Global Climate Observing System – GCOS Switzerland

Local observations…

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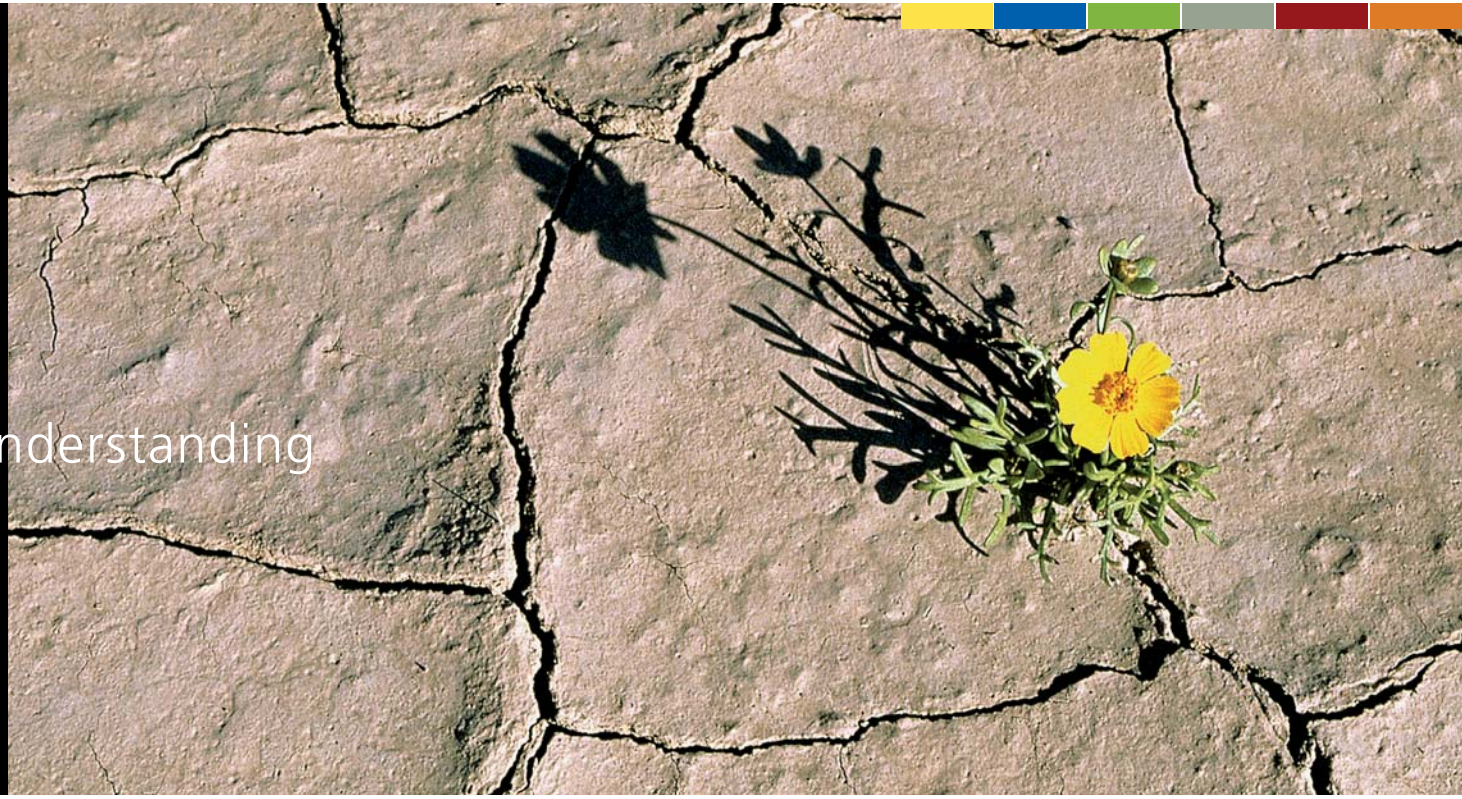
The amount of high-quality climate measurements around the world has significantly helped to improve our understanding of the climate system and its changes over the past decades. Switzerland has a long tradition of climate observation. As an important partner in international programmes, Switzerland

…for global understanding

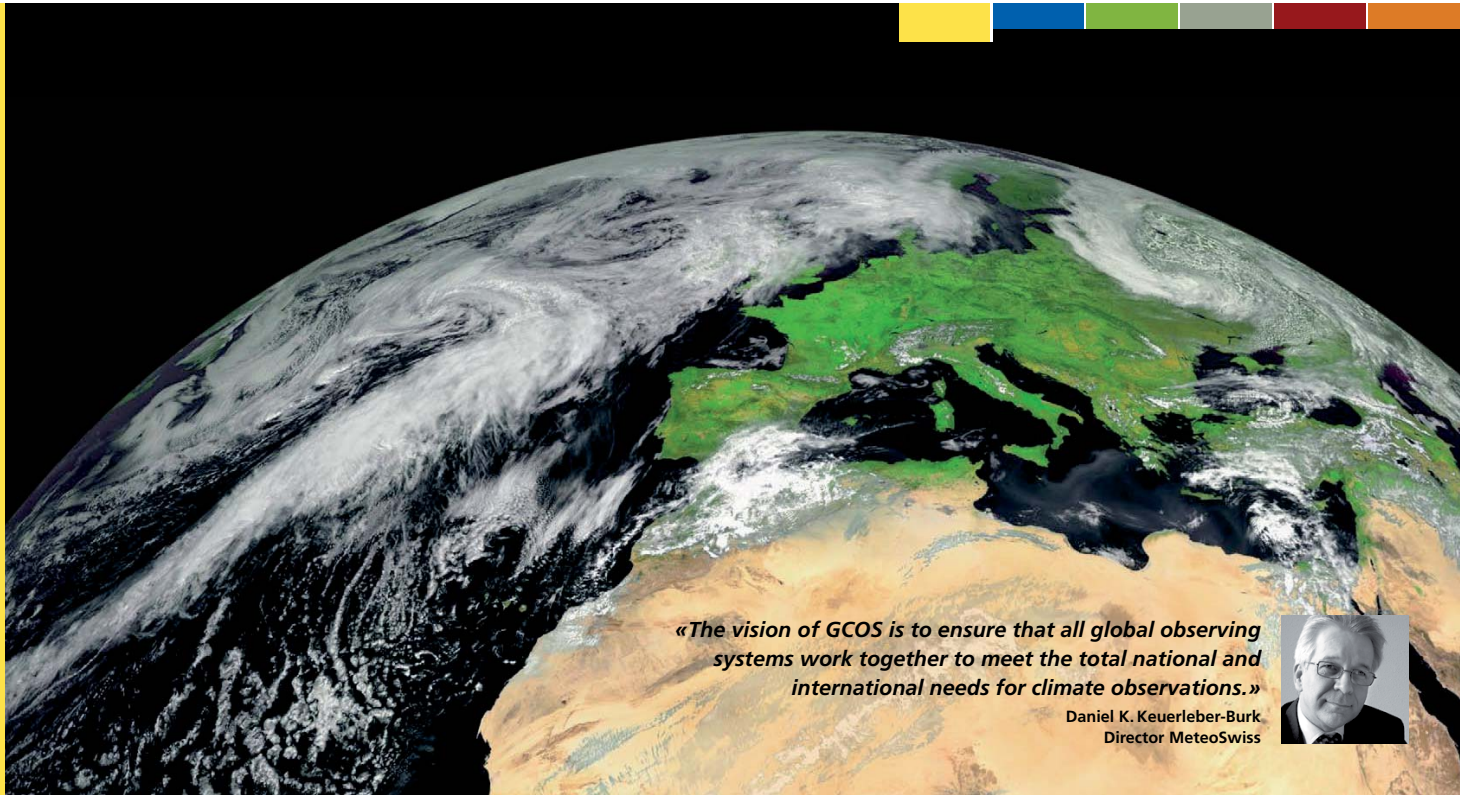
rises to the challenge of further developing systematic climate observations and of maintaining them in the long term for future generations.

Pascal Couchepin, President of the Swiss Confederation
Federal Department of Home Affairs



GCOS at a glance

The Global Climate Observing System GCOS was established in 1992. It supports the implementation of systematic climate observation in accordance with the requirements of the UN Framework Convention on Climate Change and the Kyoto Protocol. The necessary climate-relevant information should be made available to all potential users from science, politics and business – an enormous challenge. GCOS is coordinated at the global level by four organisations: the World Meteorological Organization (WMO), the UN Environment Programme (UNEP), the Intergovernmental Oceanographic Commission (IOC) of UNESCO, and the International Council for Science (ICSU). The GCOS Secretariat is based at WMO headquarters in Geneva. GCOS comprises measurements of some 40 so-called Essential Climate Variables in the atmosphere, the oceans and on land. The global network is supported by more detailed networks at regional and national level according to user requirements in order to effectively plan and implement the overall response to climate change.

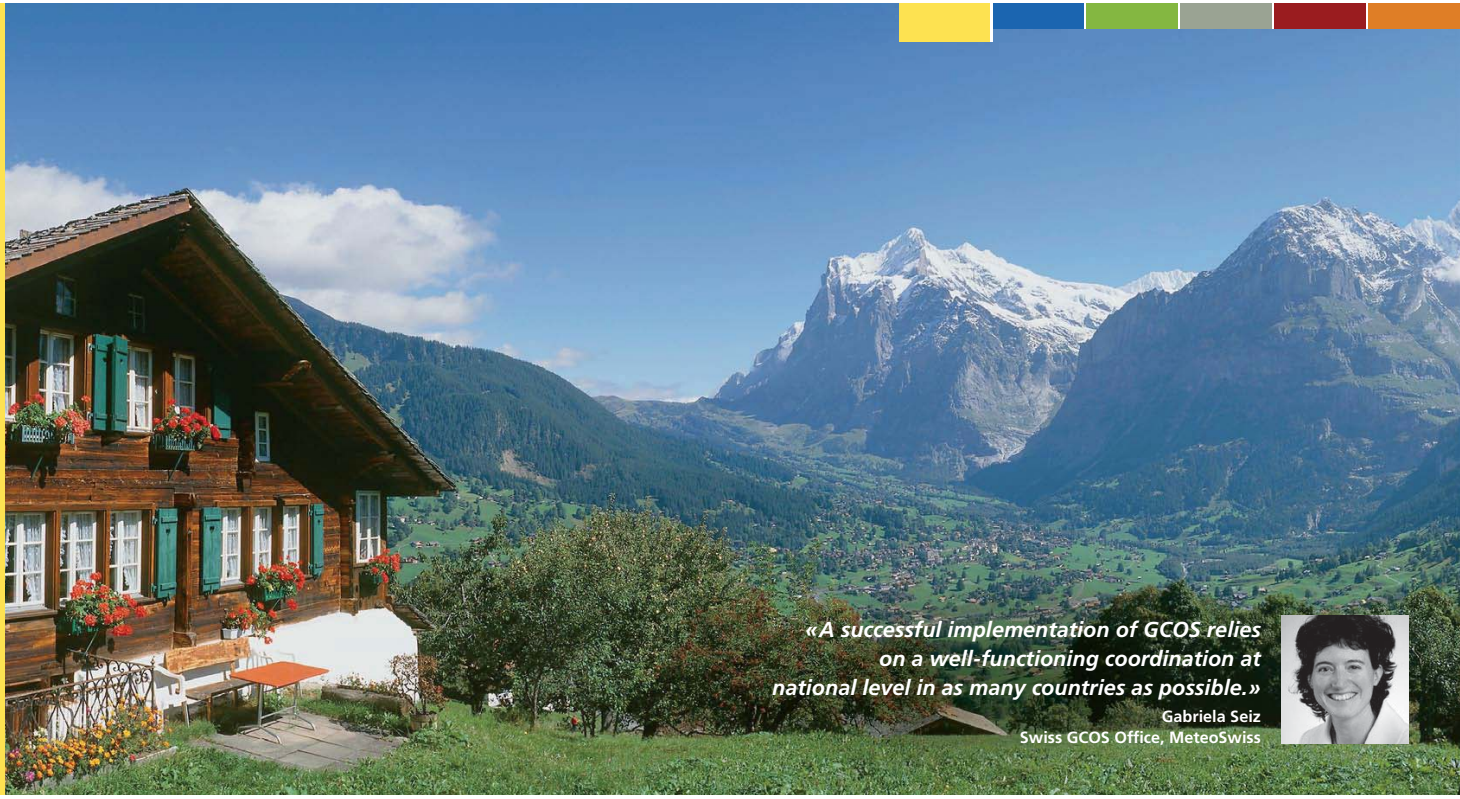


«The vision of GCOS is to ensure that all global observing systems work together to meet the total national and international needs for climate observations.»

Daniel K. Keuerleber-Burk
Director MeteoSwiss

The Swiss programme

At national level, climate observation is coordinated by the Swiss GCOS Office at the Federal Office of Meteorology and Climatology MeteoSwiss. It was established in 2003 following the ratification of the Kyoto Protocol by the Swiss Parliament. The principal duty of the Swiss GCOS Office is the coordination of all climate-relevant measurements that are conducted by federal offices, research institutes and universities. It also ensures communication with the corresponding international bodies. The annual GCOS round table serves as a platform for the exchange of information and for the planning of a coherent national climate observation practice. In collaboration with all partner institutions, the Swiss GCOS Office compiled an inventory of the most valuable long climate measurement series and international data centres in Switzerland in 2007. On the basis of this inventory, the Federal Council decided in June 2008 to ensure the long-term continuation of at-risk measurement series and international data centres.

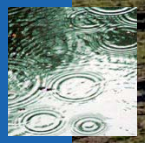


«A successful implementation of GCOS relies on a well-functioning coordination at national level in as many countries as possible.»

Gabriela Seiz
Swiss GCOS Office, MeteoSwiss

Atmosphere near the surface

The most important climate variables in the lowest atmospheric layer are temperature, precipitation, air pressure, sunshine duration and radiation. In Switzerland, the majority of these surface measurements have been systematically collected in all parts of the country since the middle of the 19th century. Many stations are still in operation today and constitute – as the national climatological reference network with a total of 28 stations – the foundation for climate change research in Switzerland. Non-digitalized data of the past are registered manually, while long data series are analysed and adjusted to take into account disturbances such as station displacements or change of instruments. Internationally, the Säntis and Grand St. Bernard stations belong to the global climatological reference network and, along with five other stations, to the European Regional Basic Climatological Network. In addition, special radiation measurements are conducted in Payerne, Locarno-Monti, Davos and on the Jungfraujoch.



«We must maintain the quality of today's observation systems in the future, while at the same time securing and making better use of measurements from the past.»

Stefan Brönnimann
ETH Zurich

In the upper air

Vertical profiles make it possible to analyse climate signals of the most important variables at different altitudes in the atmosphere. For more than 50 years, radiosondes providing information on temperature, air pressure and wind up to an altitude of 30 km as well as on water vapour in the lowest 10 km have been launched several times a day in Payerne. The soundings are complemented with measurements by ground-based remote sensing instruments, gathering data up to the stratosphere. As the principal natural greenhouse gas, water vapour plays an essential role in the global water cycle and the Earth's radiation budget as well as in the chemistry of the stratosphere. The interaction between radiation and clouds remains one of the biggest uncertainties in climate models. Therefore, the spatial distribution of clouds is of high interest. Cloud properties are measured several times a day from the ground by over 50 observers; since the 1950s they have also been recorded by satellites.

«A continuous recording and monitoring of water vapour and ozone is also essential in the stratosphere.»

Niklaus Kämpfer
University of Bern

Composition of the atmosphere

In addition to its principal components, the atmosphere contains various substances in low concentration. These substances – ozone, carbon dioxide and other greenhouse gases, reactive trace gases, aerosols and pollen – have a significant influence on the radiation budget. Surface-based measurements of total ozone in the atmosphere have been conducted in Arosa since 1926. These have been complemented since 1968 by ozone soundings in Payerne. The concentration of carbon dioxide and other greenhouse gases like methane, nitrous oxide and halogenated compounds is determined with highly sensitive measuring instruments, such as those used at the Jungfraujoch. This measurement site is one of 25 worldwide stations of the Global Atmosphere Watch (GAW) programme and also supports the implementation of international agreements. For over 10 years, the direct and indirect effects of further climate-relevant trace gases and aerosols on the atmosphere have been studied at this Alpine station.

«We need long and comparable measurement series of the principal air pollutants as the basis for international treaties and reduction scenarios.»

Brigitte Buchmann
Empa

In the water cycle

Climate variations affect the water cycle in different ways. They influence hydrological variables such as river discharge, groundwater level, water temperature and duration of lake ice cover. Such variations have an impact on the natural environment as well as consequences for agriculture, energy production and the availability of drinking water. The discharge of major rivers in Switzerland has been registered since the beginning of the 20th century. Historical records of freeze and thaw dates for lakes permit valuable inferences about past regional climatic conditions. The uninterrupted observation of the ice cover of Lake St. Moritz since 1832 is one of the longest in Central Europe. Furthermore, isotopes of oxygen and hydrogen, which are recorded in long measurement series, act as tracers, leaving a «fingerprint» of the past climate in the various components of the water cycle. Hence, aside from being used in research, they are also applied in groundwater management.

«Thanks to long measurement series of our water resources over the past 100 years, we are able to determine natural and anthropogenic changes.»

Bruno Schädler
FOEN

Snow, ice and permafrost

Glaciers are a sensitive indicator of climate change. The predominantly negative mass balance of Alpine glaciers over the past 25 years is one of the clearest signals of the recent increase in global temperatures. Likewise, permafrost is very sensitive to changes in temperature. A thawing of the frozen bedrock in the high mountains leads to instabilities, which in turn can affect mountain railways, hiking trails, roads and mountain villages.

Snow cover plays a key role as a climate and environmental factor that fundamentally influences glaciers and permafrost. At the same time, it is also an essential factor for various sectors of the economy. Continuous snow measurements in Switzerland have been carried out since the end of the 19th century. The resulting long measurement series serve as a basis for assessing the impacts of climate change on the Alpine region.

«Long-term measurements help us to better understand changes of permafrost and, hence, take appropriate measures to protect the Alpine infrastructure.»

Jeannette Nötzli
University of Zurich

Forests and plant life

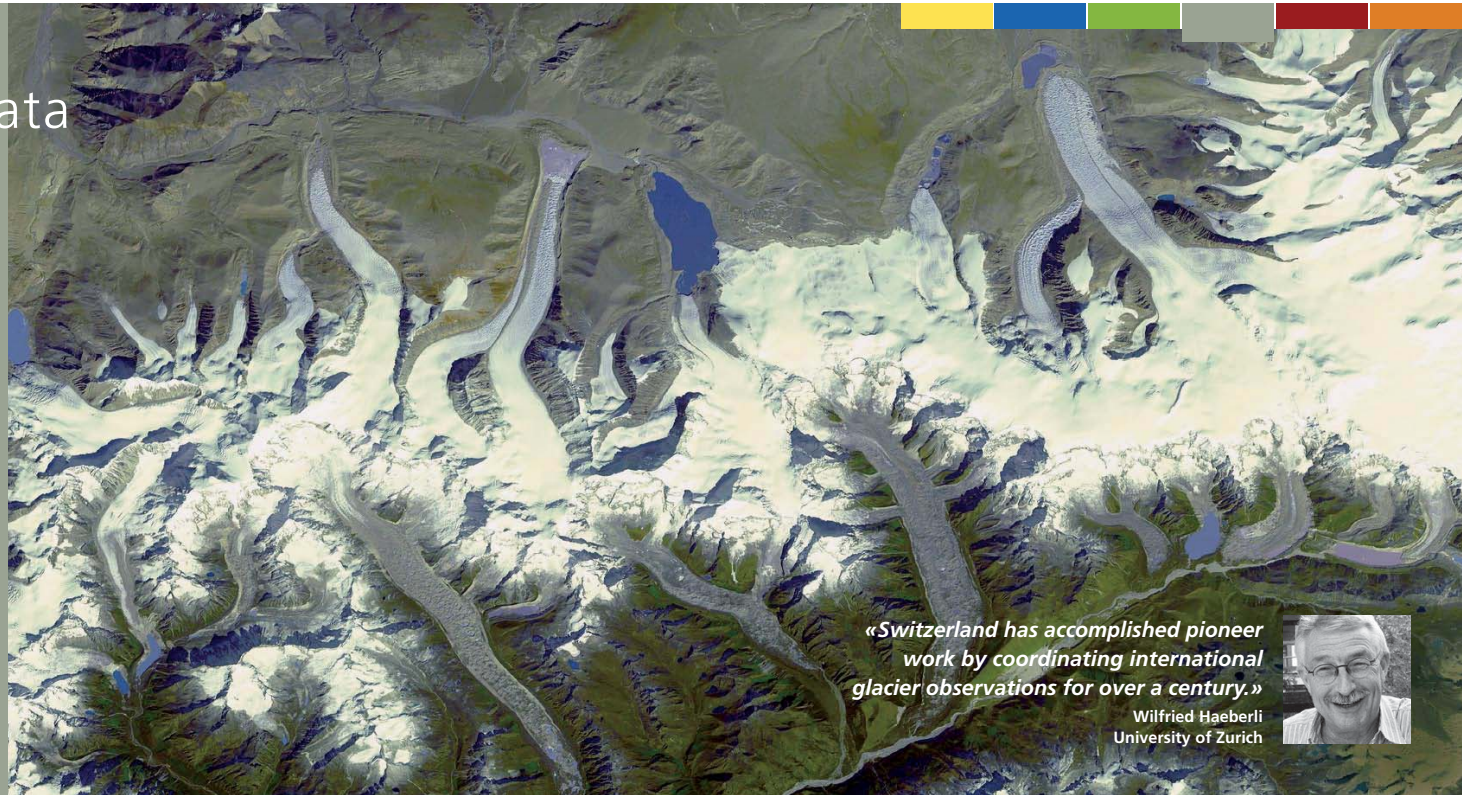
Climate influences vegetation growth and development. A change in the climate has an effect on forests, the length of the vegetation period of trees and plants and their range of distribution. A lack of precipitation and insufficient moisture can raise the risk of forest fires, influence the vitality of forests and, hence, their functions. Factors affecting the forest ecosystem, such as nutrient intakes or water availability, are analysed with the use of long-term observations of forest areas. Statistics on forest fires in Switzerland from over 100 years are an indispensable planning and decision-making tool for the authorities. Knowledge of the distribution and state of forests also helps to determine the Swiss inventory of greenhouse gases. Moreover, the effects of climate change become apparent in the dates of leaf unfolding of individual trees and plants, such as those recorded in Switzerland since the 19th century.

«Our long-term research on ecosystems contributes substantially to underlining the need for a sustainable management of natural resources.»

Norbert Kräuchi
WSL

Global exchange of data

International data centres collect, examine and archive data of various Essential Climate Variables acquired throughout the world and place these at the disposal of science and the general public. By providing the high-quality data needed to respond to climate questions, they assume an important role. Switzerland operates the World Glacier Monitoring Service (WGMS), the international data centre for glaciers. The global observation of glaciers is of great significance to both the monitoring of the climate system and the regional water balance. The WGMS presently manages detailed data of about 1,700 glaciers around the world. Switzerland also maintains a palaeo-historic database called Euro-Climhist. This database holds records of early instrumental measurements, weather observations and information about natural disasters in Switzerland and Europe back to the Middle Ages, thereby supporting the analysis of climate history.

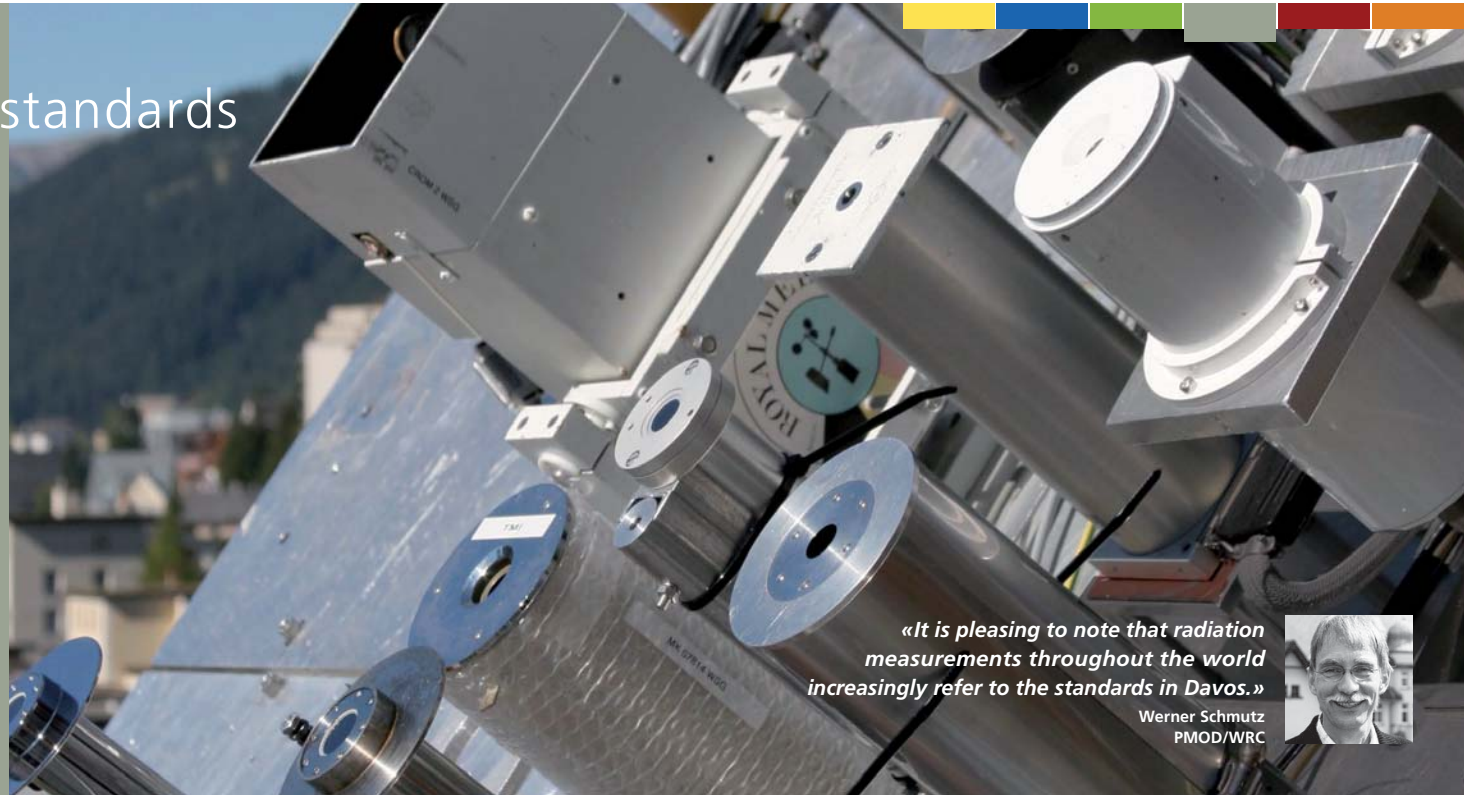


«Switzerland has accomplished pioneer work by coordinating international glacier observations for over a century.»

Wilfried Haeberli
University of Zurich

Quality and worldwide standards

In order to be able to determine the state and variability of the climate system, measurements all over the world must meet the highest quality requirements and be conducted in a standardised manner. The 10 GCOS Climate Monitoring Principles, adopted internationally in 1999, constitute the basis for these conditions. Of equal importance are the international calibration centres; with their reference instruments and regular calibration activities, they make a vital contribution to the quality of global observation programmes. Switzerland has an international mandate to manage the World Radiation Centre (PMOD/WRC) for the calibration of radiation instruments in Davos, the World Calibration Centre for surface ozone, carbon monoxide and methane (WCC-Empa) and the GAW Quality Assurance/Scientific Activity Centre (QA/SAC Switzerland) – also with a focus on surface ozone, carbon monoxide and methane – at Empa. A further 10 principles apply specifically to measurements conducted from space. They were developed and adopted internationally in 2003 in order to standardise satellite data worldwide.

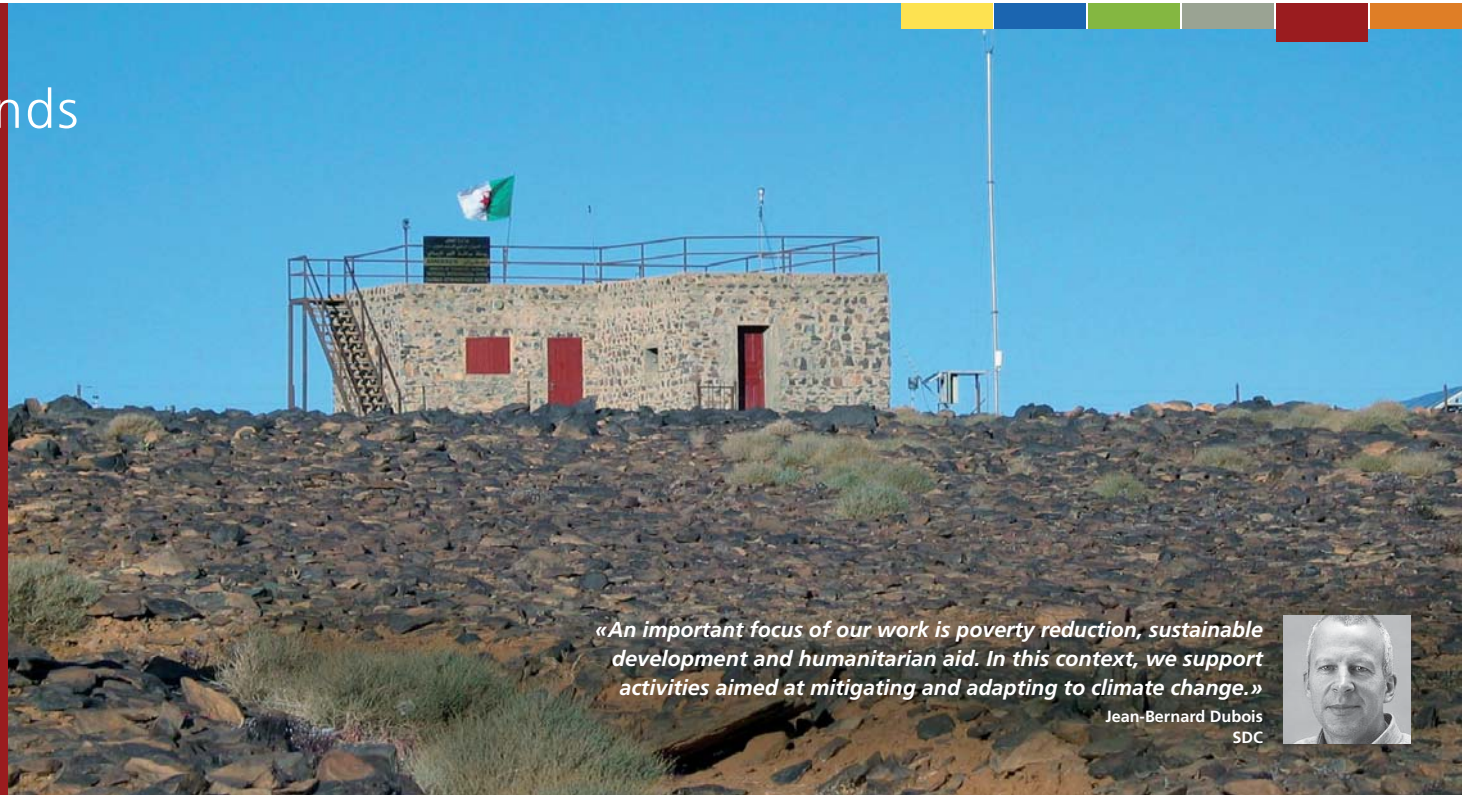


«It is pleasing to note that radiation measurements throughout the world increasingly refer to the standards in Davos.»

Werner Schmutz
PMOD/WRC

Climate knows no bounds

A comprehensive global climate observing system relies on an appropriate spatial distribution of climate-relevant observations. However, as a result of the limited technical and financial resources, the continuation of observations in developing countries is often at risk. It is particularly in these regions that the impacts of climate change are one of the main threats to stability, security and socio-economic development. To respond to this problem, a multilateral financing mechanism, the GCOS Cooperation Mechanism, was launched in 2002. The goal of the mechanism is to improve climate observations primarily in developing and emerging countries. It should also strengthen cooperation between the national GCOS offices and the development aid agencies. With the assistance of Switzerland, periodical ozone soundings have been carried out for several years in Nairobi; further important climate-relevant measurements (carbon monoxide, surface ozone) are conducted on Mount Kenya, in Indonesia and in Algeria.



«An important focus of our work is poverty reduction, sustainable development and humanitarian aid. In this context, we support activities aimed at mitigating and adapting to climate change.»

Jean-Bernard Dubois
SDC

At the service of science and society

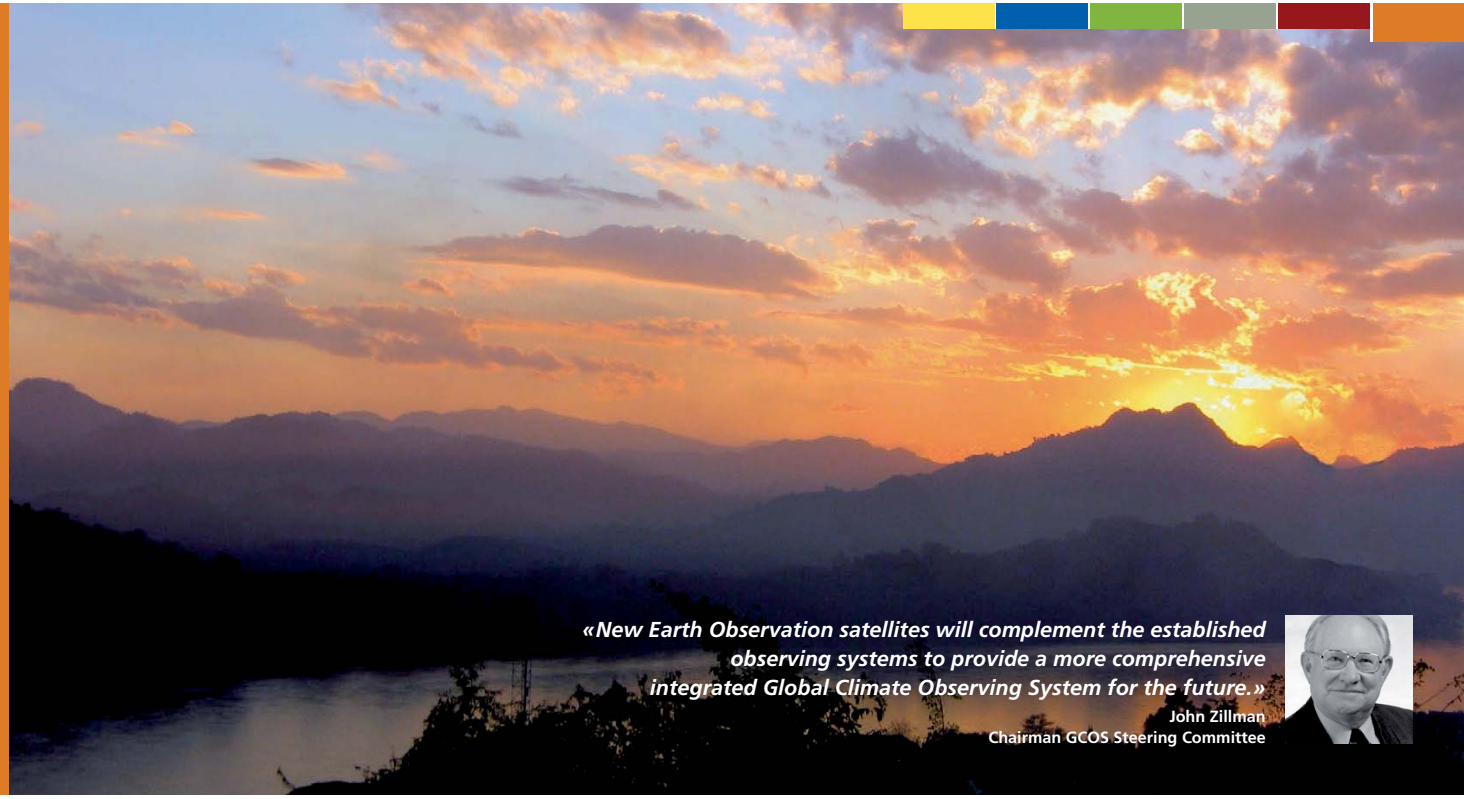
Dealing with climate change presents a great challenge to Switzerland and to the world. Long climate measurement series help describe the current state of the climate system and assess the accuracy of model-based projections of climate change. In their statements on climate, international expert groups draw upon the results of high-quality and long-term measurements. Among these expert groups is the Intergovernmental Panel on Climate Change (IPCC), which was awarded the Nobel Peace Prize in 2007. The activities of GCOS Switzerland contribute substantially to national and international climate research as well as to the planning and implementation of political measures. Hence, they constitute the basis for the preparation of regional climate scenarios. Moreover, they facilitate the early formulation of adaptation strategies for the benefit of all citizens.

«Climate and environmental changes have an influence on the resources of tomorrow. Hence, a systematic, comprehensive and long-term observation of these changes is indispensable.»

Thomas Stocker
IPCC WG I Co-Chair, University of Bern

A challenging future

Since the establishment of GCOS in 1992, the global climate observing systems have developed and produced promising results. The assessment reports of international climate experts have benefited from the improved information. However, there are still substantial gaps in the measurement networks and many existing observations are threatened. New technologies on the ground and on satellites will help to complement the current measurement systems and to close the gaps as far as possible. The efforts of the European Space Agency (ESA) and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) are of great importance to Europe and Switzerland. The Meteosat satellites, for example, already provide an over 30-year long data record. A major challenge for the future will be to ensure continuation of the important historical measurement series as well as to start new measurement series for future generations.



«New Earth Observation satellites will complement the established observing systems to provide a more comprehensive integrated Global Climate Observing System for the future.»

John Zillman
Chairman GCOS Steering Committee

Institutions

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Federal Office for the Environment (FOEN)
Federal Office of Meteorology and Climatology (MeteoSwiss)
Federal Statistical Office (FSO)
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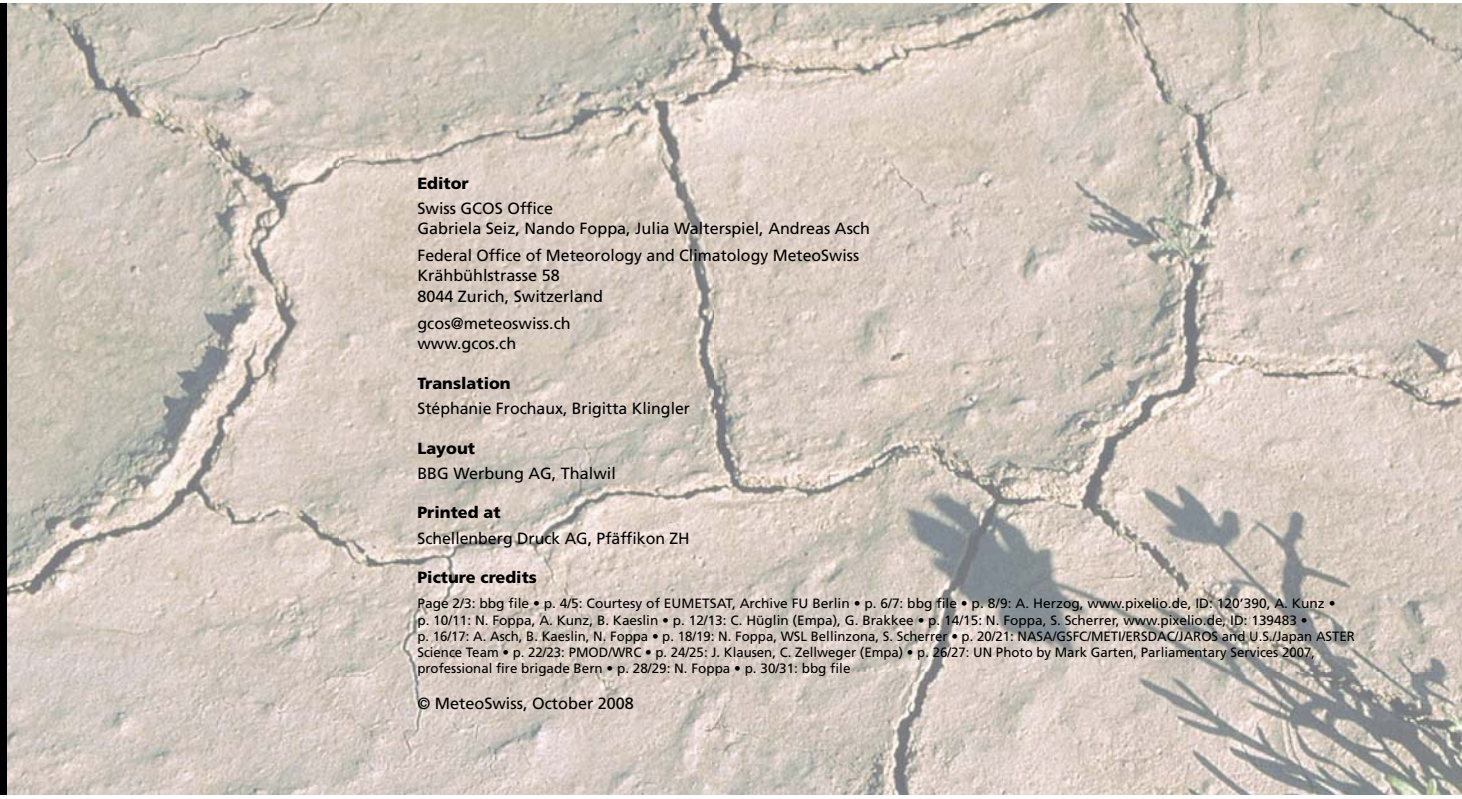

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