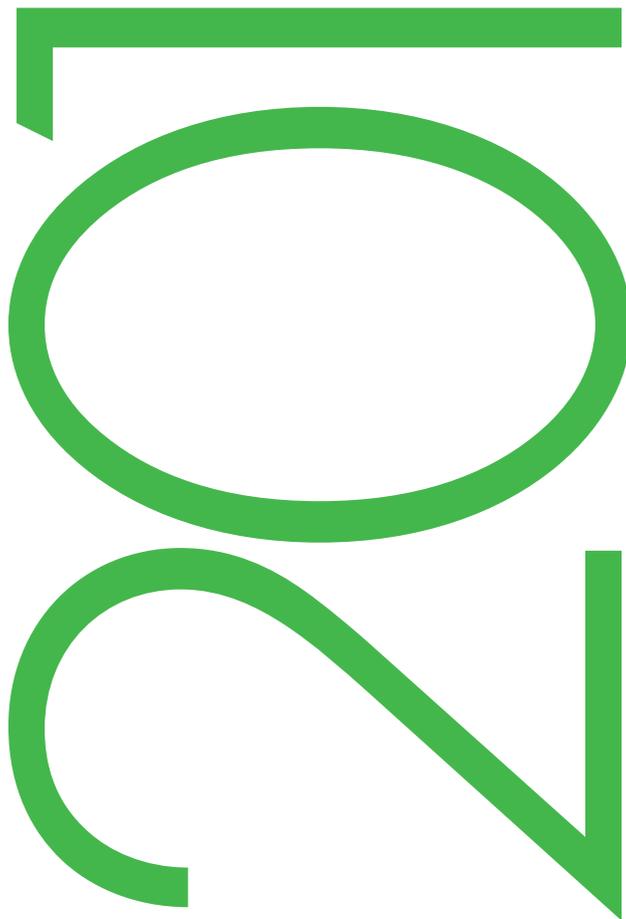


SUMMARY ANNUAL REPORT



**SMHI**

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# DIRECTOR GENERAL'S OUTLOOK



Photo: Fotofabriken - Niclas Kindahl

2018 was once again a year with new temperature records. March was the coldest month since 1962 in parts of western Norrland, May was the warmest month for 250 years in several places, and July was the warmest month ever for many parts of Sweden. The heavy spring floods in northern Sweden also exceeded some local records. SMHI had a long period with level 2 and 3 warnings. We can see that we deal with many extreme weather situations that greatly affect our community and the natural environment.

During the summer, the high temperatures led to droughts causing problems for farmers in large parts of the country. The summer fires put a lot of pressure on the Swedish community. For the first time, SMHI sent out meteorologists to the fire-stricken areas to assist the rescue leaders in their work. The extreme heat also affected large parts of northern Europe, showing that these problems are by nature not contained within national boundaries and therefore require transboundary solutions. The Director Generals of the meteorological institutes in Scandinavia and the Baltic compiled a joint article describing the seriousness of the situation and emphasizing the importance of continued collaboration for both weather forecasts and climate studies.

During the year, work has been completed on the IPCC special report on global warming of 1.5°C. SMHI is the national contact point for IPCC and has contributed both as author and reviewer of the content. When the report was launched in October, SMHI arranged a well-attended workshop together with the Swedish Environmental Protection Agency and the Swedish Energy Agency. The report concluded that it will make a big difference if global warming stops at 1.5°C and if we make sure that it doesn't reach 2°C. IPCC highlights out a number of effects of climate change that could be avoided. For example several hundred million fewer people will be affected by climate changes and increased poverty, heat waves and water shortages by limiting global warming to 1.5°C compared to 2°C or more.

We already know that climate adaptation of our society will be necessary and require significant resources, irrespective of whether or not we succeed in stopping global warming. Many sectors of society are faced with huge challenges, and it will be necessary to build up competence and invest heavily in order to carry out the work.

SMHI has for many years been the host of the Swedish National Knowledge Centre for Climate Change Adaptation. During the year, the government has changed the instructions to SMHI so that we will also be responsible for collecting and compiling the action plans from around 50 authorities which have been tasked with producing them every year. An expert group is also attached to SMHI,

with the task of evaluating the national work on climate adaptation.

The combined knowledge at SMHI is important for our work, providing services and products within meteorology, hydrology, oceanography and climatology. During the year we installed SMHI's first professor of climatology, Erik Kjellström. We will continue to recruit more professors.

During 2018, the meteorological cooperation work in northern Europe has taken several steps forward. Eight countries have previously been working together in project form with the goal of operational collaboration, and during the year two more meteorological institutes, from the Netherlands and Ireland, have been added to the group. This means that by the year 2027, 10 countries in northern Europe will work together on meteorological production in United Weather Centres. This work is a long-term strategy to be better prepared for the challenges we face.

SMHI has for many years had an infrastructure for data collection. We continuously invest in modernizing our infrastructure. Rapid technical advances and digitization have led us to develop new ways to collect data. For example any member of the public can now purchase their own fairly cheap weather station, and during the year SMHI has made it possible for these weather stations to report automatically to our systems. This means that we have access to much more data and that we can hopefully use this information in the long term to improve our forecasts.

During the year the government has given SMHI the chance of a longer rental agreement for our offices in Norrköping. Based on this decision we have reached an agreement with the property owner (Kungsleden) for a complete refurbishment and expansion of our premises making them attractive and fit-for-purpose. The renovation work will start during 2019 and should take about two years.

A review of activities at our offices in Upplands Väsby, Sundsvall, Malmö and Göteborg was carried out at the start of the year. Based on the final report I have decided that SMHI's meteorological production should be managed at three locations instead of the five we currently have. The activities in Malmö will be moved to Göteborg, and Sundsvall's activities will move to Norrköping. This means that our offices in Sundsvall and Malmö will be phased out. The office in Upplands Väsby will be moved to new premises within commuting distance from Upplands Väsby.

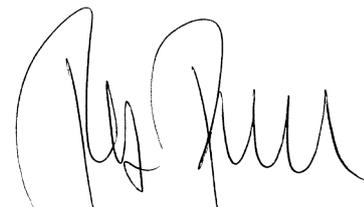
During the year SMHI has continued to strengthen the institute's presence on social media. We now regularly publish films of weather report before all major holidays and for significant weather events. We have also launched SMHI live on Instagram where employees take turns to use the account to describe their work for two week periods.

SMHI continues to receive high confidence ratings in all studies that have been carried out. We are ranked very highly for our position and reputation by both IPSOS and SIFO Kantars public surveys. This positive feedback is an acknowledgement that the services we provided are relevant and useful in several ways.

SMHI has continued to significantly increase turnover due to an increase of 15 million SEK to our government

grant, and continued growth within Copernicus. It takes time to build up a new department and recruit new staff, so we haven't yet been able to fully use the increased funds, and have therefore saved 6.7 million SEK of our grant. The accumulated result for our consulting services has also increased, which is positive. There are however still some challenges faced by SMHI's professional services, as there is strong competition. Our work with a long-term sustainable economy will continue to be important.

SMHI is an expert institute that contributes to improved public welfare in many ways. We work in a rapidly changing world, where new technical solutions provide us with new possibilities. At the same time we face many challenges caused by the constant changes and technical developments. Thanks to SMHI's scientific base, public confidence and gradual adaptation of the way we work whenever there are new requirements, we are able to continue to offer increasingly better public services.



Rolf Brennerfelt  
Director General

# CORE SERVICES

The Core Services department administers Sweden's meteorological, hydrological, oceanographic and climatological infrastructure. The department incorporates everything from measuring and collecting data to calculating, storing and processing them. Data is turned into statistics and information that can be used for important societal analyses, such as reaching national environmental quality goals. The services for forecasts and warnings provide the information needed so that action can be taken that directly affects vulnerable areas of society. Our work within climate change adaptation includes compiling and presenting information and knowledge. SMHI collaborates with other institutes, both national and international, and has been nominated as the national provider of aviation weather services. This department also manages SMHI's role as representative for Sweden for international organisations such as ECMWF (the European weather centre), WMO (UN's World Meteorological Organization) and EUMETSAT (the European Organisation for the Exploitation of Meteorological Satellites).

## **SMHI strengthened through Northern European collaboration**

The project NordNWP was started in 2015 by eight Nordic and Baltic countries with the aim of providing shared forecast calculations from the year 2022. This collaboration project gives more competence and better efficiency and quality, providing added value to society. During 2018 two more meteorological institutes were added as partners, from the Netherlands and Ireland, and the project was renamed United Weather Centres (UWC). In August the director generals of these ten meteorological institutes signed a Memorandum of Understanding, and the time plan for the project was changed so that there are now two separate phases. During phase 1, which will end in 2022, the work will be carried out by two parallel coordinated groups. One of the groups includes the already existing Metcoop (meteorological cooperation between Norway, Sweden and Finland), and will be expanded to include the Baltic meteorological institutes from Estonia, Latvia and Lithuania. The other group will be called UWC West and consists of the meteorological institutes from Denmark, Ireland, Iceland and the Netherlands, establishing an operational cooperation. After 2022 the project will enter the second phase where these two groups will merge into a joint operational production cooperation between all ten institutes by 2027.

## **Increased cooperation for warning services**

During the year SMHI has completed a pilot study together with representatives from a selection of central, regional and local authorities who have investigated a new way of working with weather warnings. This new method requires more input from different parts of society when making decisions for warnings, and warnings should also consider

the expected effect by the weather in a particular region. This new way of working means that the authorities in the areas affected are better prepared and affected citizens can be provided with better information. The project concluded that this work should be continued so that our warning service follows the results of the pilot project.

## **Continuously positive trend in monitoring of SMHI's forecasts**

New targets for weather forecasts and warnings have been used since 2017. Warnings for hazardous events (classes 2 and 3) are included in the evaluation. In the weather forecasts, accuracy is reported as a comparison between forecast and measured values for temperature, precipitation and wind speed for the current day (day 1) and day 5. The warnings for 2018 had an accuracy of 65 percent, which is slightly higher than the previous year. The accuracy of the temperature forecasts for day 1 and 5 is lower than previous year due to difficulties with predicting the cold winter as well as the heat wave during summer. The accuracy of the wind and precipitation forecasts for day 1 and 5 still has a positive trend.

## **Forecasts and education in SMHI's digital channels**

During the year SMHI has developed the weather content in SMHI's digital channels. A Twitter account was started, focusing on the current weather, with meteorologists updating the forecasts daily. SMHI also started producing weather films with forecasts over several days. The films have been published on smhi.se and also adapted for SMHI's social media channels. The films have been widely circulated, with many viewings on smhi.se. Several of the films have included interviews with the institute's experts who have explained a number of different weather phenomena.

## **Much needed modernisation of the observation network**

Thanks to the increased government grant SMHI has been able to modernize the meteorology, hydrology and oceanography observation network at a faster rate. This has been done with extra resources as well as by updating several observation networks simultaneously. About two thirds of the meteorological and hydrological stations have now been updated with new technology so that SMHI can fetch the data more frequently.

## **The UN Intergovernmental Panel on Climate Change, IPCC**

SMHI has continued as the national contact point for Sweden in the UN Panel on Climate Change (IPCC) and has represented Sweden at two policy meetings – in Paris, France and in Incheon, South Korea. The first meeting was combined with IPCC's 30th jubilee and focused on different solutions for the future financing of IPCC. The second meeting was held together with the governmental approval

of a scientific special report on Global Warming of 1.5°C which was requested by the Climate Convention at the UN climate meeting in Paris in December 2015. The report will be used to give policymakers the information they need to make decisions that tackle climate change and to widely strengthen the global response to the threat of climate change. As well as scientific and technical knowledge about possible development options and climate effects from 1.5°C of global warming the wider question of sustainable development is also addressed.

During the year SMHI has worked with increasing awareness for Sweden's climate experts about the ways they can contribute to the work of IPCC, both as authors and as reviewers of the various IPCC reports. SMHI has initiated a communicator network for IPCC, and collaborates with representatives from, for example, the Swedish Environmental Protection Agency, the Swedish Energy Agency, and the Ministry of the Environment and Energy, on issues concerning the special report. In addition, more information about the IPCC has been added on smhi.se. Sweden has also increased activity within the IPCC and now contributes to a number of working groups: synchronization of IPCC report cycles for climate negotiations, the future financing of the IPCC and the IPCC Gender Task Group, in which Sweden is joint chair together with Kenya. During the year SMHI has participated in a number of meetings and conferences to spread information about IPCC as an organization, its process and the ways of influencing IPCC work, but also to share the results from the special report on Global Warming of 1.5°C. When SMHI has arranged events they have been broadcast on the website and are available from smhi.se.

### **The Swedish National Knowledge Centre for Climate Change Adaptation**

The aim of the Swedish National Knowledge Centre for Climate Change Adaptation (Knowledge Centre) is to contribute to a society that is sustainable in both the current climate and in the future. Work is carried out to support Swedish climate adaptation while also providing expertise for international climate adaptation. The Knowledge Centre creates the prerequisites for good community planning and a sustainable and safe community, for the current climate and in the future. Work focuses on creating, distributing and making knowledge available to policymakers, leading cooperative activities and increasing awareness, involvement and knowledge in the community. Activities involve collecting, processing and presenting information, decision documents and methods as well as creating meeting places and forums within the community. The Knowledge Centre also has an expert role within the field of climate adaptation.

#### Increased awareness and knowledge of climate adaptation

The summer of 2018 was warm and dry, and the climate effects and climate adaptation was a frequently discussed topic. On several occasions the Knowledge Centre distributed material for news articles and reports to the daily press,

as part of the work with increasing awareness and knowledge. Around 20 articles were published on smhi.se, and the Knowledge Centre was mentioned in 120 different articles in the media during the year.

During 2018 a basic course in climate adaptation was organized for 40 participants, mostly from local and county councils. Evaluation of the course showed that it contributed to both increased knowledge as well as opportunities for collaboration and networking.

The Climate adaptation newsletter is sent out four times per year in Swedish, reaching 1054 subscribers. During 2018 the newsletter discussed topics such as the Nordic cultural heritage in a changing climate, securing landslides along the Göta älv river and climate change in relation to safeguarding electricity availability.

One of the main activities for the Knowledge Centre is to increase awareness through talks and presentations. 30 different communication activities were carried out during the year for different target groups.

#### Nordic conference for climate adaptation

In October the Knowledge Centre jointly organised the fifth Nordic climate adaptation conference which was held in Norrköping. The conference was hosted by SMHI, Norrköping city council and Linköping University. The conference was planned as a meeting place for exchanging ideas for climate adaptation and finding possible solutions in different sectors of society, by spreading the latest research and practical experience of climate adaptation, as well as through discussions on integrating measures to adapt and reduce emissions of greenhouse gases.

The conference gathered over 400 participants from 14 countries with representatives from local councils, regional and national institutes, researchers and businesses. Participants discussed and learned about climate adaptation for a broad range of sectors including food production, sea level rise, social equality, and enterprise. Over 93 percent of the participants who contributed the conference evaluation were very satisfied or somewhat satisfied with the conference as a whole.

#### International coordination

The Knowledge Centre also assists the government cabinet office with expertise on climate adaptation in different international contexts. During 2018 this has included participation in the European Commission Working group on Climate Adaptation, as well as being the point of contact for the European Environment Agency. The Knowledge Centre has been responsible for the climate adaptation section in Sweden's seventh national report under the United Nations Framework Convention on Climate Change. SMHI also has the role of implementation of the national strategy for climate adaptation through statute 2018:1428 concerning climate adaptation for authorities, and carried out preparatory work at the end of the year for its introduction on 1 January 2019.

#### Expert group for rising sea levels in Sweden

SMHI has established an expert function for rising sea levels in Sweden, with the purpose of increasing SMHI's ability to provide the best possible information for making decisions for Swedish society's adaptation to future sea levels. The function consists of a group of experts who particularly focus on current sea level and rising sea levels. This function also carries out research to meet Sweden's information requirements. During 2018 this expert group has helped to review the upcoming Special Report on the Ocean and Cryosphere in a Changing Climate, as decided by the IPCC. SMHI has also participated in conferences addressing coastal issues and climate change, and has also started to review SMHI's statistics for sea level.

#### Increased knowledge about water usage

SMHI has started to compile an analysis of Sweden's water usage. Better information about water usage is an important aspect of climate adaptation measures for the future climate which brings increased problems such as water shortage and droughts. The analysis includes water usage for drinking water, livestock, agriculture, and usage by power stations and industries. This work has been carried out together with relevant authorities including county councils, water management associations and the Swedish Agency for Marine and Water Management. These authorities were gathered for a workshop in November to discuss and agree the direction in which to continue the work, including methods for data collection and legal management of water usage.

#### Water shortage for surface water

During 2018 SMHI has produced material showing which areas are most susceptible to water shortage, and what could cause this. Water shortage occurs when the demand for water exceeds the supply, and in a warmer climate, less water is available in some parts of the country during certain times of the year, so it is important that society adapts to the change in climate. SMHI has made a summary of this information concerning water shortage and physical actions that can reduce surface water shortages. A report will be launched in May 2019, which can be used together with climate analyses for each county in Sweden.

#### **SMHI support for EU disaster preparedness**

SMHI participates in a project that provides information to the EU Emergency Response Coordination Centre (ERCC), which is responsible for providing information for catastrophes involving earthquakes, volcanic eruptions, floods, and severe weather. The information is then used to monitor and coordinate relief actions both within and outside Europe. This was run as a pilot project during 2017 and was put into operation in October 2018. SMHI works together with the European Weather Centre to provide flood forecasts and related information the ERCC.

#### **Continuing regular marine monitoring**

The monthly expeditions in the Baltic, Skagerrak and Kat-

tegat form a large part of SMHI's marine environmental work. Long, continuous sampling series are very important for analysing the environmental state of the seas surrounding Sweden. The work is usually carried out on board specially adapted vessels, and for the last few years SMHI has used the Finnish Research Institute's RV Aranda. Since Aranda has been under renovation during the year, SMHI used temporarily rented vessels from Finland and Denmark. However there have been serious supply problems for these vessels, and SMHI had to cancel three of the twelve planned cruises, including two during the summer, and another cruise had to be cut short. This means there is a gap in the time series, and data supply to the international sea conventions HELCOM and OSPAR has suffered. Even if most of SMHI's commitments have been carried out, the missing data from the extremely warm summer is significant.

After solving the problems with the rented research vessels SMHI was able to carry out monitoring as planned for the last three months. SMHI will now use RV Aranda until Sweden's new national research vessel RV Svea is ready for service in autumn 2019.

# RESEARCH

The research department develops knowledge needed by SMHI and the society. By using applied and problem-oriented research and development, SMHI tries to answer research questions within the fields of meteorology, hydrology, oceanography and climatology. The department also develops observation and modelling systems which are important tools for describing the variations in the weather, water and climate, in small and large areas, short-term and long-term. International cooperation is often necessary to support work with environmental goals, climate adaptation, and the global goals of Agenda 2030. Research gives SMHI a strong scientific foundation, building knowledge needed to meet the global societal challenges and contributing the best possible decision-making information to the community, both in Sweden and internationally.

## **Production of a new generation of climate simulations**

SMHI's production of new global climate simulations has now started after a long period of model development. They correspond to the goals of the Paris agreement and will also contribute the UN climate panel IPCC's sixth assessment report on climate change. Sweden is therefore contributing to an important milestone in the global work with increased knowledge about a changed climate. The climate simulations are coordinated and made available through CMIP6, the new version of the large international archive with climate simulations which SMHI is building together with a number of other contributors from all over the world. This makes it possible to compare results from different climate models and with different amounts of emitted greenhouse gases, including carbon dioxide, to the atmosphere. Through these simulations, society gains a better understanding of how the climate can change depending on the amount of greenhouse gases emitted and how society develops. It is also possible to study threshold effects and irreversible changes. The simulations can then be used as a foundation for new climate services that can also explain the results so that different areas of society can use them as decision-making tools to limit climate change, for adapting society to a changed climate and for research, as well as for following up the goals of the Paris Agreement and Agenda 2030.

## **Cooperation to lift African researchers internationally**

Cooperation between researchers in Sweden and Africa has been ongoing for many years, and continued in 2018 within the CORDEX framework for regional climate modelling. Coordination work supported by SMHI has trained climate researchers from four regions in Africa (western, central, eastern and southern) to analyse climate simulations. Researchers have highlighted specific issues regarding health, biodiversity, agriculture and hydrology in the different regions. They have provided increased input to society concern-

ing vulnerability, effects and adaptation to a changed climate. The climate researchers have also been trained in scientific writing, resulting in six scientific articles from African researchers in the UN climate panel IPCC's Special Report on Global Warming of 1.5 °C. Six researchers from the CORDEX network in Africa have also been selected as main authors for different chapters of the IPCC's coming Sixth Assessment Report, AR6.

## **Expansion of the European archive of climate simulations**

SMHI has been tasked together with eight subcontractors to expand the Copernicus programme's open archive to include detailed regional climate simulations for Europe. These detailed regional simulations are based on global simulations from the two latest versions of the large international archive of climate simulations, CMIP5 and CMIP6, and will form part of the Copernicus data service. The first simulations have now been delivered. Data from the archive can be used to compare the way the climate changes based on different emission volumes of greenhouse gases. Researchers are also better able to describe the uncertainties in the way the climate changes. The wide selection of regional climate simulations provides new possibilities to build climate services to make it easier for society to use the data. The project will continue until 2021.

## **Very high resolution climate simulations show extreme weather**

Together with five European national weather services, SMHI has formed a cooperation for climate modelling to develop an application of the weather forecast model Harmonie for very high resolution climate modelling (1-3 km), Harmonie-Climate. Very high resolution modelling requires access to a significantly greater calculation capacity on high performance super computers as compared to earlier high resolution modelling (12-15 km). Coordination between the institutes has led to the start of the first common climate simulations for Scandinavia during the year. In an experimental study in one of the EU Horizon 2020 projects, SMHI together with the Royal Netherlands Meteorological Institute has demonstrated the usefulness of the very high resolution by investigating precipitation for ten rainy summer months from the last 20 years to see the difference in precipitation if the climate had been two degrees warmer. The study shows that the increase in intensity of downpours would be doubled if a very high resolution model (1-3 km) was used for the calculations, compared to a model with lower resolution (12-15 km). This is one example of the increase in detail from using a very high resolution, which is necessary for describing extreme weather events such as downpours. The very high resolution information gives us new information about extreme weather events and forms a valuable foundation for adapting society to the extreme events that will become more common in a changing climate.

### **Hydrological models for water issues all over the world**

The ongoing climate changes and other global challenges affect water availability all over the world, giving consequences to both society and the natural environment. In order to meet these changes, information is needed for sustainable community planning and climate adaptation. SMHI has developed a global hydrological modelling system which covers all land areas globally, and which is called World Wide Hype. This provides a global perspective for water issues and creates opportunities for work and research around these questions throughout the world. The global model builds on the open source Hype, which is developed by SMHI. SMHI uses the model for both research and development projects, providing new knowledge and contributing to decisions for sustainable water management. During the spring, SMHI completed the version of the model that is used to produce global climate impact indicators for the Copernicus Climate Change Service. The climate impact indicators are published through an open web service and can be downloaded free of charge. They are now used in a number of climate adaptation studies in different parts of the world.

### **Research on the continued challenges for the Baltic Sea in a changing climate**

During the year SMHI has finished several international projects on the challenges to the Baltic Sea in a changing climate. The projects have been financed by the Bonus programme with national financing from the Swedish Research Council (Formas) and the Swedish Environmental Protection Agency. Together the projects have provided a lot of new knowledge about the way the Baltic Sea is affected by both climate change and developments in society. The results confirm previous studies and show that nutrient emissions from land will continue to cause problems with eutrophication in the Baltic Sea. The ecosystem will be affected; for example key species such as bladder wrack could disappear from the northern Baltic. There will be a drastic reduction in areas where cod are able to breed. Climate change will affect development, but the international agreement to reduce the nutrient load, the Baltic Sea Action Plan, will improve the sea environment even in a changing climate. The changes that have already occurred in the Baltic Sea, such as warming, acidification, eutrophication and hypoxia, could occur in other coastal areas in the world oceans. The Baltic Sea can then be used as a model when planning what actions to take. Knowledge is important in the decision processes in all Baltic countries to create sustainable conditions for the sea and the societies around it.

### **High marks for SMHI's air quality model**

Poor air quality is still a big problem in Europe. It can lead to increased mortality and negatively affects crops and the ecosystem. The regional dispersion model Match can be used by SMHI to calculate low level ozone, deposition of nitrogen and sulphur, and air-borne particles over Europe.

A European cooperation has evaluated nine air quality models, including SMHI's model, in order to evaluate the ability to capture observed trends in air quality during the period 1990-2010 and to study how emission fluctuations, long distance transport from other continents, and variations in the weather have contributed to the changes. SMHI's model satisfies the international requirements for the model quality and is one of the better models in the comparison. Quality controlled models are an important tool for developing effective strategies for improved air quality.

# PROFESSIONAL SERVICES

The professional services department provides branch-specific and customer integrated services to the community. The services are based on experience and expertise from all of SMHI's areas of competence, combined with cooperation with external partners. The customer benefits are increased security, sustainability and more confident decisions, both in Sweden and internationally. During the year we have developed and adapted our work within several fields. The goal is to further increase our capability to benefit our customers' activities. A number of sales areas have shown good improvements in results, while others are still being restructured. Further work is reviewing how profitable certain sales areas are. We are also campaigning to further establish SMHI in international development work.

## **Winter road forecasts for the Swedish Transport Administration**

SMHI continues to deliver winter road condition forecasts to the Swedish Transport Administration, focusing on snow clearance and ice management. This work contributes to fewer accidents, as well as to a more sustainable and environmentally friendly way of maintaining roads in winter.

SMHI delivers forecasts so that the Transport Administration has time to take action, reduce the risk of skidding and plan for better use of resources. In addition to forecast services during the whole year, with increased production during the winter half year, there was significant focus on training. SMHI's meteorologists trained the entrepreneurs and traffic controllers at the Transport Administration, teaching them about meteorology and icy weather.

SMHI holds daily weather conferences with the different traffic control centres on both regional and national levels. The traffic control centres control all train traffic and manage disruptions that can be caused by technical faults or extreme weather events. During the year the Transport Administration has also asked for seasonal reports that summarise the weather for specific periods.

## **Significant environmental gains from replacing wood burners**

Small scale wood burning is a significant source of benzo(a)pyrene and particles in the outside air in Sweden. Since the emissions occur where people live, there is significant exposure with consequences for public health. During 2018 SMHI was commissioned by the Swedish Environmental Protection Agency to calculate the dispersion of benzo(a)pyrene and PM2.5 particulates from small scale wood burners in residential areas in Skellefteå, Strömsund and Alingsås. These areas have been identified in a previous preliminary evaluation as having high levels of benzo(a)pyrene. Calculations were made using different assumptions about wood burning habits and were compared with the monitored values. The calculations showed that in order to satisfy the fresh air environmental monitoring target, significant emission reductions were needed from small scale

wood burners. However the calculations also showed that this could be achieved if old wood burners were replaced with environmentally approved wood burners. The results of the project are an important start for the governmental task assigned to the Environmental Protection Agency to study and analyse emissions from small scale wood burners. This task will be presented in February 2019.

## **The effect of air traffic emissions on the environment**

Air pollutants have a negative effect on the ecosystem and on human health, leading to extra costs for society. There has previously been a lack of information about the geographic distribution of aircraft emission at different altitudes in Swedish air space. At the request of the Swedish National Road and Transport Research Institute (VTI), SMHI calculated the effect of air traffic emissions in Swedish air space on the environment. Information has been produced by SMHI using calculation models designed to handle large volumes of data and complex relations, and contributes to VTI's calculations of marginal costs for air traffic. SMHI had to develop a new method for calculating geographical and vertically distributed emissions from aircraft. The emissions were then used as input to the regional dispersion model Match which is part of the Match Sweden system, a national system for compiling the transformation, transport and fallout of air pollutants in Sweden. This new method will be used for Sweden's reporting of emissions in the air according to the UN air convention.

## **Electricity trading based on weather data**

Successful electricity trading needs continual updates of the latest weather forecasts. Electricity prices are controlled more and more by weather parameters, as wind and solar energy increases, and since the electricity grids are connected throughout Europe. SMHI systems can deliver the latest information in seconds. Specially developed products can recalculate the meteorological and hydrological parameters into energy terms. Experienced meteorologists and hydrologists process the weather data to give added value where they can express the most likely weather developments in the short term (days) and in the longer term (months). For several years SMHI has cooperated with Montel, a Norwegian information company that provides the electricity industry with information. Together, models have been developed that forecast electricity prices. In order to provide better and more relevant weather information to the electricity market, Montel started a subsidiary, Energy Quantified, which together with SMHI has created a web service for following the latest meteorological and hydrological forecasts.

## **Continued investments for shipping**

SMHI guides ships around the clock and all over the world, aiming to provide the safest and most energy efficient transport. During the year SMHI has adapted its customer systems so that they satisfy the EU requirements for carbon

dioxide emission – a step towards compiling and reducing marine traffic emissions. During the year the EU project Sea Traffic Management (STM) ended, led by the Swedish Maritime Agency, aiming to improve safety, reduce environmental impact and increase efficiency at sea by sharing information with new smart services. SMHI contributed to the STM project with practical user support to accurately predict arrival times using weather forecasts, based on a combination of several model calculations. SMHI can see great potential in the increase in openness that STM is aiming for: more participants sharing information for improved efficiency and safety. The project has agreed on a standard format which is important for sharing information about routes between different parties.

### **Improved product for ground bearing capacity for more efficient forestry**

The SMHI Timbr service has been developed based on the forestry industry's need to reduce ground damage and carry out more efficient and sustainable forestry. SMHI Timbr aims to provide the forestry industry with forecasts of the ground bearing capacity in a forest. The forecasts are then used for planning purposes in order to avoid transport damage by working in the right place at the right time. During 2017 SMHI and the forestry corporation Stora Enso started working together on ground bearing capacity at the sites where the forecasts are used. SMHI Timbr calculates the ground bearing capacity and creates an index combining SMHI data with forestry data to create a digital service that can easily be used for planning tree felling. During the year this cooperation intensified and Stora Enso will be using SMHI's service for 18 months for the majority of timber production in Sweden. During this test period SMHI and Stora Enso have identified and jointly prioritized a number of new functions that will improve SMHI Timbr as well as adapting it to Stora Enso's production process.

### **Developmental support to Ethiopian sister institutes**

Starting from this year SMHI has been given the task by the Swedish International Development Cooperation Agency (Sida) to spend 3 years on strengthening the institutional capacity for SMHI's Ethiopian equivalents for weather and water. As well as the national weather and hydrological institutes, the work will include three water district institutes as well as the Ministry of the Environment. The work will focus on weather, hydrology and climate information as well as the IT infrastructure in order to improve operational services in Ethiopia. SMHI is responsible for developing the forecast and warning systems, climate analysis, and the infrastructure around these services. The purpose is to help the Ethiopian institutes so that they have better information and tools in order to be able to analyse relevant river flows and their development, or climate changes and their effect on future water resources. Improving communication between the institutes is also an important aspect.

# FINANCIAL PERFORMANCE

## Income statement - (EUR 000) 2018

Exchange rate - Average rate for the current year	10,2567
<b>Operating income</b>	<b>85 481</b>
Personnel expenses	-42 293
Premises expenses	-2 630
Other operating expenses	-34 958
Financial expenses and amortisation	-3 052
<b>Operating expenses</b>	<b>-82 933</b>
<b>Surplus/deficit of the year</b>	<b>2 547</b>

## Balance sheet - (EUR 000) 2018

Exchange rate - Closing rate on 31 December 2018	10,2753
<b>Non-current assets</b>	
Intangible assets	2 004
Tangible assets	9 845
<b>Total non-current assets</b>	<b>11 849</b>
<b>Current assets</b>	
Inventories	282
Receivables	22 785
Cash and cash equivalents	9 262
<b>Total current assets</b>	<b>32 328</b>
<b>Total assets</b>	<b>44 177</b>
<b>Equity and liabilities</b>	
Equity	5 309
Provisions	752
Liabilities	38 116
<b>Total equity and liabilities</b>	<b>44 177</b>



SMHI plays a vital role as a reliable expert authority. Thanks to our robust knowledge of weather, water and climate, we contribute to a more sustainable society.

We collect vast amounts of data which we process, model and visualize based on different scenarios. We monitor global developments and use our own research to build and disseminate knowledge and services that are rooted in science. We evaluate, analyse, forecast and conduct follow-ups. Every hour of every day, all year round.

That is why we can promise you up-to-date decision support that facilitates short and long term planning – from recreational hikes to future infrastructure. Our support helps society achieve the Swedish environmental quality goals and manage tomorrow's global challenges.

SMHI. Always the best support for your decisions.



**SMHI – SWEDISH METEOROLOGICAL AND HYDROLOGICAL INSTITUTE**

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