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Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

Annual Report 2013

Editorial

Christian Plüss
Director General MeteoSwiss until 2013

Peter Binder
Director General MeteoSwiss as of 2014

A look back

Luckily, in 2013 Switzerland was spared too many dramatic weather situations. In return, MeteoSwiss launched an additional channel for the publication of warnings and information on weather of all kinds: an app for smartphones and tablets. The overwhelming success of this app testifies to the fact that we have met a real need of the public: there were 1.5 million downloads by the end of the year. This made it possible to warn the population of severe precipitation and the flooding it caused at the beginning of June. Further important milestones in 2013 were the introduction of a new reference period for climate monitoring and the approval of the new Performance Mandate 2014–2016. The new Performance Mandate and the confirmation by the Federal Council of the strategy MeteoSwiss has adopted bring my term of office as Director to a close. I can look back on a brief but productive and fascinating period. Above all, I have been impressed by the great motivation and enthusiasm for weather and climate issues that I have encountered among MeteoSwiss staff in all parts of the country. We can be proud of what we have achieved together over the past years.

It is my pleasure to announce the promotion of my former deputy, Peter Binder, to the position of Director of the Federal Office as from January 2014. He has had a hand in all the vital decisions of the recent years. I wish MeteoSwiss a lot of success in the future. Personally, I will continue to benefit from the excellent weather information provided by MeteoSwiss in my new position in the energy industry as well as in my private outdoor activities.

A look forward

I am very happy about my nomination as Director of MeteoSwiss as from the beginning of 2014. The outlook for the goals we have set ourselves for this year promises a lot of challenge: the move of our headquarters from Zürichberg to Zurich Airport, the go-live of our new website and the operational start of our fourth radar on the Plaine Morte in the Valais.

MeteoSwiss is successful thanks to the work of each of its employees. Working together with them, I look forward to addressing and mastering the challenges which await us in the future.

Christian Plüss
Director General MeteoSwiss until 2013

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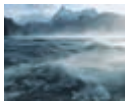

Photo series
Aurora Borealis above Lake Constance on the evening of 30 October 2003 (photo: Andreas Walker).
"Föhn" storm over Lake Uri on 7 February 2001 (photo: Andreas Walker).

Contents

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To ensure that exceptional weather situations do not lead to unpleasant surprises, the federal specialist units for natural hazards work together in close collaboration. The impact of the severe weather of spring 2013 was contained thanks to the tried-and-tested collaboration of the specialist teams (the image shows Neuburg-Dättnau, 2010).

Front against Frederik

The intensive rainfall in St. Gall on 31 May and 1 June 2013 was an event that happens only every 50 to 100 years. The severe weather that dominated the northern slopes of the Alps, Central and Eastern Switzerland at the beginning of summer was a tremendous challenge for the experts of MeteoSwiss and the federal specialist units for natural hazards.

"We have to be prepared for unremitting strong precipitation in the next couple of hours", with these words the anchorwoman leads into the programme. Behind her images show the swelling waters of a river. It is Friday, 31 May 2013. The uncommonly grey, wet and cold spring that Switzerland has experienced this year exits with a tumultuous finale. Depression Frederik announces the meteorological summer: severe precipitation and flooding north of the Alps is forecast for the weekend.

Precipitation – but how much?

For days meteorologists of MeteoSwiss have monitored the development of the severe weather situation: depression Frederik is moving north along the Alps on an eastern trajectory, bringing damp and mild air masses to the regions north of the Alps. It is clear that this will generate copious precipitation. Not so clear, however, is the total amount of rain that will fall by Sunday. The individual weather models differ widely: forecasts for the regions affected range from 30 to 200 millimeters precipitation per square meter within 48 hours. To be on the safe side, MeteoSwiss issues a level-3 severe weather warning for all areas under threat on 30 May. This corresponds to a precipitation total of 80 to 110 millimeters.

Aggravating the situation even further is the fact that in the week before snow fell in places down to low altitudes. With the expected rise in temperature the regional snow melt will further contribute to the swelling of rivers and streams. The danger of flooding is imminent. This is why not just the specialists of MeteoSwiss are alerted but also their colleagues at the Federal Office for the Environment (FOEN), the Institute for Snow and Avalanche Research (SLF) and the Swiss Federal Office for Forest, Snow and Landscape Research

Winterthur 2008: stream bursting its banks. *Abundant and long-lasting precipitation led to local flooding in Central and Eastern Switzerland.*

The next flooding *is bound to happen sometime (Winterthur-Wülflingen, Töss falls, 2008).*

(WSL). Jointly they activate the specialist unit for natural hazards in order to assess the complex danger situation more accurately and to ensure better communication.

A-Team for natural hazards

This specialist unit is the operational body of the Steering Committee Intervention against Natural Hazards (LAINAT) of the Confederation. In the wake of the flood of the century in 2005 which caused enormous damage, the Federal Council ordered LAINAT to be set up, a collaboration between MeteoSwiss, the Federal Office for the Environment, the Federal Office for Civil Protection, The Federal Office for Forest, Snow and Landscape Research, the Institute for Snow and Avalanche Research and the Swiss Seismological Service. LAINAT facilitates concerted action to cope with any such events in the future and to issue reliable warnings. Since then experts have met in this specialist unit whenever a complex danger situation of a certain magnitude has presented itself. With every incident, the federal natural hazard teams have gained additional experience and perfected their collaboration. This explains the calm and focused way this unit approached the severe weather situation developing on 31 May.

Good communication prevents damage

While outside torrential rain has been pouring down since the early morning hours, MeteoSwiss forecasters have been assessing the latest weather models and on Friday morning step up the alert from a level-3 to a level-4 warning in certain areas. In a routine procedure they report their prediction to their colleagues in the specialist unit, who assess the overall situation by means of additional measurements and observations. Together they issue a communiqué to the media: "Intense persistent rain along the northern slopes of the Alps – the federal authorities warn of flooding and mudslides." Within a few minutes, the message is released on the online portals of leading newspapers and is taken up on radio and TV news programmes. In the following hours and days further up-dated messages will inform the public of recent developments.

In addition, MeteoSwiss and the other specialist teams inform cantonal and communal authorities continually and without delay of the latest developments. Thanks to this support, the operational units in the affected cantons are able to correctly regulate individual river weirs, to timely evacuate two camping sites in the canton of Zurich, to install hosepipes for the drainage of flood water in the canton of Aargau and to take many other protective measures.

> The situation is serious, but under control.

In the course of Monday, first the weather, then the flood situation eases off. It becomes clear that the amount of damage is limited. A higher toll has been avoided thanks to the uninterrupted surveillance of experts, the concerted collaboration of the federal specialist units and the reliable flow of information. Or, as the anchorwoman said as early as Friday: "The situation is serious, but under control."

For further information on the specialist unit for natural hazard go to:
> www.meteoschweiz.admin.ch/medialib/documents/de/themenblaetter.Par.0012.File.tmp/unwetterwarn.pdf
> www.meteoschweiz.admin.ch/web/en/danger/danger.html

Security, safety and meteorology go hand in hand

Blows of fate seldom occur in isolation. The consequences are far-reaching and complex. This is why the Confederation and the cantons have created the National Security Network (NSN), in which several agencies cooperate in the event of crises, coordinating their activities. One of them is MeteoSwiss.

In June 2013 heavy precipitation leads to flooding and mudslides which block roads and railway lines. Shortly after a hailstorm destroys crops and fruit plantations in Western Switzerland. The weather can create a lot of damage to infrastructure, harm the economy and transport networks and endanger the population. A potentially dangerous situation becomes even more menacing if the weather exacerbates an existing crisis. Let us assume the following scenario: a cyber attack is launched against the Swiss power industry. This happens just as a severe storm hits Switzerland and causes widespread damage to the power grid. After a 48-hour power failure there is a shortage of electricity which goes on for several weeks. To make matters worse, this event coincides with a flu pandemic that peaks with a quarter of the Swiss population being ill. It is precisely this scenario which the National Security Network (NSN) will rehearse in November 2014 with the participation of MeteoSwiss.

One for all, all for one

The National Security Network is a crisis management system which becomes active at the moment when a situation threatening national safety and security arises. This might be a military attack, a natural disaster or a pandemic. It was created in 2010 by the Federal Council who acknowledged the fact that threats are of an increasingly complex nature and have to be faced by a concerted response.

The main agents in the NSN are the Confederation, cantons and communities. However, the network also includes organisations belonging to the private sector such as power providers or transport services. The coordinated cooperation, which is interdisciplinary and defies territorial and institutional borders, facilitates the use of synergies and the sharing of experience and knowledge. The role of MeteoSwiss in all this is to help prevent danger and to mitigate crises by providing expert meteorological and climatological advice.

Mandated by law

This is a duty MeteoSwiss had been fulfilling long before the creation of NSN. Services relevant to security and safety are mandated by law: MeteoSwiss issues warnings of weather hazards, provides meteorological information for the aviation industry and for aviation safety and it monitors radioactivity and air pollutants. Since the 1970s MeteoSwiss has had the lead in the "Coordinated Sector Weather". Then, as now, MeteoSwiss is at the service of the authorities responsible for civil protection, the army and other partners in the economy and industry. It issues warnings and delivers information, in everyday life as well as in the event of a crisis. Because security, safety and meteorology go hand in hand.

The National Security Network orchestrates measures *taken by the Confederation, cantons, communities and private organisations.*

In order to respond in a concerted effort *to floodings such as this in the year 2000 in Locarno, the Federal Council created the National Security Network Switzerland in 2010.*

A canton in need of meteorological support

Masses of rubble have been threatening the town of Domat/Ems in the canton of Grisons since spring 2013. At any time there could be a dangerous mudslide triggered by rain and melt water. In order to better monitor the situation the authorities have asked MeteoSwiss for support.

Monday morning, shortly before midday. Adriano Bottoni finds an email from MeteoSwiss in his in-box: "Precipitation forecast for the Val Parghera. Expected amount for Monday, 29 April 2013: 7 to 12 millimeters, especially from the afternoon onwards, snow line above 1800 meters." For a short while now, Bottoni, Deputy Head of the Command Staff of the Canton of Grisons, has been receiving a daily email with precipitation forecasts for the next 24 hours and the five subsequent days. The reason: there is a high risk of mudslides in the Val Parghera above Domat/Ems, and any precipitation increases the risk considerably.

9000 ship containers full of rubble

More than half a million cubic meters of rubble, wood and soil have accumulated in the Val Parghera according to estimates by experts – this is roughly equal to the load of 9000 ship containers. In Mid-April 2013 the masses begin to move after continual precipitation and the onset of snowmelt. Several small mudslides occur. A stretch of the main road to Chur is buried and the road remains blocked for weeks. Moreover, the Rhaetian Railway and the motorway are in danger too, because part of the rubble still up on the mountainside could become lose and slide down to the valley floor in a huge mudslide under the impact of rain and melt water. A race against time has begun for the operational units and the Command Staff of the canton.

"It was clear to us that we needed precipitation forecasts specific to the danger area, in order to correctly assess the risk and to respond with adequate measures", says Adriano Bottoni. "This is why I contacted MeteoSwiss. Their Weather Service gave us support immediately."

Tailor-made forecasts

This kind of cooperation is not unusual. MeteoSwiss has always been advising cantons and communities in their weather- and climate-related risk assessment, offering tailor-made observations and forecasts. Thanks to the precipitation information, the persons responsible for the Val Parghera have always been one step ahead of the weather. "We were able to rely completely on the forecasts of MeteoSwiss", says Bottoni, "and this really helped us in our efforts to clear and protect the area."

In August the weather situation *near Domat/Ems was back to normal.*

Since August the situation in Domat/Ems has improved. Daily precipitation forecasts are no longer necessary. However, the danger is not over. Currently, about 200,000 cubic meters of rubble are still in the Val Parghera. "In spring 2014 the risk of mudslides could increase again when the snow melts", suspects Bottoni. But he knows that he can count on the support of MeteoSwiss anytime.

April 2013 near Domat/Ems: rain and melt water *triggered a mudslide. A rapid stream of mud and coarse rock material flowed down-valley.*

Short articles

The Ticino delegation of the Federal Parliament *visited the Regional Centre of Locarno-Monti in 2013.*

On a guided tour *the members of Parliament got an insight into the fascinating work of MeteoSvizzera.*

Public service at its best

Severe weather warnings, forecasts and observations throughout Switzerland or the weather information it provides via its app or its website are only some of the examples of services to the public that MeteoSwiss supplies. Last spring the Ticino delegation of the Federal Parliament visited the Regional Centre of Locarno-Monti.

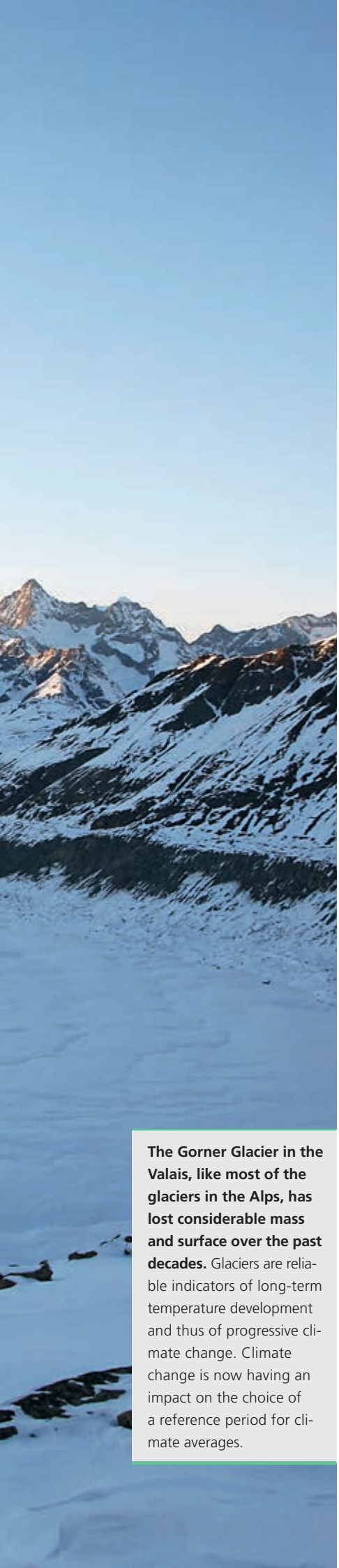
The visiting members of Parliament attended presentations and guided tours and engaged in many personal conversations which gave them insight into the various activities of MeteoSvizzera. The young National Councillor Marco Romano maintains: "MeteoSvizzera is a successful example of federalism which is alive in a way that has – sadly – become a rarity. On Ticino territory, local employees who are highly specialised and motivated provide services which are of great importance and create a huge added value for the entire country." The President of the Ticino delegation, Fabio Regazzi, notes "the deep passion and the group spirit of the Locarno-Monti team who works in a fascinating and important field of activity. Weather concerns every one of us." The Delegation Secretary, Verio Pini, emphasises: "I have been especially impressed by the international cooperation in the satellite sector, by the precision achieved in radar meteorology and, not least, by the expertise of the individual teams: a competence centre that is world-class."

New: Rhaeto-Romanic brochure available

In 2013 the brochure "Dem Wetter einen Schritt voraus" (One step ahead of the weather), which exists in German, French and Italian, was published in Rhaeto-Romanic, the fourth official language of Switzerland. MeteoSwiss is pleased to make its meteorological know-how available to the Rhaeto-Romanic community, too. It is a well-known fact, encountered in the media, in business or from personal experience: a storm brings aviation to a standstill, icy conditions on the roads cause chaos, a weekend trip has to be cancelled. Weather conditions affect our lives to a great extent. We rely on weather forecasts to know when to pack an umbrella or when to get our warm jackets out. But how is such a forecast generated? The MeteoSwiss publication answers these and other questions in a vivid and easy-to-understand way. The brochure is divided into four main chapters: measurements and observations, data processing and models, interpretation and forecasting, warnings and special forecasts. The translation was done in cooperation with a Rhaeto-Romanic translator and the central language services of the Federal Chancellery.

Go to the following link to download the brochure in Rhaeto-Romanic:
> www.meteoschweiz.admin.ch/web/de/meteoschweiz/dokumentation/broschuere_wetterprognose.html

The brochure "Dem Wetter einen Schritt voraus" *was made available in Rhaeto-Romanic in 2013.*



The Gorner Glacier in the Valais, like most of the glaciers in the Alps, has lost considerable mass and surface over the past decades. Glaciers are reliable indicators of long-term temperature development and thus of progressive climate change. Climate change is now having an impact on the choice of a reference period for climate averages.

Standard averages overtaken by climate change

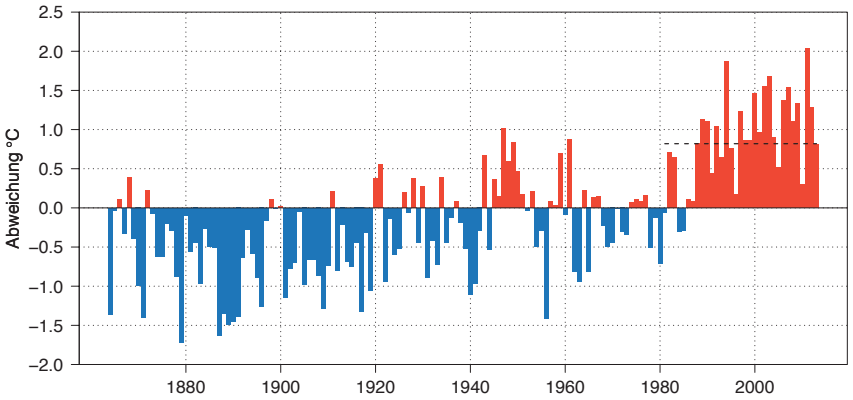
Last February was significantly too warm compared with the long-term average. Making statements of this kind as a result of analysing the weather of the past months is one of the standard products of any climate service. But what is normal? Climate "normals" describe the average expected weather conditions of a region – as long as the climate remains essentially the same. Progressive climate change has now necessitated an adjustment of the existing reference period 1961–1990.

The winter months on the Swiss Plateau are frequently characterized by grey and quite cold weather with high fog and a north-easterly wind. The same month, however, can be mild and sunny in the following year. August in Switzerland is often humid, hot and thundery, but sometimes it is wet, cold and rainy. Weather conditions in Switzerland vary considerably from year to year. But what does a "normal" January look like on the Swiss Plateau and how does one imagine a typical August in Lugano?

Climate normals provide answers – average values obtained from 30-year data sets. They describe the average weather conditions of specific regions and list the relevant average temperatures, the average precipitation totals and a number of further weather parameters. However, climate normals not only serve as points of reference for current weather conditions, they are also regarded as expected values for the climate. This is why they are interesting for industries such as tourism or construction. Moreover, climate normals provide the basis for the representation of long-term climate development and global comparison.

Adjustment every 30 years

The climate normals in use since 1991 are average values for the period 1961 to 1990. Periods of 30 years are necessary to account for the natural variability of the climate. According to a definition by the World Meteorological Organization (WMO) dating from 1935, the same so-called standard periods are used worldwide to determine climate normals. International coordination is paramount in ensuring that climatological statements by individual weather services can be compared irrespective of and beyond national borders. The fixed standard periods do not overlap and every 30 years they



Long-term development of annual temperature in Switzerland from 1864 to 2013, *shown as deviation from the average for the standard period 1961–1990. Red years were warmer, blue years colder than the standard period. The normal period 1981–2010 is also indicated as by a broken line.*

are replaced by a new period. The normals of the period 1961–1990 should therefore be replaced in 2021 by those for the period 1991–2020.

Overtaken by climate change

For over 25 years now there has not been one single year in Switzerland which was colder than the long-term average of the reference period 1961–1990. On the one hand, this fact illustrates perfectly the progressive change in climate that is also affecting Switzerland. On the other hand, it is obvious that the period 1961–1990 has lost its validity for expected temperature values.

WMO has reacted to these problems and suggests introducing a further normal period (e.g. 1981–1990) in addition to the standard period 1961–1990 and replacing this additional normal period every 10 years. This should yield averages which describe the current climate appropriately and which can be used more reliably as expected values. The standard period 1961–1990 is maintained in order to guarantee an unchanged basis for the observation of long-term climate development.

MeteoSwiss has adopted this proposal and has prepared new climate normals for essential observation parameters such as temperature, precipitation and sunshine duration for the beginning of 2013. Alongside the existing 1961–1990 normals the additional normals for the period 1981–2010 are now available.

The new normal period is warmer

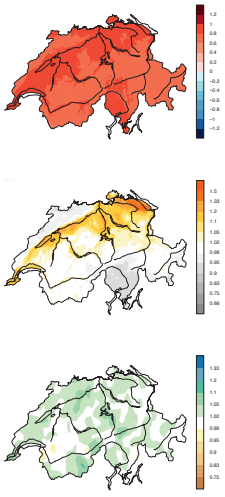
Normals of the old and the new reference period sometimes exhibit quite remarkable differences. This is immediately obvious where temperature is concerned: from 1981 to 2010 the annual mean temperature in Switzerland was 0.5 to 1 °C warmer than between 1961 and 1990. The lowland regions on both sides of the Alps show an increase in temperature which is slightly above the increase at higher altitudes. In addition, spring and summer months have contributed more to the average increase in temperature than the autumn and winter months.

Blue above, grey below – is this normal? *Climate "normals" tell us about the climate we can expect in the future.*

The annual mean precipitation does not differ significantly in the two reference periods. However, differences are obvious as regards the seasons. Especially south of the Alps, for instance, the months of February have become much drier while the autumn months September and October are significantly wetter. Overall, the differences between the two reference periods mainly reflect the natural variation of precipitation in Switzerland.

The average sunshine duration on the Swiss Plateau has increased at the rate of 5 to 10 percent compared with the old standard period. Swiss regions at higher altitudes, however, have not undergone any changes in that respect. The increase in sunshine duration on the Plateau can be explained by the less frequent occurrence of high fog and fog patches in winter.

For further information on the introduction of the reference period 1981–2010 and on the comparison of new and old reference periods please see:
> www.meteoschweiz.ch/climate



Differences in the annual averages *between the new and the standard periods for temperature (top; in C°), sunshine duration (middle; in %), and precipitation (bottom; in %). Switzerland as a whole has become warmer; the Swiss Plateau sunnier.*

Making Swiss climate change more visible

Climate indicators such as heating days or tropical nights show the extent to which climate is changing in Switzerland. MeteoSwiss collects, computes and publicises various climate indicators. Not only do they make climate change more visible, they also serve as planning tools for users.

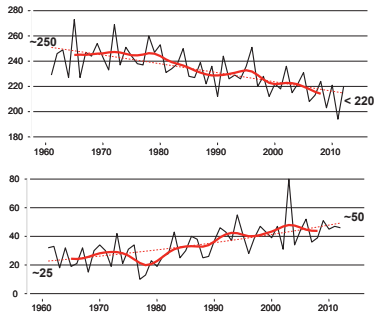
Climate indicators are indicative values that are useful in analysing past and future effects of climate change in a more focused way. Thanks to climate indicators, answers to practical questions can be found: how has the snow situation developed in Davos? On how many days is heating necessary in Berne compared to the past? Or: how will the number of summer days in Lugano change in the future?

Fewer heating days, more cooling days

The indicator "heating days" shows that there are progressively fewer days in Switzerland where heating is necessary. Heating days are days with a daily mean temperature of below 12 °C. In the 1960s Berne recorded on average 250 heating days per year, 2012 this number had decreased to 220 which is 12 percent less. It is just the other way round with cooling days, days with a daily mean temperature of above 18.3 °C. Their number has doubled in the past 50 years: from an average 25 to 50 cooling days a year.

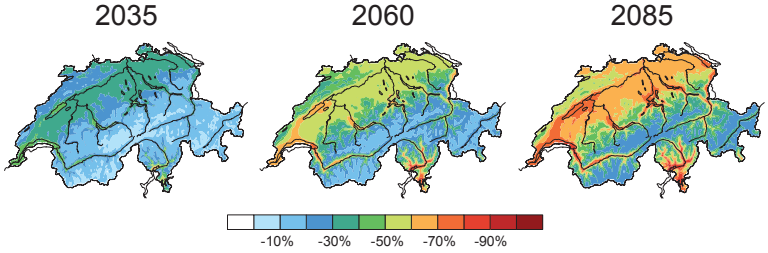
Planning tools facilitate the adjustment to climate change

Climate indicators not only enable the tracing back of climate change over the past decades, they also facilitate the prediction of future developments. Such estimates for the future climate in Switzerland provide an essential planning tool for the Confederation, for cantons and decision makers, enabling them to create adjustment strategies for climate change. A practical example is the estimate for clearing snow on the roads. The expenditure for snow clearing depends largely on the number of days with fresh snow. At present there are between 10 and 20 days with snowfall on the Swiss Plateau each winter. The relevant climate indicators show a trend for fewer days: the number could decrease by 60 to 85 percent by the year 2085 – diminishing expenditure for snow clearing accordingly.



***In Berne heating days have decreased by 12 percent** since 1960, while cooling days have doubled in the same period.*

***Traffic chaos on the motorway, caused by snow.** The number of days with fresh snow helps make it possible to estimate costs for snow clearing on transport routes.*



***Expected change in the number of days with fresh snow** for an A1B emission scenario for the years 2035, 2060 and 2085 (in percent, mid-range estimate).*

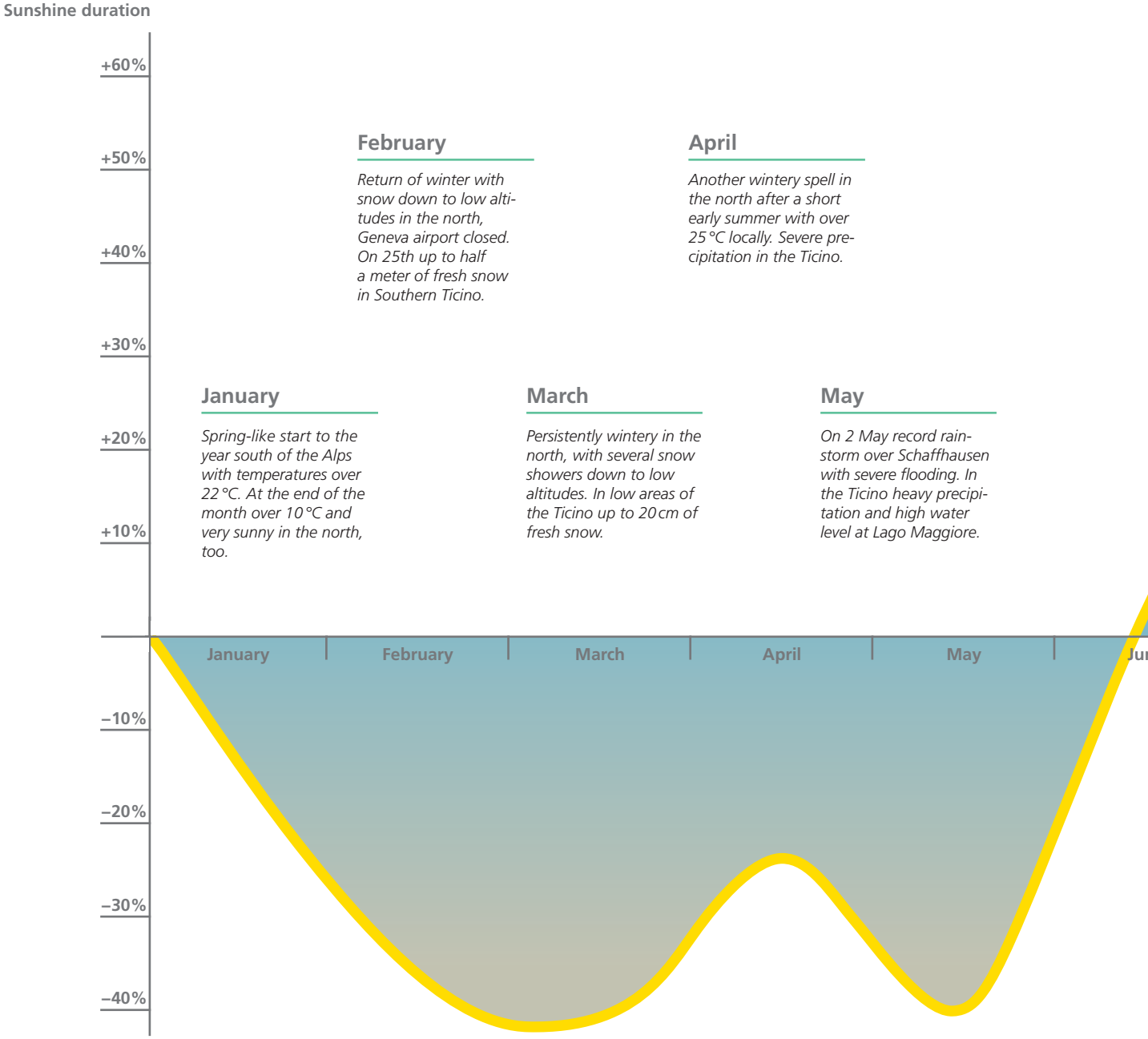
Climate indicators available online

The climate indicator browser on the MeteoSwiss website enables users to look at the changes to a variety of climate indicators over the past decades. Seasons, periods and stations can be selected at will. The diagrams thus created can also be downloaded in PDF format.

> www.meteoschweiz.admin.ch/web/en/climate/climate_today/climate_indicators/indicators_browser.html

The strange sunshine year 2013: From extremely grey to extremely sunny

Three times the sun was the focus of weather observations: first there was a dispiriting record lack of sunshine from January to May, then summer sunshine that attained almost record levels and finally, towards the end of the year, record sunshine duration.



February

Return of winter with snow down to low altitudes in the north, Geneva airport closed. On 25th up to half a meter of fresh snow in Southern Ticino.

April

Another wintery spell in the north after a short early summer with over 25 °C locally. Severe precipitation in the Ticino.

January

Spring-like start to the year south of the Alps with temperatures over 22 °C. At the end of the month over 10 °C and very sunny in the north, too.

March

Persistently wintery in the north, with several snow showers down to low altitudes. In low areas of the Ticino up to 20 cm of fresh snow.

May

On 2 May record rainstorm over Schaffhausen with severe flooding. In the Ticino heavy precipitation and high water level at Lago Maggiore.

Winter

Coldest winter for over 40 years on the Jungfraujoch. Here the last comparable cold winters date back to 1968/69 and 1969/70.

January to May

In the region from Basel to Zurich and St. Gall the January to May period with the least sunshine in the series with validated data since 1959, in the long Zurich series since observations started in 1884.

May to June

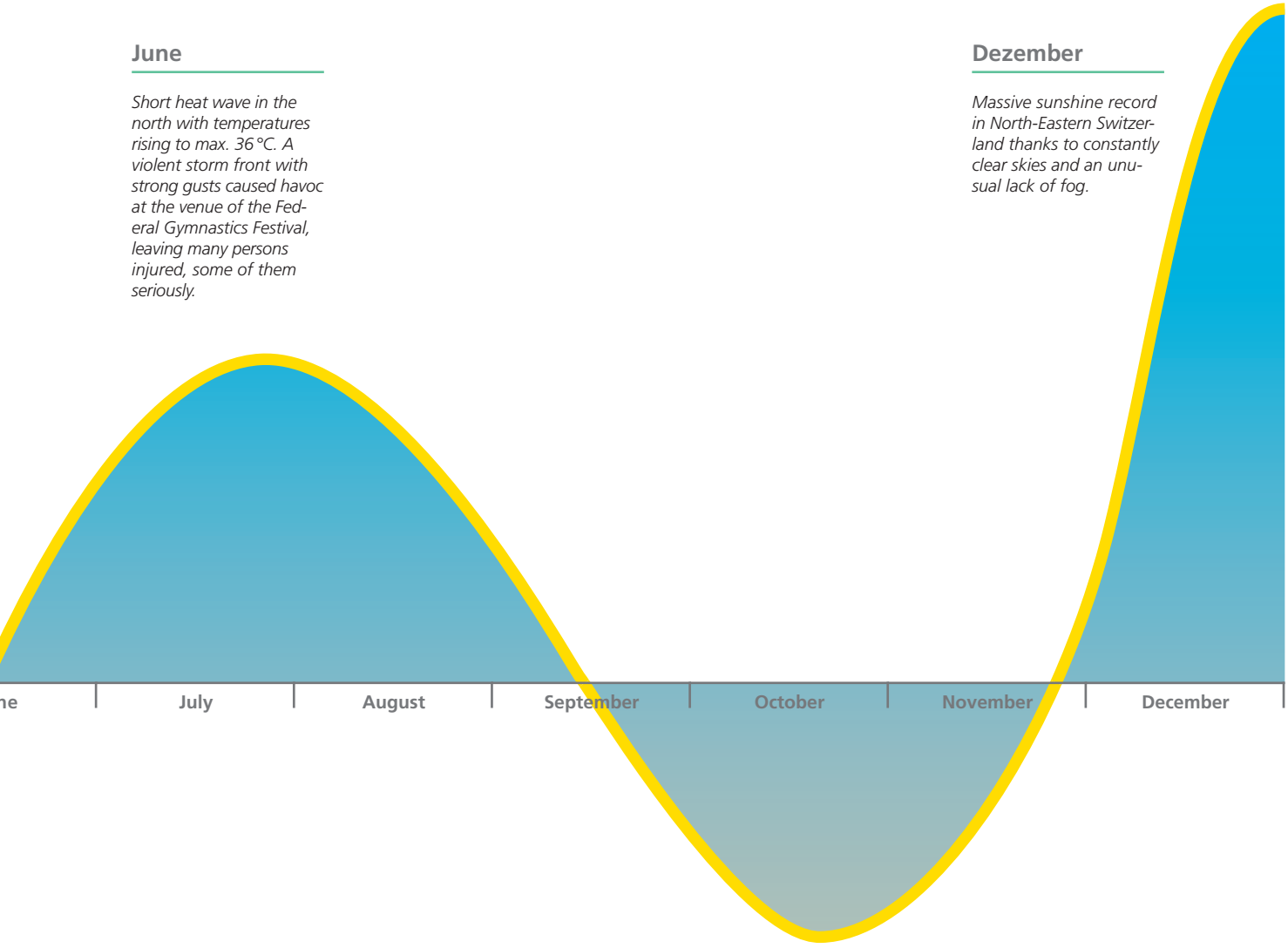
From 31 May to 2 June severe weather with record precipitation in Eastern Switzerland, mainly in the Säntis area. Regionally the highest 2-day precipitation total for over 100 years.

June

Short heat wave in the north with temperatures rising to max. 36 °C. A violent storm front with strong gusts caused havoc at the venue of the Federal Gymnastics Festival, leaving many persons injured, some of them seriously.

Dezember

Massive sunshine record in North-Eastern Switzerland thanks to constantly clear skies and an unusual lack of fog.



Summer

In July and August almost constant sunny, high-summer weather. On the plain north of the Alps second- or third-sunniest summer in the period with validated data since 1959.

Annual temperature

The Swiss average temperature for 2013 equalled precisely the 30-year average 1981–2010. Globally, the year 2013 was recorded as the fourth-warmest since 1880.

Over 200 weather stations supply round-the-clock data that MeteoSwiss collects and processes in the so-called Data Warehouse. This data is stored in man-high servers, which are at any moment available online via interfaces to external systems. The towering cloud shown here (Cumulus congestus) was photographed in 2011 during a descent into Zurich Airport.

Machine for 10 billion data

Every 10 minutes, 24 hours a day, 365 days a year over 200 weather stations generate a set of observation values. Added to this are the data provided by other systems, such as radar observation. What happens to this huge amount of data? A glimpse into the Data Warehouse, the core of MeteoSwiss operations.

Each of us uses weather forecasts and looks at radar images and climate diagrams. However, hardly anyone is conscious of the immense amount of data that has to be collected and processed in order to produce these products. The raw material is hidden in the depths of the Data Warehouse. Here an endless flow of data is imported and observation values are monitored, stored and sorted in order to provide meteorologists and climatologists with data they can access easily and quickly for the production of their forecasts and models. 10 billion data sets are stored in the Data Warehouse – and the number is increasing daily.

Only a state-of-the-art electronic data bank system is up to the task of organizing and making available such an enormous amount of data automatically and fast. While in a pre-digital age information was stored away on card files which had to be painstakingly dug out of dusty archives, today this information is stored in servers as tall as a person and brought to the screen by mouse click. Fundamentally, the principle has remained the same as in analogous times: data are collected and computed, monitored, referenced, systematically filed and retrieved on demand.

Like a real warehouse

The Data Warehouse consists of an integration and an analysis layer which execute certain tasks. These processes are comparable to those of a real warehouse. First, measured values arrive from a multitude of sources – among others from the surface data network, weather radars, profile measurements and international data providers. With their import the measured values arrive in the central data bank where they are entered, processed and submitted to quality control. After such treatment the data are ready for analysis and data delivery.

Here values are organised according to their format – point data and grid data – and they are partly grouped into data sets for individual applications and user groups. This simplifies data analysis. In order to represent measured values as tables, maps and diagrams, several tools are available not only to MeteoSwiss meteorologists and climatologists but also to partner institutions, customers and private persons.

The so-called metadata repository is the foundation of the Data Warehouse. Here information on the description of measured values is centrally catalogued. These metadata include, for instance, the geographical coordinates of an individual weather station, the observation programme or details of the measuring instrument which records the relevant data. Moreover, the metadata repository identifies the rules that govern the internal processes in the Data Warehouse.

For reliable weather and climate forecasts

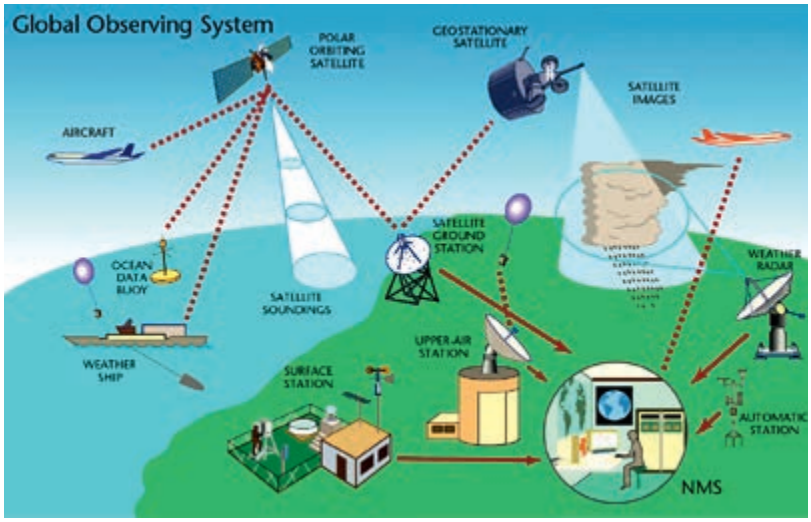
The Data Warehouse is far more than a data storeroom. Gathering measured values is only worthwhile if they can be retrieved at any moment – and if these values are free of error. This is why quality control is one of the essential functions of the Data Warehouse.

Erroneous measurements not only lead to wrong weather forecasts, they also falsify the long-term measurement series on which climate models are based. The historical observation data set of MeteoSwiss reaches back to the year 1864. The data then recorded by sight and entered by hand were recently digitalised and integrated into the Data Warehouse. Together with contemporary observations they constitute measurement series that reveal the way in which the climate has changed in Switzerland over the past 150 years. Quality control – above all homogenisation – ensures the correctness of these measurement series and the plausibility of climate scenarios derived from them.

> The historical observation data set of MeteoSwiss reaches back to the year 1864.

Another strong point of the Data Warehouse: MeteoSwiss is able to integrate external data supplied by customers and partners. This is important for conducting joint research projects or for condensing underlying data.

The Data Warehouse will undergo continuous further development in order to maintain its efficiency and its state-of-the art technology. It is only by means of a clean, efficient and secure data management that it is possible to provide up-to-date weather and climate services.



Measured values arrive in the Data Warehouse from a multitude of sources, *such as national weather stations, weather radars, profile measurements or international data providers. (Source: World Meteorological Organisation)*

Innovation in pollen measurement

Information on pollen count is an important tool for all sufferers of hay fever striving to keep their allergy in check. In future pollen information could be available for all of Switzerland in real time, thanks to an automated measuring method. MeteoSwiss has put it to the test.

***Hazel** – great potential for triggering allergies.*

Every week bio-meteorologists of MeteoSwiss evaluate the pollen caught in specific traps. At 14 stations distributed throughout the country these measuring instruments filter particles – among them pollen – out of the air. At the laboratory specialists analyse these specimens under the microscope following a standardised procedure: they count the pollen grain by grain and determine the type of pollen. It is a painstaking and time-consuming manual task. Pollen concentration information is updated weekly on the website of the National Weather Service. Sufferers of pollen allergies depend on this kind of service in order to optimise their medication and plan outdoor activities. If a faster method of determining pollen concentration were available, this would yield an improved forecast and bring considerable relief to patients.

Automatically faster

In cooperation with the universities of Cork, Kyoto and Geneva and the German company Helmut Hund, MeteoSwiss conducted a test series with automated systems for the recognition of pollen. This method could one day facilitate an automatic collection of pollen data in real time. One of the four systems tested is based on the analysis of microscopic images. The three other systems use laser diffusion and laser-induced fluorescence; airborne particles are stimulated by laser beams, the specific qualities of pollen grains allowing their identification.

The prototypes tested out-of-doors in real-life conditions have to be able to record even tiny concentrations of pollen grains per cubic meter of air. Since even low concentrations of pollen can have a negative impact on the health of allergy sufferers. In addition, the systems have to be able to identify different pollen types because not all allergy sufferers react to the same pollen and not all pollen are allergenic.

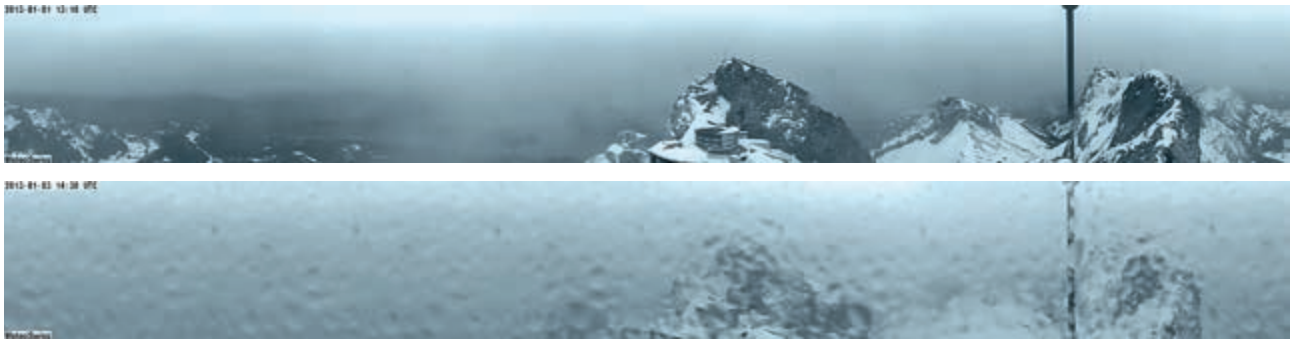
Promising results

With a view to evaluating the performance of the automated systems, MeteoSwiss and its partners compared the results of the four prototypes with the reference values of three traditional pollen traps. The results are encouraging. MeteoSwiss is striving to expand its pollen measuring network in the coming years with an automated system. However, it is still early days for the new methods and further developments and refinements are necessary. For this reason MeteoSwiss will continue with these activities in 2014 and promote innovation in the field of pollen count technology.

Pollen count forecasts are published at
> www.meteoswiss.ch and
> www.pollenundallergie.ch.

Learning from past weather

The more experience the computer gains, the better it works at searching for errors. MeteoSwiss is therefore developing intelligent methods that enable computers to learn to distinguish plausible from erroneous measured values based on their "experience" of past weather.



Every ten minutes panorama cameras provide a picture of the current weather. *Should visibility be obscured by water and ice on the lens, this can be detected automatically by a model-based quality control system. (Image: Pilatus)*

Reliable observation is a precondition for accurate weather forecasts and well-founded statements on climate change. This is why MeteoSwiss submits observation data to a strict quality control procedure. This would be impossible without computers since the network of automated surface weather stations, SwissMetNet, alone generates more than 1.3 million observation values per day.

On the way from the measuring device to the filing in the Data Warehouse, measured values undergo a multitude of rule-based tests. Non-plausible values are tagged. For instance, negative wind speed – a physical impossibility. Or an air temperature of 30 °C in January – climatologically highly improbable in our latitudes.

At certain stations, specialists monitor the computer's decisions. Should a certain measured value turn out to be actually wrong, it is corrected. If, however, there is a false alarm, the specialists remove the tags.

The tests within the test

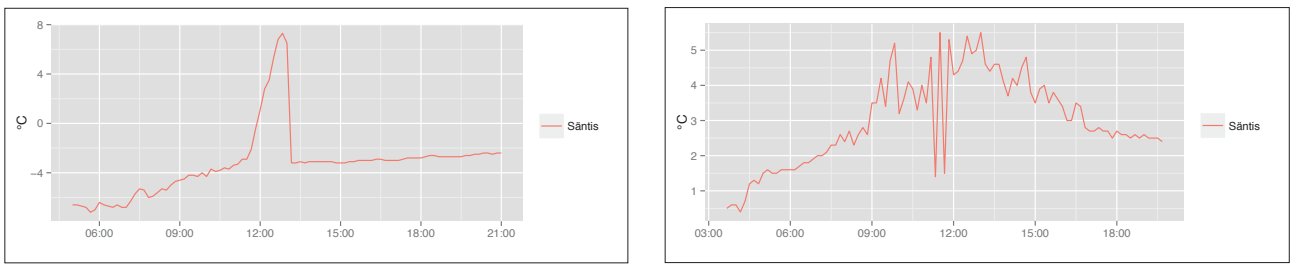
The evaluation of the rules shows how good the individual tests are. The result: simple rules that only examine one measured value trigger only a few false alarms but miss out on many measuring errors. By contrast, complex rules that compare several measured values, indeed find more implausible values but cause too many measuring errors.

Making computers more intelligent

This is why MeteoSwiss pursues a new approach in addition to simple tests: model-based quality control. Instead of specialists establishing a complex set of rules, the computer learns a statistical model of the past weather which enables it to examine the plausibility of each measured value. Outliers are tagged and can be examined by a specialist.

In contrast to rule-based tests, models provide a quantitative indication of how much a measured value deviates from a normal value. Another advantage is the fact that variables, such as weather camera images, for which it would be very difficult to find suitable rules can be modelled. At the end of the day, one single model may be able to replace several rule-based tests.

A model-based quality control system is still in its development stage and is only operational in test mode. Initial experience, however, is encouraging, as the tests conducted for temperature measurements as well as weather camera images have proved.

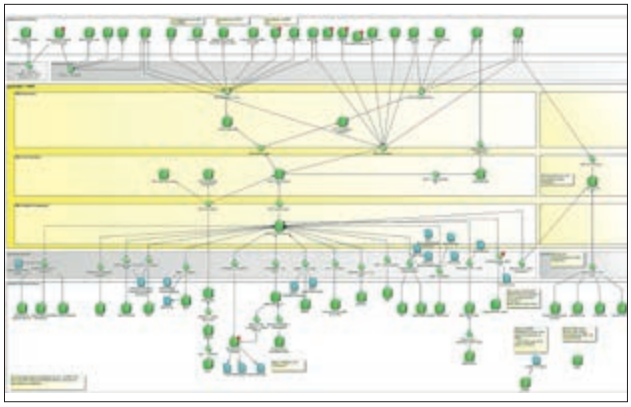


Observed air temperature on Säntis: *one single model recognises values which are too high and deviations which are not plausible.*

Short articles

Redesign of the weather data workshop

Around the clock MeteoSwiss observes the meteorological situation in Switzerland and evaluates measurement data. These activities are not only the basis for weather and climate forecasts but also for various products and services. It is a complex apparatus of business processes, data flow, applications, IT systems and technologies which makes this large range of products and services possible.



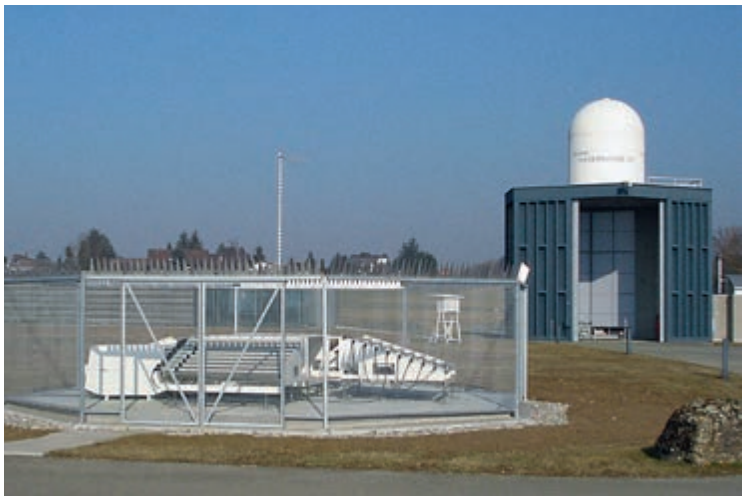
The weather data workshop is a complex apparatus *of business processes, data flow, applications, IT systems and technologies.*

MeteoSwiss closely examines this interaction in the project "Architecture of the Production Environment" which was launched in 2013. Specialist departments and IT have jointly established a planning basis with a view to redesigning the weather data workshop. Its aim is the systematic development of the production environment in a way to sustainably reduce its complexity by standardising certain elements and processes. With this project MeteoSwiss also seeks to lower its costs for development and operations.

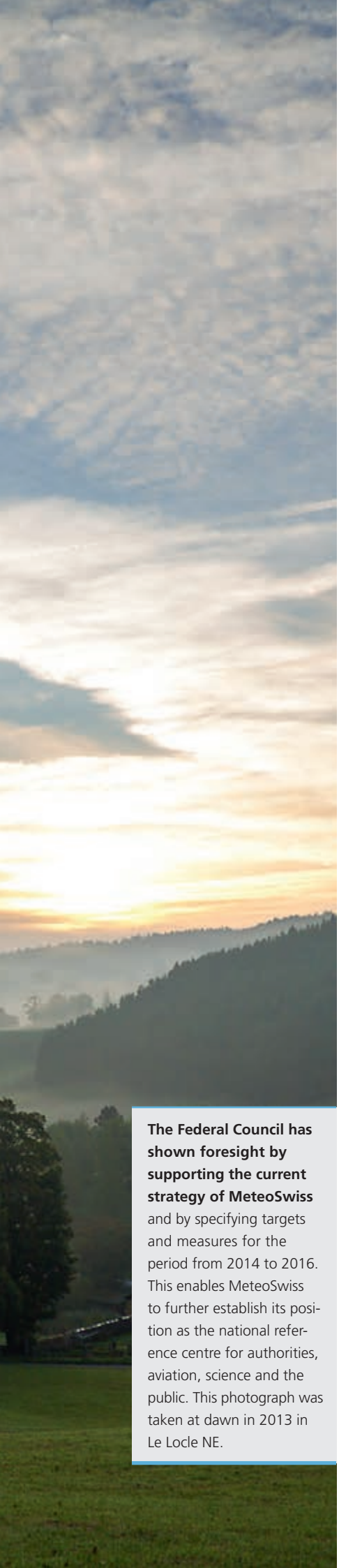
With the revision of its production environment MeteoSwiss remains true to its strategy and its performance mandate while responding to the needs of its customers and its various specialist departments. In future such architectural considerations will be anchored as a supporting element in product development, thus enabling MeteoSwiss to continuously and efficiently expand its range of products and services – for the benefit of its customers and the general public.

Volcanic ash in focus

At the end of April 2013, MeteoSwiss launched the project E-PROFILE in cooperation with the European National Meteorological Services (EUMETNET). Under the leadership of MeteoSwiss, 17 European weather services will build a common network for the monitoring of volcanic ash. In future this should facilitate more precise recordings and better forecasts with respect to the spread, altitude and density of volcanic ash clouds. This would particularly benefit the aviation industry since it is most immediately affected by the consequences of a volcanic eruption. E-PROFILE combines two measuring components: the first is the large number of wind radars which record wind conditions responsible for the horizontal diffusion of ash particles across Europe. The second are the over 200 laser-supported measuring instruments throughout Europe, so-called ceilometers, which detect aerosols and ash particles in the atmosphere. The vertical and horizontal spread of ash clouds can be deduced from these observations. With this project the Federal Office of Meteorology and Climatology MeteoSwiss is taking the lead in building a European observation network for volcanic ash particles.



Under the lead of MeteoSwiss 17 European weather services are building a network for *the monitoring of volcanic ash. So-called wind profilers record wind conditions which have an impact on the horizontal spread of ash particles.*



The Federal Council has shown foresight by supporting the current strategy of MeteoSwiss and by specifying targets and measures for the period from 2014 to 2016. This enables MeteoSwiss to further establish its position as the national reference centre for authorities, aviation, science and the public. This photograph was taken at dawn in 2013 in Le Locle NE.

Prospects are good for MeteoSwiss

MeteoSwiss is the national weather and climate service for Switzerland and an important partner in international cooperation. With a view to strengthening this position even further, MeteoSwiss pursues tangible goals, strategies and measures. These are anchored in the performance mandate.

As a Federal Office with global budget, MeteoSwiss receives a performance mandate from the Federal Council. This document defines the strategy, the required performance levels and targets as well as funding. The performance mandate is periodically renewed. In December 2013 the Federal Council set the targets and measures for the period from 2014 to 2016 and confirmed the current strategy. This strategy is built on a threefold foundation: differentiation, cooperation and optimisation of internal operations.

The strategy

MeteoSwiss is the national know-how leader in matters of weather and climate and enjoys an excellent international reputation. The Federal Office is totally focused on remaining the first contact for the authorities, science and aviation when it comes to providing reliable, spatially and temporally high-resolution weather and climate services. This requires a more differentiated public perception. Cooperation projects, both on a national and on an international level, are very important to achieve that. Together with other weather services, observation and forecasting systems can be further developed. Because weather does not stop at borders. Within the framework of research projects, MeteoSwiss creates, jointly with its partners, practical applications based on scientific findings. Such collaboration projects will become more frequent in future.

In order to remain at the forefront and to be able to do research in the field of technical innovation, the optimisation of internal processes is a must: MeteoSwiss is stepping up its efficiency by reflecting on its work processes and adapting them if necessary by means of automation and standardisation. An example is the relocation of MeteoSwiss headquarters to Zurich Airport: a step which reduces costs of infrastructure and makes use of operational synergies.

MeteoSwiss moves its headquarters *from Krähbühlstrasse, Zurich to Zurich Airport.*

The service portfolio is closely monitored and adapted to the needs of customers.

The targets

Following the strategic guidelines, several targets are defined in the Performance Mandate 2014–2016. This includes, among other things, ensuring that core operations run smoothly, that is, the collection, processing, verification and distribution of weather and climate data.

The basis for this is a well-functioning, failure-resistent measurement and data infrastructure. The renovation and expansion of observation networks has been in progress already for some years. In 2013 MeteoSwiss expanded the automated surface data network by over 40 stations and installed a new weather radar in the canton of Valais. This work will be completed between 2014 and 2016 with another 30 surface stations and a fifth weather radar in the canton of Grisons. Thus weather and climate will be monitored even more closely and with a higher spatial resolution in future. In order to efficiently process and reliably supply these data and the products generated from them, MeteoSwiss is considering the construction of an integrated data and information platform. It is on this platform that customers, partners and the public should be able in future to access the MeteoSwiss product range. This defines the internet as the main channel for obtaining information, data and warnings; MeteoSwiss therefore plans to strengthen its presence online, for instance, by means of a new website and the further development of mobile applications.

Liberalisation of data

One of the most ambitious targets in the Performance Mandate 2014–2016 is the liberalisation of data. The "Open Government Data" principle regulates the open access to official data and information. In 2012 the Swiss Parliament passed a motion to create the legal basis for free access to meteorological data. MeteoSwiss is now mandated to create the legal, financial and technical/organisational framework necessary for implementing the liberalisation of data.

Even though MeteoSwiss will lose income through the free-of-charge supply of data, the relevant liberalisation has a clear advantage: the use of this data will enhance economic benefits. There is great demand for meteorological data and products due to the increasing impact of weather and climate factors. The free access to data will bring many additional users to the Federal Office. Thus MeteoSwiss will establish itself even more firmly as the national reference centre and become the contact of choice for authorities, aviation, science and the public.

> The free access to data will bring many additional users to the Federal Office.

MeteoSwiss app is number one

Weather apps give everybody access to the latest weather developments anytime and anywhere. More and more people are using them. Most of these users rely on the MeteoSwiss app.

Persistent fair weather for the MeteoSwiss app: in Switzerland it is the uncontested number one in the field of free-of-charge weather apps running on iOS and Android. For months it has had the most downloads of all free apps available and in the annual rating of all free apps for iPad it comes third – behind Skype and Youtube. This success has surpassed all expectations.

Awarded "Best of Swiss Apps"

Since its launch in February 2013, over 1.5 million users have downloaded the MeteoSwiss app and have opened it 82 million times. 95 percent of this has taken place in Switzerland, but also in neighbouring countries. Even in Somalia, Greenland and Micronesia some people have accessed the app.

1.5 million downloads in less than a year – *demand for the MeteoSwiss App has exceeded all expectations.*

Gold for MeteoSwiss: *its weather app wins first prize in the category Public Affairs at the Best of Swiss Apps Award Night.*

With 4.7 out of 5 stars the rating in the App Store is excellent. Users appreciate the clarity, the speed and the precipitation animation. In professional circles, too, the MeteoSwiss app has been honoured: at the Best of Swiss Apps Award Night 2013 it was awarded first prize in the category Public Affairs.

Push warnings popular

Looking at the statistics for the first eleven months, one learns that users most frequently access the local forecast, followed by the precipitation animation, the forecast chart for the week, the current observation values and the danger map. In addition, many users have subscribed to the push messages for severe weather warnings. Thus in summer 2013 around 1.3 million push messages went out in a level-4 warning situation. This number is expected to grow in future while the total of downloads is still increasing. Those responsible for the app now reckon with over 2 million push messages per event. The public and the authorities in charge of the Confederation, cantons and communities have access to timely and active warnings thanks to this push channel of the MeteoSwiss app.

MeteoSwiss is not resting on its laurels and is developing the app further. A Windows version is in the pipeline for 2014. Other plans are for creating further possibilities of customising the app, higher resolution of local and wind forecasts and additional offers for specific customer segments. With these innovations MeteoSwiss is responding to the needs of users in order to provide them with the best possible weather service now and in future – and to remain number one.

Opportunities for Swiss industry

The construction and operation of weather satellites require the highest technical and scientific expertise. An ideal field of engagement for the highly-developed Swiss industry sector. In order to promote satellite programmes and potential contracts for the relevant industries, MeteoSwiss has organised the first EUMETSAT Swiss Industry Day.

EUMETSAT, the European Organisation for the Exploitation of Meteorological Satellites, is responsible for the operation of European weather satellites. As a member state, Switzerland contributes 3 percent to the cost of EUMETSAT and in return has access to all its data and products.

Within the framework of the current and planned satellite programmes, EUMETSAT regularly awards contracts to industry, for instance in the field of information technology. Swiss enterprises may also make bids for these tenders. In order to promote this opportunity and the better exploitation of economic potential, MeteoSwiss organised the first EUMETSAT Swiss Industry Day in June 2013, in cooperation with the State Secretariat for Education, Research and Innovation (SERI). The focus of this event was on the exchange of information and the dialogue between Swiss industry and EUMETSAT.

Presentation and personal contacts

Around 20 representatives of Swiss industry accepted the invitation and obtained information from EUMETSAT about its current and planned programmes. This included information on the follow-up programme of the polar-orbiting satellites, on which the member states will take a decision in the course of 2014. Contracts for the industry that might become available in this context were presented in detail to the participants. In addition, participants had the opportunity for bilateral discussions with EUMETSAT representatives.

Around 20 representatives of Swiss industry *took part in the first EUMETSAT Swiss Industry Day which was organised by MeteoSwiss.*

A successful première

Both the representatives of Swiss industry and EUMETSAT appreciated the event. Raoul Keller, General Secretary of the Swiss Space Industries Group (SSIG), said: "The Industry Day was important for me as a representative of SSIG since it offered me an insight into complex space programmes and gave me the chance to make direct contact with the decision makers of EUMETSAT." In future MeteoSwiss would like to organise similar events to promote exchange between Swiss industry and international organisations.

EUMETSAT presented *its current and planned programmes.*

Short articles

In the future meteorological stations may also be of interest to the energy sector. *In the context of an energy turnaround, the industry would like to know more about the relationship between weather and energy demand.*

Geologists yesterday, meteorologists tomorrow

Until recently meteorology was not of any great importance for the energy sector. Although the correlation between the weather and the consumption of electricity and heat has long been known, the issue was often treated in terms of gross oversimplification. With the expansion of renewable sources of energy things have changed. Within the context of the Energy Strategy 2050, MeteoSwiss has been commissioned by the Confederation to review its expertise and services for the energy sector, thus making an important contribution to securing supplies.

MeteoSwiss has contacted established and new agents of the energy sector in order to find out what their challenges are and what kind of weather information they might need to meet them. While any former cooperation was usually restricted to the supply of data, MeteoSwiss forged a close partnership with the energy sector in 2013 which has already yielded several projects aimed at providing more precise predictions for energy production and energy needs.

In addition, MeteoSwiss and the University of St.Gall are cooperating in an interdisciplinary Energy Competence Centre (SCCER) in order to jointly support the energy sector in its search for new business models. An innovative and interdisciplinary approach to finding marketable solutions is indispensable if energy supply security is to be guaranteed in the future as well.

Website makeover in preparation

After almost ten years in operation, the current MeteoSwiss website is no longer up to date: user guidance, barrier-free access, design and technical implementation have to be optimised and implemented in accordance with new requirements. The new MeteoSwiss website will be launched in the course of 2014. Work on the concept has been completed and the implementation process has started. Central to the design are the information needs of the Swiss public. MeteoSwiss will be focusing on a comprehensive menu of weather and climate information on its new website.

The aim is a site which provides easy-to-understand, dialogue-based answers to questions about weather and climate. The contents will be available in the three national languages German, French and Italian (often in English as well) and they will be accessible on many different terminal devices.

Key facts and figures 2013

In 2013 total income amounted to CHF 36.3 million which was CHF 2.4 million above budget. This was due to additional earnings in the product group Weather Forecast & Warning.

The financial year 2013 closed with expenditure of CHF 97.2 million that is, CHF 2.1 million below budget. The lower costs mainly due to a delay in the project MeteoSwiss Headquarters (move from the location Krähbühlstrasse to Zurich Airport).

Income statement in million CHF

	Account 2012	Budget 2013	Account 2013	Absolute deviation from the budget 2013	Relative deviation from the budget 2013
Earnings	**34.3**	**33.9**	**36.3**	**2.4**	**7.1%**
Funding received	25.5	23.5	26.4	2.9	12.3%
Internal services charged	8.8	10.4	10.1	–0.3	–2.9%
Funding not received	0.0	0.0	–0.2	–0.2	
Expenses	**90.2**	**99.3**	**97.2**	**–2.1**	**–2.1%**
Funding received, therefrom	63.4	68.6	70.6	2.0	2.9%
Personnel expenses	45.9	49.7	49.5	–0.2	–0.4%
Operating expenses	17.5	18.9	21.1	2.2	11.6%
Contributions to int. organisations	13.8	15.0	13.1	–1.9	–12.7%
Internal services charged	9.3	11.3	10.2	–1.1	–9.7%
Depreciation/provisions	3.7	4.4	3.3	–1.1	–25.0%
Balance	**55.9**	**65.4**	**60.9**	**–4.5**	**–6.9%**

Investments were below budget by CHF 2.3 million. This was due to delays in the projects MeteoSwiss Headquarters (move from Krähbühlstrasse to Zurich Airport) and Rad4Alp.

Capital budgeting in million CHF

	Account 2012	Budget 2013	Account 2013	Absolute deviation from the budget 2013	Relative deviation from the budget 2013
Capital outlays	3.5	4.2	1.9	–2.3	–54.8%

Staff structure

	Number of employees
Women full-time	49
Women part-time	68
Women total	117
Men full-time	177
Men part-time	71
Men total	248
Fixed-term	65
Unlimited	300
Total number of employees	**365**

Mother tongue

	Number of employees
German	237
French	91
Italian	32
Raetho-Romanic	1
English	1
Other	3

Education

	Number of employees
University	204
University of applied sciences	23
Higher professional education	22
Matriculation	11
Vocational education	95
No vocational education	1
Apprentices	9

Age structure

	Number of employees
Under 20	7
20 to 29	35
30 to 39	82
40 to 49	127
50 to 59	95
60 to 65	19

Outside the global budget MeteoSwiss paid contributions of CHF 13.1 million to international organisations and institutions, which was CHF 1.9 million below budget. The main factors for this were delays in a programme run by WMO (World Meteorological Organization), which resulted in lower contributions payable to WMO. In addition, funding requirements for the new EUMETNET programmes were lower than initially budgeted.

Contributions to international organisations in million CHF

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
WMO	1.4	1.4	1.4	1.5	1.5	1.4	1.4	1.4	1.6	2.0	2.2	2.2	1.9
EUMETSAT	14.0	12.7	10.9	10.7	10.3	10.3	9.0	7.9	8.9	10.1	9.8	8.4	7.9
WRC	0.8	0.8	0.8	1.1	1.0	1.1	1.1	1.3	1.3	1.3	1.3	1.4	1.4
EZMW	1.9	1.9	1.7	1.9	1.9	1.9	2.2	2.0	1.7	1.8	1.6	1.6	1.6
European Cooperation (EUMETNET. ECOMET)	0.1	0.1	0.2	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.2	0.3
Total	**18.2**	**16.9**	**15.0**	**15.5**	**15.0**	**15.0**	**14.0**	**13.0**	**13.8**	**15.5**	**15.2**	**13.8**	**13.1**

WMO	World Meteorological Organization (Geneva, CH)
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites (Darmstadt, DE)
WRC	World Radiation Center (Davos, CH)
EZMW	Europäisches Zentrum für mittelfristige Wettervorhersage (Reading, GB)
EUMETNET	Netzwerk Europäischer Wetterdienste (Brussels, BE)
ECOMET	European Cooperation in Meteorology (Brussels, BE)

Earnings were CHF 2.2 million above budget for 2013. This was due partly to additional contracts with the military. As a consequence the targeted cost-recovery ratio of 43% was achieved.

Cost and performance accounting in million CHF

	Account 2012		Budget 2013		Account 2013	
	Earnings	Expenses	Earnings	Expenses	Earnings	Expenses
Weather forecast and warning	6.8	26.4	6.5	27.0	7.1	29.5
Aviation weather service	19.1	19.1	19.2	19.2	19.1	18.9
Meteorological data	5.0	17.5	6.2	18.7	6.5	20.2
Climate services	0.2	9.3	0.2	9.4	0.3	10.5
Further services	3.2	2.5	1.8	1.5	3.1	2.3
International tasks	0.0	2.1	0.0	2.5	0.0	2.5
Total	**34.3**	**76.9**	**33.9**	**78.3**	**36.1**	**83.9**
Revenue to cost ratio		**45%**		**43%**		**43%**

MeteoSchweiz
Krähbühlstrasse 58
CH-8044 Zürich

T +41 44 256 91 11
www.meteoschweiz.ch

MeteoSchweiz
Flugwetterzentrale
CH-8058 Zürich-Flughafen

T +41 43 816 20 10
www.meteoswiss.ch

MeteoSvizzera
Via ai Monti 146
CH-6605 Locarno-Monti

T +41 91 756 23 11
www.meteosvizzera.ch

MétéoSuisse
7bis, av. de la Paix
CH-1211 Genève 2

T +41 22 716 28 28
www.meteosuisse.ch

MétéoSuisse
Chemin de l'Aérologie
CH-1530 Payerne

T +41 26 662 62 11
www.meteosuisse.ch