

# GLACIERS AND ICE CAPS

by Michael Zemp, Wilfried Haeberli, Martin Hoelzle and Frank Paul



**Glaciers are among the most fascinating elements of nature. Due to their proximity to melting conditions, glaciers react strongly to climatic changes and thus offer information on essential variables required for global climate monitoring. Striking glacier shrinking has been reported since the end of the Little Ice Age around the world, and potential future vanishing might severely affect sea-level rise, fresh water resources and human activities.**

## GLACIER MONITORING

Worldwide collection of information about glacier changes was initiated in 1894, with the foundation of the International Glacier Commission at the 6th International Geological Congress in Zurich, Switzerland. Since 1986, the World Glacier Monitoring Service (WGMS), based in Zurich, has been continuing to collect and publish standardized information on ongoing glacier changes. The WGMS is a service of the International Association for the Cryospheric Sciences of the International Union of Geodesy and Geophysics (IACS/IUGG) and maintains a network of local investigators and national correspondents in all the countries involved in glacier monitoring. In close collaboration with the National Snow and Ice Data Center (NSIDC) and the Global Land Ice Measurements from Space (GLIMS) initiative, the WGMS is in charge of the Global Terrestrial Network for Glaciers (GTN-G). The three organizations are jointly responsible for the development and implementation of the international observation strategy for glaciers and ice caps, and provide standards for the monitoring of glacier fluctuations and for the compilation of glacier inventories.

## AVAILABLE OBSERVATIONS

The WGMS hosts an unprecedented dataset of information about spatial glacier distribution and changes over time, which is readily available to the scientific community and the public. At present, the database contains about 34 000 front variation and 3 000 annual mass balance observations for 1 725 and 200 glaciers, respectively.

The World Glacier Inventory makes available information on location, classification, area, length, orientation and altitude range for over 71 000 glaciers from around the 1970s (mainly derived from aerial photographs and maps). This corresponds to about 44% of the total number and 23% of the total estimated area of all glaciers and ice caps worldwide.

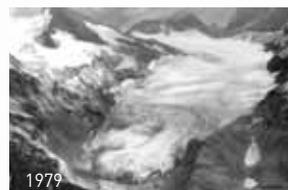
The GLIMS initiative was designed to continue this inventorying task with space-borne sensors, in close cooperation with NSIDC and WGMS. New projects, such as the International Polar Year (IPY) and the GlobGlacier data user element, by the European Space Agency, aim at making a major contribution to the current WGMS and GLIMS databases.



1928



1966



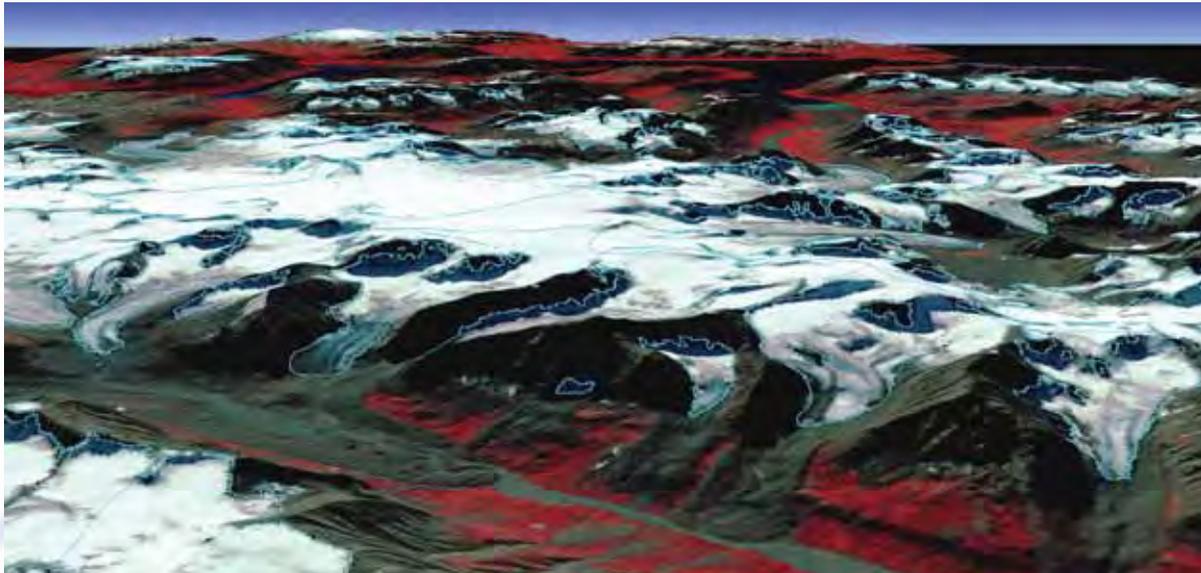
1979



2003

Retreat of South Cascade Glacier, USA. Photographs from the US Forest Service (1928) and the US Geological Survey (1966, 1979, 2003)

## Long-term financial commitment is essential to continue worldwide glacier monitoring



Abundant valley and cirque type glaciers on Disko Island, Greenland. Many of them show pronounced trimlines, indicating their former Little Ice Age extent. The perspective view is created from a Landsat ETM+ scene (bands 4, 3, 2 as RGB) from August 2001 (obtained from the GLCF, Maryland, USA) that is draped over a DEM (provided by GEUS, Copenhagen, DK) and superimposed with glacier outlines from 2001

### RAPID ICE LOSS

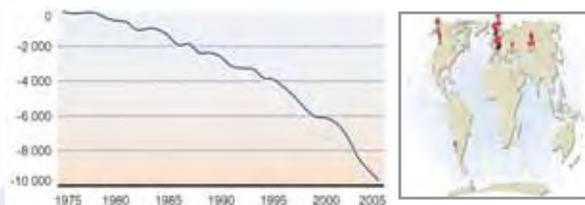
Since the end of the Little Ice Age, glaciers around the globe have been shrinking significantly, with increasing rates of ice loss since the mid-1980s. On a time-scale of decades, glaciers in various mountain ranges have shown intermittent re-advances. However, under current IPCC climate scenarios, the ongoing trend of worldwide and fast, 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 by the end of the 21st century.

### RECENT ACTIVITIES

- Compilation of glacier fluctuation data for the period 2000–2005.
- Call for preliminary mass balance data for the year 2006.
- Development of new mass balance measurement programmes in Colombia, India and New Zealand.
- New remote sensing-based glacier inventories for parts of Baffin Island, Greenland and Norway.
- International workshop on glacier mass balance measurements and modelling, 26–28 March 2008, in Norway.

### FUNDING SITUATION

For many years, the WGMS has been the principal mechanism for assembling and reporting glacier fluctuation data at the global level and in a standardized manner. However, its continuing operation is threatened by the absence of a long-term financial commitment to support this essential activity. At present, the WGMS is run by a total of 150% staff positions funded by the Department of Geography of the University of Zurich (25%) and by a bridging credit of the Swiss National Science Foundation (125%, until March 2009). A secure financial basis of about US\$250 000 per year, i.e. an additional funding of US\$1 million for the period 2008–2012, is needed by the WGMS to guarantee the continuation of the operational business, to maintain the international network and to face the challenges of the 21st century—challenges that most probably are going to be of historic dimensions, both in nature and in science.



Mass balance: Cumulative mass balance of 30 reference glaciers from GTN-G network with continuous mass balance series from 1976–2005. Data provided by the WGMS

### RELATED LINKS:

**WGMS:** [www.wgms.ch](http://www.wgms.ch) | **NSIDC:** [www.nsidc.org](http://www.nsidc.org) | **GLIMS:** [www.glims.org](http://www.glims.org) | **IACS/IUGG:** [www.cryosphericsscience.org](http://www.cryosphericsscience.org)  
**ESA project GlobGlacier:** <http://dup.esrin.esa.int/projects/summary98.asp> | **WGMS and the IPY:** [www.wgms.ch/ipy.html](http://www.wgms.ch/ipy.html)  
**Workshop on glacier mass balance 2008:** [www.nve.no/mbworkshop](http://www.nve.no/mbworkshop)