

# WGMS Summer School on Glacier Mass Balance Measurements and Analysis

2-7 September 2013

## *Executive Summary*

Glacier changes are recognized as key indicators of climatic changes and make an important contribution to the local hazard situation, the regional water cycle, and the global sea level rise. Internationally coordinated efforts in glacier monitoring for more than a century have resulted in an unprecedented database on global glacier distribution and glacier changes in length, area, volume, and mass. However, the available observation series – especially long-term programmes – are strongly biased to the Northern Hemisphere and Europe. Among the regions with limited glacier observations, the Andes and Central Asia are probably the most vulnerable to secondary impacts related to glacier changes. Here the glaciers make a major contribution to water availability during dry seasons and the glacier-related hazards, such as glacier lake outburst floods, and endanger the local societies and their infrastructure. Strengthening both the glaciological expertise and the regional exchange between observers is essential in order to improve the availability and quality of glacier mass balance observations from these regions.

In 2013, the World Glacier Monitoring Service (<http://www.wgms.ch>) organized a **Summer School on Mass Balance Measurements and Analysis** in Switzerland. The summer school was carried out within the framework of the project “Capacity Building and Twinning for Climate Observing Systems” (CATCOS), which is led by MeteoSwiss and funded by the Swiss Agency for Development and Cooperation (SDC). The summer school was co-sponsored by the Global Climate Observing System (GCOS), the Global Cryosphere Watch of the World Meteorological Organization (GCW/WMO), and the International Association of Cryospheric Sciences of the International Union of Geodesy and Geophysics (IACS/IUGG). The course was dedicated to participants from the Andes and from Asia who are involved in ongoing mass balance measurements in their regions. Based on an announcement on CRYOLIST (<http://cryolist.org/>) and within the WGMS network of National Correspondents and Principal Investigators, more than 80 valid applications have been received. From these a total of 15 training positions were offered to a maximum of two candidates from countries in the two regions of focus (Andes: AR, BO, CL, CO, EC, PE; Asia: CN, IN, KG, KZ, MN, NP).

The summer school was held at Hotel Riffelberg, situated above Zermatt at an altitude of 2548 m asl, from 2-7 September. The course consisted of presentations and practicals in both office and field work. The first day of the course started with a series of lectures about the international context of glacier mass balance monitoring, theoretical background, and examples on how to get from point measurements to glacier-wide balance estimates. This theoretical background was deepened in two afternoons with office exercises using data from nearby Findelengletscher. The second and third days were dedicated to field work exercises and safety training in the ablation area of Findelengletscher (2600-3200 m asl) and in the accumulation area of Theodulgletscher (3200-4100 m asl). The fourth day was held in the seminar room again with outlooks on uncertainty assessment and reanalysing of mass balance measurement series and on the use of computer modelling and snowline monitoring from terrestrial and space borne surveys for mass balance analysis. Discussions after each talk and during the field and office practicals allowed putting the international concepts into regional context and clarifying technical details.

In conclusion, this summer school introduced good practises for glacier mass balance measurements and analysis and dedicated time for discussing potential adoptions in order to fit regional peculiarities. The course evaluation by the participants resulted in a very good overall satisfaction with a clear desire for more summer schools, maybe organized in the Andes and Asia.