUSTA	2273	EASTERN ALPS	PIAVE BASIN	46.25	11.87	1947	1948	2005	17			
IT	812	FRANE	2624			46.78	10.74	1926	1927	1956	17			
IT	229	FREBOUZIE	1225			45.87	7.00	1946	1947	1987	24			
IT	197	FREDUAZ OCCIDENT.	2406			45.66	6.91	1986	1987	1991	5			
IT	218	FRENAY	2415			45.81	6.89	1946	1947	1975	14			
IT	0218B	FREYNAY	1218			45.82	6.93	1956	1958	1975	8			
IT	0218A	FREYNAY	1219			45.82	6.93	1960	1975	1975	1			
IT	969	FROPPA DI FUORI	2647			46.51	12.34	1985	1986	1997	11			
IT		GALAMBRA RAMO OCC.	2659			45.11	6.86	1942	1953	1961	8			
IT	26	GALAMBRA RAMO OR.	1293			45.11	6.86	1897	1898	2000	40			
IT	518	GAVIA (VEDRETTA)	1174			46.36	10.47	1925	1929	1975	27			
IT	75	GAY	1262			45.51	7.31	1963	1973	1975	2			
IT	6	GELAS	1291			44.13	7.39	1923	1924	1999	42			
IT	354	GEMELLI DI BAN	1176			46.40	8.36	1961	1962	1971	9			
IT	163	GIASSON	1246			45.56	7.06	1931	1971	1999	10			
IT	929	GIGANTE CENTR.	646	EASTERN ALPS	ADIGE BASIN	46.90	12.12	1972	1974	2005	22			
IT	930	GIGANTE OCC.	645	EASTERN ALPS	ADIGE BASIN	46.90	12.10	1972	1973	2005	26			
IT	928	GIGANTI OR.	1116			46.92	12.13	1972	1974	1995	5			
IT	813	GIOGO ALTO	656	CENTRAL ALPS	ADIGE BASIN	46.78	10.80	1929	1930	2000	38			
IT	720	GIOVERETTO INF.	2593			46.50	10.77	1923	1924	1995	9			
IT	719	GIOVERETTO SUP.	2592			46.50	10.78	1923	1924	1995	6			
IT	5661	GLENO 5661	1141			46.05	10.13	1961	1970	1973	2			
IT	5662	GLENO 5662	1142			46.05	10.13	1942	1949	1973	13			
IT	168	GLIAIRETTA VAUDET	1248			45.51	7.02	1943	1948	2000	20			
IT	148	GOLETTA	683	WESTERN ALPS	DORA BALTEA B.	45.50	7.06	1927	1928	2005	38			
IT	727	GRAMES ORIENT. + CENTRALE	2599			46.47	10.72	1923	1924	1975	7			
IT	127	GRAN NEYRON	1283			45.55	7.26	1927	1928	1979	11			
IT	130	GRAN PARADISO	1235			45.52	7.25	1928	1933	2000	21			
IT	893	GRAN PILASTRO	652	EASTERN ALPS	ADIGE BASIN	46.97	11.72	1925	1926	2001	37			
IT	290	GRAN SOMETTA	1205			45.92	7.68	1960	1961	1969	8			
IT	115	GRAN VAL	2374			45.56	7.29	1975	1986	2000	6			
IT	143	GRAN VAUDALA	1241			45.50	7.12	1971	1972	2000	8			
IT	502	GRAN ZEBRU	1164			46.47	10.57	1925	1926	1975	20			
IT	111	GRAND CROUX CENTR.	1273			45.52	7.31	1895	1903	2001	47			
IT	134	GRAND ETRET	1238			45.48	7.22	1950	1951	2000	13			
IT	238	GRANDE ROCHERE	1228			45.82	7.06	1971	1974	1974	1			
IT	226	GRANDES JORASSES	1224			45.87	7.00	1949	1950	1975	18			
IT	260	GRANDES MURAILLES	622	WESTERN ALPS	DORA B. BASIN	45.95	7.58	1960	1961	2005	37			
IT	123	GRIVOLA	1280			45.60	7.26	1970	1972	1975	2			
IT	122	GRIVOLETTA	1279			45.60	7.28	1969	1974	1974	1			
IT	232	GRUETTA ORIENT.	2418			45.90	7.03	1994	1995	2001	6			
IT	357	HOHSAND SETT. (SABBIONE SETT.)	631	WESTERN ALPS	TICINO BASIN	46.40	8.30	1925	1926	2005	32			
IT	306	INDREN OCC.	1209			45.89	7.86	1921	1922	2000	43			
IT	162	INVERGNAN	1245			45.56	7.07	1971	1972	1999	8			
IT	280	JUMEAUX	2441			45.94	7.60	1927	1928	2001	17			
IT	699	LA MARE (VEDRETTA DE)	636	CENTRAL ALPS	ADIGE BASIN	46.43	10.63	1895	1897	2005	67			
IT	517	LAGO BIANCO	1173			46.34	10.51	1929	1930	1977	32			
IT	500	LAGO DEL CONF. SE	2529			46.44	10.52	1929	1930	1938	5			
IT	499	LAGO DEL CONF. SW	2528			46.44	10.50	1926	1928	1938	5			
IT	657	LAGOL	1154			46.15	10.86	1935	1936	2001	37			
IT	913	LANA	650	EASTERN ALPS	ADIGE BASIN	47.07	12.21	1976	1977	2005	27			
IT	634	LARES	1149			46.13	10.60	1919	1920	2005	33			
IT	755	LASTE	2608			46.52	10.64	1929	1930	1939	5			
IT	116	LAUSON	1275			45.56	7.28	1927	1928	2005	24			
IT	129	LAVACCIU	1285			45.52	7.25	1928	1933	2001	22			
IT	144	LAVASSEY	1242			45.48	7.11	1927	1928	2001	36			
IT	352	LEBENDUN	2481			46.39	8.34	1985	1986	1998	9			
IT	337	LEONE	2473			46.26	8.11	1962	1963	1995	5			
IT	283	LEONE (PENNINE)	1201			45.97	7.63	1925	1926	1995	16			
IT	230	LESCHAUX	1226			45.88	7.01	1973	1974	1974	1			
IT	209	LEX BLANCHE	682	WESTERN ALPS	DORA BALTEA BAS	45.78	6.82	1929	1930	1998	63			
IT	490	LO ZEBRU (VEDRETTA DE)	1160			46.48	10.56	1925	1926	1998	24			
IT	637	LOBBIA	1150			46.16	10.58	1895	1899	2005	61			
IT	321	LOCCE SETT.	2462			45.93	7.92	1985	1986	2001	10			
IT	7	LOUROUSA (GELAS SETT.)	2328			44.19	7.30	1926	1927	1947	17			
IT	733	LUNGA (VEDRETTA)	661	CENTRAL ALPS	ADIGE BASIN	46.47	10.62	1899	1901	2005	51	2004	2005	2
IT	543	LUPO	1138			46.08	9.99	1931	1936	1999	14			
IT	304	LYS	620	WESTERN ALPS	DORA B. BASIN	45.90	7.83	1901	1902	2005	95			
IT	0931X	M. NEVOSO OCC.	679	EASTERN ALPS	ADIGE BASIN	46.92	12.08	1973	1974	1994	11			
IT	279	M.BLANC DU CRETON	2440			45.92	7.59	1985	1986	2001	5			
IT	771	MADACCIO	1129			46.51	10.48	1899	1904	1995	20			
IT	875	MALAVALLE	672	CENTRAL ALPS	ADIGE BASIN	46.95	11.20	1914	1915	2005	34	2002	2005	4
IT	3	MALEDIA	1288			44.12	7.40	1923	1924	1980	46			
IT	639	MANDRONE	664	CENTRAL ALPS	SARCA BASIN	46.17	10.55	1899	1911	2005	52			
IT	941	MARMOLADA CENTR.	676	EASTERN ALPS	DOLOMITES	46.44	11.87	1901	1902	2005	37			
IT	700	MARMOTTE	1125			46.45	10.67	1925	1933	1977	15			
IT	541	MAROVIN	2547			46.08	10.00	1939	1953	2001	18			
IT	49	MARTELOT	1301			45.38	7.17	1927	1928	2001	25			
IT	788	MAZIA	2620			46.78	10.72	1926	1927	1953	18			
IT	213	MIAGE	613	WESTERN ALPS	DORA BALTEA BAS	45.81	6.84	1926	1927	1987	49			
IT	991	MINE	2653			46.45	10.15	1942	1946	1990	15			
IT	492	MINIERA	1161			46.48	10.55	1925	1926	1995	15			
IT	222	MON FRETY	1220			45.84	6.93	1949	1950	1974	11			
IT	281	MON TABEL	1199			45.96	7.61	1925	1926	1995	38			
IT	723	MONACHE OR.	2272	CENTRAL ALPS	ADIGE BASIN	46.48	10.75	1994	1995	2000	6			
IT	132	MONCIAIR	1237			45.49	7.24	1950	1951	2001	25			
IT	131	MONCORVE	1236			45.50	7.25	1927	1928	2001	36			
IT	110	MONEY	1272			45.53	7.34	1895	1903	2001	39			
IT	258	MONT BRAULE	1234			45.94	7.53	1926	1927	1975	21			
IT	244	MONT GELE	1229			45.90	7.37	1961	1962	1975	12			
IT	495	MONTAGNA VECCHIA	2523			46.45	10.53	1925	1926	1996	10			
IT	128	MONTANDEYNE	1284			45.54	7.26	1928	1929	2000	8			
IT	981	MONTASIO OCC.	641	EASTERN ALPS	TAGLIAMENTO BAS	46.44	13.44	1920	1921	1999	42			
IT	980	MONTASIO OR.	1121			46.44	13.44	1920	1921	1994	28			
IT	161	MONTE FORCIAZ	2387			45.57	7.08	1986	1987	1999	8			
IT	347	MONTE GIOVE	2477			46.36	8.39	1996	1997	2001	3			
IT	0931B	MONTE NEVOSO 2	1422	EASTERN ALPS	ADIGE BASIN	46.92	12.08	1974	1975	1975	1			
IT	180	MORION OR.	1250			45.63	7.03	1937	1938	1974	11			
IT	341	MOTTISCIA	1214			46.30	8.14	1962	1963	1995	9			
IT	47	MULINET MERID.	2351			45.36	7.17	1931	1955	2001	21			
IT	48	MULINET SETT.	1300			45.37	7.17	1904	1907	2001	41			
IT	4	MURAION	1289			44.13	7.40	1924	1925	1989	46			
IT	30	MUTTET	2343			45.16	6.89	1928	1929	1960	2			
IT	640	NARDIS OCC.	639	CENTRAL ALPS	SARCA BASIN	46.21	10.66	1921	1927	2004	68			
IT	58	NEL OCCIDENT.	2356			45.42	7.16	1954	1955	1956	2			
IT	57	NEL CENTRALE	1303			45.42	7.17	1957	1959	2000	15			
IT	56	NEL ORIENTALE	1302			45.41	7.18	1927	1928	1978	5			
IT	308	NETSCHO	2452			45.82	7.86	1921	1922	2000	42			
IT	902	NEVES OR.	651	CENTRAL ALPS	ADIGE BASIN	46.98	11.80	1898	1910	2004	41			
IT	633	NISCLI	677	CENTRAL ALPS	SARCA BASIN	46.11	10.61	1919	1920	2005	47			
IT	72	NOASCHETTA	1261			45.51	7.27	1927	1928	1999	13			
IT	324	NORDEND	1211			45.95	7.89	1949	1950	2000	18			
IT	509	NW S.GIACOMO	2535			46.40	10.56	1926	1927	1995	13			
IT	790	OBERETTES DI LEVANTE	2622			46.76	10.73	1926	1927	1942	14			
IT	789	OBERETTES DI PONENTE	2621			46.77	10.72	1926	1927	1953	15			
IT	692	OCCID. VIOZ	2584			46.39	10.63	1925	1926	1941	5			
IT	254	OREN MERID.	1230			45.95	7.48	1962	1972	1974	2			
IT	255	OREN SETTENR.	1231			45.95	7.49	1964	1969	1974	4			
IT	372	ORSAREIGLS	2489			46.50	9.37	1934	1947	1976	18			
IT	688	ORSI	2580			46.37	10.60	1925	1926	1946	5			
IT	769	ORTLES BASSO DE	1128			46.51	10.51	1970	1971	1977	5			
IT	356	OSAND MER. (SABBIONE MER.)	1178			46.41	8.31	1923	1941	2001	24			
IT	0506C	PALON DELLA MARE LOBO OR.	2534			46.41	10.60	1989	1990	2001	11			
IT	504	PASQUALE DI DENTRO	2531			46.45	10.59	1927	1928	1939	9			
IT	513	PASSO DEL DOSEGU	1170			46.36	10.54	1925	1929	1990	10			
IT	390	PASSO DI BONDO	2496			46.29	9.62	1989	1995	2000	5			
IT	107	PATRI INFERIORE	2371			45.54	7.35	1926	1927	1958	22			
IT	2	PEIRABROC	1287			44.12	7.41	1923	1924	1999	53			
IT	876	PENDENTE	675	CENTRAL ALPS	ADIGE BASIN	46.97	11.24	1922	1923	2005	35	1996	2005	10
IT	108	PENE BLANCHE	1270			45.54	7.35	1951	1974	1974	1			
IT	37	PERA CIAVAL	1296			45.23	7.09	1951	1973	1973	1			

PU	PSFG	NAME	WGMS ID	GENERAL LOCATION	SPECIFIC LOCATION	LATITUDE	LONGITUDE	FV FirstRY	FV FirstSY	FV LastSY	FV NoObs	MB FirstRY	MB LastSY	MB NoObs
IT	0511B	TRESERO LINGUA MER.	2537			46.38	10.54	1925	1926	2002	28			
IT	0511A	TRESERO LINGUA SETT.	2536			46.38	10.54	1926	1927	1975	29			
IT	112	TRIBOLAZIONE	1274			45.52	7.28	1926	1927	2001	39			
IT	234	TRIOLET	1227			45.89	7.02	1926	1927	1975	40			
IT	567	TROBIO (TRE CONFINI)	1143			46.05	10.09	1909	1910	1973	24			
IT	566	TROBIO-GLENO	2553			46.06	10.09	1930	1934	1970	5			
IT	650	TUCKETT	2570			46.19	10.90	1945	1946	2001	24			
IT	117	TUF MERIDIONALE	1276			45.57	7.28	1935	1952	2000	11			
IT	284	TYNDALL	1202			45.97	7.65	1925	1926	1995	46			
IT	259	TZA DE TZAN	623	WESTERN ALPS	DORA B. BASIN	45.98	7.57	1925	1926	2001	57			
IT	729	ULTIMA (VEDR.)	633	CENTRAL ALPS	ADIGE BASIN	46.47	10.69	1925	1930	1995	30			
IT	983	URSIC	2652			46.36	13.44	1923	1925	1969	25			
IT	185	USSELETTES	1252			45.67	7.02	1958	1975	1975	1			
IT	519	VAL DELL'ALPE MERID.	1133			46.39	10.44	1926	1930	1999	12			
IT	467	VAL LIA (PIAZZI OR.)	1188			46.42	10.29	1933	1951	1975	11			
IT	367	VAL LOGA	2484			46.48	9.28	1932	1947	1968	22			
IT	996	VAL NERA OCC.	1123			46.43	10.12	1958	1959	1969	10			
IT	705	VAL SAENT CENTR. (FUORI)	2586			46.46	10.73	1946	1947	1977	15			
IT	477	VAL VIOLA OCC.	1156			46.39	10.17	1931	1932	2000	21			
IT	476	VAL VIOLA OR.	1155			46.39	10.17	1931	1932	2000	19			
IT	198	VALAISAN	2407			45.66	6.91	1986	1987	1999	10			
IT	103	VALEILLE	1268			45.52	7.38	1926	1927	1999	33			
IT	13	VALLANTA INFERIORE	2331			44.67	7.08	1984	1985	2000	9			
IT	919	VALLE DEL VENTO	649	EASTERN ALPS	ADIGE BASIN	47.04	12.20	1980	1981	2005	22			
IT	777	VALLELUNGA	659	CENTRAL ALPS	ADIGE BASIN	46.82	10.73	1922	1923	1999	55			
IT	649	VALLESINELLA	2569			46.19	10.90	1945	1946	1972	17			
IT	106	VALLETTA	1269			45.55	7.36	1969	1974	1974	1			
IT	25	VALLONETTO	2341			45.11	6.84	1927	1928	1960	4			
IT	687	VALPIANA	2579			46.37	10.57	1925	1926	1946	5			
IT	289	VALTOURNANCHE	621	WESTERN ALPS	DORA BALTEA B.	45.93	7.70	1926	1927	2005	69			
IT	142	VAUDALETTA	2379			45.52	7.14	1972	1973	1999	6			
IT	425	VAZZEDA	2509			46.31	9.73	1924	1925	1998	12			
IT	772	VEDRETTA PIANA CGI	2618			46.51	10.46	1922	1923	1977	8			
IT	581	VENEROCOLO	665	CENTRAL ALPS	OGLIO BASIN	46.16	10.51	1919	1920	2005	47			
IT	698	VENEZIA (VEDR.)	673	CENTRAL ALPS	ADIGE BASIN	46.41	10.64	1926	1934	2004	18			
IT	416	VENTINA	629	CENTRAL ALPS	ADDA BASIN	46.27	9.77	1899	1907	2005	80			
IT	0942A	VERNEL ORIENT	2639			46.45	11.84	1925	1926	1966	8			
IT	297	VERRA (GRANDE DI)	1206			45.92	7.75	1913	1914	2001	60			
IT	298	VERRA (PICCOLO DI)	1207			45.91	7.77	1913	1914	1995	51			
IT	471	VERVA MAGGIORE (BASSO)	1190			46.40	10.27	1931	1932	1994	23			
IT	17	VISO	2335			44.68	7.09	1958	1961	1989	8			
IT	21	VISO NORD ORIENT.	2339			44.68	7.10	1961	1962	1988	5			
IT	483	VITELLI	671	CENTRAL ALPS	ADDA BASIN	46.50	10.45	1921	1923	1999	47			
IT	328	WEISSTHOR	2467			45.98	7.90	1921	1922	1950	15			
IT	659	XII APOSTOLI	2573			46.14	10.85	1944	1945	1998	17			
IT	749	ZAI DI DENTRO	1515	CENTRAL ALPS	ADIGE BASIN	46.56	10.64	1924	1930	2005	25			
IT	750	ZAI DI MEZZO	1127			46.55	10.64	1930	1934	2005	23			
IT	751	ZAY DI FUORI	609	CENTRAL ALPS	ADIGE BASIN	46.54	10.64	1897	1899	2005	26			
JP	1	HAMAGURI YUKI	897	N.JAPAN ALPS	TATEYAMA REGION	36.60	137.62					1981	2005	22
KE	4	CESAR	694	EAST AFRICA	MOUNT KENYA	-0.13	37.30	1899	1908	2004	6			
KE	6	DARWIN	696	EAST AFRICA	MOUNT KENYA	-0.15	37.30	1919	1963	2004	8			
KE	10	DIAMOND	692	EAST AFRICA	MOUNT KENYA	-0.15	37.30	1947	1963	2004	4			
KE	11	FOREL	691	EAST AFRICA	MOUNT KENYA	-0.15	37.30	1947	1963	2004	4			
KE	9	GREGORY	693	EAST AFRICA	MOUNT KENYA	-0.15	37.32	1930	1944	2004	8			
KE	12	HEIM	690	EAST AFRICA	MOUNT KENYA	-0.15	37.30	1947	1963	2004	4			
KE	3	JOSEPH	689	EAST AFRICA	MOUNT KENYA	-0.13	37.30	1899	1930	2004	6			
KE	0009B	KOLBE	1065			-0.15	37.32	1899	1920	1947	3			
KE	1	KRAPF	688	EAST AFRICA	MOUNT KENYA	-0.15	37.30	1930	1944	2004	6			
KE	8	LEWIS	695	EAST AFRICA	MOUNT KENYA	-0.15	37.30	1893	1899	2004	15	1979	1996	18
KE	14	MELHUISH	1066			-0.15	37.30	1947	1987	1987	1			
KE	13	NORTHEY	698	EAST AFRICA	MOUNT KENYA	-0.15	37.30	1944	1963	2004	5			
KE	5	TYNDALL	697	EAST AFRICA	MOUNT KENYA	-0.15	37.30	1893	1899	2004	15			
MX	102	NOROCCIDENTAL	915	CENTRAL MEXICO	POPOCATEPETL V.	19.02	-98.62	1958	1982	1982	1			
MX	101	VENTORRILLO	914	CENTRAL MEXICO	POPOCATEPETL V.	19.02	-98.62	1921	1950	1999	9	1995	1998	4
NO	36204	AALFOTBREEN	317	WESTERN NORWAY	NORDFJORD	61.75	5.65	1974	1976	1978	3	1963	2005	43
NO	37323	AUSTDALSBREEN	321	WESTERN NORWAY	JOSTEDALSBREEN	61.80	7.35	1912	1913	2000	14	1987	2005	19
NO	31220	AUSTERDALSBREEN	288	WEST NORWAY	TOSTEDALSBREEN	61.62	6.93	1908	1909	2005	70			
NO	15504	AUSTRE BROEGGERBREEN	292	SPITSBERGEN	KONGSFJORD	78.88	11.83					1967	2005	39
NO	0053A	AUSTRE MEMURUBR	1317			61.55	8.50	1902	1903	1953	14	1968	1972	5
NO	12503	AUSTRE TORELL	293	SPITSBERGEN	HORNSUND REGION	77.18	15.33	1936	1958	1988	7			
NO	31013	BERGSETBREEN	2290		KRUNDALEN	61.65	7.03	1996	1997	2005	9			
NO	7421	BLAISEN	1328			68.33	17.85					1965	1968	4
NO	1930	BLOMSTERSKARDBR	1321			59.98	6.28	1998	1999	1999	1			
NO	37219	BOEDALSBREEN	2291		LOEN	61.77	7.12	1996	1997	2005	9			
NO	548	BOEVERBREEN	2298	CENTRAL NORWAY	JOTUNHEIMEN	61.55	8.09	1903	1904	2005	24			
NO	33014	BOEYABREEN	2297	WESTERN NORWAY	JOSTEDAL	61.30	6.46	1903	1905	2005	51			
NO	20408	BONDHUSBREEN	318	SOUTHERN NORWAY	HARDANGERFJORD	60.03	6.33	1902	1903	2005	71	1977	1981	5
NO	20515	BOTNABREEN	2292		FOLGEFONNA	60.20	6.43	1996	1997	2005	9			
NO		BREIDALBLIKKBREA	2671	SOUTHWESTERN NORWAY	SONDRE FOLGEFONNA	60.10	6.40	2002	2003	2005	3	1963	2005	9
NO	37109	BRENNDALSBREEN	2293	WESTERN NORWAY	OLDEN	61.68	6.92	1996	1997	2005	9			
NO	37110	BRIKSDALSBREEN	314	WEST NORWAY	OLDEN	61.65	6.92	1897	1899	2005	106			
NO	21307	BUARBREEN	315	WESTERN NORWAY	FOLGEFONN	60.02	6.40	1908	1909	2005	51			
NO	7393	CAINHAVARRE	1330			68.10	18.00					1965	1968	4
NO	12408	CHOMJAKOV	309	SPITSBERGEN	HORNSUND REGION	76.95	16.43	1961	1983	1985	2			
NO	67011	ENGABREEN	298	NORTH NORWAY	SVARTISEN	66.65	13.85	1909	1910	2005	70	1970	2005	36

PU	PSFG	NAME	WGMS ID	GENERAL LOCATION	SPECIFIC LOCATION	LATITUDE	LONGITUDE	FV FirstRY	FV FirstSY	FV LastSY	FV NoObs	MB FirstRY	MB LastSY	MB NoObs
IT	301	PERAZZI	2450			45.90	7.78	1926	1927	1944	17			
IT	139	PERCIA	1240			45.47	7.20	1934	1975	1975	1			
IT	41	PIAN GIAS	2348			45.31	7.13	1927	1928	1995	8			
IT	326	PICCOLO FILLAR	2465			45.96	7.89	1922	1923	1998	23			
IT	312	PIODE	619	WESTERN ALPS	SESIA BASIN	45.91	7.88	1914	1915	2005	56			
IT	0312A	PIODE (RAMO OCC.)	2454			45.91	7.88	1921	1922	1973	14			
IT	313	PIODE (RAMO ORIENT.) PARROT	2455			45.92	7.88	1921	1922	1972	15			
IT	577	PISGANA OCC.	666	CENTRAL ALPS	OGLIO BASIN	46.19	10.52	1912	1918	2005	55			
IT	365	PIZZO FERRE	1181			46.47	9.28	1926	1927	2001	56			
IT	443	PIZZO SCALINO	1187			46.28	9.98	1885	1899	2005	55			
IT	225	PLANPINCIEUX	1223			45.86	6.98	1949	1950	1999	19			
IT	481	PLATIGLIOLE	624	CENTRAL ALPS	ADDA BASIN	46.51	10.45	1897	1905	1993	19			
IT	172	PLATTES DES CHAMOIS	1249			45.53	7.00	1948	1949	2001	13			
IT	1005	PONCIAGNA	2657			46.39	9.43	1931	1932	1995	7			
IT	936	POPENA	2637			46.58	12.21	1957	1958	1997	14			
IT	987	POPERA OCC.	1122			46.63	12.39	1932	1933	1995	11			
IT	549	POROLA	1139			46.07	9.98	1940	1942	1976	22			
IT	658	PRA FIORITO	1124			46.15	10.86	1911	1920	2001	32			
IT	235	PRE DE BAR	681	WESTERN ALPS	DORA BALTEA BAS	45.91	7.04	1897	1904	2005	80			
IT	408	PREDAROSSA	1182			46.26	9.74	1913	1916	2001	34			
IT	678	PRESANELLA	637	CENTRAL ALPS	ADIGE BASIN	46.23	10.66	1920	1925	2004	56			
IT	524	PROFA	1135			46.39	10.43	1938	1975	1975	1			
IT	602	PRUDENZINI	1146			46.13	10.47	1968	1969	1969	1			
IT	19	PUNTA DANTE	2337			44.67	7.10	1974	1975	1987	2			
IT	515	PUNTA SFORZELLINA OCC.	1172			46.36	10.52	1925	1929	1975	11			
IT	514	PUNTA SFORZELLINA SETT.	1171			46.36	10.53	1925	1929	1975	11			
IT	889	QUAIRA BIANCA	686	EASTERN ALPS	ADIGE BASIN	46.55	10.86	1929	1930	2005	33			
IT	16	QUARNERO	2334			44.66	7.09	1986	1987	1989	3			
IT	795	RAMULDA SETT.	1132			46.73	10.72	1929	1931	1973	21			
IT	399	RASICA ORIENT.	2499			46.29	9.68	1989	1990	2001	10			
IT	120	RAYES NOIRES (ROSSA)	1277			45.58	7.27	1973	1974	1974	1			
IT	339	REBBIO	1212			46.29	8.12	1962	1963	1971	8			
IT	466	RINALPI	2517			46.43	10.28	1931	1932	1985	13			
IT	908	RIOTORBO	2635			47.02	11.90	1926	1927	1944	17			
IT	78	ROCCIA VIVA	2364			45.51	7.33	1988	1989	1992	4			
IT	35	ROCCIAMELONE	2345			45.21	7.08	1970	1971	1999	10			
IT	224	ROCHEFORT	1222			45.85	6.97	1946	1947	1999	19			
IT	754	ROSIM	610	CENTRAL ALPS	ADIGE BASIN	46.53	10.64	1897	1898	2005	29			
IT	506	ROSOLE	1166			46.44	10.61	1925	1926	2001	40			
IT	697	ROSSA (VEDR.)	674	CENTRAL ALPS	ADIGE BASIN	46.42	10.63	1897	1898	2004	42			
IT	920	ROSSO DESTRO	648	EASTERN ALPS	ADIGE BASIN	47.03	12.20	1928	1930	2005	28			
IT	0189B	RUITOR ORIENT.	2397			45.50	7.00	1961	1962	1973	7			
IT	189	RUTOR	612	WESTERN ALPS	DORA BALTEA BAS	45.50	7.00	1926	1927	2005	75			
IT	0189A	RUTOR	2396			45.50	7.00	1926	1927	1972	34			
IT	726	SAENT (SETT. DI)	2598			46.48	10.73	1924	1925	1977	7			
IT	604	SALARNO	1147			46.14	10.51	1919	1920	1999	15			
IT	794	SALDURA MER.	1131			46.73	10.74	1929	1930	1973	20			
IT	691	SALINE	2583			46.39	10.63	1925	1926	1946	6			
IT	508	SAN GIACOMO	1168			46.40	10.56	1926	1927	1976	18			
IT	926	SASSOLUNGO OCC.	678	EASTERN ALPS	ADIGE BASIN	46.93	12.14	1931	1932	1998	15			
IT	527	SAVORETTA	1136			46.34	10.44	1926	1927	1996	9			
IT	550	SCAIS	1140			46.07	9.98	1931	1933	1975	24			
IT	432	SCERSCEN INFERIORE	1186			46.35	9.85	1890	1897	2001	49			
IT	433	SCERSCEN SUP. (LOBO OR.)	2511			46.36	9.90	1926	1927	2001	21			
IT	46	SEA	1299			45.34	7.14	1927	1928	2001	30			
IT	207	SEIGNE	2411			45.77	6.81	1988	1989	1997	5			
IT	18	SELLA	2336			44.68	7.09	1984	1985	1988	4			
IT	102	SENGIE SETT.	1267			45.54	7.40	1917	1918	1995	9			
IT	728	SERANA (VEDR.)	634	CENTRAL ALPS	ADIGE BASIN	46.47	10.70	1933	1935	1995	14			
IT	314	SESIA	1210			45.92	7.90	1914	1915	1976	37			
IT	31	SEVINE ORIENT.	2344			45.16	6.90	1928	1929	1974	2			
IT	516	SFORZELLINA	667	CENTRAL ALPS	ADDA BASIN	46.35	10.51	1925	1926	2005	61	1987	2000	14
IT	653	SFULMINI	1152			46.17	10.90	1934	1935	1976	27			
IT	422	SISSONE	2506			46.30	9.72	1926	1927	2001	28			
IT	0006A	SIULA (GELAS SETT.)	2327			44.13	7.39	1927	1928	1972	15			
IT	522	SOBRETTA NE (VEDR. MOLERBI)	1134			46.40	10.43	1925	1926	1975	3			
IT	147	SOCHES TSANTELEINA	1244			45.49	7.07	1950	1951	2001	22			
IT	265	SOLATSET	1193			45.91	7.55	1968	1969	1973	3			
IT	762	SOLDA (VEDRETTA DI)	660	CENTRAL ALPS	ADIGE BASIN	46.49	10.57	1922	1923	1995	42			
IT	974	SORAPIS CENTRALE	1119			46.51	12.22	1899	1900	2000	31			
IT	975	SORAPIS OCC.	1120			46.51	12.21	1901	1902	1986	21			
IT	973	SORAPIS OR.	1118			46.51	12.23	1900	1901	2000	29			
IT	369	SPIAN. TAMBÒ SUP.	2486			46.50	9.29	1945	1946	1966	5			
IT	710	STERNAI SETT & MERID.	2590			46.48	10.76	1946	1947	1977	13			
IT	371	SURETTA MERID.	2488			46.51	9.36	1926	1927	2001	46			
IT	340	TARAMONA	1213			46.29	8.13	1962	1963	1995	9			
IT	79	TELECCIO	1263			45.52	7.36	1934	1952	1987	4			
IT	829	TESSA	653	CENTRAL ALPS	ADIGE BASIN	46.73	10.98	1926	1927	2004	31			
IT	95	TESSONET MER.	1266			45.62	7.47	1971	1972	1994	5			
IT	126	TIMORION	1282			45.55	7.27	1952	1974	1974	1			
IT	155	TORRENT	2384			45.58	7.09	1922	1962	2001	18			
IT	221	TOULES	614	WESTERN ALPS	DORA BALTEA BAS	45.83	6.93	1932	1933	2004	48			
IT	121	TRAJO	1278			45.60	7.27	1932	1953	1976	16			
IT	947	TRAVIGNOLO	1514	EASTERN BASIN	ADIGE BASIN	46.29	11.82	1952	1953	2005	13			
IT	511	TRESERO	669	CENTRAL ALPS	ADDA BASIN	46.38	10.54	1925	1926	2000	46			

PU	PSFG	NAME	WGMS ID	GENERAL LOCATION	SPECIFIC LOCATION	LATITUDE	LONGITUDE	FV FirstRY	FV FirstSY	FV LastSY	FV NoObs	MB FirstRY	MB LastSY	MB NoObs
NO	31015	FAABERGSTOELSB.	289	WEST NORWAY	TOSTEDAL	61.72	7.23	1899	1903	2005	98			
NO	67012	FONDALSBREEN	2299	NORTHERN NORWAY	SVARTISEN	66.30	13.49	1909	1910	1942	33			
NO		GRAAFJELLSBREA	2672	SOUTHWESTERN NORWAY	SONDRE FOLGEFONNA	60.10	6.40	2002	2003	2005	3	1964	2005	10
NO	547	GRAASUBREEN	299	SOUTHERN NORWAY	JOTUNHEIMEN	61.65	8.60					1962	2005	44
NO	12419	HANSBREEN	306	SPITSBERGEN	HORNSUND REGION	77.08	15.67	1918	1936	2004	23	1989	2005	15
NO	36206	HANSEBREEN	322	WESTERN NORWAY	NORDFJORD	61.75	5.68					1986	2005	17
NO	30704	HARBARDSBREEN	2320	WESTERN NORWAY	JOSTEDAL	61.67	7.58					1998	2001	4
NO	22303	HARDANGERJOEKULEN	304	CENTRAL NORWAY	HARDANGERVIDDA	60.53	7.37	1980	1981	1983	3	1963	2005	43
NO	530	HEIMRE ILLAABRE	2300	CENTRAL NORWAY	JOTUNHEIMEN	61.39	8.15	1903	1904	1959	17			
NO	511	HELLSTUGUBREEN	300	SOUTHERN NORWAY	JOTUNHEIMEN	61.57	8.43	1901	1902	2005	49	1962	2005	44
NO	5507	HOEGTUVBREEN	286	NORTH NORWAY	RANA	66.45	13.65					1971	1977	7
NO	12411	HORN	308	SPITSBERGEN	HORNSUND REGION	77.07	16.82	1961	1983	1985	2			
NO	15402	IRENEBREEN	2669	SPITSBERGEN	KAFFIOYRA	78.40	12.05	2000	2001	2005	5	2002	2005	4
NO		JOSTEFONN	1676	SOUTH NORWAY		60.53	7.37					1996	2000	5
NO	37223	KJENNDALSBREEN	2294		LOEN	61.70	7.02	1996	1997	2005	9			
NO	12404	KOERBER	310	SPITSBERGEN	HORNSUND REGION	76.95	16.08	1960	1961	1984	2			
NO	15510	KONGSVEGEN	1456			78.80	12.98					1987	2005	19
NO		KOPPANGSBREEN	2309	NORTHERN NORWAY		69.68	20.08	1998	1999	2005	5			
NO	12415	KVALFANGAR	296	SPITSBERGEN	HORNSUND REGION	77.10	16.10	1961	1983	1984	2			
NO	85008	LANGFJORDJOEKUL	323	NORTHERN NORWAY	WESTERN FINMARK	70.12	21.77	1998	1999	2005	7	1989	2005	17
NO	548	LEIRBREEN	301	SOUTHERN NORWAY	JOTUNHEIMEN	61.57	8.10	1907	1908	2004	33			
NO	31019	LODALSBREEN	2301	WESTERN NORWAY	JOSTEDAL	61.78	7.24	1899	1903	1970	63			
NO	4302	MIDTDALSBREEN	2295		HARDANGERJOKULE	60.57	7.47	1982	1983	2005	23	2000	2001	2
NO	15506	MIDTRE LOVENBREEN	291	SPITSBERGEN	KONGSFJORD	78.88	12.07					1968	2005	38
NO	12416	MUEHLBACHER	295	SPITSBERGEN	HORNSUND REGION	77.12	15.93	1961	1983	1985	3			
NO	31014	NIGARDSBREEN	290	WEST NORWAY	JOSTEDAL	61.72	7.13	1908	1909	2005	91	1962	2005	44
NO	531	NORDRE ILLAABRE	2302	CENTRAL NORWAY	JOTUNHEIMEN	61.37	8.16	1903	1904	1961	22			
NO	64902	OKSTINDBREEN	324	NORTHERN NORWAY	KORGEN	66.23	14.37					1986	1997	12
NO	12417	PAIERL	294	SPITSBERGEN	HORNSUND REGION	77.13	15.75	1900	1918	1985	5			
NO	22303	REMBESDALSKAAKI	2296		HARDANGERJOKULE	60.53	7.37	1995	1996	2005	9			
NO		RUNDVASSBREEN	2670	NORTH NORWAY	BLAAMANNSISEN	67.30	16.10					2002	2004	3
NO	12407	SAMARIN	311	SPITSBERGEN	HORNSUND REGION	76.87	16.40	1900	1918	1985	4			
NO	534	SONDRE ILLAABRE	2303	CENTRAL NORWAY	JOTUNHEIMEN	61.35	8.16	1903	1904	1961	22			
NO	31027	SPOERTEGGBREEN	319	WESTERN NORWAY	BREHEIMEN	61.61	7.47					1988	1991	4
NO	31021	STEGHOLTBREEN	313	WEST NORWAY	JOSTEDAL	61.80	7.32	1908	1909	2005	97			
NO		STEINDALSBREEN	2310	NORTHERN NORWAY		69.39	18.89	1998	1999	2005	4			
NO	541	STORBREEN	302	CENTRAL NORWAY	JOTUNHEIMEN	61.57	8.13	1901	1902	2004	54	1949	2005	57
NO		STORGJUVBREEN	2308	NORTHERN NORWAY		61.64	8.28	1997	1998	2005	8			
NO	67313	STORGLOMBREEN	297	NORTHERN NORWAY	SVARTISEN	66.67	14.00					1985	2005	10
NO	7381	STORSTEINSFJELL	1329			68.22	17.92					1964	1995	10
NO	30720	STYGGEDALSBREEN	303	CENTRAL NORWAY	JOTUNHEIMEN	61.48	7.88	1901	1902	2005	81			
NO	33014	SUPPHELLEBREEN	287	SOUTHERN NORWAY	JOSTEDALSBREEN	61.52	6.80	1899	1903	2005	61	1981	1982	2
NO	65509	SVARTISHEIBREEN	320	NORTHERN NORWAY	SVARTISEN	66.55	13.77	1903	1904	1958	13	1988	1995	8
NO	523	SVELLNOSBREEN	2304	CENTRAL NORWAY	JOTUNHEIMEN	61.62	8.32	1901	1902	1912	11			
NO	67315	TRETTEN-NULL-TO	312	NORHERN NORWAY	SVARTISEN	66.72	14.02					1985	1986	2
NO	68507	TROLLBERGDALSBR	316	NORTH NORWAY	SVARTISEN	66.72	14.45	1956	1957	1970	14	1970	1994	11
NO	3100	TUNSBERGDALSBRE	1316			61.60	7.05	1900	1903	1975	55	1966	1972	7
NO	522	TVERRAABREEN	2305	CENTRAL NORWAY	JOTUNHEIMEN	61.60	8.30	1901	1902	1963	33			
NO	3733A	VESLEDALSBREEN	1331			61.83	7.27	1905	1906	1965	25	1967	1967	1
NO	0053B	VESTRE MEMURUBR	1318			61.53	8.45	1902	1903	1953	16	1968	1971	4
NO	15403	WALDEMARBREEN	2307	SPITSBERGEN	KAFFIOYRA	78.67	12.00	1909	1936	2005	17	1995	2005	11
NO	12501	WERENSKIOLD	305	SPITSBERGEN	HORNSUND REGION	77.08	15.40	1978	1982	1988	5	1980	1980	1
NO	12414	WIBE	307	SPITSBERGEN	HORNSUND REGION	77.07	16.17	1961	1983	1985	3			
NP	5	AX010	906	HIMALAYAS	SHORONG HIMAL	27.70	86.57	1978	1989	1999	7	1996	1999	4
NP	6	AX030	911	HIMALAYAS	SHORONG HIMAL	27.72	86.57	1978	1989	1989	1			
NP	7	DX080	907	HIMALAYAS	KHUMBU HIMAL	27.95	86.67	1976	1989	1995	2			
NP	8	EB050	910	HIMALAYAS	KHUMBU HIMAL	27.95	86.75	1976	1989	1989	1			
NP	11	GYAJO	1069	HIMALAYAS	KHUMBU HIMAL	27.88	86.68	1970	1973	1995	3			
NP	10	KONGMA	909	HIMALAYAS	KHUMBU HIMAL	27.93	86.83	1978	1989	1995	2			
NP	9	KONGMA TIKPE	908	HIMALAYAS	KHUMBU HIMAL	27.92	86.83	1978	1989	1995	2			
NP	12	RIKHA SAMBA	1516	HIMALAYAS	DHAULAGIRI	28.83	83.50	1974	1994	1999	3	1999	1999	1
NP	13	THULAGI	1535	HIMALAYA	MANASLU HIMAL	28.48	84.50	1958	1972	1988	4			
NP	4	YALA	912	HIMALAYAS	LANGTANG VALLEY	28.25	85.62	1982	1987	1996	4			
NZ		ABEL	1546	WHATAROA	PERTH	-43.32	170.63	1989	1993	1995	3			
NZ		ADAMS	2923	WANGANUI	ADAMS	-43.32	170.72	1879	1892	2003	13			
NZ		ALMER/SALISBURY	1548	WAIHO	WAIHO	-43.47	170.22	1989	1993	2005	12			
NZ		ANDY	1590	OLIVINES	WILLIAMSON	-44.43	168.37	1987	1993	2005	12			
NZ		ASHBURTON	1570	S.ASHBURTON	S.ASHBURTON	-43.37	170.97	1989	1993	2005	8			
NZ		AXIUS	2283	WAIATOTO	TE NAHI	-44.17	168.98	1987	1998	2002	4			
NZ		BALFOUR	1604	BALFOUR	COOK	-43.55	170.12	1985	1995	2005	9			
NZ		BARLOW	1608	PERTH	WHATAROA	-43.30	170.63	1989	1992	2000	5			
NZ		BARRIER	2281	FIORDLAND	PYKE	-44.42	168.36	1987	1998	1999	2			
NZ		BLAIR	1551	WAITAKI	HUXLEY	-43.95	169.72	1989	1993	1995	3			
NZ		BONAR	1587	WAIPARA	WAIPARA	-44.40	168.72	1987	1995	2000	3			
NZ		BREWSTER	1597	WILLS-BURKE	HAAST	-44.07	169.43	1989	1992	2005	14	2005	2005	1
NZ		BURTON	1606	CALLERY	WAIHO	-43.45	170.32	1989	1993	2000	7			
NZ		BUTLER	1544	RAKAIA	LOUPER	-43.25	170.93	1989	1992	2005	14			
NZ		CAMERON	1565	RAKAIA	CAMERON	-43.33	171.00	1988	1993	2005	10			
NZ		CARIA	1558	ARAWHATA	MT. CARIA	-44.38	168.52	1989	1993	1995	3			
NZ	711M1	CLASSEN	1579	WAITAKI	GODLEY	-43.50	170.42	1989	1994	2002	7			
NZ	693C1	COLIN CAMPBELL	1571	RANGITATA	CLYDE	-43.32	170.72	1988	1995	2001	3			
NZ		CROW	1564	WAIMAKARIRI	CROW	-42.92	171.50	1988	1995	2005	5			
NZ		DAINTY	2287	WESTERN ALPS	WANGANUI	-43.23	170.89	1994	1996	2000	5			
NZ		DART	898	OTAGO	DART RIVER	-44.45	168.60	1980	1981	2005	18			
NZ		DISPUTE	2286	WESTERN ALPS	TURNBULL	-44.14	168.96	1988	1998	2002	4			

PU	PSFG	NAME	WGMS ID	GENERAL LOCATION	SPECIFIC LOCATION	LATITUDE	LONGITUDE	FV FirstRY	FV FirstSY	FV LastSY	FV NoObs	MB FirstRY	MB LastSY	MB NoObs
NZ		DONALD	2284	WESTERN ALPS	WAIATOTO	-44.24	168.87	1988	2000	2000	1			
NZ		DONNE	1585	HOLLYFORD	TUTOKO	-44.58	168.02	1987	1995	2003	6			
NZ		DOUGLAS (KAR.)	1601	KARANGARUA	DOUGLAS	-43.68	170.00	1987	1993	2005	11			
NZ		DOUGLAS (RAK.)	1543	RAKAIA	CAMERON	-43.37	170.98	1989	1992	1995	4			
NZ		EVANS	1611	WANGANUI	WANGANUI	-43.20	170.92	1988	1992	2003	7			
NZ		FITZGERALD (GOD)	2278	EASTERN ALPS	GODLEY	-43.47	170.57	1988	2000	2001	2			
NZ		FITZGERALD (KAR)	1602	KARANGARUA	DOUGLAS	-43.72	170.02	1984	1993	1995	2			
NZ		FOX	1536	COOK	FOX	-43.53	170.15	1989	1991	2005	13			
NZ		FRANKLIN	2964	OTIRA	TARAMAKAU	-42.87	171.67	1989	1993	1995	3			
NZ		FRANZ JOSEF	899	WESTLAND	WAIHO RIVER	-43.50	170.22	1980	1981	2005	25			
NZ		FRESHFIELD	2966	EASTERN ALPS	TASMAN	-43.58	170.19	1988	1996	2002	3			
NZ		GLENMARY	1550	WAITAKI	DOBSON	-44.00	169.88	1989	1994	2000	5			
NZ		GODLEY	1581	WAITAKI	GODLEY	-43.43	170.57	1989	1995	2003	6			
NZ		GREY & MAUD	1580	WAITAKI	GODLEY	-43.45	170.48	1989	1994	2004	7			
NZ		GUNN	1560	HOLLYFORD	HOLLYFORD	-44.76	168.09	1989	1993	2005	12			
NZ		HOOKER	1576	WAITAKI	HOOKER	-43.60	170.12	1985	1992	2002	9			
NZ		HORACE WALKER	1600	KARANGARUA	DOUGLAS	-43.67	169.97	1988	1995	2005	6			
NZ		IVORY	900	WESTLAND	WAITAHA RIVER	-43.13	170.92	1980	1981	2005	23	1970	1975	6
NZ		JACK	1553	PARINGA	OTOKO	-43.82	169.63	1989	1993	1995	3			
NZ		JACKSON	1552	HAAST	LANDSBOROUGH	-43.88	169.78	1948	1949	1994	2			
NZ		JALF	1549	WAIKUKUPA	WAIKUKUPA	-43.47	170.15	1989	1993	1995	3			
NZ		KAHUTEA	1569	RAKAIA	WILBERFORCE	-43.02	171.38	1989	1995	2004	8			
NZ		KEA	1545	WANGANUI	GALWAY CK	-43.18	170.80	1989	1993	1995	3			
NZ		LA PEROUSE	1605	COOK	COOK	-43.57	170.12	1984	1995	2005	10			
NZ		LAMBERT	1612	WANGANUI	GARDEN OF ALLAH	-43.30	170.75	1989	1992	2005	8			
NZ		LAWRENCE	2275	EASTERN ALPS	LAWRENCE	-43.32	171.00	1996	1997	2002	5			
NZ		LE BLANC	1595	LANDSBOROUGH	HAAST	-43.78	169.97	1985	1994	1995	2			
NZ		LEEB-LORNTY	2288	WESTERN ALPS	WANGANUI	-43.22	170.90	1985	1999	2005	6			
NZ		LINDSAY	1556	OKURU		-44.00	169.13	1989	1993	1995	3			
NZ		LLAWRENNY	1561	ARTHUR	POSIEDON CK	-44.65	167.80	1989	1993	1995	3			
NZ		LYELL	1567	RAKAIA	LYELL	-43.28	170.83	1989	1995	2004	6			
NZ		MACAULAY	2280	EASTERN ALPS	MACAULAY	-43.49	170.60	1988	2000	2000	1			
NZ		MARCHANT	1598	COPLAND	KARANGARUA	-43.62	170.03	1986	1995	1995	1			
NZ		MARION	1591	ARAWHATA	JOE	-44.47	168.48	1989	1993	2005	8			
NZ		MARMADUKE DIXON	1541	WAIMAKA RIRI	WHITE	-42.98	171.38	1989	1993	2005	11			
NZ		MATHAIAS	2997	RAKAIA	S.MATHAIAS	-43.18	171.03	2000	2000	2003	3			
NZ		MC COY	1572	RANGITATA	CLYDE	-43.32	170.80	1985	1995	2000	3			
NZ		MUELLER	1575	WAITAKI	HOOKER	-43.75	170.02	1989	1991	2005	7			
NZ		MURCHISON	1578	WAITAKI	MURCHISON	-43.52	170.40	1989	1993	2005	10			
NZ		PARK PASS	1559	CLUTHA	ROCK BURN	-44.58	168.23	1989	1994	2005	11			
NZ		POET	1594	LANSBOROUGH	HAAST	-43.75	169.97	1986	1995	1995	1			
NZ		RAMSAY	1568	RAKAIA	RAKAIA	-43.22	170.93	1983	1995	2004	6			
NZ		REISCHEK	1566	RAKAIA	REISCHEK STM	-43.32	171.00	1989	1995	2005	8			
NZ		RETREAT	1542	HOKITIKA	FARQUHARSON CK	-42.97	171.30	1989	1993	1995	3			
NZ		RICHARDSON	1574	WAITAKI	HOPKINS	-43.80	169.95	1987	1993	2000	4			
NZ		RIDGE	1547	WAITAKI	CASS	-43.62	170.37	1989	1994	1995	2			
NZ		ROLLESTON	1538	TARAMAKAU	OTIRA	-42.88	171.52	1989	1993	1995	3			
NZ		SALE	1614	WHITCOMBE	WHITCOMBE	-43.22	170.95	1993	1995	2004	6			
NZ		SEPARATION	2279	EASTERN ALPS	GODLEY	-43.48	170.58	1995	1996	2000	2			
NZ		SIEGE	1616	WHATAROA	BARLOW	-43.27	170.53	1989	1992	2005	11			
NZ		SINCLAIR	1573	RANGITATA	CLYDE	-43.37	170.87	1985	1995	1995	1			
NZ		SNOW WHITE	1588	ARAWHATA	ARAWHATA	-44.45	168.58	1987	1993	2005	8			
NZ		SNOWBALL	1589	ARAWHATA	JOE	-44.45	168.52	1987	1993	2003	7			
NZ		SOUTH CAMERON	3019	RAKAIA	CAMERON	-43.35	170.99	2002	2004	2004	1			
NZ		SPENCER	1607	CALLERY	WAIHO	-43.50	170.28	1989	1992	2000	7			
NZ		ST. JAMES	2274	RAKAIA	RAMSAY	-43.28	170.89	1985	1996	2003	5			
NZ		STRAUCHON	1599	COPLAND	KARANGARUA	-43.62	170.08	1986	1994	2005	6			
NZ		STUART	1555	WILKIN	BLUE R	-44.12	169.27	1989	1992	1995	4			
NZ		TASMAN	1074	WAITAKI	TASMAN	-43.52	170.32	1989	1991	2005	15	1959	1959	1
NZ		TEWAEWAE	2276	EASTERN ALPS	HOOKER-MUELLER	-43.68	170.07	2000	2000	2004	4			
NZ		THERMA	1592	WAIATOTO	WAIATOTO	-44.37	168.77	1987	1995	1995	1			
NZ		THURNEYSON	1554	AHURIRI	CANYON CK	-44.17	169.60	1989	1992	2005	11			
NZ		TORNADO	1586	OLIVINES	ARAWATA	-44.37	168.42	1986	1995	1995	1			
NZ	664C1	UNNAMED NZ664C	1539	WAI MAKARIRI	MT CARRINGTON	-42.92	171.48	1989	1993	1995	2			
NZ	685F1	UNNAMED NZ685F	1540	RAKAIA	AVOCA	-43.05	171.40	1989	1993	1994	2			
NZ	7.52E+03	UNNAMED NZ752E	1557	SHOTOVER	FOG PK	-44.52	168.80	1989	1993	1995	3			
NZ	797G1	UNNAMED NZ797G	1562	CLINTON	BARRIER PK	-44.83	167.77	1989	1993	1995	3			
NZ		UNNAMED NZ851A/036	2282	FIORDLAND	PYKE	-44.44	168.36	1987	1998	1999	2			
NZ		UNNAMED NZ868B	1596	LANDSBOROUGH	BAKER CK	-43.83	169.88	1980	1995	1995	1			
NZ		VICTORIA	3034	FOX	COOK	-43.50	170.17	1989	1995	2005	5			
NZ		WHATAROA	2285	WESTERN ALPS	WHATOAROA	-43.40	170.53	1988	1999	2005	5			
NZ		WHITBOURNE	1583	CLUTHA	DART	-44.47	168.57	1988	1995	2001	3			
NZ		WHITE	3037	WAIMAKARIRI	WHITE	-43.00	171.38	1989	1993	2005	11			
NZ		WHYMPER	1609	WHATAROA	WHATAROA	-43.48	170.37	1980	1995	2005	10			
NZ		WIGLEY	1610	WHATAROA	WHATAROA	-43.42	170.35	1989	1992	2000	6			
NZ		WILKINSON	1615	WHITCOMBE	WILKINSON	-43.20	170.93	1989	1995	2005	7			
NZ		ZORA	1593	LANDSBOROUGH	HAAST	-43.75	169.83	1986	1995	2005	7			
PE	3	ARTESONRAJU	3292	CORD.BLANCA	PARON BASIN	-8.95	-77.62		2005	2005	1	2005	2005	1
PE	3	BROGGI	220	CORD.BLANCA	LLANGANUCO VAL.	-8.98	-77.58	1948	1968	2004	32			
PE	9	GAJAP-YANACARCO	223	CORD.BLANCA	PATIVILCA BASIN	-9.83	-77.17	1980	1981	2005	13			
PE	7	HUARAPASCA	222	CORD.BLANCA	PACHACOTO BASIN	-9.85	-77.18	1980	1981	1990	9			
PE	8	PASTORURI	224	CORD.BLANCA	PACHACOTO BASIN	-9.90	-77.17	1980	1981	2005	15			
PE	1	QUELCCAYA	219	SE ANDES	SICUANI NE	-13.93	-70.82	1963	1974	1980	3	1976	1980	5
PE	0002B	SAFUNA	1343			-7.83	-77.05	1968	1969	1974	5			
PE	6	SANTA ROSA	225	CORD. RAURA	RIO HUAURA BAS.	-10.48	-76.72	1977	1978	1983	6			

PU	PSFG	NAME	WGMS ID	GENERAL LOCATION	SPECIFIC LOCATION	LATITUDE	LONGITUDE	FV FirstRY	FV FirstSY	FV LastSY	FV NoObs	MB FirstRY	MB LastSY	MB NoObs
PE	3	SHALLAP	3293	CORD.BLANCA	QUILLCAY BASIN	-9.48	-77.33		2005	2005	1			
PE	1	SHULLCON	3294	CORD. CENTRAL	1D3522BB-BC-CA BASIN	-11.88	-76.05	2001	2002	2005	3			
PE	5	URUASHRAJU	221	CORD.BLANCA	RIO NEGRO BASIN	-9.58	-77.32	1948	1968	2005	29			
PE	4	YANAMAREY	226	CORD.BLANCA	YANAYACU BASIN	-9.65	-77.27	1971	1972	2005	30	2005	2005	1
PK	35	ALING	1630	KARAKORUM	HUSHE RIVER	35.47	76.22	1970	1989	1993	2			
PK	4	BUALTAR	987	KARAKORUM	HUNZA BASIN	36.12	74.80	1939	1988	1995	3			
PK	1001	CHOGO LUNGMA	972	KARAKORUM	SHIGAR	36.00	75.00	1902	1913	1989	5			
PK	1501	CHUNGPAR-TASH.	985	NANGA PARBAT		35.23	74.72	1856	1934	1987	3			
PK	28	KARAMBAR	1002	KARAKORUM	ISHKOMAN-GILGIT	36.80	74.17	1955	1993	1994	2			
PK	13	MINAPIN	994	KARAKORUM	HUNZA VALLEY	36.18	74.58	1889	1893	1987	7			
PK	1508	SHAIGIRI	976	NANGA PARBAT		35.18	74.58	1934	1958	1987	2			
PK	1506	TAP	974	NANGA PARABAT		35.20	74.62	1934	1958	1987	2			
PK	1515	TOSHAIN RUPAL	973	NANGA PARABAT		35.17	74.57	1934	1958	1987	2			
PL	140	MIEGUSZOWIECKIE	903	W. CAPATHIANS	TATRA MOUNTAINS	49.18	20.07	1980	1981	2005	22			
PL	111	POD BULA	1617	W. CARPATHIANS	TATRA MOUNTAINS	49.18	20.08	1980	1981	2005	25			
PL	180	POD CUBRYNA	902	W. CARPATHIANS	TATRA MOUNTAINS	49.19	20.05	1980	1981	2005	24			
PL	1	TATRAS PATCHES	901	CARPATHIANS	TATRA MOUNTAINS	49.22	20.08	1978	1984	1984	1			
SE	780	HYLLGLACIAEREN	344	N SWEDEN	NW SAREK	67.58	17.47	1967	1968	2003	19			
SE	787	ISFALLSGLAC.	333	N SWEDEN	KEBNEKAISE	67.92	18.57	1897	1910	2005	53			
SE	798	KARSOJIETNA	330	N SWEDEN	ABISKO	68.35	18.32	1908	1909	1997	49	1982	1993	8
SE	795	KUOTOTJAKKAGL.	328	N SWEDEN	N KEBNEKAISE	68.15	18.57	1970	1971	1977	6			
SE	799	MARMAGLACIAEREN	1461	NORTHERN SWEDEN	KEBNEKAISE	68.83	18.67					1990	2005	16
SE	766	MIKKAJEKNA	338	N SWEDEN	SAREK	67.40	17.70	1897	1899	2002	41			
SE	763	PARTEJEKNA	327	N SWEDEN	S SAREK	67.17	17.67	1967	1970	2003	24	1997	2000	4
SE	797	PASSUSJIETNA E.	331	N SWEDEN	N KEBNEKAISE	68.05	18.43	1968	1969	2000	19			
SE	796	PASSUSJIETNA W	345	N SWEDEN	N KEBNEKAISE	68.05	18.38	1968	1969	1995	14			
SE	785	RABOTS GLACIAER	334	N SWEDEN	KEBNEKAISE	67.90	18.55	1950	1951	2002	31	1982	2005	23
SE	790	RIUKOJIETNA	342	N SWEDEN	KEBNEKAISE	68.08	18.08	1963	1968	2002	19	1986	2005	19
SE	764	RUOPSOKJEKNA	340	N SWEDEN	NE SAREK	67.33	17.98	1965	1967	2000	17			
SE	767	RUOTESJEKNA	337	N SWEDEN	SAREK	67.42	17.47	1965	1967	2002	22			
SE	759	SALAJEKNA	341	N SWEDEN	SULITELMA	67.12	16.38	1898	1908	2002	23			
SE	789	SE KASKASATJ GL	329	NORTHERN SWEDEN	KEBNEKAISE	67.93	18.60	1950	1951	2005	31			
SE	788	STORGLACIAEREN	332	N SWEDEN	KEBNEKAISE	67.90	18.57	1897	1908	2003	63	1946	2005	60
SE	784	STOUR RAEITAGL.	335	N SWEDEN	KEBNEKAISE	67.97	18.38	1970	1971	1998	12			
SE	768	SUOTTASJEKNA	336	N SWEDEN	N SAREK	67.47	17.58	1896	1901	2002	24			
SE	791	TARFALAGL	326	NORTHERN SWEDEN	KEBNEKAISE	67.93	18.65	1897	1910	1951	5	1986	2005	12
SE	783	UNNA RAEITA GL.	343	N SWEDEN	KEBNEKAISE	67.97	18.43	1949	1951	2000	18			
SE	765	VARTASJEKNA	339	N SWEDEN	SAREK	67.45	17.67	1967	1968	2003	21			
SU		1.14.03.17	2184	EASTERN PAMIR		39.27	73.55	1973	1980	1990	2			
SU		10.14.03.17	2188	EASTERN PAMIR		39.08	73.70	1973	1980	1990	2			
SU		100.14.03.14	2223	EASTERN PAMIR		37.98	72.72	1973	1978	1990	2			
SU		101.14.03.14	2224	EASTERN PAMIR		37.98	72.75	1973	1990	1990	1			
SU		12.14.03.17	2189	EASTERN PAMIR		39.13	73.70	1980	1990	1990	1			
SU		134.14.03.17	2158	EASTERN PAMIR		38.85	73.03	1973	1980	1980	1			
SU		136.14.03.17	2159	EASTERN PAMIR		38.85	73.02	1973	1980	1990	2			
SU		139.14.03.17	2160	EASTERN PAMIR		38.87	73.00	1973	1980	1990	2			
SU		15.14.03.17	2190	EASTERN PAMIR		39.12	73.68	1980	1990	1990	1			
SU		152.14.03.14	2225	EASTERN PAMIR		37.90	73.02	1973	1990	1990	1			
SU		155.14.03.14	2226	EASTERN PAMIR		37.95	73.02	1973	1990	1990	1			
SU		159.14.03.14	2227	EASTERN PAMIR		37.92	73.03	1973	1990	1990	1			
SU		16.14.03.17	2191	EASTERN PAMIR		39.10	73.67	1980	1990	1990	1			
SU		160.14.03.14	2228	EASTERN PAMIR		37.92	73.05	1973	1990	1990	1			
SU		161.14.03.14	2229	EASTERN PAMIR		37.95	73.07	1973	1990	1990	1			
SU		165.14.03.14	2230	EASTERN PAMIR		37.92	73.08	1973	1990	1990	1			
SU		168.14.03.14	2231	EASTERN PAMIR		37.93	73.12	1973	1990	1990	1			
SU		169.14.03.14	2232	EASTERN PAMIR		37.92	73.13	1973	1990	1990	1			
SU		170.14.03.14	2233	EASTERN PAMIR		37.92	73.15	1973	1990	1990	1			
SU		172.14.03.14	2234	EASTERN PAMIR		37.93	73.18	1973	1990	1990	1			
SU		173.14.03.14	2235	EASTERN PAMIR		37.93	73.18	1973	1990	1990	1			
SU		174.14.03.14	2236	EASTERN PAMIR		37.93	73.20	1973	1990	1990	1			
SU		208.14.03.14	2237	EASTERN PAMIR		38.12	73.08	1973	1990	1990	1			
SU		239.14.03.17	2161	EASTERN PAMIR		39.12	72.95	1973	1980	1990	2			
SU		240.14.03.17	2162	EASTERN PAMIR		39.08	72.95	1973	1980	1990	2			
SU		241.14.03.17	2163	EASTERN PAMIR		39.07	72.92	1973	1980	1990	2			
SU		242.14.03.14	2238	EASTERN PAMIR		38.20	73.12	1973	1990	1990	1			
SU		242.14.03.17	2164	EASTERN PAMIR		39.08	72.93	1973	1980	1990	2			
SU		243.14.03.14	2239	EASTERN PAMIR		38.20	73.13	1973	1990	1990	1			
SU		254.14.03.17	2168	EASTERN PAMIR		39.07	72.85	1973	1980	1990	2			
SU		257.14.03.17	2169	EASTERN PAMIR		39.10	72.85	1980	1990	1990	1			
SU		259.14.03.17	2170	EASTERN PAMIR		39.10	72.87	1973	1980	1990	2			
SU		26.14.03.17	2193	EASTERN PAMIR		38.97	73.82	1980	1990	1990	1			
SU		260.14.03.17	2171	EASTERN PAMIR		39.10	72.88	1980	1990	1990	1			
SU		261.14.03.17	2172	EASTERN PAMIR		39.12	72.87	1980	1990	1990	1			
SU		262.14.03.17	2173	EASTERN PAMIR		39.13	72.87	1973	1980	1990	2			
SU		263.14.03.17	2174	EASTERN PAMIR		39.13	72.90	1973	1980	1990	2			
SU		264.14.03.17	2175	EASTERN PAMIR		39.15	72.90	1973	1980	1980	1			
SU		268.14.03.17	2176	EASTERN PAMIR		39.17	72.95	1973	1980	1990	2			
SU		269.14.03.17	2177	EASTERN PAMIR		39.17	72.97	1973	1980	1990	2			
SU		270.14.03.17	2178	EASTERN PAMIR		39.18	73.02	1973	1980	1990	2			
SU		271.14.03.17	2179	EASTERN PAMIR		39.20	73.03	1973	1980	1990	2			
SU		273.14.03.14	2240	EASTERN PAMIR		38.18	73.13	1973	1990	1990	1			
SU		273.14.03.17	2180	EASTERN PAMIR		39.20	72.98	1973	1980	1990	2			
SU		279.14.03.14	2241	EASTERN PAMIR		38.13	73.03	1973	1990	1990	1			
SU		280.14.03.14	2242	EASTERN PAMIR		38.13	73.07	1973	1990	1990	1			
SU		281.14.03.14	2244	EASTERN PAMIR		38.12	73.10	1973	1990	1990	1			
SU		284.14.03.14	2245	EASTERN PAMIR		38.05	73.10	1973	1990	1990	1			
SU		3.14.03.17	2185	EASTERN PAMIR		39.23	73.58	1973	1980	1990	2			
SU		30.14.03.17	2194	EASTERN PAMIR		38.95	73.78	1980	1990	1990	1			
SU		306.14.03.14	2246	EASTERN PAMIR		38.05	73.23	1973	1990	1990	1			
SU		31.14.03.14	2211	EASTERN PAMIR		38.10	72.47	1973	1978	1990	2			
SU		31.14.03.17	2195	EASTERN PAMIR		38.95	73.77	1980	1990	1990	1			
SU		314.14.03.08	2101	EASTERN PAMIR		39.17	72.78	1973	1980	1990	2			
SU		315.14.03.08	2102	EASTERN PAMIR		39.18	72.82	1973	1980	1990	2			
SU		324.14.03.08	2103	EASTERN PAMIR		39.20	72.72	1980	1990	1990	1			
SU		329.14.03.14	2247	EASTERN PAMIR		38.08	73.25	1973	1990	1990	1			
SU		331.14.03.14	2248	EASTERN PAMIR		38.10	73.30	1973	1990	1990	1			
SU		336.14.03.14	2249	EASTERN PAMIR		38.08	73.28	1973	1990	1990	1			
SU		34.14.03.17	2196	EASTERN PAMIR		38.93	73.73	1980	1990	1990	1			
SU		36.14.03.17	2197	EASTERN PAMIR		38.92	73.73	1980	1990	1990	1			
SU		375.14.03.15	2250	EASTERN PAMIR		37.68	72.77	1973	1990	1990	1			
SU		38.14.03.14	2212	EASTERN PAMIR		38.08	72.53	1973	1978	1990	2			
SU		385.14.03.15	2253	EASTERN PAMIR		37.70	72.70	1973	1990	1990	1			
SU		388.14.03.15	2254	EASTERN PAMIR		37.72	72.68	1973	1990	1990	1			
SU		39.14.03.14	2213	EASTERN PAMIR		38.07	72.53	1973	1978	1990	2			
SU		390.14.03.15	2255	EASTERN PAMIR		37.70	72.65	1973	1990	1990	1			
SU		394.14.03.15	2256	EASTERN PAMIR		37.72	72.63	1973	1990	1990	1			
SU		40.14.03.17	2198	EASTERN PAMIR		38.90	73.88	1980	1990	1990	1			
SU		41.14.03.17	2199	EASTERN PAMIR		38.87	73.70	1980	1990	1990	1			
SU		42.14.03.17	2182	EASTERN PAMIR		39.30	73.18	1973	1980	1990	2			
SU		429.14.03.15	2257	EASTERN PAMIR		37.60	72.72	1973	1990	1990	1			
SU		434.14.03.15	2258	EASTERN PAMIR		37.57	72.70	1973	1990	1990	1			
SU		44.14.03.14	2214	EASTERN PAMIR		38.03	72.57	1973	1978	1990	2			
SU		446.14.03.13	2203	EASTERN PAMIR		38.43	73.47	1980	1990	1990	1			
SU		447.14.03.08	2105	EASTERN PAMIR		39.07	72.73	1973	1980	1990	2			
SU		448.14.03.08	2106	EASTERN PAMIR		39.08	72.73	1973	1980	1990	2			
SU		449.14.03.08	2107	EASTERN PAMIR		39.05	72.73	1973	1980	1990	2			
SU		449.14.03.13	2204	EASTERN PAMIR		38.43	73.43	1980	1990	1990	1			
SU		453.14.03.13	2205	EASTERN PAMIR		38.48	73.40	1980	1990	1990	1			
SU		46.14.03.14	2215	EASTERN PAMIR		38.02	72.53	1973	1978	1990	2			
SU		464.14.03.08	2108	EASTERN PAMIR		39.07	72.80	1973	1980	1990	2			
SU		469.14.03.08	2109	EASTERN PAMIR		39.05	72.80	1973	1980	1990	2			
SU		47.14.03.14	2216	EASTERN PAMIR		38.00	72.53	1973	1978	1990	2			
SU		471.14.03.08	2110	EASTERN PAMIR		39.03	72.80	1973	1980	1990	2			
SU		473.14.03.08	2111	EASTERN PAMIR		39.02	72.78	1973	1980	1990	2			
SU		474.14.03.08	2112	EASTERN PAMIR		39.00	72.77	1973	1980	1990	2			
SU		499.14.03.13	2206	EASTERN PAMIR		38.48	73.37	1980	1990	1990	1			
SU		5.14.03.17	2186	EASTERN PAMIR		39.23	73.60	1973	1980	1990	2			
SU		503.14.03.08	2113	EASTERN PAMIR		38.87	72.95	1973	1980	1990	2			
SU		506.14.03.08	2114	EASTERN PAMIR		38.87	72.93	1973	1980	1990	2			
SU		508.14.03.08	2115	EASTERN PAMIR		38.88	72.93	1973	1980	1990	2			
SU		509.14.03.08	2116	EASTERN PAMIR		38.90	72.93	1973	1980	1990	2			
SU		512.14.03.08	2117	EASTERN PAMIR		38.87	72.92	1973	1980	1990	2			
SU		514.14.03.08	2118	EASTERN PAMIR		38.88	72.87	1973	1980	1990	2			
SU		519.14.03.08	2119	EASTERN PAMIR		38.92	72.88	1973	1980	1990	2			
SU		52.14.03.14	2217	EASTERN PAMIR		37.97	72.57	1973	1978	1990	2			
SU		520.14.03.08	2120	EASTERN PAMIR		38.88	72.87	1973	1980	1990	2			
SU		531.14.03.08	2121	EASTERN PAMIR		38.92	72.82	1973	1980	1990	2			
SU		532.14.03.08	2122	EASTERN PAMIR		38.92	72.82	1973	1980	1990	2			
SU		538.14.03.08	2123	EASTERN PAMIR		38.80	72.97	1973	1980	1990	2			
SU		54.14.03.14	2218	EASTERN PAMIR		37.97	72.60	1973	1978	1990	2			
SU		541.14.03.08	2124	EASTERN PAMIR		38.82	72.95	1973	1980	1990	2			
SU		543.14.03.08	2125	EASTERN PAMIR		38.80	72.95	1973	1980	1990	2			
SU		544.14.03.08	2126	EASTERN PAMIR		38.78	72.93	1973	1980	1990	2			
SU		549.14.03.08	2127	EASTERN PAMIR		38.82	72.90	1973	1980	1990	2			
SU		551.14.03.08	2128	EASTERN PAMIR		38.80	72.88	1973	1980	1990	2			
SU		558.14.03.08	2129	EASTERN PAMIR		38.77	72.80	1973	1980	1990	2			
SU		560.14.03.08	2130	EASTERN PAMIR		38.77	72.78	1973	1980	1990	2			
SU		572.14.03.08	2132	EASTERN PAMIR		38.85	72.75	1973	1980	1990	2			
SU		573.14.03.08	2133	EASTERN PAMIR		38.88	72.75	1973	1980	1990	2			
SU		578.14.03.08	2135	EASTERN PAMIR		38.83	72.73	1973	1980	1990	2			
SU		579.14.03.08	2136	EASTERN PAMIR		38.82	72.68	1973	1980	1990	2			
SU		580.14.03.08	2137	EASTERN PAMIR		38.83	72.68	1980	1990	1990	1			
SU		582.14.03.08	2138	EASTERN PAMIR		38.85	72.70	1973	1980	1990	2			
SU		586.14.03.08	2139	EASTERN PAMIR		38.88	72.68	1973	1980	1990	2			
SU		591.14.03.08	2141	EASTERN PAMIR		38.85	72.63	1973	1980	1990	2			
SU		593.14.03.08	2143	EASTERN PAMIR		38.80	72.62	1973	1980	1990	2			
SU		597.14.03.14	2243	EASTERN PAMIR		38.13	73.07	1973	1990	1990	1			
SU		598.14.03.14	2208	EASTERN PAMIR		38.48	73.62	1980	1990	1990	1			
SU		599.14.03.08	2145	EASTERN PAMIR		38.88	72.58	1973	1980	1990	2			
SU		600.14.03.08	2146	EASTERN PAMIR		38.88	72.57	1973	1980	1990	2			
SU		605.14.03.08	2148	EASTERN PAMIR		38.93	72.60	1973	1980	1990	2			
SU		606.14.03.08	2149	EASTERN PAMIR		38.95	72.63	1973	1980	1990	2			
SU		608.14.03.08	2151	EASTERN PAMIR		38.97	72.65	1973	1980	1990	2			
SU		612.14.03.08	2152	EASTERN PAMIR		38.98	72.62	1973	1980	1990	2			
SU		614.14.03.08	2153	EASTERN PAMIR		39.00	72.60	1973	1980	1990	2			
SU		617.14.03.08	2154	EASTERN PAMIR		38.95	72.60	1973	1980	1990	2			
SU		622.14.03.08	2156	EASTERN PAMIR		38.95	72.57	1973	1980	1990	2			
SU		623.14.03.08	2157	EASTERN PAMIR		38.95	72.55	1973	1980	1990	2			
SU		72.14.03.17	2201	EASTERN PAMIR		38.83	73.65	1980	1990	1990	1			
SU		8.14.03.17	2187	EASTERN PAMIR		39.15	73.68	1980	1990	1990	1			

PU	PSFG	NAME	WGMS ID	GENERAL LOCATION	SPECIFIC LOCATION	LATITUDE	LONGITUDE	FV FirstRY	FV FirstSY	FV LastSY	FV NoObs	MB FirstRY	MB LastSY	MB NoObs
SU		83.14.03.14	2219	EASTERN PAMIR		38.08	72.63	1973	1978	1990	2			
SU		87.14.03.14	2220	EASTERN PAMIR		38.08	72.68	1973	1990	1990	1			
SU		89.14.03.14	2221	EASTERN PAMIR		38.08	72.72	1973	1990	1990	1			
SU		93.14.03.14	2222	EASTERN PAMIR		38.02	72.72	1973	1990	1990	1			
SU		93.14.03.17	2209	EASTERN PAMIR		38.45	73.57	1980	1990	1990	1			
SU		96.14.03.17	2210	EASTERN PAMIR		38.45	73.53	1980	1990	1990	1			
SU	3037	ABANO	767	CAUCASUS	MOUNTAIN KAZBEK	42.70	44.53	1860	1959	1990	26			
SU		ABAYA	1098			45.07	80.27	1965	1969	1972	4			
SU	4101	ABRAMOV	732	PAMIR ALAI	ALAI RANGE	39.63	71.60	1954	1967	1997	12	1968	1998	31
SU	4036	AKBAYTAL	709	PAMIR	KARAKUL BASIN	38.45	73.55	1960	1962	1990	8			
SU	5067	AKBULAKULKUN	750	TIEN-SHAN	MAIDANTALSKIY	42.17	70.50	1962	1963	1990	25			
SU	5115	AKSU ZAPADNIY	802	TIEN-SHAN	KJUNGEI ALA-TOO	42.85	77.08	1956	1977	1990	10			
SU	5116	AKSU-VOSTOCHNIY	784	TIEN-SHAN	KJUNGEI ALA-TOO	42.85	77.10	1921	1980	1990	10			
SU	3002	ALIBEKSKIY	699	NORTH CAUCASUS	CUBAN RIVER	43.28	41.53	1965	1966	1995	26			
SU		ALTYNSARINA	1091			44.93	79.45	1953	1972	1972	1			
SU	5104	AYLAMA	736	TYAN SHAN	TERSKEY ALATAU	42.03	80.00	1957	1977	1977	1			
SU		AYSBERGOV	1077			45.25	80.82	1965	1973	1973	1			
SU	5066	AYUTOR-2	751	TIEN-SHAN	UGAMSKIY RIDGE	42.08	70.50	1961	1962	1990	27			
SU	4038	BAKCHIGIR	711	PAMIR	BARTANG YU. AL.	37.62	72.73	1972	1975	1990	3			
SU		BARKRAK PRAVYY	1104			42.14	71.03	1962	1963	1972	10			
SU	5072	BARKRAK SREDNIY	818	TIEN-SHAN	PSKEM	42.08	71.17	1970	1971	1990	18			
SU	4063	BATYRBAI	823	GISSARO-ALAI	GISSARSKIY RID.	39.08	67.58	1961	1962	1990	20			
SU		BELEULI	2104	EASTERN PAMIR		39.08	72.77	1973	1980	1980	1			
SU	3006	BEZENGI	703	NORTH CAUCASUS	TEREK RIVER	43.13	42.97	1888	1965	1998	29			
SU		BEZSONOVA	1092			44.89	79.48	1953	1972	1972	1			
SU	5105	BEZYMYANNYY	737	TYAN SHAN	AKSHIYRAK MASS.	42.03	80.00	1943	1957	1974	2			
SU	3026	BIRDZHALYCHIRAN	756	NORTH CAUCASUS	ELBRUS MOUNTAIN	43.37	42.53	1958	1986	1997	2			
SU	3034	BITYUKTYUBE	764	NORTH CAUCASUS	ELBRUS MOUNTAIN	43.37	42.40	1959	1986	1997	3			
SU		BOLSHOY ABYL-OY	1082	ALTAY	KATUNSKY RANGE	49.80	86.70	1850	1952	1962	2			
SU	3004	BOLSHOY AZAU	701	NORTH CAUCASUS	ELBRUS MOUNTAIN	43.28	42.43	1969	1970	1997	23			
SU	7104	BOLSHOY MAASHEY	792	ALTAY	SEVERO-CHUISKIY	50.12	87.58	1924	1932	1990	15			
SU	5110	BORDU	829	TYAN SHAN	AKSHIYRAK MASS.	42.03	80.00	1932	1955	1974	2			
SU		BUZ-CHUBEK	2200	EASTERN PAMIR		38.83	73.62	1980	1990	1990	1			
SU	3035	CHACHI	765	CAUCASUS	MOUNTAIN KAZBEK	42.70	44.55	1964	1968	1990	8			
SU		CHAKYDZHILGA	2131	EASTERN PAMIR		38.80	72.75	1973	1980	1990	2			
SU		CHALAATI	1110			43.13	42.70	1887	1933	1974	14			
SU	5119	CHONG-TUR PRAVI	799	TIEN-SHAN	TALASS	42.30	73.30	1980	1981	1990	9			
SU	3027	CHUNGURCHATCHIR	757	NORTH CAUCASUS	ELBRUS MOUNTAIN	43.37	42.55	1958	1986	1997	2			
SU	5109	DAVIDOVA	804	TIEN-SHAN	AKSHIYRAK	42.03	80.00	1932	1943	1985	7	1984	1985	2
SU	3036	DEVDORAKI	766	CAUCASUS	MOUNTAIN KAZBEK	42.72	44.53	1960	1961	1990	27			
SU	4047	DIAKHANDARA	713	PAMIR GISSARSKI	SURKH BASIN	38.20	72.84	1964	1965	1978	6			
SU	4013	DIDAL	722	PAMIR	PAMIRO-ALAY	38.20	72.84	1973	1975	1985	10			
SU	3010	DJANKUAT	726	NORTH CAUCASUS	BAKSAN RIVER	43.20	42.77	1887	1967	2005	21	1968	2005	38
SU	5121	DOLONATA	798	TIEN-SHAN	KUNGEI-ALA-TOO	42.83	77.05	1927	1979	1990	10			
SU	4104	DUGOVA	820	TIEN-SHAN	ALAI	42.03	80.00	1972	1982	1984	2			
SU		DUSAKASAY	2147	EASTERN PAMIR		38.90	72.55	1973	1980	1990	2			
SU		DZHAMBULA	1099			43.08	77.23	1967	1968	1972	5			
SU		DZHAYLYAUKUMSAY	2142	EASTERN PAMIR		38.80	72.57	1973	1980	1990	2			
SU	7106	DZHELO	1081	ALTAI	SEVERO-CHUISKIY	50.12	88.30	1936	1952	2005	21			
SU	5117	DZHUUKUCHAK	801	TIEN-SHAN	TERSKEI ALA-TOO	42.00	78.10	1977	1981	1990	4			
SU		FYODOROVICHA	1095			45.03	80.07	1966	1967	1974	8			
SU		GAGARINA	1096			45.07	80.08	1966	1967	1974	8			
SU	3031	GARABASHI	761	NORTH CAUCASUS	ELBRUS MOUNTAIN	43.30	42.47	1959	1987	1997	3	1984	2005	22
SU	4022	GARMO	719	PAMIR	PAMIRO-ALAY	38.20	72.84	1972	1975	1985	11			
SU		GEBLERA (Katunsky)	1083	ALTAY	KATUNSKY RANGE	49.80	86.70	1833	1895	1985	11			
SU	4039	GEOGRAPHICHESKO	717	PAMIRS	VANCH RIVER	38.67	72.22	1962	1963	1989	13			
SU		GERASIMOVA	1100			45.08	80.32	1966	1967	1972	6			
SU	3038	GERGETI	768	CAUCASUS	MOUNTAIN KAZBEK	42.68	44.51	1860	1959	1990	28			
SU		GLACIOLOGA	786			43.12	77.62	1982	1983	1985	3			
SU	5060	GOLUBIN	753	TIEN-SHAN	KIRGHIZIA	42.47	74.50	1975	1976	1990	14	1969	1994	26
SU	8001	GRECHISHKINA	832	KAMCHATKA	SREDNYY KHREBET	58.00	160.65					1979	1979	1
SU		ICHKELSAY	2140	EASTERN PAMIR		38.80	72.65	1973	1980	1990	2			
SU	2001	IGAN	730	POLAZ UZAL	BOLSHAYA KHADAT	67.61	66.03	1958	1966	1981	6	1976	1978	3
SU	5076	IGLI TUYUKSU	816	TIEN-SHAN	M. ALMATINKA	43.00	77.10					1976	1990	15
SU	3029	IRIK	759	NORTH CAUCASUS	ELBRUS MOUNTAIN	43.33	42.50	1958	1983	1997	2			
SU	3028	IRIKCHAT	758	NORTH CAUCASUS	ELBRUS MOUNTAIN	43.33	42.53	1958	1983	1997	2			
SU	5001	KALESNIK	819	TIEN-SHAN	PSKEMSKIY RIDGE	42.17	71.17	1966	1967	1990	20			
SU		KARA-ART	2192	EASTERN PAMIR		38.93	73.82	1973	1980	1990	2			
SU	5080	KARA-BATKAK	813	TIEN-SHAN	TERSKEY-ALA-TOO	42.10	78.30	1971	1972	1998	24	1957	1998	42
SU	5068	KARABULAK	749	TYAN SHAN WEST	SYRDARYA BASIN	42.03	80.00	1960	1968	1985	15			
SU	3022	KARACHAUL	835	NORTH CAUCASUS	ELBRUS MOUNTAIN	43.38	42.45	1957	1986	1997	2			
SU		KAVRAYSKOGO	1078			45.25	80.78	1965	1971	1973	2			
SU	5107	KELDYKE	738	TYAN SHAN	TERSKEY ALATAU	42.03	80.00	1955	1977	1977	1			
SU	5118	KENG-TUR	800	TIEN-SHAN	CHATKAL	41.80	71.50	1978	1981	1989	7			
SU	4021	KHADYRSHA	720	PAMIRS	MUKSU RIVER	38.95	71.80	1977	1978	1990	11			
SU	3003	KHAKEL	700	NORTH CAUCASUS	CUBAN RIVER	43.23	41.85	1965	1966	2000	28	1976	1979	4
SU	3042	KIBISHA	772	CAUCASUS	MOUNTAIN KAZBEK	42.63	44.75	1964	1968	1990	8			
SU	4056	KIRCHIN	742	GISSARO-ALAI	TURKESTANSKIY	39.67	70.75	1964	1965	1990	21			
SU		KIRTISHO	1112			42.50	43.50	1966	1967	1973	7			
SU	4061	KIZILGORUM	825	PAMIR-ALAY	SYRDARYA BASIN	38.20	72.84	1940	1960	1985	16			
SU	4059	KLJUEV	739	GISSARO-ALAI	ALAISKIY RIDGE	39.42	70.75	1936	1960	1990	24			
SU	4057	KOKBELES	741	GISSARO-ALAI	TURKESTANSKIY	39.67	70.75	1964	1965	1990	20			
SU	5103	KOLPAKOVSKOGO	735	TYAN SHAN	TERSKEY ALATAU	42.03	80.00	1957	1974	1977	2			
SU	3015	KORELDASH	783	CAUCASUS	RIONI RIVER	42.97	43.17	1966	1967	1990	16			
SU	7103	KORUMDU	793	ALTAY	SEVERO-CHUISKIY	50.13	87.68	1936	1937	2005	38			
SU	8003	KORYTO	791	KAMCHATKA	KRONOTSKY PENIN	54.68	161.00	1971	1982	2000	6	1982	2000	6
SU		KORZHENEVSKOGO	1105			43.08	77.36	1964	1965	1974	10			
SU	8005	KOZELSKIY	790	KAMCHATKA	AVACHINSKAYA	53.23	158.82	1948	1967	2000	15	1973	1997	25
SU	3009	KOZITSITI	706	NORTH CAUCASUS	ARDON RIVER	42.63	43.72	1974	1975	2000	8			
SU		KRASNOSLOBODTSEV	2183	EASTERN PAMIR		39.35	73.22	1973	1980	1990	2			
SU	8006	KROPOTKINA	789	KAMCHATKA	B.SEMYACHIC	54.32	160.02	1986	2000	2000	1	1985	1985	1
SU		KVISH	1109			46.16	42.49	1964	1968	1973	2			
SU	3033	KYUKYURTLYU	763	NORTH CAUCASUS	ELBRUS MOUNTAIN	43.35	42.38	1959	1983	1997	2			
SU		KYZYLDZHILGA	2207	EASTERN PAMIR		38.48	73.58	1980	1990	1990	1			
SU	4100	KYZYLKUL	731	PAMIR	SURKHOD	38.20	72.84	1975	1976	1980	5			
SU		LEKZIR	1111			43.15	42.76	1887	1933	1973	4			
SU	7102	LEVIY AKTRU	794	ALTAY	SEVERO-CHUISKIY	50.08	87.72	1975	1976	2005	30	1977	2005	29
SU	7107	LEVIY KARAGEMSK	1084	ALTAI	SEVERO-CHUISKIY	50.23	88.17	1850	1938	2005	27			
SU	4037	M. OKTYABRSKIY	710	PAMIR	KARAKUL BASIN	39.18	73.00	1963	1964	1990	7			
SU	7100	MALIY AKTRU	795	ALTAY	SEVERO-CHUISKIY	50.08	87.75	1911	1936	2005	51	1962	2005	44
SU	3032	MALIY AZAU	762	NORTH CAUCASUS	ELBRUS MOUNTAIN	43.28	42.45	1959	1987	1997	3			
SU	7083	MALYY BERELSKIY	830	ALTAY	KATUNSKY RANGE	49.80	86.70	1962	1967	1978	9			
SU	5091	MANSHUK MAMETOV	811	TIEN-SHAN	M. ALMATINKA	43.00	77.10	1958	1962	1970	5	1976	1990	15
SU	3001	MARUKHSKIY	727	NORTH CAUCASUS	CUBAN RIVER	43.36	41.42	1964	1966	2000	31	1967	1977	11
SU	5094	MAYAKOVSKIY	808	TIEN-SHAN	M. ALMATINKA	43.00	77.10					1976	1990	15
SU	4042	MAZARSKIY	746	PAMIRS	OBIHINGOU RIVER	38.62	71.57	1958	1962	1990	19			
SU	4040	MEDVEZHIY	716	PAMIRS	VANCH RIVER	38.58	72.28	1962	1963	1985	12			
SU	2003	MGU	728	POLAZ UZAL	MALAYA SCHUCHIA	67.65	66.00	1953	1960	1981	5			
SU	3025	MIKELCHIRAN	755	NORTH CAUCASUS	ELBRUS MOUNTAIN	43.37	42.50	1958	1986	1997	2			
SU	3043	MIZHIRGICHIRAN	1509	NORTH CAUCASUS	TEREK RIVER	43.05	43.17	1888	1989	1998	6			
SU	3039	MNA	769	CAUCASUS	MOUNTAIN KAZBEK	42.70	44.47	1963	1966	1990	9			
SU	5090	MOLODEZHNIY	812	TIEN-SHAN	ZAILIYSKIY	43.00	77.10	1958	1973	1990	11	1976	1990	15
SU	6002	MURAVLEV	796	DZHUNGARSKIY		45.10	80.23	1966	1982	1991	10	1979	1991	13
SU	3020	MURKAR	776	CAUCASUS	SAMUR RIVER	41.23	47.77	1964	1968	1985	9			
SU	4041	MUSHKETOV	715	PAMIRS	MUKSU RIVER	39.00	72.10	1962	1963	1990	22			
SU	8011	MUTNOVSKIY NE	788	KAMCHATKA	MUTNOVSKY VOLC.	52.46	158.22	1995	1996	2000	5	1980	1984	5
SU	8012	MUTNOVSKIY SW	787	KAMCHATKA	MUTNOVSKY VOLC.	52.45	158.19	1995	1996	1999	4	1980	1984	5
SU		NANKALDY	2150	EASTERN PAMIR		38.95	72.63	1980	1990	1990	1			
SU		NICHKEDZHILGA	2134	EASTERN PAMIR		38.80	72.70	1973	1980	1990	2			
SU	7108	NO. 122 (UNIVERSITET)	1508	ALTAI	SEVERO-CHUISKIY	50.25	88.12	1985	1986	1995	9			
SU	7105	NO. 125 (VODOPADNIY)	780	ALTAY	SEVERO-CHUISKIY	50.10	87.70	1985	1986	2005	20	1977	2005	29
SU	3005	NO. 462V (KULAK NIZHNIY)	702	NORTH CAUCASUS	TEREK RIVER	43.08	42.92	1970	1971	1998	17			
SU	1001	NO.104	707	ARCTICA	SEVERNAYA ZEM.	79.37	95.65	1985	1986	1990	5	1976	1988	6
SU	5081	NO.131	782	TIEN-SHAN	TERSKEY ALA-TOO	41.85	77.77					1988	1991	4
SU	3041	NO.191	771	CAUCASUS	TEREK RIVER	42.55	44.77	1970	1973	1990	4			
SU	4045	NO.314	712	GISSARO-ALAI	ZERAVSHAN RIVER	39.37	70.12	1980	1981	1990	9	1983	1985	3
SU	5106	NO.356	805	TIEN-SHAN	AKSHIYRAK	41.83	78.18	1985	1986	1990	5	1985	1989	5
SU	3016	NO.396	775	CAUCASUS	KURA RIVER	42.58	44.32	1974	1975	1990	10			
SU	4003	NO.503	723	PAMIRS	SURKHOB RIVER	39.02	70.90	1974	1976	1989	11			
SU	4007	NO.507	827	PAMIR	PAMIRO-ALAY	38.20	72.84	1975	1976	1985	7			
SU	4017	NO.517	721	PAMIRS	SURKHOB RIVER	38.97	70.67	1975	1976	1989	12			
SU	4064	NO.675	714	GISSARO-ALAI	ZERAVSHAN RIVER	38.95	68.27	1977	1981	1990	9			
SU	4103	NO.676	821	TIEN-SHAN	GISSARO-ALAY	42.03	80.00	1977	1981	1985	3			
SU		OBRUCHEVA (DZ)	1433			67.63	65.80	1966	1967	1974	8			
SU	2002	OBRUCHEVA (UR)	729	POLAZ UZAL	BOLSHAYA KHADAT	67.63	65.80	1953	1960	1981	8	1976	1977	2
SU	5093	ORDZHONIKIDZE	809	TIEN-SHAN	M. ALMATINKA	43.00	77.10					1976	1990	15
SU	5071	PAKHTAKOR	747	TIEN-SHAN	PSKEMSKIY RIDGE	42.20	70.17	1963	1968	1990	17			
SU	5095	PARTIZAN	807	TIEN-SHAN	M. ALMATINKA	43.00	77.10					1976	1990	15
SU	7101	PRAVIY AKTRU	831	ALTAY	SEVERO-CHUISKIY	50.08	87.73	1936	1939	1980	14	1980	1990	11
SU	7109	PRAVIY KARAGEMSKIY	1085	ALTAI	SEVERO-CHUISKIY	50.17	88.13	1850	1952	2005	20			
SU	4055	RAIGORODSKIY	743	GISSARO-ALAI	TURKESTANSKIY	39.67	70.75	1908	1960	1990	27			
SU	4044	RAMA	744	GISSARO-ALAI	ZERAVSHAN RIVER	39.17	70.45	1963	1964	1990	18			
SU		RODZEVICHA	1086		Altay	49.50	87.00	1850	1897	1986	9			
SU		SAPOZHNIKOVA	1087			44.90	79.45	1850	1897	1986	9			
SU		SEVERNIY DZHAYLYAUKUMSAY	2144	EASTERN PAMIR		38.87	72.55	1973	1980	1990	2			
SU		SEVERNIY ZULUMART	2099	EASTERN PAMIR		39.08	72.80	1973	1980	1990	2			
SU	4062	SEVERTSOV	824	GISSARO-ALAI	GISSARSKIY RID.	39.08	67.67	1961	1962	1990	23			
SU		SHCHUKINA	1101			45.01	80.45	1966	1967	1972	6			
SU	5078	SHOKALSKIY	815	TIEN-SHAN	ZAILIYSKIY	43.00	77.30	1961	1962	1990	23			
SU		SHULTSA	1097			45.07	80.15	1966	1967	1972	6			
SU	6001	SHUMSKIY	797	DZHUNGARSKIY		45.08	80.23	1966	1967	1991	24	1967	1991	25
SU	3008	SKAZKA	705	NORTH CAUCASUS	TEREK RIVER	42.83	43.67	1890	1970	2000	27			
SU	4023	SKOGACH	718	PAMIRS	OBIHINGOU RIVER	38.72	71.50	1973	1975	1990	16			
SU	3040	SUATISI SREDNIY	770	CAUCASUS	MOUNTAIN KAZBEK	42.70	44.42	1882	1965	1990	22			
SU	5082	SUYOK ZAPADNIY	781	TIEN-SHAN	DJETIM-BEL RIDG	41.78	77.78					1971	1991	5
SU	5079	TALGAR YUZHNIY	814	TIEN-SHAN	ZAILIYSKIY	43.10	77.30	1969	1972	1990	15			
SU	3012	TBILISA	724	CAUCASUS	RIONI RIVER	43.13	42.47	1967	1968	1984	4	1968	1980	13
SU	5070	TEKESHSAI-I	748	TIEN-SHAN	MAIDANTALSKIY	42.08	70.67	1962	1963	1990	22			
SU	3030	TERSKOL	760	NORTH CAUCASUS	ELBRUS MOUNTAIN	43.30	42.48	1959	1987	1997	2			
SU	3019	TIKHITSAR	777	CAUCASUS	SAMUR RIVER	41.23	47.78	1959	1968	1985	16			
SU	5002	TOKMAKSOLDY-I	754	TIEN-SHAN	PSKEMSKIY RIDGE	42.17	71.17	1975	1976	1990	13			
SU		TRONOVA	1093			44.89	79.38	1953	1972	1972	1			
SU	5075	TS.TUYUKSUYSKIY	817	TIEN-SHAN	ZAILIYSKIY	43.05	77.08	1902	1908	2005	44	1957	2005	49
SU	3014	TSANERI	774	CAUCASUS	INGURI RIVER	43.08	43.00	1887	1933	1990	9			
SU	3007	TSEYA	704	NORTH CAUCASUS	TEREK RIVER	42.92	43.67	1890	1965	2000	32			
SU	4060	TURAMUZ-I	826	GISSARO-ALAI	ALAISKIY RIDGE	39.42	70.83	1968	1969	1990	14			
SU	4046	TURO	785	GISSARO-ALAI	ZERAVSHAN RIVER	39.53	70.13	1980	1981	1990	9			
SU	5065	TURPAKBEL NIZHN	752	TIEN-SHAN	UGAMSKIY RIDGE	42.08	70.50	1961	1963	1990	24			
SU	4058	TUTEK	740	GISSARO-ALAI	ALAISKIY RIDGE	39.42	70.75	1961	1963	1990	20			
SU	3021	ULLUCHIRAN	836	NORTH CAUCASUS	ELBRUS MOUNTAIN	43.38	42.43	1957	1986	1997	2			

PU	PSFG	NAME	WGMS ID	GENERAL LOCATION	SPECIFIC LOCATION	LATITUDE	LONGITUDE	FV FirstRY	FV FirstSY	FV LastSY	FV NoObs	MB FirstRY	MB LastSY	MB NoObs
SU		ULLUKAM	2098	NORTH CAUCASUS	ELBRUS MOUNTAIN	43.32	42.40	1959	1997	1997	1			
SU	3023	ULLUKOL	834	NORTH CAUCASUS	ELBRUS MOUNTAIN	43.38	42.47	1957	1986	1997	2			
SU	3024	ULLUMALIENDERKU	833	NORTH CAUCASUS	ELBRUS MOUNTAIN	43.38	42.48	1957	1986	1997	2			
SU		URTA-BAKCHIGIR 1	2252	EASTERN PAMIR		37.67	72.72	1973	1990	1990	1			
SU		URTA-BAKCHIGIR 2	2251	EASTERN PAMIR		37.67	72.73	1973	1978	1990	2			
SU	3013	USHBA	773	CAUCASUS	INGURI RIVER	43.13	42.65	1887	1933	1990	9			
SU	5096	VISYACHIY-1-2	806	TIEN-SHAN	M. ALMATINKA	43.00	77.10					1976	1990	15
SU		VOLODARSKIY 1	2165	EASTERN PAMIR		39.03	72.88	1973	1980	1990	2			
SU		VOLODARSKIY 2	2166	EASTERN PAMIR		39.05	72.85	1973	1980	1990	2			
SU		VOLODARSKIY 3	2167	EASTERN PAMIR		39.05	72.90	1973	1980	1990	2			
SU	3018	YUGO-VOSTOCHNIY	778	CAUCASUS	SULAK RIVER	42.35	46.27	1959	1960	2000	31			
SU	3011	YUNOM	725	NORTH CAUCASUS	ADYRSU VALLEY	43.23	42.87					1977	1977	1
SU	3017	YUZHNIY	779	CAUCASUS	SULAK RIVER	42.35	46.25	1959	1960	2000	31			
SU		YUZHNIY KARAYKASHAN	2155	EASTERN PAMIR		38.92	72.55	1973	1980	1990	2			
SU		ZAPADNIY OKTYABRSKIY	2181	EASTERN PAMIR		39.22	72.97	1973	1980	1990	2			
SU	4043	ZERAVSHANSKIY	745	GISSARO-ALAI	ZERAVSHAN RIVER	39.52	70.67	1880	1975	1990	14			
SU		ZORTASHKOL	2202	EASTERN PAMIR		38.45	73.50	1980	1990	1990	1			
SU	5092	ZOYA KOSMODEMYA	810	TIEN-SHAN	M. ALMATINKA	43.00	77.10					1976	1990	15
SU		ZULUMART	2100	EASTERN PAMIR		39.13	72.78	1973	1980	1990	2			
UG	1	SPEKE	1088			0.40	29.88	1958	1974	1974	1			
US	1123	AHTNA	112	WRANGELL MTNS	MT WRANGELL	62.12	-143.87	1957	1977	1980	3			
US	2137	ANDERSON	216	WASHINGTON	OLYMPIC MTNS	47.72	-123.33	1909	1927	1970	8			
US	7011	ANDREWS	1341			40.28	-104.98	1969	1970	1970	1			
US	406	APPLEGATE	92	KENAI MTNS	KINGS BAY	60.47	-148.60	1966	1974	1974	1			
US	7000	ARAPAHO	1354			40.05	-105.03	1969	1970	1970	1			
US	7002	ARIKAREE	1356			40.05	-105.03	1969	1970	1970	1			
US	607	BAKER	102	CHUGACH MTNS	HARRIMAN FIORD	61.08	-148.35	1966	1971	1974	2			
US	1337	BALDWIN	1359			58.93	-136.28	1964	1968	1974	2			
US	615	BARNARD	165	CHUGACH MTNS	COLLEGE FIORD	61.17	-147.92	1966	1974	1985	3			
US	612	BARRY	168	CHUGACH MTNS	BARRY ARM	61.17	-148.10	1898	1899	1985	7			
US	413	BARTLETT	1390			60.62	-147.70	1966	1974	1974	1			
US	2122	BEAR PASS	189	WASHINGTON	OLYMPIC MTNS	47.80	-123.60	1933	1939	1965	4			
US	418	BELOIT	97	KENAI MTNS	BLACKSTONE BAY	60.63	-148.68	1966	1974	1976	2			
US	1120	BETSELI	109	WRANGELL MTNS	MT SANFORD	62.17	-144.03	1957	1977	1980	4			
US	2127	BLACK	211	WASHINGTON	OLYMPIC MTNS	47.82	-123.72	1924	1933	1977	5			
US	419	BLACKSTONE	98	KENAI MTNS	BLACKSTONE BAY	60.65	-148.72	1966	1974	1976	2			
US	2126	BLUE GLACIER	210	WASHINGTON	OLYMPIC MTS.	47.82	-123.68	1938	1939	1995	44	1956	1999	44
US	2005	BOULDER	1364			48.77	-120.88	1964	1965	2003	6			
US	626	BRILLIANT	157	CHUGACH MTS.	UNAKWIK INLET	61.12	-147.45	1984	1985	1985	1			
US	618	BRYN MAWR	162	CHUGACH MTNS	COLLEGE FIORD	61.23	-147.82	1905	1910	1981	4			
US	320	CANTWELL	1669	ALASKA RANGE	CHULITNA -SUSI.	63.43	-149.38	1950	1993	1993	1			
US	2020	CARBON	204	M CASCADE MTNS	MT RAINIER	46.93	-121.78	1931	1932	1990	7			
US	2106	CARRIE	187	WASHINGTON	OLYMPIC MTNS	47.88	-123.63	1889	1933	1965	3			
US	611	CASCADE	169	CHUGACH MTNS	BARRY ARM	61.15	-148.18	1966	1974	1985	2			
US	604	CATARACT	100	CHUGACH MTNS	HARRIMAN FIORD	60.03	-148.42	1966	1974	1974	1			
US	1313A	CHARPENTIER	144	ST.ELIAS MTS.	GLACIER BAY	58.67	-136.58	1879	1892	1985	5			
US	402	CHENEGA	180	KENAI MTS.	ICY BAY	60.28	-148.48	1984	1985	1985	1			
US	1124	CHETASLINA	113	WRANGELL MTNS	MT WRANELL	61.95	-144.28	1977	1978	1979	2			
US	634	CHILDS	152	CHUGACH MTNS	COPPER RIVER	60.68	-144.92	1968	1974	1985	2			
US	409	CLAREMONT NORTH	176	KENAI MTNS	KINGS BAY	60.53	-148.68	1966	1974	1985	3			
US	408	CLAREMONT WEST	177	KENAI MTNS	KINGS BAY	60.52	-148.70	1966	1974	1985	3			
US	1322	CLARK US	116	ST ELIAS MTNS	GLACIER BAY	58.80	-137.12	1968	1974	1980	2			
US	2011	COLEMAN	1369			48.80	-120.82	1949	1953	1968	5			
US	2057	COLUMBIA (2057)	76	NORTH CASCADE		47.97	-121.35	1985	1986	2005	10	1984	2005	22
US	627	COLUMBIA (627)	156	CHUGACH MTNS	P.WILLIAM SOUND	61.00	-147.10	1892	1899	2000	31	1978	1978	1
US	404	CONTACT	178	KENAI MTS.	KINGS BAY	60.45	-148.42	1984	1985	1985	1			
US	2025	COWLITZ	202	M CASCADE MTNS	MT RAINIER	46.82	-121.70	1966	1967	1990	5			
US	613	COXE	167	CHUGACH MTNS	BARRY ARM	61.13	-148.08	1966	1974	1985	3			
US	2052	DANIELS	83	NORTH CASCADES		47.57	-121.17	1985	1986	2005	6	1984	2005	22
US	2009	DEMING	1368			48.75	-120.82	1962	1965	2005	5			
US	606	DETACHED	101	CHUGACH MTNS	HARRIMAN FIORD	61.07	-148.40	1966	1971	1976	3			
US	207	EAST FORK	182	ALASKA RANGE	SUSITNA RIVER	63.43	-146.78					1982	1983	2
US	1808	EAST TWIN	1361			58.58	-132.78	1968	1974	1974	1			
US	2008	EASTON	1367			48.75	-120.83	1967	1970	2005	7	1990	2005	16
US	2113	EEL	188	WASHINGTON	OLYMPIC MTNS	47.73	-123.33	1920	1939	1976	8			
US	391	EKLUTNA	85	SOUTH ALASKA	CHUGACH MNTS.	61.25	-148.97	1986	1986	1988	3	1986	1988	3
US	2022	EMMONS	203	WASHINGTON CASCADES	MT RAINIER	46.85	-121.72	1931	1932	1985	8	2003	2003	1
US	390	EXIT GLACIER	86	SOUTHERN ALASKA	KENAI MOUNTAINS	60.18	-149.65	1988	1989	1990	2			
US	7012	FAIR	1342			40.07	-105.02	1969	1970	1970	1			
US	405	FALLING	91	KENAI MTNS	KINGS BAY	60.48	-148.53	1966	1974	1974	1			
US	1309A	FINGER	145	ST.ELIAS MTS.	FAIRWEATHER RNG	58.48	-137.12	1984	1985	1985	1			
US	2053	FOSS	84	NORTH CASCADES		47.55	-121.20	2000	2005	2005	1	1984	2005	22
US	1314	GEIKIE	143	ST ELIAS MTNS	GLACIER BAY	58.60	-136.62	1879	1892	1985	8			
US	1321	GILMAN	138	ST ELIAS MTNS	GLACIER BAY	58.82	-137.07	1967	1974	1985	3			
US	1330	GRAND PACIFIC	132	ST ELIAS MTNS	GLACIER BAY	59.17	-137.17	1879	1892	1985	7			
US	5000	GRINNELL	217	ROCKY MTNS	GLACIER NAT PK	48.75	-113.73	1925	1926	1969	8			
US	200	GULKANA	90	ALASKA RANGE	DELTA BASIN	63.25	-145.42	1968	1969	1975	7	1966	2005	40
US	602	HARRIMAN	172	CHUGACH MTNS	HARRIMAN FIORD	60.95	-148.50	1925	1931	1985	5			
US	621	HARVARD	160	CHUGACH MTNS	COLLEGE FIORD	61.35	-145.58	1905	1909	1985	6			
US	7001	HENDERSON	1355			40.05	-105.03	1969	1970	1970	1			
US	2124	HOH	191	WASHINGTON	OLYMPIC MTNS	47.80	-123.67	1933	1939	1977	9			
US	1806	HOLE IN TH.WALL	125	COAST MTNS	TAKU RIVER	58.47	-134.03	1968	1974	1980	2			
US	614	HOLYOKE	166	CHUGACH MTNS	COLLEGE FIORD	61.17	-147.97	1966	1974	1985	3			
US	1320	HOONAH	139	ST ELIAS MTNS	GLACIER BAY	58.83	-137.05	1968	1971	1985	4			
US	4001	HOTLUM GLACIER	194	CASCADE RANGE	MOUNT SHASTA	41.42	-122.18	1920	1935	1944	2			
US	2130	HUBERT	213	WASHINGTON	OLYMPIC MTNS	47.78	-123.70	1924	1933	1977	6			
US	1315	HUGH MILLER	142	ST ELIAS MTNS	GLACIER BAY	58.73	-136.68	1879	1892	1985	8			
US	2132	HUMES	214	WASHINGTON	OLYMPIC MTNS	47.78	-123.65	1907	1913	1977	12			
US	2125	ICE RIVER	209	WASHINGTON	OLYMPIC MTNS	47.82	-123.67	1924	1933	1976	6			
US	2054	ICE WORM	82	NORTH CASCADES		47.55	-121.17	2000	2005	2005	1	1984	2005	22
US	7004	ISABELLE	1358			40.07	-105.02	1969	1970	1970	1			
US	1323	JOHNS HOPKINS	137	ST ELIAS MTNS	GLACIER BAY	58.80	-137.17	1879	1892	1985	10			
US	1325	KADACHAN	117	ST ELIAS MTNS	GLACIER BAY	58.88	-137.10	1968	1974	1980	2			
US	1319	KASHOTO	140	ST ELIAS MTNS	GLACIER BAY	58.95	-137.02	1968	1971	1985	4			
US	2028	KAUTZ	200	M CASCADE MTNS	MT RAINIER	46.82	-121.78	1966	1967	1985	3			
US	1317	LAMPLUGH	114	ST ELIAS MTNS	GLACIER BAY	58.83	-136.90	1879	1892	1980	5			
US	1308	LAPEROUSE	146	ST.ELIAS MTS.	FAIRWEATHER RNG	58.52	-137.23	1980	1985	1985	1			
US	416	LAWRENCE	95	KENAI MTNS	BLACKSTONE BAY	60.67	-148.62	1966	1974	1974	1			
US	600	LEARNARD	173	CHUGACH MTS.	PASSAGE CANAL	60.80	-148.72	1984	1985	1985	1			
US	1900	LECONTE	206	COAST MOUNTAINS		56.82	-132.37	1983	1985	1985	1			
US		LEMON CREEK	3334	COAST RANGE	JUNEAU ICEFIELD	58.38	-134.40					1953	2005	53
US	1305A	LITUYA	149	ST.ELIAS MTS.	FAIRWEATHER RNG	58.80	-137.52	1984	1985	1985	1			
US	2055	LOWER CURTIS	77	NORTH CASCADES		48.83	-121.62	1985	1986	2005	8	1984	2005	22
US	2056	LYNCH	81	NORTH CASCADES		47.57	-121.18	2000	2005	2005	1	1984	2005	22
US	208	MACLAREN	181	ALASKA RANGE	SUSITNA RIVER	63.35	-146.53					1981	1983	3
US	1328	MARGERIE	133	ST ELIAS MTNS	GLACIER BAY	59.00	-137.17	1966	1974	1985	3			
US	417	MARQUETTE	96	KENAI MTNS	BLACKSTONE BAY	60.65	-148.65	1966	1974	1976	2			
US	2002	MAZAMA	1362			48.80	-120.87	1967	1970	1974	2			
US	1342	MCBRIDE	208	ST ELIAS MTNS	GLACIER BAY	59.08	-136.07	1967	1974	1985	3			
US	1	MCCALL	1388	NE BROOKS RANGE	DEMARC.PT B5	69.28	-143.83	1968	1969	2000	10	1993	2000	8
US	625	MEARES	158	CHUGACH MTNS	UNAKWIK INLET	61.18	-147.47	1898	1905	1985	5			
US	1802	MENDENHALL	122	COAST MTNS	STEPHENS PASS.	58.48	-134.53	1968	1974	1980	2			
US	315	MIDDLE TOKLAT	1668	ALASKA RANGE	YUKON-TANANA	63.38	-149.92	1954	1992	1992	1			
US	1340	MUIR	129	ST ELIAS MTNS	GLACIER BAY	59.10	-136.38	1879	1892	1985	13			
US	1121	N MAC KEITH	110	WRANGELL MTNS	MT WRANGELL	62.13	-144.00	1957	1977	1980	4			
US	7003	NAVAJO	1357			40.05	-105.02	1969	1970	1970	1			
US	403	NELLIE JUAN	179	KENAI MTS.	PORT NELLIE JUA	60.45	-148.40	1964	1966	1985	4			
US	2027	NISQUALLY	201	WASHINGTON CASCADES	MT RAINIER	46.82	-121.74	1857	1885	1990	53	2003	2003	1
US	2078	NOISY CREEK	1666	WASHINGTON	NORTH CASCADES	48.67	-121.53					1993	2005	7
US	1804	NORRIS	123	COAST MTNS	TAKU INLET	58.45	-134.18	1941	1950	1980	3			
US	1306A	NORTH CRILLON	148	ST.ELIAS MTS.	FAIRWEATHER RNG	58.63	-137.38	1984	1985	1985	1			
US	2016	NORTH GUARDIAN	1352			48.13	-121.58	1965	1966	1968	3			
US	2076	NORTH KLAWATTI	1664	WASHINGTON	NORTH CASCADES	48.57	-121.12					1993	2005	7
US	2033	NORTH MOWICH	195	M CASCADE MTNS	MT RAINIER	46.88	-121.82	1980	1982	1984	2			
US	2004	PARK	1363			48.78	-120.90	1964	1965	1975	6			
US	608	PENNIMAN EAST	103	CHUGACH MTNS	HARRIMAN FIORD	61.10	-148.33	1966	1974	1976	2			
US	609	PENNIMAN WEST	104	CHUGACH MTNS	HARRIMAN FIORD	61.08	-148.35	1966	1974	1976	2			
US	1338	PLATEAU	121	ST ELIAS MTNS	GLACIER BAY	58.98	-136.38	1879	1892	1974	9			
US	525	PORTAGE	174	KENAI MTS.	TURNAGAIN ARM	60.75	-148.80	1965	1966	1985	4			
US	2031	PUYALLUP	197	M CASCADE MTNS	MT RAINIER	46.85	-121.83	1967	1974	1984	2			
US	2133	QUEETS	215	WASHINGTON	OLYMPIC MTNS	47.77	-123.60	1913	1916	1976	15			
US	2003	RAINBOW	79	NORTH CASCADES	MT. BAKER	48.80	-121.77	1967	1970	2005	11	1984	2005	22
US	1316	REID	141	ST ELIAS MTNS	GLACIER BAY	58.80	-136.80	1879	1892	1985	6			
US	1333	RENDU	130	ST ELIAS MTNS	GLACIER BAY	59.07	-136.82	1929	1931	1985	7			
US	1341	RIGGS	128	ST ELIAS MTNS	GLACIER BAY	59.10	-136.17	1964	1968	1985	4			
US	603	ROARING	99	CHUGACH MTNS	HARRIMAN FIORD	61.00	-148.45	1966	1974	1976	2			
US	1332	ROMER	131	ST ELIAS MTNS	GLACIER BAY	58.98	-136.73	1968	1974	1985	3			
US	2012	ROOSEVELT	1349			48.80	-120.82	1964	1965	1968	4			
US	1122	S MAC KEITH	111	WRANGELL MTNS	MT WRANGELL	62.10	-143.97	1957	1977	1980	2			
US	2079	SANDALEE	1667	WASHINGTON	NORTH CASCADES	48.42	-120.80					1995	2005	5
US	1351	SCIDMORE	207	ST ELIAS MTNS	GLACIER BAY	58.80	-136.72	1984	1985	1985	1			
US	610	SERPENTINE	170	CHUGACH MTNS	HARRIMAN FIORD	61.12	-148.28	1905	1909	1985	4			
US	635	SHERIDAN	151	CHUGACH MTNS	GLACIER RIVER	60.60	-145.25	1968	1974	1985	3			
US	636	SHERMAN	107	CHUGACH MTNS	GLACIER RIVER	60.55	-145.15	1964	1965	1968	4			
US	2075A	SHOESTRING A	185	CASCADE RANGE	MT ST HELENS	46.20	-122.18	1960	1975	1975	1			
US	2075B	SHOESTRING B	186	CASCADE RANGE	MT ST HELENS	46.20	-122.18	1975	1979	1979	1			
US		SHOLES	3295	NORTH CASCADES	Mt. Baker	48.80	-121.78					1990	2005	16
US	628	SHOUP	155	CHUGACH MTNS	PORT VALDEZ	61.20	-146.53	1980	1985	1985	1			
US	2077	SILVER	1665	WASHINGTON	NORTH CASCADES	48.98	-121.25					1993	2005	7
US	619	SMITH	161	CHUGACH MTNS	COLLEGE FIORD	61.27	-147.78	1899	1909	1985	4			
US	2013	SOUTH CASCADE	205	N CASCADE MTNS	S FORK CASCADE	48.37	-121.05	1964	1965	2000	35	1953	2005	52
US	1307A	SOUTH CRILLON	147	ST.ELIAS MTS.	FAIRWEATHER RNG	58.62	-137.37	1984	1985	1985	1			
US	2032	SOUTH MOWICH	196	M CASCADE MTNS	MT RAINIER	46.87	-121.83	1981	1985	1985	1			
US	0414B	SPENCER	1391			60.67	-147.72	1966	1974	1974	1			
US	5001	SPERRY	218	ROCKY MTNS	GLACIER NAT PK	48.63	-113.75	1938	1948	1973	7			
US	2007	SQUAK	1366			48.75	-120.87	1970	1974	1974	1			
US	7005	ST VRAIN NO 1	1335			40.15	-105.03	1969	1970	1970	1			
US	7006	ST VRAIN NO 2	1336			42.15	-105.03	1969	1970	1970	1			
US	7007	ST VRAIN NO 3	1337			42.15	-105.02	1969	1970	1970	1			
US	7008	ST VRAIN NO 4	1338			42.17	-105.02	1969	1970	1970	1			
US	7009	ST VRAIN NO 5	1339			40.17	-105.00	1969	1970	1970	1			
US	7010	ST VRAIN NO 6	1340			40.17	-105.00	1969	1970	1970	1			
US	605	SURPRISE	171	CHUGACH MTNS	HARRIMAN FIORD	61.03	-148.48	1899	1900	1985	5			
US	206	SUSITNA	183	ALASKA RANGE	MT.HAYES	63.52	-146.95					1981	1983	3
US	2029B	TAHOMA NORTH SL	1430	M CASCADE MTNS	MT RAINIER	46.82	-121.82	1967	1973	1975	2			
US	2030	TAHOMA NORTH-L.	198	M CASCADE MTNS	MT RAINIER	46.83	-121.82	1980	1985	1990	2			
US	2029A	TAHOMA SOUTH-L.	199	M CASCADE MTNS	MT RAINIER	46.82	-121.82	1964	1966	1990	9			
US	1805	TAKU	124	COAST MTNS	TAKU INLET	58.55	-134.13	1965	1968	1980	3			
US	2006A	TALUM	1365			48.75	-120.87	1970	1974	1974	1			
US	2006B	TALUM-L LOBE	1431			48.75	-120.87	1970	1974	1974	1			

PU	PSFG	NAME	WGMS ID	GENERAL LOCATION	SPECIFIC LOCATION	LATITUDE	LONGITUDE	FV FirstRY	FV FirstSY	FV LastSY	FV NoObs	MB FirstRY	MB LastSY	MB NoObs
US	410	TAYLOR US	93	KENAI MTNS	KINGS BAY	60.57	-148.63	1964	1966	1974	2			
US	0414A	TEBENKOF	175	KENAI MTS.	BLACKSTONE BAY	60.72	-148.48	1984	1985	1985	1			
US	1327	TOPEKA	134	ST ELIAS MTNS	GLACIER BAY	58.93	-137.08	1968	1974	1985	3			
US	1326	TOYATTE	135	ST ELIAS MTNS	GLACIER BAY	58.90	-137.10	1968	1971	1985	6			
US	412	TRAIL	1389			60.55	-147.75	1957	1966	1974	2			
US	1324	TYEEN	136	ST ELIAS MTNS	GLACIER BAY	58.87	-137.15	1968	1971	1985	3			
US	623	UNNAMED US0623	1387			61.20	-147.03	1966	1971	1974	2			
US	1318	UNNAMED US1318	115	ST ELIAS MTNS	GLACIER BAY	58.88	-137.00	1968	1974	1974	1			
US	1329	UNNAMED US1329	118	ST ELIAS MTNS	GLACIER BAY	59.05	-137.12	1966	1974	1980	2			
US	1331	UNNAMED US1331	119	ST ELIAS MTNS	GLACIER BAY	59.05	-136.88	1968	1974	1980	2			
US	1334	UNNAMED US1334	120	ST ELIAS MTNS	GLACIER BAY	59.07	-136.73	1968	1974	1980	3			
US	2123	UNNAMED US2123	190	WASHINGTON	OLYMPIC MTNS	47.80	-123.62	1933	1939	1965	4			
US	624	UNNAMED US624	106	CHUGACH MTNS	COLLEGE FIORD	61.20	-147.65	1966	1971	1976	3			
US	629	VALDEZ	154	CHUGACH MTNS	PORT VALDEZ	61.25	-146.17	1910	1914	1985	4			
US	617	VASSAR	163	CHUGACH MTNS	COLLEGE FIORD	61.22	-147.87	1905	1910	1985	3			
US	2051	WATSON	89	NORTH CASCADES		48.65	-121.57	1998	2003	2003	1	1988	1990	3
US	616	WELLESLEY	164	CHUGACH MTNS	COLLEGE FIORD	61.20	-147.92	1966	1974	1985	2			
US	205	WEST FORK	184	ALASKA RANGE	SUSITNA BASIN	63.52	-147.38					1981	1983	3
US	195	WEST GULKANA	78	ALASKA RANGE	ISABEL PASS	68.27	-145.47	1985	1986	1987	2			
US	1807	WEST TWIN	126	COAST MTNS	TAKU RIVER	58.58	-133.97	1968	1974	1974	1			
US	2128	WHITE%	212	WASHINGTON	OLYMPIC MTNS	47.80	-123.73	1815	1924	1977	11			
US	4009	WHITNEY GLACIER	192	CASCADE RANGE	MOUNT SHASTA	41.42	-122.22	1944	1951	1984	4			
US	4004	WINTUN GLACIER	193	CASCADE RANGE	MOUNT SHASTA	41.40	-122.17	1883	1934	1944	2			
US	411	WOLVERINE	94	KENAI MTNS	NELLIE JUAN	60.40	-148.92	1968	1969	1975	7	1966	2004	39
US	630	WORTHINGTON	153	CHUGACH MTNS	TSINA RIVER	61.17	-145.77	1964	1966	1985	3			
US	1809	WRIGHT	127	COAST MTNS	TAKU RIVER	58.47	-133.50	1964	1967	1980	7			
US	622	YALE	159	CHUGACH MTNS	COLLEGE FIORD	61.27	-147.52	1899	1910	1985	7			
US	2050	YAWNING	75	NORTH CASCADES		48.45	-121.03	2000	2005	2005	1	1984	2005	22