

A photograph of a wet road at dusk. A street lamp on the left illuminates the scene, casting a warm glow. The road is wet, and a large puddle in the foreground reflects the lamp and the surrounding trees. The background shows a line of trees and a clear sky.

SMHI 2009

SWEDISH METEOROLOGICAL AND HYDROLOGICAL INSTITUTE

DIRECTOR GENERAL'S OUTLOOK

I am convinced that the need for knowledge on the part of the public, authorities, politicians, researchers, and companies is a crucial factor upholding the high quality of our work. It spurs us on in developing the methods and models used.

Considerable effort has been made to increase the quality of our forecasts. This includes the development of models for high-quality forecasting for small areas and the ability to interpret the model results. High-resolution models demand enormous computing capacity, which comes at a high cost. Accordingly, we cooperate with the National Supercomputer Centre in Linköping as well as with the European Meteorological Institutes.

CLIMATE EXPERTISE IN DEMAND

The climate issue is a major focus, and SMHI is in demand as an expert possessing authoritative knowledge. By means of national and international cooperation, climate models and advanced decision support have been developed. We have also received a commission from the Swedish Research Council to ensure that data from Swedish climate and environment research are stored and made available on a long-term basis. On commission from Swedish International Development Cooperation Agency (Sida), SMHI provide climate education to participants from developing countries.

RENEWED WEBSITE

The upgraded website, www.smhi.se, serves as a portal to SMHI's extensive knowledge of climate, weather, and

water. Detailed weather forecasts are available via this portal, which is subject to ongoing development.

WATER MODELS AND DATA MADE AVAILABLE

In recent years, SMHI has been an important partner in building a production system for water management in Sweden. In this area, a productive combination of our fields of expertise contributes to fulfilling the Swedish Environmental Objectives.

COMPETENCE IN TIMES OF CHANGE

A high retirement rate causes loss of institutional knowledge, but the addition of many new employees brings a new, extended range of competence to SMHI. New products, increased product quality, and partnerships are all parts of our strategy. Ongoing development in accordance with employer and customer demands is the way forward.

Lena Häll Eriksson
Lena Häll Eriksson,
Director-General

ORGANISATION

RESEARCH

CORE SERVICES

LEGAL ADVISOR
COMMUNICATIONS
BUSINESS DEVELOPMENT
MANAGEMENT SYSTEMS

HUMAN
RESOURCES

DG

FINANCE

BUSINESS &
MEDIA SERVICES

IT

ENVIRONMENT &
SAFETY SERVICES

CLIMATE

The climate issue is the focus in various ways. SMHI provides expert knowledge, research, and information both nationally and internationally. In cooperation with central and local authorities as well as other actors, prerequisites are created to meet societal needs for support.

SMHI provides expert support to Swedish delegations in international climate contexts. SMHI also contributes to Sweden's national reporting to UNFCCC, providing information on present and future climate change in Sweden and on the state of climate research and systematic climate monitoring.

GLOBAL AND REGIONAL CLIMATE MODELS

Since the mid 1990s, SMHI's Rossby Centre has produced future climate scenarios. Regional climate models have been developed as the main tool with which to study the climate system and its processes.

A global climate model, EC-Earth, is now developed by a consortium of research groups from several European countries. The model increases our ability to analyse how global and large-scale climate processes influence the regional climate in Europe and Sweden.

STAKEHOLDER COMMUNICATION AND SUPPORT

A vast material of climate scenarios and observational data has been produced and made available to both Swedish and European stakeholders. Ongoing stakeholder discussion of the need for decision support has prompted SMHI to initiate communication between

users and researchers in various fields. A special target group is the County Administration Boards in Sweden.

Climate information, data, products, and services are available via a common portal at www.smhi.se. Data concerning a range of variables and climate scenarios can be easily downloaded via a map application.

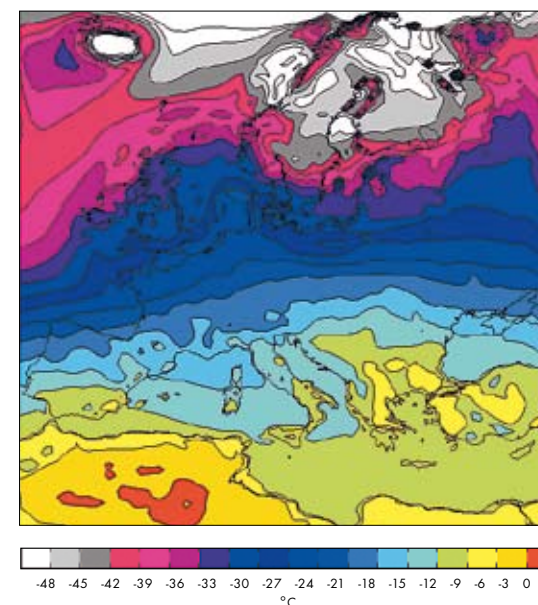
There is also a web portal, developed to support local and regional authorities in climate change adaptation efforts. This work is the result of cooperation between seven national authorities.

SMHI hosts the portal for the Swedish IPY Data Centre. It presents information and access to data from Swedish research conducted as part of the International Polar Year programme. A new national resource is also being built to store and make available data from Swedish climate and environmental research. Both resources have been commissioned by the Swedish Research Council.

SMHI Business Services offers expert lectures as well as consultancy support on climate change issues.

Extreme climates from a 100,000-year perspective

Changes in climate from a 100,000-year perspective have been examined using climate models, indicating a great temperature difference between colder and warmer periods. During winters, differences up to 40 degrees are indicated. This project represents cooperation between SMHI, KTH Royal Institute of Technology, Lund University, and Stockholm University, commissioned by the Swedish Nuclear Fuel and Waste Management Company (SKB).



The map shows calculated differences in winter mean temperature between the ice age of 200,000 years ago and a warmer climate 6000 years from now.



MADELEINE MÅNSSON, METEOROLOGIST

The Meteorological Forecast and Warning Service provides general weather predictions to bolster preparedness for rescue service needs. Severe weather, nuclear energy failures, oil spills, or forest fires are all events when accurate weather forecasting is important. For the public, this service is mostly known for the weather reports broadcast on the radio and for weather information provided via the Internet.

FORECASTS

SMHI provides forecasting and warning services in meteorology, hydrology, and oceanography. This work is ongoing, and SMHI has 24/7 preparedness for emergencies. In addition, SMHI is developing various decision-support tools for operations and businesses depending on water and weather.

Verifications of forecasts and warnings indicate that model development leads to better forecast quality. Development efforts are focused on achieving more accurate and detailed forecasts, both geographically and temporally, and on providing customised and easily accessible information.

ADVANCED MODELLING SYSTEMS

The regional weather prediction model, HIRLAM, is using a recently developed advanced four-dimensional analysis system. This system optimises the use of various observations in making calculations for 0–48-hour forecasts.

For longer-range weather predictions, forecasts from the global model at the European Centre for Medium-Range Weather Forecasts (ECMWF) are used. SMHI is actively involved in developing this model, together with about thirty European countries. Improved use of and access to satellite data from the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) and other satellite operators have contributed greatly to improved forecasts.

Greater demand for accuracy and modelling detail require more precise physical and mathematical descriptions. A new, very-high-resolution forecasting model,

called HARMONIE, developed as part of an international cooperation effort, is now being tested.

A first in Europe, SMHI's hydrological forecast service uses probability forecasts. Intense cooperation with rescue services and county administrative boards is initiated when emergency warnings are issued.

DISASTER PREVENTION AND NATURAL HAZARDS

Modelling tools and operational service to simulate oil spills at sea are supplied by SMHI. This enables fast and correct action to be taken to prevent and mitigate disasters.

SMHI is involved in a European project to provide improved marine services, forecasts, processed satellite data, and in-situ observations to users. The project links research and operational oceanography.

Sweden has a national platform for work on natural hazards, and SMHI is an active national authority in the platform. SMHI also takes part in the activities of Global Monitoring for Environment and Security (GMES), an important European programme for monitoring the environment and improving security for citizens.

REGIONAL COOPERATION

The Nordic Meteorological Institutes cooperate on aviation weather forecasting, regarding both new products and education. Several ongoing projects are seeking to improve the tools for aviation weather forecasting.

SMHI leads an EU project to facilitate the exchange of weather radar data in the Baltic region. The project also aims to develop high-quality and easily accessed local information using common methods and a common interface.

ENVIRONMENT

SMHI helps Sweden achieve its environmental objectives by producing meteorological, hydrological, oceanographic, and climatologic information for decision makers. SMHI's research includes the development of tools integrating land, water, and atmospheric processes.

Information from SMHI is used in efforts to improve the Baltic Sea and North Sea environments, the air environment in population centres, and the management of Sweden's lakes and watercourses.

THE BALTIC SEA STATUS

The environmental status of the Baltic Sea is followed by monitoring indicators, such as yearly runoff to the Baltic Sea, oxygen development in bottom layers, winter access to nutrition to enable the spring algal bloom, and algal development in summer. Algal blooms are monitored with the help of satellite imaging.

There is a natural shortage of oxygen in the semi-enclosed Baltic Sea due to a lack of water exchange with the North Sea, a situation that has worsened in recent years. A contributing factor is eutrophication.

CLIMATE CHANGE AFFECTS THE BALTIC SEA ECOSYSTEM

The Baltic Sea's environmental problems are partly due to oxygen shortage in the deep basins and eutrophication. Added to these problems, the Baltic Sea is one of the fastest warming seas worldwide. Higher temperatures change the sea ice extent, primary production, and oxy-

gen status. These processes are studied using measurements, analyses, model development, and calculations. To study the effects of climate change on the ecosystem, model systems must couple physical, chemical, and biological processes.

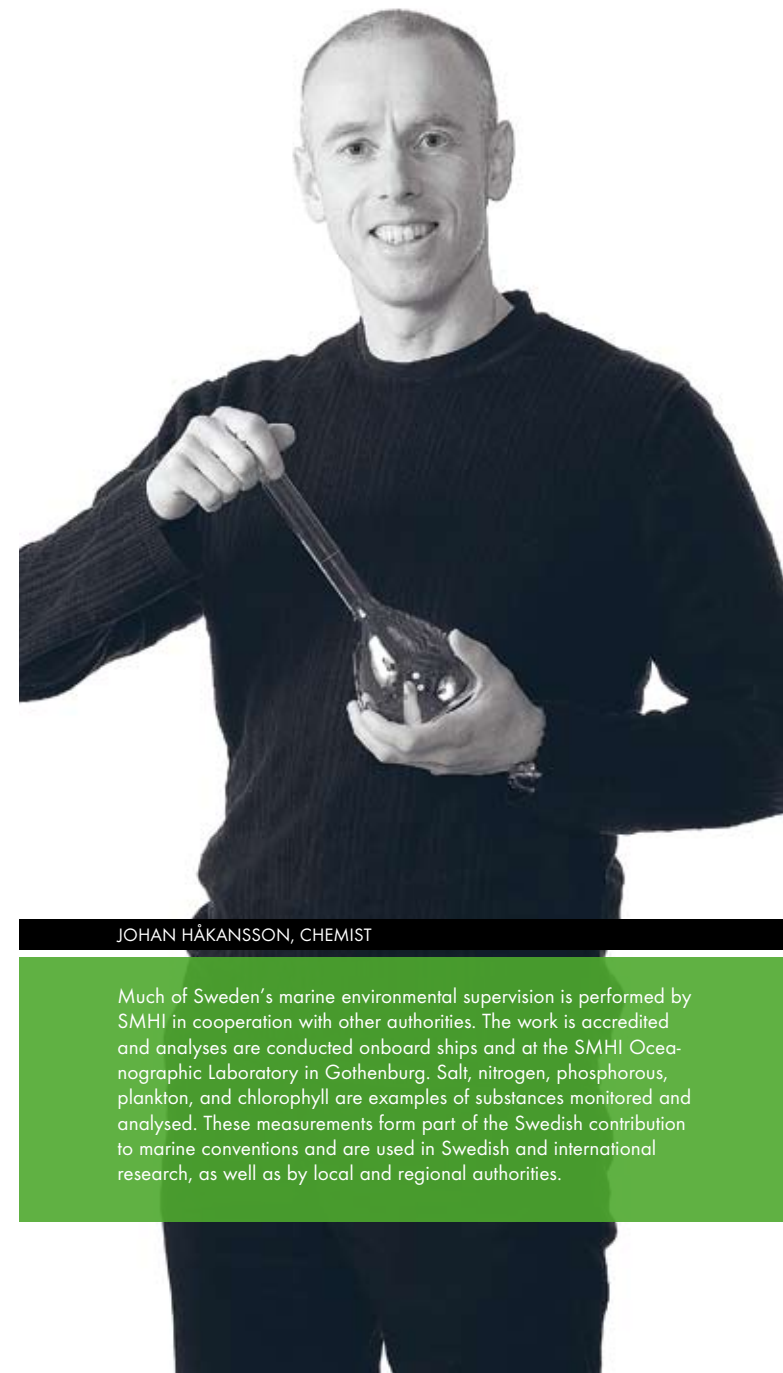
SMHI participates in a number of projects to address the urgent need for policy-relevant information. These projects examine the combined future impacts of climate change and of industrial and agricultural practices in the Baltic Sea catchment on the Sea's ecosystem.

SWEDISH OCEANOGRAPHIC DATA CENTRE

National and regional oceanography and marine biology data are hosted at SMHI, commissioned by the Swedish Environment Protection Agency. Coastal data are also available via the SMHI website. All these data are freely available via the Internet.

FOCUS ON THE ARCTIC

SMHI participates in many efforts to improve our understanding of processes affecting Arctic Sea ice and the actions needed to promote the sustainable development of the Arctic. The research and cooperation activities around the Baltic Sea are used as examples of what can be achieved in the Arctic.



JOHAN HÅKANSSON, CHEMIST

Much of Sweden's marine environmental supervision is performed by SMHI in cooperation with other authorities. The work is accredited and analyses are conducted onboard ships and at the SMHI Oceanographic Laboratory in Gothenburg. Salt, nitrogen, phosphorous, plankton, and chlorophyll are examples of substances monitored and analysed. These measurements form part of the Swedish contribution to marine conventions and are used in Swedish and international research, as well as by local and regional authorities.



CHANTAL DONNELLY, RESEARCHER

Methods for calculating water flows and water quality are being developed at the Hydrological Research Unit. The same methods that are used for the Swedish water administration can be applied in other areas. For example, a concept is being developed for modelling coastal runoff on a European scale.

WATER MANAGEMENT PARTNER

SMHI is an active partner in Sweden's water management. A major initiative has been taken to form an operationally reliable, quality-assured information and production system accessible via the Internet.

The various parts of SMHI's hydrological and oceanographic production systems are being adapted to Sweden's water management requirements. The work involves creating, managing, and making available information, data, and modelling tools covering all of Sweden with sufficient resolution to capture water occurrences.

HIGH-RESOLUTION HYDROLOGICAL CALCULATIONS

Water management needs increasingly detailed information on water quality and water flows for individual lakes and watercourses. SMHI has developed a new hydrological model, S-HYPE, for calculating water flows with a very high level of geographical detail. For each area, water flows, soil moisture, snow depth, and other variables are calculated. Nitrogen and phosphorous turnover in soil, groundwater, and watercourses can also be calculated.

OBSERVATIONS ARE NECESSARY

SMHI has access to approximately 600 stations. A new network of 50 mobile hydrological stations is being created, spread equally among Sweden's five water administrative areas. A web-based system is also being developed for reporting observation data from the public. These data are stored and used to improve the quality of model results.

Human activities influence and load watercourses, lakes, and seas, so the "human factor" must be taken into account when making calculations. Together with other authorities, SMHI has formulated a proposal for a database to serve users' future information needs. The register of dams in Sweden has also started to be updated.

AIR ENVIRONMENT STATUS

Clean air is a prerequisite for sustainable development. SMHI develops and uses various models to examine air pollution on the local, urban, and regional scales. These models are combined with meteorological forecasts to produce air quality forecasts of atmospheric particles and gases. Calculations using the web-based SIMAIR modelling system provide a good opportunity to examine the generation and dispersion of air pollutants in all parts of Sweden. This system is also applicable to other regions.

Air pollution is still a major problem in Europe. A web service, SMHI's MATCH Air Quality Forecast and Information System (MAQS), provides online air quality forecasts for Europe. MAQS is the result of many years of European collaborative research into modelling chemical transport/atmospheric dispersion and air quality.

BUSINESS SERVICES

Product development is a prioritised area. The aim is to increase customer benefits, which in turn can lead to lower environmental impact, promote climate change adaptation, and increase energy efficiency. Various related partnerships are in progress.

SMHI Business Services have done well in areas delivering qualified decision support, despite the economic recession.

MARKET DEVELOPMENT

Climate change issues, the risk of flooding in particular, have been behind much of the demand for SMHI's services and products. There has been increased interest in multiple factor analyses as decision support.

As well, the EU demand for greater energy efficiency in the housing sector has increased interest in weather forecast-driven heating.

Greater demand for customer-specific applications is a general trend. SMHI is continuing to work in line with the WeatherSync® concept, synchronising customer activities with the effects of weather and water conditions.

ENHANCED QUALITY EFFORTS

Competition on the weather forecasting market is increasing. SMHI strives to produce high-quality products that confirm its position as a reliable actor. For example, SMHI produces a web-based verification tool for energy forecasts, wind energy prognoses from wind forecasts, and customised weather information for road and track maintenance.

User-friendly interfaces are more important than ever. SMHI uses advanced visualisation techniques to meet customer needs, for example, in assisting land operators and maritime captains choose safe and optimal shipping routes.

DOWNSCALED CALCULATIONS

Higher-resolution models and calculation tools make it possible to present more detailed decision-support material. One example is the modelling of wind loading on buildings and structures, to facilitate calculation of material supply and stability as well as comfort around the buildings. Another example is air quality, where calculations are currently made on detailed scales down to the road crossing level.

PARTNERS IN COOPERATION

SMHI cooperates with various actors to increase product usability, reach new markets, and strengthen market position. Cooperation partners include the aviation weather service providers in the Nordic countries, the Gulf Agency Company for vessel guidance, and the If Group insurance company.

INTERNATIONAL COMPETENCE BUILDING

SMHI supports competence development worldwide in its areas of operation. Collaboration projects with the Botswana Weather Service have been running since 2006, and international courses on climate change and air quality are offered with the help of funding from the Swedish International Development Cooperation Agency (Sida).



ANDREA DE ANGELIS, SERVICE DESIGNER

To produce good services, user needs must be the focus. SMHI customers demand modern visualisation techniques, good service design, and intuitive interfaces for services and products. Our service designer analyses the user's internal processes, identifies and creates new needs, simplifies routines and changes behaviour. Everything is done with a focus on customer satisfaction.

About SMHI

The Swedish Meteorological and Hydrological Institute (SMHI) is a government agency operating under the auspices of the Ministry of the Environment. An expert organisation in the fields of meteorology, hydrology, oceanography, and climatology, SMHI aims to provide social benefits by increasing safety, and fostering a more sustainable society.

Air and water are crucial to life on earth and to the environment. Knowledge and advanced information let us meet the challenges presented by our climate, weather, and air and water conditions.

SMHI manages and develops information that provides knowledge and advanced decision-making information for public services, the private sector, and the public. General forecasts and weather warnings, industry-specific services, simulations and analyses, statistics, climate studies, and contracted research are just a few of its many services. SMHI's national and international cooperation is extensive as well.

SMHI operations are funded in various ways, by government subsidy, on contract for other government agencies, by research funding, and on commercial terms through its business services. SMHI has just over 600 employees and a turnover of approximately SEK 600 million, of which approximately SEK 200 million is in the business services area.

SMHI

SMHI – SWEDISH METEOROLOGICAL AND HYDROLOGICAL INSTITUTE

SE-60176 Norrköping, Sweden

Tel. +46 11 495 80 00 Fax. +46 11 495 80 01

Customer services +46 11 495 82 00 www.smhi.se