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Additional emphasis on safety services and research on climate change

The Finnish Meteorological Institute, or FMI, has reformed its organisation as of January 2008, the aim being to provide a wider variety of high-quality safety services to various customer sectors. To serve both internal and external customers in a more effective way, the ICT and Observation Services have been placed under the new Weather and Safety Division. The Division groups together about half of the FMI's resources. Collaboration with, e.g. the rescue authorities, the defence forces and the state road enterprise was deepened. The winter road maintenance services were continued, and a new mobile road route service was operationalised.

The second half of the FMI's resources is devoted to the Research and Development Division. Additional resources have been allocated to climate research, which now also covers the socioeconomic impacts of weather and climate. The climate research done at the FMI includes climate modelling collaboration with Max Planck Institute, boreal forest and Arctic wetland greenhouse gas measurements, aerosol climate studies and conventional time series analysis. The transition from gasoline to diesel vehicles and well as the increased use of wood to heat private homes mean rising particle contents in ambient air, which in turn has health impacts. New models for estimating the related mortality have been developed together with the Finnish Institute of Occupational Health. Arctic and Antarctic research programmes were carried out with several international partners during the International Polar Year.

The Finnish Meteorological Institute works in partnership with high-level international organisations and with partners in Finland. The FMI hosts several centres of excellence together with the University of Kuopio and the University of Helsinki. FMI expertise is also essential for partnering private enterprises. In Europe, for instance, short-range forecasting model development and joint satellite programmes, with the participation also of North American partners, have been executed successfully. Scientific co-operation is also carried out with, e.g. Indian, Chinese and Argentinean partners. Since the 1980s, the FMI has implemented development or partnership projects in the fields of meteorology in almost 80 countries. Several regional development co-operation programmes are expected to be funded in the near future.

In 2007 the FMI exceeded all of the numeric performance targets set by the government for the quality of various forecast products, the number of peer-reviewed and other publications, external funding, the satisfaction of various customer groups, personnel satisfaction, the functionality of observation systems and for operational service systems. All of the management positions were vacant in late 2007, and the staff of the Institute were encouraged to rotate to new positions. As a result, about 25% of the personnel now occupy new positions, offering the FMI an opportunity for renewal and transfer of expertise. The FMI is also encouraging its personnel staff to work in international positions for limited periods. In addition, several international experts are now working at the FMI.

I would like to thank both our international and domestic partners, as well as the competent staff, for a very successful year 2007.

Petteri Taalas
Director General

Climate change challenges society

IN 2007, CLIMATE CHANGE WAS IN THE NEWS INCREASINGLY OFTEN. THE FINNISH METEOROLOGICAL INSTITUTE'S TASK IS TO PROVIDE SOCIETY WITH INFORMATION ABOUT THE PAST AND FUTURE CLIMATE AND ITS CHANGES.

THE IPCC GROUP AN ACTIVE MOUTHPIECE

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) confirmed scientists' previous views that climate change is taking place as a result of human activities. Published in 2007, the report attracted wide attention. It also played an important role in the climate negotiations held in Bali.

During the preparation of the Fourth Assessment Report, the Finnish national IPCC Group was led by Research Manager Raino Heino of the Finnish Meteorological Institute. The Group secretary was Senior Researcher Kirsti Jylhä.

"The IPCC Group is Finland's voice, giving information to the IPCC," says Kirsti Jylhä in describing the Group's role. "As such, the Group does not take any stands; instead, it formulates the Finnish stand through various actors," she specifies the procedure.

"The Group formed a broad picture of the roles of various actors in the climate sector. Some issues aroused lively debate, for instance, the guidelines for greenhouse gas inventories and their revision, and the Finnish stand on the handling of peat," Jylhä explains.

The FMI continues to hold the chairmanship

Petteri Taalas, Director General of the Finnish Meteorological Institute, has been appointed to chair the national IPCC Group during the fifth period starting in 2008. The working group is responsible for collecting and presenting Finnish views for IPCC reports. It also disseminates information about the results and various stages of the IPCC's efforts and promotes the participation of Finnish experts in IPCC work.

Besides the chairman, the Group has two other representatives from the Meteorological Institute: Head of Unit, Research Professor Ari Laaksonen and Researcher, Head of Group Heikki Tuomenvirta, who serves as secretary of the Group.

THE METEOROLOGICAL INSTITUTE MEETS THE CHALLENGES OF CLIMATE CHANGE

As part of the centre of excellence funded by the Academy of Finland, the Finnish Meteorological Institute studies physical, chemical and biological processes pertaining to the climate and its change. The work is based on the Institute's observation programme, development of models, and scientific expertise, as well as on broad international cooperation. Above all, the research findings are applied to Finnish conditions.

In order to observe changes taking place in the climate, the Meteorological Institute prepares long measurement series of a uniform quality. This is particularly important in the case of phenomena where changes become visible only in time series spanning several decades.

The monitoring of climate change and air quality in northern regions makes use of the measurements of aerosol and greenhouse gas concentrations in the atmosphere, which the Meteorological Institute carries out, for instance, at the Pallas-Sodankylä station. The Institute also contributes to research on Asia's air pollution problems by measuring the concentrations of fine particles in India and China.

Satellites increasingly important

Satellite measurements play an increasingly important role in the monitoring of climate change. By participating in satellite projects, the Finnish Meteorological Institute receives observational data covering a wider area than surface measurements. The Institute is leading two networks that produce observations associated with ozone and UV radiation and contributes to projects that produce climate observations and measure the snow and ice cover.

By participating in the development of the international COSMOS atmospheric model, the Meteorological Institute strives, in particular, to improve the descriptions of fine particles, clouds and the passage of radiation. By contributing to global modelling, the Institute can also develop local models on impacts and adaptation. The regional cli-

The media abounds with news about climate change. Heikki Tuomenvirta being interviewed by science journalist Jari Mäkinen.

mate model under development will produce more accurate information about climate change in Finland and in the neighbouring regions.

Climate change affects the Finnish society in many ways. As the snow line is receding towards the north, driving conditions in winter will change. Changing climate conditions will alter the growing season, will affect the hydrologic cycle and will attract new animal species whose impact on the Finnish environment is still unknown. More frequent downpours pose a challenge to the drainage systems of cities, and violent storms are a risk to the built infrastructure, from power grids to road networks. It is increasingly important to examine the social and economic impacts of climate change now that climate change has taken centre stage in international politics. To meet this need, the Meteorological Institute will set up a new multidisciplinary group, which will comprise expertise from the sectors of natural sciences, economics and social sciences.

Another warm year

THE YEAR 2007 WAS UNUSUALLY WARM. THERE WERE FEW WINTER DAYS, AND THE MEAN TEMPERATURE OF MARCH WAS RECORD HIGH. AFTER A MILD AUTUMN, THE YEAR ENDED WITH AN EXCEPTIONALLY WARM DECEMBER.

"Throughout the country, the mean temperature in 2007 was 1.0–1.6 degrees higher than the average," says meteorologist Hanna Tietäväinen. "In Southern Finland, the mean temperature was about 6°C and in Northern Finland between 0 and +3°C."

FEW WINTER DAYS IN 2007

"In autumn 2006, thermal winter – or the time when the daily mean temperature is under zero degrees – began between five and nine weeks later than usual in Southern and Central Finland. In all, thermal winter was 60–80 days shorter than the average," Hanna Tietäväinen explains.

In 2007, thermal spring began about a month earlier than the average, or in early March, in all of Finland with the exception of Lapland. There was not much snow, either.

"Even up to the southern parts of Oulu Province, there was no snow on the ground until mid-January 2007. By mid-March, the permanent snow cover had already melted in Southern and Southwestern Finland.

In most regions of Southern and Western Finland, thermal winter began at the usual time, or 12–13 November, in autumn 2007. In Northern and Eastern Finland, thermal winter started at the turn of October–November. Winter came to Lapland a couple of weeks later than the average. On the southern coast, thermal winter had not yet started by the end of the year.

MARCH AND DECEMBER PARTICULARLY WARM

Hanna Tietäväinen mentions March as a special month in 2007.

"In March, the mean temperature was 3–3.5 degrees higher than normal throughout the country. At Helsinki-Vantaa Airport, for instance, the temperature reached 17.5°C on 27 March."

With the exception of the northernmost Lapland, January was also between two and four degrees warmer than usual. In contrast, the mean temperature of February was 3–7 degrees lower than the average.

Thanks to the warm August, the mean temperature of summer 2007 was 0.5–1.5 degrees higher than the long-term average. The warm weather continued in autumn, too: in Southern and Central Finland, autumn was about one degree and in Lapland 1–2 degrees warmer than normal.

"December was also milder than the average in the whole country, and exceptionally mild in Lapland. In Southern and Central Finland, temperatures were about 3–6 and in Northern Finland as much as 9 degrees higher than normal at that time of the year."

UNEVEN DISTRIBUTION OF RAIN

Rainfall in June-August was distributed very unevenly between various regions. In some areas, precipitation exceeded 300 mm, whereas the average sum of precipitation for the summer months in inland areas is 180–230 mm.

"However, the precipitation measured during the year in the whole of Finland was slightly higher than the average for the reference period 1971–2000. In inland areas, the rainiest month of the year was July and on the southern and southwestern coast it was September".

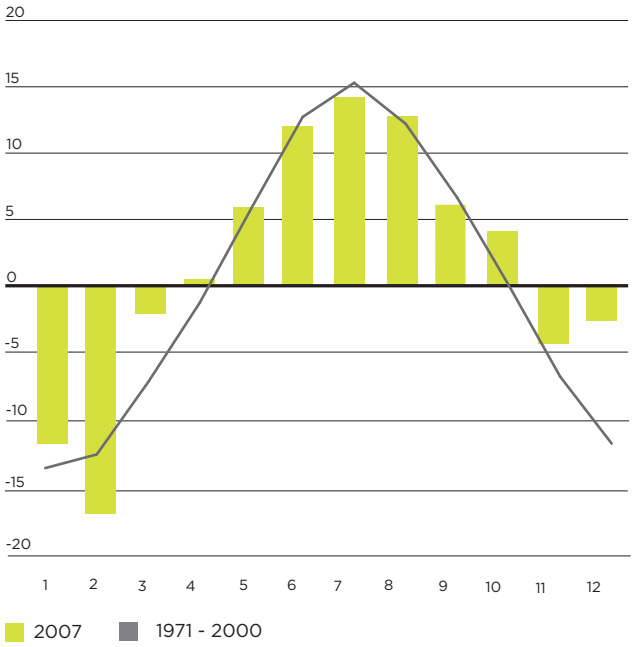
By the end of August, just under 60,000 lightning strokes had been recorded in Finland's land areas. This is about half of the average for summer. A thunderstorm that Hanna Tietäväinen specially mentions is the fierce thunderstorm, accompanied by exceptionally strong lightning, that hit Uusimaa on 22 August.

"There were few trombs over land areas in summer 2007, but many waterspouts were seen in August and September. The total number of trombs and waterspouts recorded during the summer season was about 15."

Records in 2007

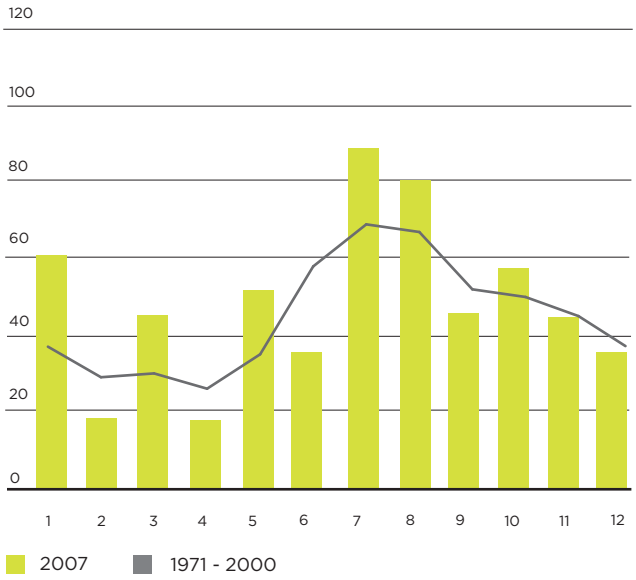
Lowest temperature	-39.9°C	8 February Salla Naruska
Highest temperature	30.7°C	14 August Parikkala Koitsanlahti
Highest number of hot days	23	Porvoo, Anjalankoski, Varkaus
The last hot day of the summer season	23 August	Pori, Kokemäki, Kankaapää, Kauhava, Ylistaro
Thermal winter began in Southern Finland	19 January	
Record-high mean temperature for March	3.1°C	Helsinki Kaisaniemi
New temperature record for March in Finland	17.5°C	27 March Helsinki-Vantaa Airport
Highest monthly precipitation in 2007 in July	211 mm	Puumala Sorjola

Rovaniemi (Monthly mean temperature, °C)



Turku (Monthly mean temperature, °C)

Rovaniemi (Annual precipitation, mm)



Turku (Annual precipitation, mm)

Hazardous and harmful weather conditions in 2007

THE FINNISH METEOROLOGICAL INSTITUTE'S WEATHER SERVICES HELP REDUCE DAMAGE AND ACCIDENTS CAUSED BY THE WEATHER. IN 2007, THE READINESS SERVICE WORKING UNDER THE WEATHER WARNING CENTRE SENT 82 ADVANCE WARNINGS ABOUT HAZARDOUS WEATHER TO THE RESCUE AUTHORITIES AND OTHER AUTHORITIES.

During 2007, there were 25 stormy days in Finnish sea areas (23 days on average). The highest wind speed in sea areas, 27 metres per second, was measured twice in January. Heavy rains caused problems during summer, for instance, in Pori, Jyväskylä and in the southern coastal areas.

AN OFFICIAL BULLETIN WARNS OF DANGER

The Finnish Meteorological Institute is entitled to issue official bulletins, which are either emergency bulletins or other official bulletins. An emergency bulletin is issued when there is an imminent threat to human life. It is broadcast without delay on all radio and TV channels, interrupting all programmes being aired. Other official bulletins are issued when the threat to human life is not so imminent. They are broadcast via the channels of the Finnish Broadcasting Company.

THE MOST NOTABLE HAZARDOUS WEATHER CONDITIONS IN 2007

Storm on 9–10 January

The highest average wind speeds were 21–25 m/s in sea areas and gusts of 20 m/s in land areas. Because trees fell on power lines, at least 16,000 households were left without electricity.

The year's strongest storm on 14–15 January

Although the strongest winds of this very violent storm bypassed Finland, the highest wind speed of the year, 27 m/s, was measured in Märket. The sea water level remained high in Finland's sea areas on several days around mid-January; this caused occasional water damage.

Floods in urban areas on 27 May, 14 August, 22 August and 24 August

In late May, air humidity rose exceptionally high for the time of the year. Thunderstorms that swept over Uusimaa brought 20–40 mm of rain within a couple of hours and caused flooding in streets, particularly in Helsinki. In August, heavy downpours occurred in the Helsinki area and in the regions of Hanko, Kotka and Mikkeli.

Flash flood in Pori on 12 August

The worst flood in summer 2007 was experienced in Pori, where as much as 50–100 mm of water came down within less than three hours when a narrow strip of showers remained over the city. Officially, the greatest precipitation was 80 mm, measured in Luvia. The rescue authorities received hundreds of alarms, and the cost of damage caused to property amounted to millions of euros.

Gusts with thunder on 19 July in Valkeala

Gusts of wind accompanying a thunderstorm reached speeds of over 20 m/s and caused trees to fall dangerously in Hillosensalmi, Valkeala. The gusts swept over an area where there are many summer cabins, but no one was injured.

Thunderstorm in Uusimaa and on the southern coast on 22 August

The Meteorological Institute issued the only official bulletin of the year when a thunderstorm with very strong lightning was approaching the Helsinki area from the west. Owing to the pouring rain and frequent lightning strokes, the rescue authorities needed to pump water, radio transmissions of the Finnish Broadcasting Company broke off, traffic lights went dead, and tens of thousands of households were without electricity. One person was struck by lightning. Later that day, the same storm caused damage in Kymenlaakso and Southern Karelia.

Weather safety around the clock

THE WEATHER AND SAFETY DIVISION OF THE FINNISH METEOROLOGICAL INSTITUTE IS RESPONSIBLE FOR WEATHER SERVICES CONTRIBUTING TO THE SAFETY OF SOCIETY.

The Finnish Meteorological Institute produces meteorological services important for public safety and for the smooth running of business and the economy, and maintains preparedness for disturbances during normal times and for exceptional situations. The Weather Warning Centre, operating 24 hours a day, draws up nationwide forecasts for land and marine areas and issues warnings pertaining to the weather. In addition, the Centre produces services for the authorities, such as the rescue authorities, the Finnish Border Guard, the Navy, the Radiation and Nuclear Safety Authority, and the Road Administration. The Weather Warning Centre also includes the Aviation and Military Weather Service, which provides forecast and warning services for the needs of civil aviation and national defence in Finland. Commercially priced special weather services for enterprises and private individuals are produced in the separate Commercial Services unit.

The factors underlying the efficient provision of services include state-of-the-art observation methods and communications systems and innovative development of products and services. The Meteorological Institute maintains a databank for Finnish climate and weather data, where all significant information is stored in easily retrievable, backed-up data warehouses complying with international standards.

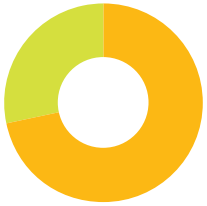
As part of the process of developing increasingly centralised and more automated production, the Meteorological Institute decided to move its operations from Helsinki-Vantaa Airport to the Head Office in Kumpula during 2008.

In 2007, altogether 99.9 per cent of forecasts and warnings were delivered as planned. The customer satisfaction index calculated from the authorities' responses to a questionnaire survey was 3.72 on a scale of 1–5 (3.9 in 2006). Customers' satisfaction with commercial services reached a new record and was 4.1 in 2007 (4.0 in 2006).

Weather and Safety
Total Expenditure € 18.8 Million

Weather and Safety	18.8
Other Divisions	28.4

Weather and Safety
267 Person-years



Budgetary Funding	192
Earned Revenue	75

Weather and Safety
Funding € 18.8 Million

Budgetary Funding	10.2
Earned Revenue	8.6
External Funding	0.001

Accuracy of weather forecasts, %

Variable	2007	2006	2005
One-day temperature forecasts	87.0	87.1	87.1
Two-day temperature forecasts	82.0	80.2	80.2
One-day forecasts for the probability of rain	88.5	88.4	85.3
Two-day forecasts for the probability of rain	82.8	82.1	81.7
Wind warnings in one-day forecasts	85.9	84.0	84.0
Wind warnings in two-day forecasts	81.9	80.6	80.3

Availability of systems

	% in 2007	% in 2006	% in 2005
Reliability of basic weather stations	99.5	99.2	98.0
Availability of radar systems (mean)	98.2	99.3	99.3
Availability of satellite systems (mean)	98.5	98.1	98.3
Availability of information systems (mean)	99.8	99.6	99.9

Society's benefits from weather services five times greater than the costs

ACCORDING TO A STUDY ON THE EFFECTIVENESS OF THE FINNISH METEOROLOGICAL INSTITUTE'S SERVICES, CONDUCTED BY VTT TECHNICAL RESEARCH CENTRE OF FINLAND, EACH EURO INVESTED IN WEATHER SERVICES BRINGS BACK FIVE EUROS EVERY YEAR.

Transport reaps the greatest benefits of weather and road information services: the benefits resulting from improved safety, better maintenance of traffic routes, and more efficient logistics exceed 100 million euros each year. Similarly, the gains to pedestrians and cyclists from weather services may also reach 100 million euros annually, thanks to the improved maintenance of walkways and biking routes and fewer slipping accidents.

Weather services help the building and property management sectors to save an estimated 10 million euros a year. The figure for energy generation is roughly the same. For agriculture, the benefits of weather services are estimated at about 30 million euros a year.

TENFOLD GAINS BY DEVELOPING SERVICES

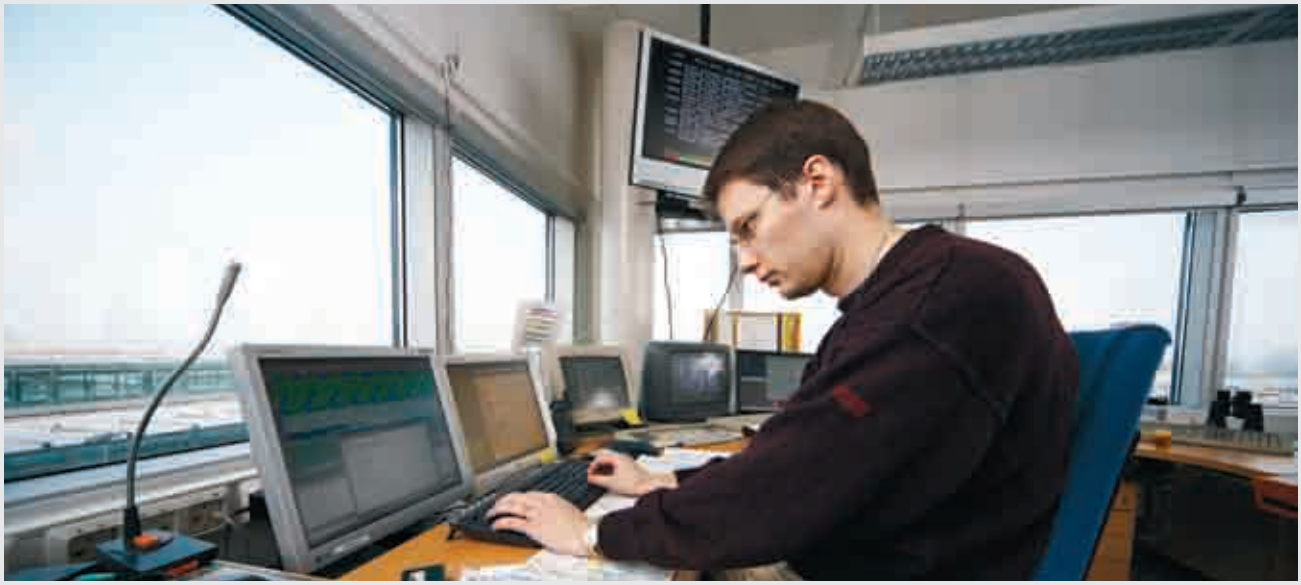
According to VTT, it is possible in the future that each euro invested in weather information services is repaid as much as tenfold in benefits. This requires, for instance, that services are developed, their availability and usability are raised, and communications equipment is improved.

The study conducted in spring 2007 is part of the more extensive EVASERVE research project of VTT, where methods and tools are developed for evaluating information services.

Summary of socio-economic value of FMI for different user segments

	Benefit (M€)
Road transport	13 – 18
Pedestrians	80 – 100
Railway transport	0.4
Maritime	32 – 50
Aviation	54 – 55
Logistics	Tens of millions
Building construction and facilities management	15 – 30
Agriculture	34
Expected total benefit with current services	**> 239 - 303**

The Finnish system of measuring the accuracy of terminal area forecasts adopted in other Nordic countries as well



Visibility, cloud height, wind direction and current weather are among the features of terminal area forecasts verified for quality. Matti Heinonen compiling a forecast.

THE FINNISH METEOROLOGICAL INSTITUTE HAS DEVELOPED A SYSTEM FOR MEASURING THE QUALITY OF TERMINAL AREA FORECASTS, WHICH WAS TAKEN INTO USE IN ALL OF THE NORDIC COUNTRIES DURING 2007.

During the past few years, the Finnish Meteorological Institute has been developing an accurate system for monitoring the quality of terminal area forecasts (TAF). A standard product in aviation weather service, TAFs give pilots data on weather conditions at the destination airport. A terminal area forecast is indispensable for planning the flight.

"The system developed by the Meteorological Institute was adopted in all of the Nordic countries in 2007. The Finnish system was ranked the best in a comparison between the Nordic systems. At present, the TAFs made by the meteorological institutes of the other Nordic countries are also verified in Finland," says Heikki Juntti, Head of the Weather Warning Centre.

Forecasting the aviation weather is challenging, and the forecasts are vital for aviation safety. The meteorologist plays a significant role when aviation weather forecasts are compiled. In fact, the greatest strength of the verification system developed in Finland is that individual meteorologists receive immediate feedback on the quality of each forecast they make. Unlike other corresponding systems, this system is not limited to giving only statistical data on the accuracy of forecasts.

"In this way, we can see the effect that the various stages of the forecast process have on quality and we can develop the forecast process itself. By means of Nordic cooperation in aviation weather forecasting, the Meteorological Institute seeks ways to reduce the costs of aviation weather forecasts and make the forecasts more consistent. The intention is that the cooperation would be expanded in the future to encompass joint production of aviation weather forecasts," Heikki Juntti explains.

Ten years of road weather service

In cooperation with Destia, the Finnish Meteorological Institute maintains Varo, the route forecast and warning service for drivers. To increase the safe and smooth flow of traffic, drivers receive information and advance warnings through mobile devices.

THE ROAD WEATHER SERVICE LAUNCHED BY THE FINNISH METEOROLOGICAL INSTITUTE AND THE FINNISH ROAD ADMINISTRATION IN 1997 COMBINES INFORMATION ON THE WEATHER AND ROAD MAINTENANCE, INCREASING MOTORISTS' SAFETY.

Road weather is one of the best known warning services of the Finnish Meteorological Institute. When drawing up a forecast, the meteorologist has access to the Road Administration's assessments of road conditions for each province and to the forecast for road conditions produced by the Meteorological Institute's road weather model. When these two types of data are combined, drivers receive accurate information on the effects of the weather and road maintenance on driving conditions on the main roads during the next 24 hours.

Road weather warnings are read on the YLE Radio Suomi channels, and they can also be seen on TV channels and on the Meteorological Institute's website.

Road weather service is developed in a cooperation group formed by the Finnish Meteorological Institute, the Finnish Road Administration, the Finnish Broadcasting Company, Liikenneturva (Central Organization for Traffic Safety in Finland), the Finnish Motor Insurers' Centre, the Police, and VTT.

CAUTION IN TRAFFIC WHEN DRIVING CONDITIONS ARE VERY BAD

In road weather, driving conditions are divided into three categories: normal, bad and very bad.

"Very bad conditions are the most common in Uusimaa, where the traffic volumes are also the greatest. During winter, there are 5–10 days when the number of traffic accidents is exceptionally high," says Senior Meteorologist Ilkka Juga.

"Typical features of days like this are heavy snowfall, strong winds and temperatures below the freezing point. Traffic accident figures are also higher than average on days with weak or moderate snowfall and temperatures between -10 and -20°C."

"The service is developed constantly so that road weather warnings would reach motorists on such days. However, it's not enough just to receive the information. We hope that drivers really take heed of the warnings when they are on the road," Ilkka Juga points out.

Trade and industry benefit from weather services

"Many sectors are sensitive to variations in the weather," says Leila Maiche of the Meteorological Institute's Commercial Services.

CHANGES IN THE WEATHER PLAY A MAJOR ROLE IN RETAIL SALE IN FINLAND. UTILISATION OF WEATHER DATA IN TRADE LOGISTICS AND IN INDUSTRIAL PRODUCTION HAS BEEN INCREASING FROM YEAR TO YEAR.

"The exceptional weather conditions in recent years accentuate the importance of weather forecasts in many sectors. Weather data can be used to improve competitiveness and customer satisfaction in trade," says Leila Maiche, Account Manager.

The Finnish Meteorological Institute tailors its weather services according to customers' needs. Inspired by the unusually warm weather in 2007, the Institute's Commercial Services launched new research and development projects.

THE WEATHER AFFECTS DEMAND FOR PRODUCTS

Trade is becoming more international and competition is stiffer. This situation challenges trade and industry to develop new means for making their operations more efficient. For this reason, issues pertaining to the weather and climate have also gained more weight in the business world.

"For instance, some seasonal summer foods – say, soft drinks and beer, barbecue foods and ice cream – are closely tied to the weather. Our weather services can help make the supply chain of products more efficient. For example, when an increase in demand is predicted, shops can stock up enough fresh products to meet the demand."

"When orders and demand can be predicted, it is also easier for shops to plan when labour is needed and when marketing campaigns should be launched," Leila Maiche points out.

More weather observations from Finland for international use

The map behind Pauli Rissanen reveals that the Meteorological Institute has a total of about 500 observation stations throughout Finland.

THE NEW NUMBERING SYSTEM AND AUTOMATION OF THE FINNISH METEOROLOGICAL INSTITUTE'S OBSERVATION STATIONS HAVE MULTIPLIED THE NUMBER OF WEATHER OBSERVATIONS DISTRIBUTED INTERNATIONALLY.

The Finnish Meteorological Institute has doubled the number of weather observation messages sent every hour to the GTS network used by the member states of the World Meteorological Organization. Similarly, the number of basic weather messages sent once every three hours has increased by 75 per cent because new stations have been added to the distribution list.

The previous system of identification numbering at 118 observation stations operated by the Finnish Meteorological Institute was not consistent with the recommendations given by the World Meteorological Organization. For this reason, the data collected by these stations could not be sent for international distribution.

Besides the international distribution of observational data, the change had an impact on many of the Meteorological Institute's customer products, where the new numbering also had to be incorporated. In the end, the reform was brought to a successful conclusion within a couple of hours, and no essential observational data were lost. The storing and transmission of data also continued normally.

MORE OBSERVATIONS THROUGH AUTOMATION

Thanks to the automation of the Meteorological Institute's observation stations, weather observations are obtained more frequently than before.

"The objective is to upgrade the data transmission technology of the observation stations so that, within a couple of years, all observation stations operated by the Meteorological Institute can give users real-time observational data whenever needed," says Senior Researcher Pauli Rissanen.

In all, the Meteorological Institute now has approximately 150 automatic weather observation stations, of which about 90 send data every ten minutes.

Thanks to the automation and the new numbering system, more than a hundred Finnish observation stations can now send both SYNOP messages, compiled every three hours, and hourly messages for international distribution.

The IT system in Sodankylä guarantees fast connections

THE IT INFRASTRUCTURE OF THE ARCTIC RESEARCH CENTRE WAS MODERNISED, E.G. TO ENABLE INCREASINGLY BETTER RECEPTION OF SATELLITE DATA.

The Arctic Research Centre serves as an observation and research platform for the Meteorological Institute's own research and outside research projects. The Research Centre and the measurement station for background air quality on top of Sammaltunturi mountain together form the Global Atmospheric Watch (GAW) station of Pallas-Sodankylä. The Centre also has a satellite data centre that supports several polar satellites measuring the ozone layer.

In consequence, great demands are placed on the speed and functional capacity of the Research Centre's information systems. In order to produce advanced network solutions, the environment must be uniform. The modernisation carried out by the Information Management Services in 2007 guarantees that customers receive their data at the right time.

"During the development project, most of the IT infrastructure in Sodankylä was upgraded: the active components of the communications network, the firewall system, the card server platform and the virtual server environment, the data entry system, and the back-up environment for servers and the data warehouse," says planner Markku Kivioja from Sodankylä, listing the elements of the major undertaking.

The network of fast connections and the server environment are monitored from Helsinki 24 hours a day.

Climate research to meet the needs of society

THE FINNISH METEOROLOGICAL INSTITUTE ENGAGES IN HIGH-STANDARD RESEARCH AND DEVELOPMENT OF METHODS IN FOCAL AREAS RESPONDING TO SOCIETY'S NEEDS. THESE FOCAL AREAS ARE THE WEATHER AND SAFETY, CLIMATE CHANGE AND ITS IMPACTS ON SOCIETY, THE IMPACTS OF THE ATMOSPHERE ON THE ENVIRONMENT AND PEOPLE, AND EARTH OBSERVATION AND SPACE.

The aim of the research conducted at the Meteorological Institute is to meet society's changing information needs as efficiently as possible. Expertise in research lays the foundation for the Institute's own service production and tailored service packages. Based on research, new service concepts associated with the weather and the climate are developed, for instance, to improve traffic safety, smoothness of transport and overall safety, and to reduce the detrimental effects of air impurities on health and the environment.

Up-to-date information on topics such as the climate and its change is provided for decision-makers and the authorities. Expertise is also utilised in international development and consultancy projects, for instance, in the new EU Member States and Russia, and in Africa, Asia and South and Central America.

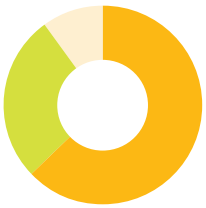
Scientific partnerships with Finnish and international bodies further strengthen the Meteorological Institute's competence. The Institute is engaged in close cooperation, for example, with the University of Helsinki and the University of Kuopio and supports the further development of internationally competitive concentrations of excellence in various locations, such as Kumpula in Helsinki, Kuopio and Lapland.

In summer 2007, an international evaluation was conducted on the Finnish Meteorological Institute's research activities during the past three years. The evaluation concluded that the Institute's research met high international standards. The reorganisation carried out during the latter half of 2007 addresses the new challenges detected during the evaluation: The competence acquired in space research was targeted at areas having an increasing need for know-how. More resources were allocated to the research programme on climate change.

Research and Development
Total Expenditure €16.9 Million

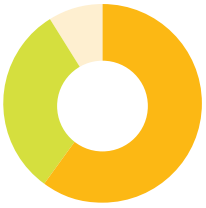
Research and Development	16.9
Other Divisions	30.3

Research and Development
266 Person-years



Budgetary Funding	167
Earned Revenue	73
External Funding	26

Research and Development
Funding €16.9 Million



Budgetary Funding	10.2
Earned Revenue	5.3
External Funding	1.5

THE FINNISH METEOROLOGICAL INSTITUTE CONDUCTS RESEARCH WITHIN SIX FIXED-TERM RESEARCH PROGRAMMES:

CLIMATE CHANGE
The unit focusing on various aspects of climate change investigates the past and present climate and makes models for the future. The unit generates information on topics such as the socio-economic impacts of the climate and the weather, and interaction between greenhouse gases, aerosols and the climate.

AIR QUALITY
The unit studies the effects of air quality on the environment, health and the climate, for instance, the composition of fine particles in urban air. The unit develops air quality models and measurement technology, and monitors Finnish air quality by conducting measurements in background areas as part of international follow-up programmes. The chemical laboratory of the unit serves as the national reference laboratory.

METEOROLOGY
The unit for meteorological research serves as an expert in meteorology, especially in matters pertaining to weather safety. The objects for research and development include weather models, meteorological applications and meteorological remote sensing. The Meteorological Institute creates methods suited to the Finnish conditions that are used for preparing pictures of the prevailing weather, air quality and radioactivity situations and for issuing forecasts and warnings to the public at large and to society.

EARTH OBSERVATION
The unit applies diverse remote sensing measurements for studying the Earth's surface, the atmosphere and space weather, and develops radar and space technology. The research material includes measurement data obtained, for instance, from satellites, radars, planetary probes and ozone soundings. The unit participates in the design and implementation of equipment and in the processing of measurement data, and develops end products from remote sensing material.

ARCTIC RESEARCH
The unit studies the various atmospheric layers in polar regions, and the interaction between snow, ice, vegetation and the Earth's crust, on the one hand, and the atmosphere on the other. The unit comprises the Arctic Research Centre in Sodankylä and a group in Helsinki that mostly studies phenomena in the upper atmosphere. The Arctic Research Centre also serves as a reception centre for satellite data.

KUOPIO UNIT
The unit focuses on atmospheric aerosol particles and UV radiation, and their effects on health and the climate. Together with the Department of Physics and the Department of Environmental Science of the University of Kuopio and with the National Public Health Institute, the unit forms the Kuopio Centre for Aerosol Research (KCAR). The Aviation and Military Weather Service Group is responsible for the provision of weather service for air traffic and the Defence Forces in Eastern Finland.

Year	2007	2006	2005
Doctoral dissertations	10	7	7
Publications subject to international peer review	234	178	173
Scientific publishing index	12 680	10 355	10 384

Information on air quality from one address

AIR QUALITY IN FINLAND CAN BE FOLLOWED IN REAL TIME THROUGH A NATIONWIDE WEB SERVICE.

The local environmental authorities measure air quality in about 50 localities throughout Finland. The Finnish Meteorological Institute measures air quality at twenty stations in background areas far from urban emission sources. These data are collected under the address **www.ilmanlaatu.fi**, which gives a comprehensive picture of air quality in the whole of Finland.

"At present, we receive real-time air quality data from ten of the Meteorological Institute's stations and from about thirty other localities. Municipalities have been eager to join this new web service, and the number of information sources is still increasing," says Virpi Tarvainen, Head of Group.

"The air quality portal gives information about air pollution and air quality measurements to many types of end-users: private individuals, the media, the authorities, and experts. In exceptional air quality situations, the portal can provide instructions on what to do. This will also make it easier for other authorities to be prepared for unexpected situations," says Virpi Tarvainen, describing the system.

The portal also contains links to measurement data and air quality statistics from past years.

www.ilmanlaatu.fi

Warm autumns increase carbon dioxide emissions from forests

To study the binding of carbon by plants, Tuomas Laurila of the Meteorological Institute (pictured here) and Timo Vesala of the University of Helsinki utilised carbon dioxide flow measurements, precise atmospheric concentration measurements, and the amounts of solar radiation absorbed by plants for photosynthesis, detected by means of remote sensing methods.

OWING TO WARM AUTUMNS, EUROPEAN FORESTS RELEASE MORE CARBON DIOXIDE INTO THE ATMOSPHERE THAN THEY DID BEFORE. ACCORDING TO A STUDY PUBLISHED IN THE SCIENCE JOURNAL **NATURE**, FORESTS MAY EVEN ACCELERATE CLIMATE CHANGE IF AUTUMNS BECOME WARMER MORE RAPIDLY THAN SPRINGS.

The Finnish Meteorological Institute participated in an international study which showed that forests may not slow down climate change as effectively as had been believed. It has generally been thought that forests reduce carbon dioxide emissions into the atmosphere by acting as 'carbon sinks'. It was believed that a warmer climate and a longer growing season would make this effect stronger.

ECOSYSTEMS HAVE A MAJOR EFFECT ON CLIMATE CHANGE

The mean temperature of autumns at northern latitudes has risen by almost one degree during the past 20 years. Warmer autumns extend the time when forests are substantial sources of carbon dioxide. As the temperature remains high, organic matter in the forest soil continues to decompose for a longer time, and more carbon dioxide is released into the atmosphere.

"If climate change means that autumns become warmer more quickly than springs, the capacity of ecosystems to bind carbon may be less than has been estimated earlier. Warmer autumns may offset the benefits brought by warm springs," says Tuomas Laurila, Head of Group, who participated in the international research team's work.

According to Tuomas Laurila, however, it is still difficult to predict how plants and the soil will eventually react to climate change. In any case, it is known that ecosystems play an important role in the concentration of carbon dioxide gas that contributes to the warming of the atmosphere.

Extreme events in the Finnish climate studied

"In most parts of Finland, the mean temperature for winter 2007–2008 was the highest in measurement history," says Ari Venäläinen.

PROVISION FOR EXTREME WEATHER EVENTS REQUIRES RELIABLE INFORMATION ON THE RANGE OF VARIATION OF THE FINNISH CLIMATE. THE FINNISH METEOROLOGICAL INSTITUTE HAS CONDUCTED AN EXTENSIVE STUDY OF EXTREME WEATHER EVENTS IN FINLAND.

Although people in Finland are generally well adapted to varying weather, we also have weather events leading to great financial losses and even casualties. In consequence, information about potentially dangerous weather events is needed widely in many sectors of society.

The Finnish Meteorological Institute has conducted a study on the range and frequency of values that some of the principal climate variables have had in Finland over a period of a good hundred years. The variables included in the study were rainfall, periods of drought, monthly and daily temperatures, hot and cold spells, snow depth, and wind speeds. The resulting tables describe the range of variation in the Finnish climate and supplement our knowledge of the local weather phenomena.

CLIMATE CHANGE INFLUENCES EXTREME WEATHER EVENTS

An important element of adaptation to climate change is to be prepared for extreme weather events. The frequency, intensity and regional distribution of destructive phenomena may change markedly in the coming years.

"The objective of this study was not to determine whether our climate has become more extreme during the last few years. However, in recent years we have experienced some very exceptional circumstances. For instance, March 2007 was so warm that, on the basis of climate observations, the probability of another equally warm March would be roughly once in a thousand years. However, if climate change is taken into account in the calculations, an equally warm March would occur within a much shorter time," explains Ari Venäläinen, Head of Group, who led the study.

To enable assessment of future extreme weather events, we must know the ranges and frequencies of these weather events in today's climate. "The next step is to estimate the probability of harmful extreme weather events by means of climate models. This will give us new information about risks in the future climate," Ari Venäläinen says.

Modelling reveals how air pollutions affect people

Jaakko Kukkonen, Mia Pohjola, Ari Karppinen and Mikhail Sofiev at the measurement station for urban air located in Kumpula, Helsinki. A future challenge is to link the data on aerosols produced by the sensitive measuring instruments to model calculations.

A CALCULATION MODEL CREATED BY EXPERTS ESTIMATES HOW THE POPULATION IS EXPOSED TO IMPURITIES IN THE AIR.

Thanks to the long-term cooperation project between the Finnish Meteorological Institute, the Helsinki Metropolitan Area Council, the National Public Health Institute and the Finnish Environment Institute, decision-makers and planners can be given information about how the air quality affects health. Results can be calculated both for the present level of emissions and for future emission scenarios.

This information is very useful, e.g. for urban, land use and transport system planners. Another practical goal is to assess how future land use and transport system solutions affect people's health.

"The information we produce may also have a major effect on the development of legislation, small-scale combustion technology, and other technical solutions," says Ari Karppinen, Head of Group.

INCREASINGLY ACCURATE CALCULATIONS

The Meteorological Institute's task has been to create models for the dispersion of impurities in the air. The Finnish Environment Institute and the Helsinki Metropolitan Area Council have focused on emissions, and the National Public Health Institute on the modelling of health effects.

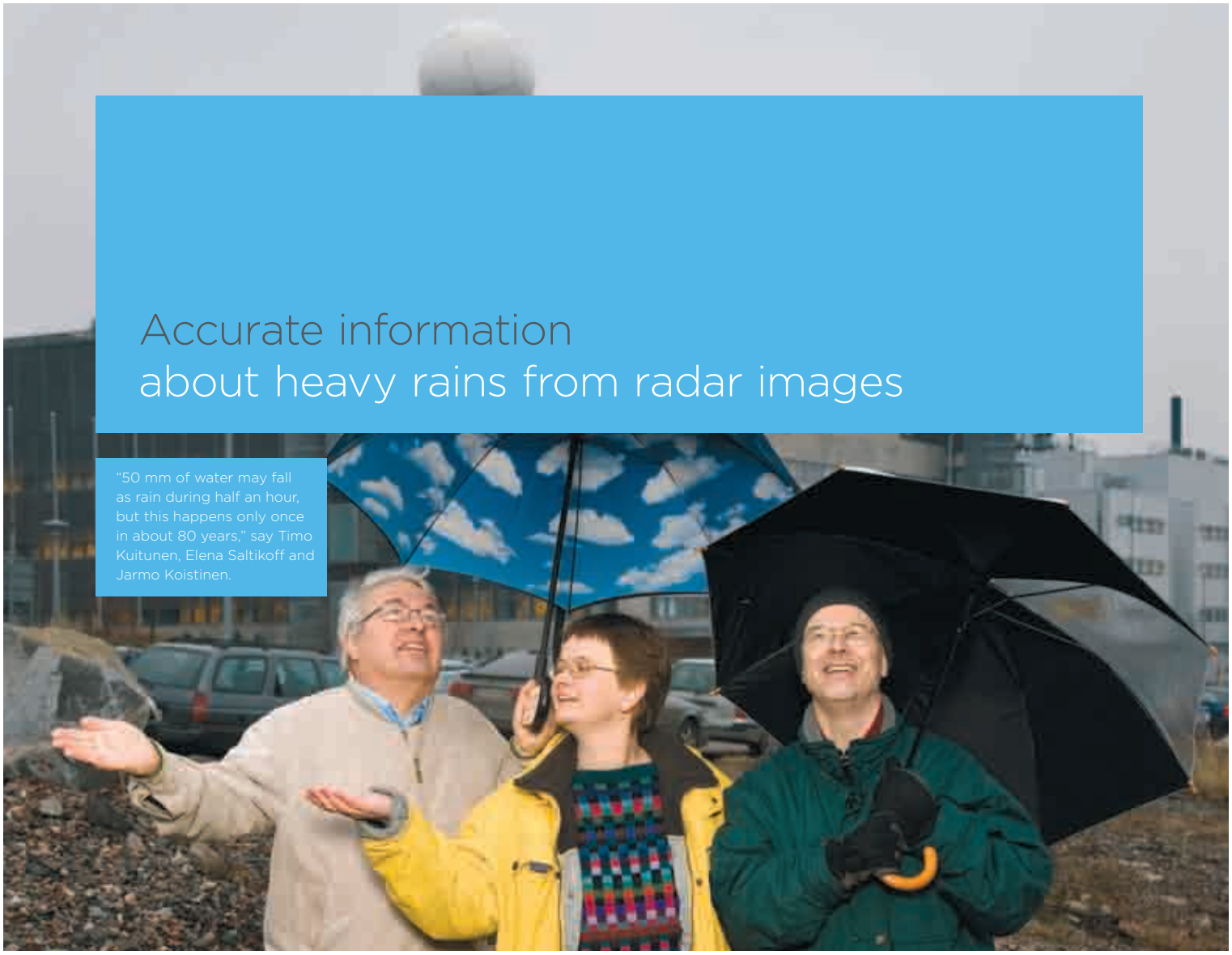
The project started with the effects that nitrogen oxides and fine particles have on people living in the Helsinki area. Later the scope was expanded to cover the effects of fine particles in all of Finland.

"Now calculations are made at regional level, with an accuracy of 5–10 kilometres throughout Finland. Among other things, the transportation of fine particles from elsewhere in Europe, their dispersion, exposure and impact in Finland are also included," says Researcher Leena Kangas.

Ari Karppinen believes that the health effects of air quality will remain an important topic of research. It has been estimated that every year about 200 Finns die prematurely because of fine particle emissions.

"The importance of factors such as traffic and the small-scale combustion of wood must be analysed further at regional level. A future goal is also to improve accuracy by integrating today's advanced measurement technology into models even better."

Accurate information about heavy rains from radar images



"50 mm of water may fall as rain during half an hour, but this happens only once in about 80 years," say Timo Kuitunen, Elena Saltikoff and Jarmo Koistinen.

THE CONSIDERABLE VOLUME OF RADAR MATERIAL COLLECTED BY THE FINNISH METEOROLOGICAL INSTITUTE PROVIDES NEW INFORMATION ABOUT THE CLIMATE OF LOCAL HEAVY RAINS. THIS INFORMATION IS NEEDED, FOR INSTANCE, WHEN PLANNING DRAINAGE AND TRANSPORT SYSTEMS.

What's the maximum amount of rain that can fall in Finland within a certain period of time? The answer is found when the statistical data received from rain stations is combined with the material produced by the radar network during many summers. The radar material collected by the Meteorological Institute contains 100 billion measurements, and the collection of material is continuing.

"The material provides information about rains with an accuracy of one kilometre and at intervals of five minutes from all over Finland," says Elena Saltikoff who works as a researcher at the Meteorological Institute.

INFORMATION ABOUT RARE SITUATIONS

"The greatest rain volumes usually come in a very small area, within a very short time. For instance, the radar material collected has given us insight into rare situations that occur in the same place, say, once in a hundred years," Elena Saltikoff explains.

Information about the climate of local heavy rains is needed, for example, in community planning.

"The climate is changing, and the importance of extreme events in society is increasing. In addition, owing to urbanisation, land use is changing and heavy rains have a stronger impact on people's lives," says Elena Saltikoff, listing the reasons for the research.

SPECIAL ATTENTION TO QUALITY

Special attention has been paid to the quality of the radar data collected. By means of a cleaning method developed at the Institute, error sources – i.e. radar echoes caused by factors other than heavy rains – can be eliminated.

"Very strong rainfalls in radar images are usually errors. However, sometimes the image may reveal a rain shower of truly exceptional intensity. It's important not to mistake this for a fault," Elena Saltikoff points out.

The project has also given information about hailstorms. The radar data have helped compile statistics about the times of the year and times of the day when hailstorms occur, and where in Finland they are the most common.

The electric sail may revolutionise space travel

THE ELECTRIC SAIL DEVELOPED BY PEKKA JANHUNEN, RESEARCHER AT THE FINNISH METEOROLOGICAL INSTITUTE, MAY PROVE TO BE AN IMPORTANT SOURCE OF PROPULSION FOR FUTURE SPACECRAFT. THIS FINNISH INVENTION MAY REVOLUTIONISE SPACE RESEARCH.

Pekka Janhunen's invention paves the way for cheaper and faster space travel. Thanks to the electric sail, small probes can travel in the Solar System fairly independently without fuel. The electric sail is a suitable source of propulsion for probes travelling to other planets, the outer reaches of the Solar System, or even near the Sun.

According to Pekka Janhunen, even wider applications of the electric sail may be possible in the future. For instance, it could be used when raw material resources existing in space are utilised.

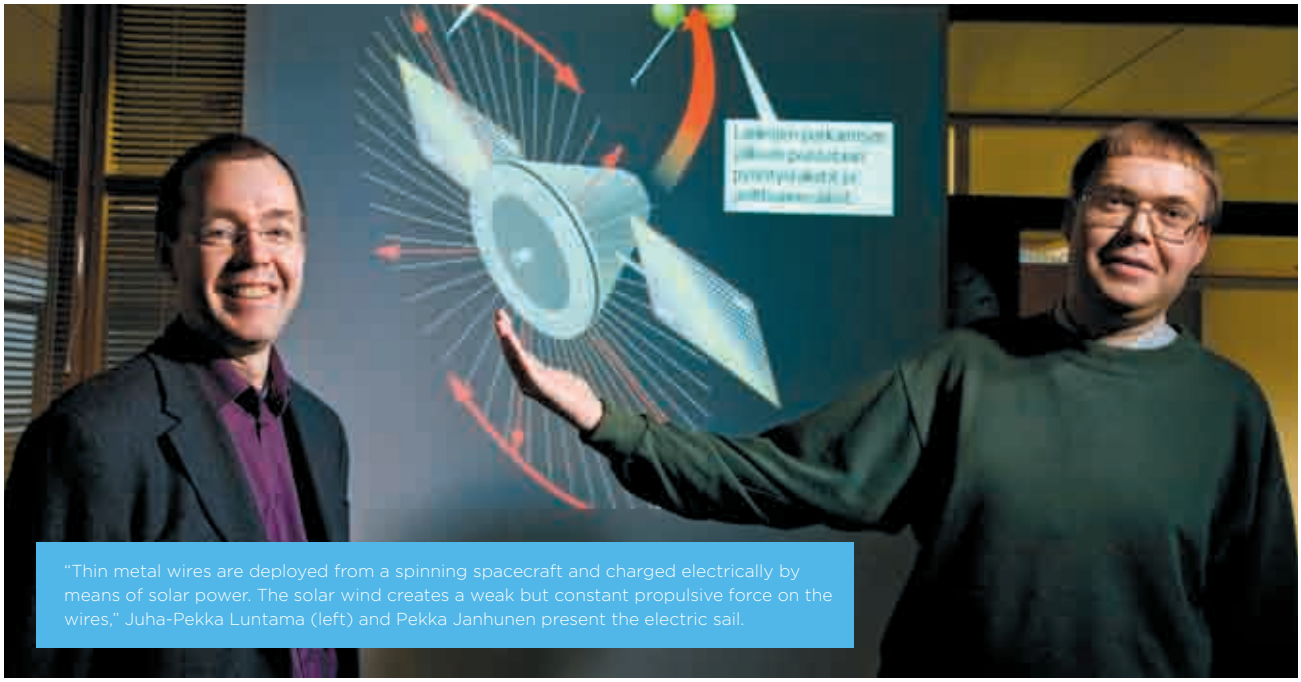
"These would no longer be merely scientific space flights. For instance, we'd be talking about the possibility of transmitting electrical energy to the Earth by means of solar power satellites," Janhunen says, envisaging the future.

INEXPENSIVE AND FAST SPACE TRAVEL

As its energy source, the electric sail utilises the solar wind, the same phenomenon that, among other things, causes auroras. The electric sail consists of thin metal wires that are deployed from a spinning spacecraft and charged electrically by means of solar power. The solar wind creates a weak but constant propulsive force on the wires, which are tens of kilometres long.

"According to calculations, a small spacecraft using the sail can reach speeds exceeding 50 kilometres per second. This makes it possible to travel even beyond our Solar System, into interstellar space," Janhunen says.

Final proof of the workability of the electric sail will be obtained only when the equipment is built and tested in practice. "If financing can be secured, a test could be implemented within four years. Thereafter it will be possible to make concrete plans for larger space projects utilising the electric sail," Janhunen projects.



"Thin metal wires are deployed from a spinning spacecraft and charged electrically by means of solar power. The solar wind creates a weak but constant propulsive force on the wires," Juha-Pekka Luntama (left) and Pekka Janhunen present the electric sail.

The Finnish Meteorological Institute modernised meteorological systems in Lithuania

The modernisation of the Lithuanian meteorological system also included training in the use of the new systems. The Finnish Meteorological Instiute has carried out similar projects, for instance, in Macedonia, Uruguay, St. Petersburg, Jamaica, and in Trinidad and Tobago.

DURING PROJECTS THAT TOGETHER LASTED FOR ABOUT TWO YEARS, THE FINNISH METEOROLOGICAL INSTITUTE MODERNISED THE LITHUANIAN METEOROLOGICAL OBSERVATION NETWORK AND SYSTEMS.

The goal of the project funded by the EU was to make Lithuania reach the level of air quality modelling required by the EU Air Quality Directive. Among other things, the modernisation involved the commissioning of new automatic weather stations in five different locations in Lithuania.

The Finnish Meteorological Institute's objective was to reach a technical standard that would enable the use of air quality models in Lithuania. The operation of air quality models and the compilation of air quality forecasts require that meteorological measurement data are received every hour and that there are proper systems for the quality management and storage of the data.

"In practice, the Meteorological Institute automated the Lithuanian weather observation network, made the transfer and processing of observations more efficient, and improved the quality assurance and use of observations in air quality monitoring," says Meteorologist Jari Härkönen, describing the work. He managed the implementation project that was brought to conclusion in Lithuania in March 2007.

Besides Jari Härkönen, 14 other experts from the Institute's Research, Weather Warning Centre, and ICT Management and Observation Services worked in the projects.

Technically, the situation in Lithuania was similar to that in Finland some 20 years ago. Before the start of the project, weather observations were still done manually. Now the Lithuanian authorities have at their disposal modernised and automated observation collection systems, databases, and quality management systems for observation data.

"Thanks to the automation, Lithuania is now prepared to assess air quality and to report on emissions in the same way as other EU Member States," Jari Härkönen sums up the results.

The Finnish Meteorological Institute studies auroras

A camera for auroras has been installed on the roof of the Meteorological Institute's office building in Helsinki to facilitate testing and development. "Although the probability of seeing auroras at the latitude of Helsinki is not high, the typical auroras visible in Southern Finland are particularly attractive," say Noora Partamies (right) and Sanna Mäkinen.

SPURRED BY THE ONGOING FOURTH INTERNATIONAL POLAR YEAR (IPY), THE WORLD SCIENTIFIC COMMUNITY IS CONDUCTING EXTENSIVE RESEARCH PROJECTS IN THE ARCTIC AND ANTARCTIC POLAR REGIONS IN 2007–2009. THE FINNISH METEOROLOGICAL INSTITUTE IS ACTIVE IN THE STUDY OF AURORAS.

The Polar Year is hosted by the International Council for Science (ICSU) and the World Meteorological Organization (WMO). Thousands of scientists from 60 states participate in the project. Research programmes number over 200. The Finnish Meteorological Institute contributes to ten international IPY projects.

NORTHERN LOCATION GIVES FINLAND AN EDGE

The Finnish Meteorological Institute acts as the coordinator of one IPY entity comprising more than 20 separate projects. The factor bringing these projects together is the impact of the Sun's activity on the physics and chemistry of near-Earth space and the Earth's upper atmosphere. In particular, Finland's contribution involves know-how in the fields of upper atmospheric chemistry and auroras.

In Finland, the behaviour of auroras is observed from surface stations by means of a diverse observation network. "A natural reason is our location that favours research into auroras; in principle, Northern Finland passes under the auroral oval every night," says Researcher Kirsti Kauristie.

The Academy of Finland has granted the Finnish Meteorological Institute research funds for a project that compares the auroral zones of the Northern and Southern Polar Regions. Apart from Finland, the Institute maintains a comprehensive network of cameras and magnetometers in the regions of Fennoscandia and the Svalbard. In spring 2008, the Institute will take into use a new-generation emCCD camera, which will enable even more accurate observations of auroras in the sky above Finland.

Active in international cooperation

Acting Director General Pekka Plathan visited Delhi, India, in January 2007. As a member of President Tarja Halonen's delegation, he participated in the Delhi Sustainable Development Summit.

INTERNATIONAL ORGANISATIONS AND NETWORKS

- **BALTMET**, Cooperational network of Baltic and Nordic meteorological institutes.
- **ECMWF**, European Centre for Medium-Range Weather Forecasts. Develops and produces numerical weather forecasts for the time range of 10–30 days.
- **EUMETNET**, Network of European National Meteorological Services.
- **EUMETSAT**, European Organisation for the Exploitation of Meteorological Satellites. Plans and maintains operational meteorological satellite systems.
- **NORDMET**, Cooperational network of Nordic meteorological institutes.
- **WMO**, World Meteorological Organization, a specialised agency of the UN for weather, climate and water.

OBSERVATION ACTIVITIES, WARNING METHODS AND WEATHER SERVICES ARE AMONG THE FUNCTIONS THAT ARE DEVELOPED IN THE FRAMEWORK OF INTERNATIONAL COOPERATION. THE FINNISH METEOROLOGICAL INSTITUTE STRIVES TO BE AN ACTIVE GLOBAL PLAYER.

The Finnish Meteorological Institute has good representation in international meteorological organisations. In the World Meteorological Organization, the Institute has a representative in each technical commission, and two Finns are working at the WMO Secretariat in Geneva. In 2006–2007, Professor Petteri Taalas, the Director General of FMI, headed the WMO Development and Regional Activities Department.

At the 15th Congress of the World Meteorological Organization, the Director General of the Finnish Meteorological Institute was elected a member of the Executive Council. He was the joint candidate of the Nordic countries and is the first Finnish representative on the WMO Executive Council in 17 years. The Executive Council meets once a year and has altogether 37 members.

Two Finns are working at the EUMETSAT Secretariat in Darmstadt. The Technical Advisory Committee of the ECMWF and the Scientific and Technical Group of EUMETSAT are chaired by representatives of the Finnish Meteorological Institute. In addition, the Institute has its representative in the Scientific Advisory Committee of the ECMWF.

EUROPEAN COOPERATION

EUMETNET strives to strengthen its position by reinforcing the network organisation. In consequence, it can work more effectively towards its

The Finnish Meteorological Institute hosts the EUMETSAT project that develops calculation methods and data processing environments for the utilisation of instruments in Metop and in other European new-generation satellites for measuring ozone, UV radiation and trace gases.

METOP IN OPERATIONAL USE

Metop, the first European polar orbiting meteorological satellite, operated by EUMETSAT, was declared operational in 2007, after six months in commissioning. Launched in October 2006, Metop collects important data about the atmosphere. Thanks to these data, the accuracy of weather forecasts can be improved markedly. New observations also develop the global monitoring of the climate and help scientists understand the complex links affecting the climate. In particular, observations about ozone and trace gases offer a new perspective to environmental problems on our planet.

goal of promoting European meteorology. The Finnish Meteorological Institute supports EUMETNET's role by covering the expenses of one representative to the EUMETNET Co-ordination Office in Brussels. EUMETNET, WMO and ECMWF have a joint representative in Brussels to advance issues pertaining to the field of meteorology within the EU.

The Finnish Meteorological Institute has also strengthened its representation in the European Commission by seconding one of Institute's employees to the GMES office for two years. GMES is an international monitoring system for the environment and security, launched by the EU and ESA in 1998. GMES provides information services associated with the environment and the related threats and works as a link between producers and users of data. GMES brings together a large volume of environmental data, which helps, among others, decision-makers in forming a clear overall picture of the state of the environment.

WORLDWIDE ACTIVITIES

The Finnish Meteorological Institute has several cooperation projects with its sister organisations, for example, in Estonia, Poland, Russia, Romania, Kazakhstan and Croatia. Research cooperation is conducted with, e.g. Argentina, El Salvador, China, India, Russia and the USA.

In consultation with the Ministry for Foreign Affairs in Finland and the WMO, the Institute has recently investigated the needs and possibilities for developing the National Meteorological and Hydrological Services in the countries in Africa, in the Balkans and in the area of the small island developing states in the Pacific according to their identified needs. These projects aim to support the preparedness to climate change and weather related natural disasters, for instance, by developing advanced warning systems for hazardous phenomena, thus promoting the economies of developing countries.

"Projects of this type give valuable support to Finland's development cooperation policy," says Director General Petteri Taalas.

These targets are also in line with the strategy adopted by the World Meteorological Organization at its Congress. According to this strategy, activities pertaining to climate change and to the prevention of natural disasters will gain more prominence in the meteorological community.

Increasingly effective administration

THE ADMINISTRATION OF THE FINNISH METEOROLOGICAL INSTITUTE IS RESPONSIBLE FOR THE COST-EFFECTIVE PROVISION OF FINANCIAL AND PERSONNEL SERVICES, FOR HUMAN RESOURCES DEVELOPMENT AND FOR PROPERTY SERVICES.

In all essential respects, the development of electronic systems for human resources and financial administration was brought to conclusion in 2007. The administrative processes are now working very cost-effectively. For instance, the electronic systems encompass all major areas of financial administration. The Institute has also introduced electronic payroll calculations and has developed electronic recruiting processes.

The Institute's internal financial steering is supported by a new cost-accounting system that is well suited to serve the Institute's expanding information needs. Data are utilised, for instance, in project monitoring, in the development of self-financed operations and in the pricing of commercial services.

The Government's productivity programme also defines the direction in which administrative operations are developed.

WELL-BEING AT WORK IS SUPPORTED

The Finnish Meteorological Institute was ranked second on the list of the Best Workplaces in Finland 2007, in the category of public and non-profit organisations. Job satisfaction was also measured by means of a State administration questionnaire (see p. 30).

The Finnish Meteorological Institute promotes well-being at work in many ways. Among other things, the Institute supports the personnel's opportunities for physical exercise during working hours, provides an occupational psychologist's services and participates in projects to develop working life.

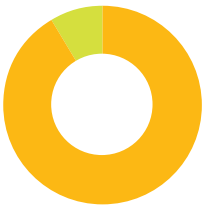
A working group has studied the content of the Institute's present job tasks and the needs to develop the pay system. It has presented a proposal for simplifying the system used to classify job demands. The Institute has also appointed an equality team, which has drawn up an equality plan reflecting the Institute's situation and has started to implement the plan.

An extensive programme to develop expert and managerial potential, the Expert Academy, was carried out as a human resources development project. Training of the management and supervisors

Administration and Director General's Office
Total Expenditure €11.5 Million*

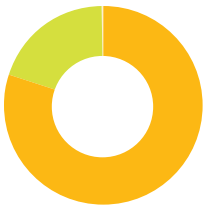
Administration	11.5
Other Divisions	35.7

Administration and Director General's Office
47 Person-years



Budgetary Funding	43
Earned Revenue	4

Administration and Director General's Office
Funding €11.5 Million



Budgetary Funding	9.2
Earned Revenue	2.3
External Funding	0.002

* Share of international membership fees €3.7 million

A work organisation of experts

will continue in 2008. The goal is to improve profitability and good personnel management.

Minor repairs were made at Dynamicum, the Institute's office building commissioned in 2005, and property engineering features continued to be broken in. An inspection under the warranty policy was conducted in the building in October 2007. Property engineering know-how is developed together with the builder; the objective is to optimise functionality and energy conservation. The Meteorological Institute is in the process of adopting the Green Office environmental management system. Thanks to the system, the Institute will reduce its load on the environment and, at the same time, will save on material and energy costs.

At the end of 2007, the Finnish Meteorological Institute had 599 employees (610 in 2006). The figure includes part-time employees and the employees hired with the help of outside funding. Budgeted funding covered the expenses of a full-time equivalent staff of 402 (404), while revenues from commercial operations and other outside funding covered the expenses of a full-time equivalent staff of 178 (179).

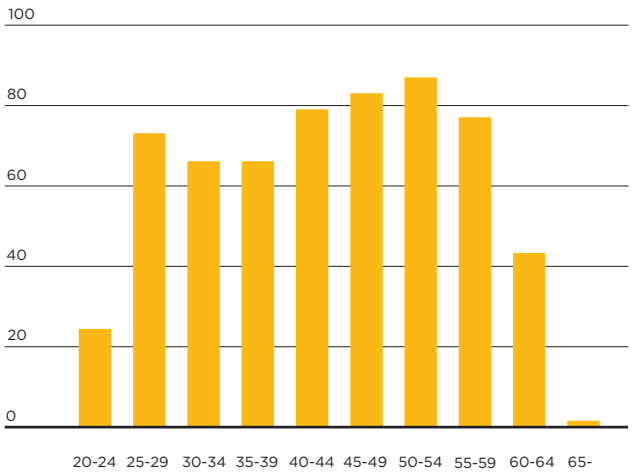
In 2007, altogether 292 Institute employees worked in an expert capacity (310 in 2006). In all, 57.7 per cent (56) of the personnel have an academic degree, and 15.9 per cent (16.2) have a postgraduate degree.

Breakdown of the Personnel´s Education

General Education	7.1
Secondary Level	29
Lowest Post-Secondary	6.2
Lowest Tertiary	9.2
Higher Tertiary	32.6
Doctoral and Licentiate´s Degree	15.9

Breakdown of the Personnel by Age Brackets

Number of Persons



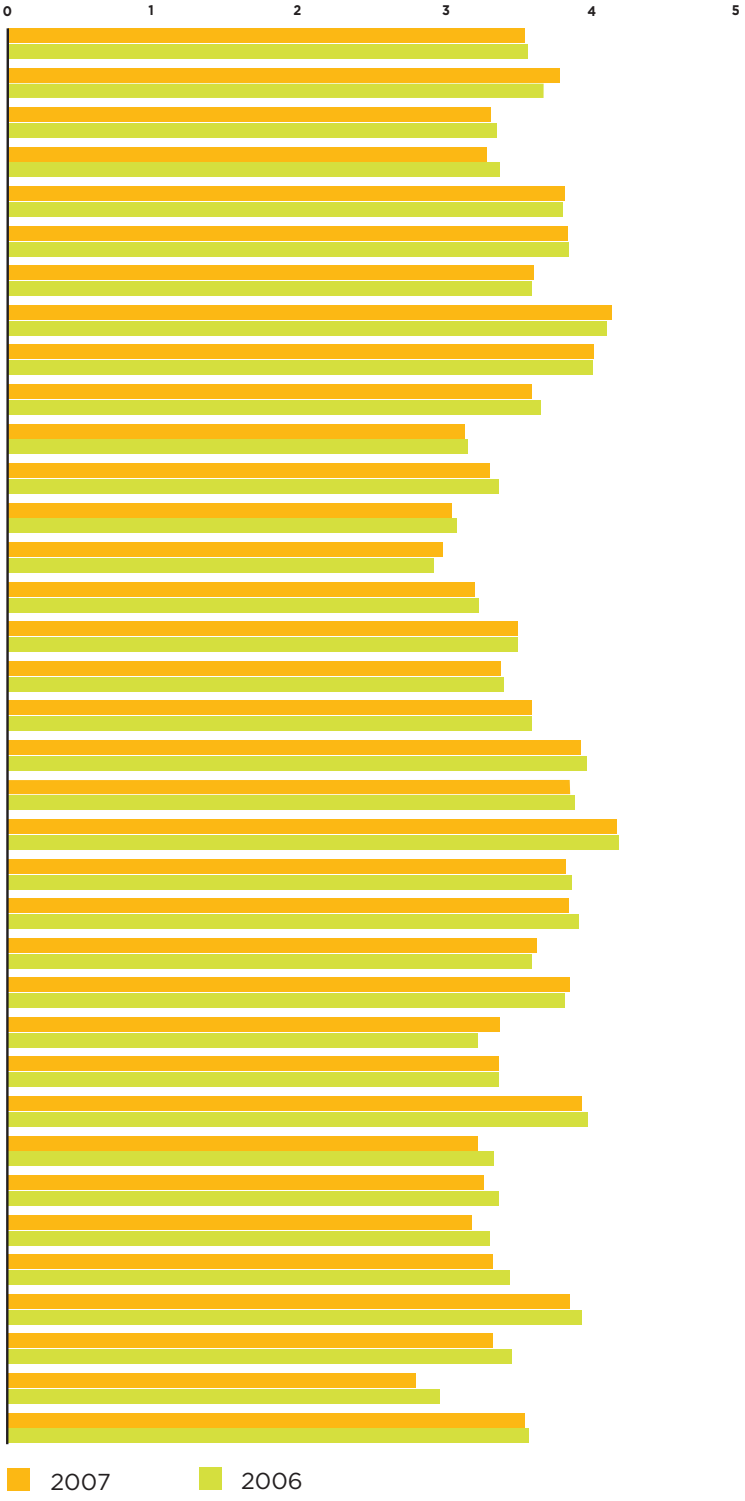
Job satisfaction remained high

Job satisfaction is measured yearly, in order to develop the Institute's work organisation and its practices.

The job satisfaction survey carried out in autumn 2007 showed that job satisfaction among the Finnish Meteorological Institute's personnel remained virtually unchanged. The job satisfaction index for the whole Institute was 3.52 whereas in 2006 it had been 3.55. The response rate in 2007 was 55 per cent.

Job Satisfaction 2007

	2007	2006
Management	3.52	3.54
Supervisor´s support in work and in creating preconditions for work	3.76	3.7
General organisation of work in the work community	3.29	3.33
Receiving feedback on work results, professionalism etc.	3.26	3.35
Fairness and humane treatment	3.79	3.78
Contet of work and professional challenges	3.81	3.82
Clarity of objectives related to results and the work	3.58	3.57
Independence of the work and the possibility to affect its content	4.11	4.08
Professional challenges	3.99	3.98
Work experienced as inspiring and a source of joy	3.57	3.63
Pay	3.11	3.13
Clear and understandable pay scheme	3.28	3.34
Pay in relation to demands of the work	3.02	3.06
Changes in pay with changes in work performance	2.96	2.9
Fairness of pay	3.18	3.21
Support for development	3.47	3.47
Career advancement and its support in the work community	3.36	3.38
On the job training and other possibilities to develop one´s expertise	3.57	3.57
Work climate and cooperation	3.90	3.94
Cooperation and climate within the community	3.83	3.86
Fairness and humane treatment (colleagues)	4.15	4.16
Respect for know-how and work input	3.80	3.84
Realisation of gender equality in the work community	3.82	3.89
Work conditions	3.60	3.57
Possibility to combine work and private life	3.83	3.79
Job security now and in the future	3.35	3.2
Coping and energy	3.34	3.34
Work premises and work equipment	3.91	3.95
Flow of information	3.20	3.31
Communication and flow of information within the work community	3.24	3.34
Openness in planning and decision-making within the work community	3.16	3.28
Employer image	3.30	3.42
Image of the employer as a good employer	3.83	3.91
Clear and understandable values	3.30	3.43
Realisation of values in practise	2.78	2.94
Total	3.52	3.55



Electronic systems bring financial benefits

ELECTRONIC SYSTEMS HAVE BEEN TAKEN INTO USE IN THE FINNISH METEOROLOGICAL INSTITUTE'S ADMINISTRATION THROUGHOUT THE 2000S, WITH GOOD RESULTS. EFFICIENT ADMINISTRATION BRINGS FINANCIAL BENEFITS.

The Finnish Meteorological Institute has introduced electronic administration systems almost as soon as they have become available: a travel management system in 2003, a system for accounts payable in 2004 and so on. The latest additions are charge cards associated with travel management and an electronic reporting system used in State administration.

The cost benefits of electronic systems came out clearly in a study conducted by the Ministry of Transport and Communications in its administrative sector. For instance, the Meteorological Institute was found to be the most efficient unit in the management of purchase accounts and travel expense accounts in the whole administrative sector.

"Account statements, receipts, payment lists and virtually all other material are circulated, approved and filed electronically," says Leena Tuomainen, Accounting Manager.

"Thanks to the personnel's positive attitude to information systems, implementation of the systems has never been any problem," she says, praising the Institute staff.

A LONG LIST OF BENEFITS

It's easy for Leena Tuomainen to list the benefits of electronic administration:

"We keep constant track of documents; nothing can be forgotten on someone's desk or lost. Documents are sent promptly to the next person processing them, and we don't need to pay penalty interest for late payment. Going through the files is fast, and everyone can see the filed documents from their own desk. When information is entered into the system only once, much time is saved."

The benefits brought by the system also show on the bottom line.

"If the handling of, say, a purchase invoice now costs us a little under eight euros, without these systems it would cost 30 euros," says Leena Tuomainen, giving a concrete example.

Electronic systems also mean that fewer people are needed for administrative tasks. Thus, efficient administration also supports the goals of the State administration's productivity programme.

Altogether 16,500 purchase accounts and travel expense accounts were processed electronically in the Meteorological Institute in 2007. The picture shows Leena Tuomainen.

The Finnish Meteorological Institute – a forerunner in e-learning

THE FINNISH METEOROLOGICAL INSTITUTE HAS BEEN RESPONSIBLE FOR LEADING EUMETCAL, THE TRAINING PROGRAMME OF THE EUROPEAN METEOROLOGICAL INSTITUTES, SINCE 2001. INTERNATIONAL COOPERATION ALSO BENEFITS THE INSTITUTE'S OWN PERSONNEL DEVELOPMENT.

EUMETNET is a European cooperation network consisting of 24 national meteorological services. Development and research projects carried out within the network raise the quality and cost-effectiveness of these services. For some years now, the Finnish Meteorological Institute has been responsible for the network's training programme.

Material for computer-aided learning has been developed in international cooperation for a long time, to meet the continuous professional development training needs of meteorologists. Now the goal is to increase the efficiency of training by introducing methods such as international blended learning courses. Having contributed to its planning and implementation, the Institute has acquired knowledge about the use of e-learning methods in personnel development.

"Besides time and money, e-learning helps save flight miles," says Meteorologist Jaakko Karppanen, who works as a training support officer for Eumetcal.

POSSIBILITIES AND CHALLENGES IN E-LEARNING

Based on the know-how acquired, the Finnish Meteorological Institute has constructed a new e-learning platform.

"The e-learning platform will be used as a basis for training in the Institute. It will support the Institute's learning goals and human resources development," Jaakko Karppanen explains.

"The objective is to make the learning platform into a cooperation tool. Using this tool, employees can distribute information and can improve their own professional skills through learning," Jaakko Karppanen concludes.

Finances 2007

OPERATING ENVIRONMENT

The Finnish Meteorological Institute's stakeholders include the authorities, industry, universities and research institutes, cooperation partners abroad, international organisations and private individuals. Allocations from the State Budget cover the expenses of the Institute's basic functions. Year by year, revenues from commercial operations and competition-based research funding have accounted for a higher share of total funding.

Business operations were separated from the Institute's other functions and were carried out by the Commercial Services profit centre, which purchased services from the Institute's basic functions at cost price. In addition, expert services were produced on commercial grounds within the Research unit.

Outside project financing from both Finland and abroad was secured for research. The principal sources of external funding were the Academy of Finland, Tekes, the European Commission, and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT).

FINANCING AND COSTS

The Institute's total expenditure came to EUR 47.22 million, or EUR 1.68 million more than the year before. Most of the difference is explained by a rise in wages and salaries. Expenditure was covered as follows: income from operations, EUR 16.16 million (34%); direct outside funding, EUR 1.47 million (3%); and allocations from the State Budget, EUR 29.60 million (63%).

Revenues from commercial operations increased by EUR 0.7 million on the previous year. The income proper from commercial services came to EUR 11.20 million, while income from jointly funded research totalled EUR 4.93 million. Commercial services yielded a surplus of 6.6 per cent.

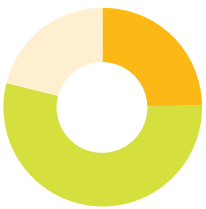
The Institute's expenses were monitored by means of an activity-based costing system. In the cost structure, the share of payroll costs rose to 57 per cent of total expenses. The share of operating costs fell to 36 per cent and the share of capital costs rose to seven per cent of total expenses. In all, the Institute's expenses rose by four per cent on the previous year.

REVIEW OF THE FINANCIAL STATEMENTS

The Income and Expense Account describes the structure of the Institute's revenues and expenses, excluding the allocations from the State Budget. Revenues from operations increased by EUR 0.6 million on the previous year; increases were recorded in revenues from both commercial and other operations.

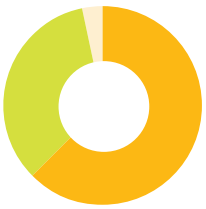
Expenditure arising from activities rose by EUR 1.34 million on the previous year.

Total Revenue by Sector
€16.1 Million



Public Sector	€4.0 Million	25%
Business	€8.7 Million	54%
Other	€3.4 Million	21%

Funding
€47.2 Million



Budgetary Funding	€29.6 Million	63%
Earned Revenue	€16.2 Million	34%
External Funding	€1.5 Million	3%

Total Revenue from Fee-based Operations by Sector
€47.2 Million

Weather and Safety	€18.8 Million	40%
Research and Development	€16.9 Million	36%
Administration	€11.5 Million	24%

Total depreciation fell slightly on 2006. The depreciation method used by the Institute was straight-line depreciation according to economic service life; the write-off periods ranged from 3 to 10 years. The balance sheet value of fixed assets and other long-term investments fell from EUR 8.63 million to EUR 7.71 million. The balance sheet value of current assets and inventories rose to EUR 3.71 million. The balance sheet total increased from EUR 11.299 million in 2006 to EUR 11.413 million.

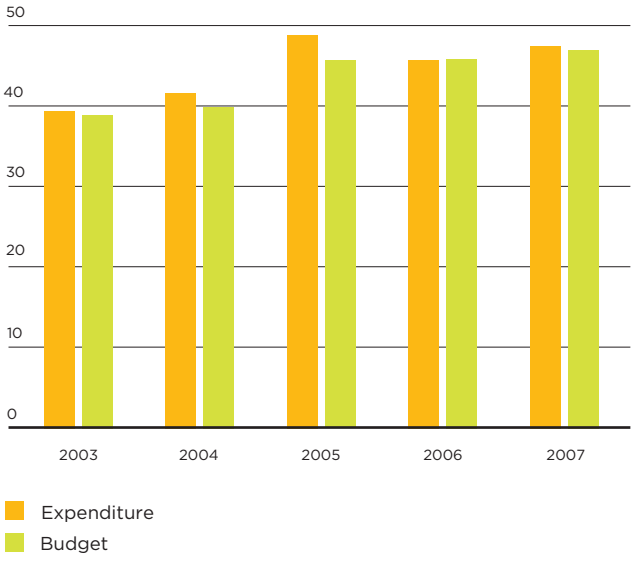
Overall, the deficit for the financial period increased by EUR 1.90 million on 2006. The change stemmed from the above-mentioned factors: increase in revenues from operations (effect on the deficit EUR +0.6 million); increase in expenses (effect EUR -1.34 million); increase in extraordinary income (effect EUR +0.02 million); and VAT adjustments (effect EUR -1.18 million).

Revenue, € Thousand	2006	2007	Change %	Share 2007
Commercial Services	11 156	11 200	0%	69%
Jointly Funded Research	4 266	4 930	16%	31%
Other	98	26	-73%	0%
TOTAL	15 520	16 156	4%	100%

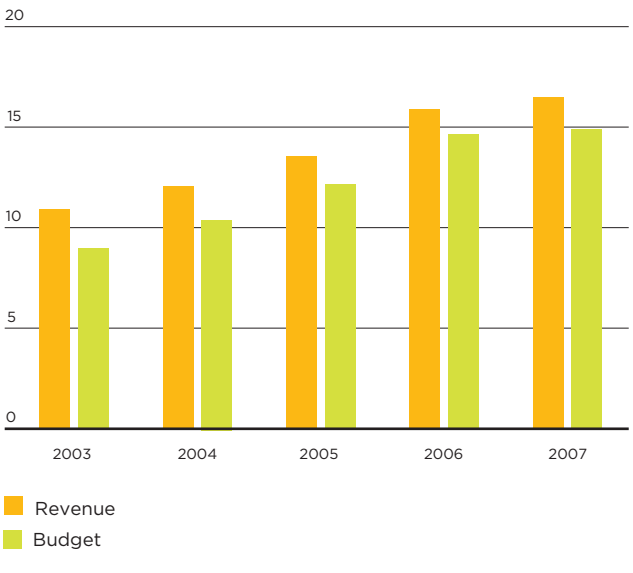
Expenditure, € Thousand	2006	2007	Change %	Share 2007
Salaries	25 762	27 397	6%	58%
Operating Expenditure	17 742	17 498	-1%	37%
Investment	2 049	2 325	13%	5%
TOTAL	45 553	47 220	4%	100%

Costs, € Thousand	2006	2007	Change %	Share 2007
Salaries	25 981	27 683	7%	57%
Operating Costs	17 905	17 691	-1%	36%
Capital Costs	3 004	3 243	8%	7%
TOTAL	46 890	48 617	4%	100%

Expenditure Trends (€ Million)



Revenue Trends (€ Million)



Income and expense account 2007

	1.1.2007 - 31.12.2007		1.1.2006 - 31.12.2006	
Operating income				
Income from fee-based operations	11 177 096.37		11 122 306.72	
Rents and compensation for use	22 501.56		43 500.06	
Other income from operations	5 318 343.87	16 517 941.80	4 750 819.50	15 916 626.28
Operating expenses				
Materials, supplies and goods				
Purchases during the year	3 188 521.97		2 979 066.98	
Personnel costs	27 684 385.25		25 991 991.84	
Rents	3 148 708.56		3 171 157.34	
Purchased services	6 270 545.44		6 222 096.66	
Other expenses	5 368 626.36		5 802 363.32	
Depreciation	2 661 660.00		2 793 326.85	
Adjustement to internal expenses	296 242.05	-48 618 689.63	318 906.72	-47 278 909.71
Surplus I		-32 100 747.83		-31 362 283.43
Financial income and expenses				
Financial income	880.29		2 212.73	
Financial expenses	-3 596.35	-2 716.06	-3 501.22	-1 288.49
Extraordinary income and expenses				
Extraordinary income	288 659.51	288 659.51	272 276.65	272 276.65
Surplus II and surplus III		-31 814 804.38		-31 091 295.27
Income from taxes and obligatory expenses				
Value added tax collected	933 721.01		2 037 316.52	
Value added tax paid	-2 793 227.23	-1 859 506.22	-2 718 611.07	-681 294.55
Surplus for the financial period		**-33 674 310.60**		**-31 772 589.82**

Assets 2007

	31.12.2007		31.12.2006	
ASSETS				
FIXED ASSETS AND OTHER NON-CURRENT INVESTMENTS				
IMMATERIAL ASSETS				
Immaterial rights	42 599.91		92 153.91	
Other non-current expenditure	63 013.95		3 528.95	
Prepayments and acquisitions in progress	0.00	105 613.86	29 406.00	125 088.86
MATERIAL ASSETS				
Structures	108 691.83		107 740.83	
Machinery and equipment	6 370 043.51		7 106 655.88	
Fixtures and furnishings	1 058 152.04		1 172 658.67	
Other material assets	2 181.90		3 385.90	
Prepayments and acquisitions in progress	47 384.21	7 586 453.49	99 439.31	8 489 880.59
SECURITIES HELD IN FIXED ASSETS AND OTHER NON-CURRENT INVESTMENTS				
Securities held in fixed assets	13 153.00	13 153.00	15 467.00	15 467.00
TOTAL		**7 705 220.35**		**8 630 436.45**
STOCK AND FINANCIAL ASSETS				
CURRENT RECEIVABLES				
Trade receivables	2 970 041.32		2 248 954.55	
Prepaid expenses and other accrued income	693 580.12		295 452.90	
Other current receivables	33 082.30		112 445.92	
Prepayments	10 633.44	3 707 337.18	11 685.82	2 668 539.19
CASH, BANK RECEIVABLES AND OTHER MONIES				
Cash accounts	444.35	444.35	517.95	517.95
TOTAL		3 707 781.53		2 669 057.14
TOTAL ASSETS		**11 413 001.88**		**11 299 493.59**
LIABILITIES				
EQUITY CAPITAL				
STATE CAPITAL				
State capital 1.1.1998	5 439 282.69		5 439 282.69	
Change in capital for previous financial periods	-2 579 171.11		-1 222 584.85	
Transfer of capital	33 459 585.28		30 416 003.56	
Surplus/deficit for the financial period	-33 674 310.60	2 645 386.26	-31 772 589.82	2 860 111.58
CREDITORS				
CURRENT				
Advanced received	1 559 424.60		1 519 327.16	
Trade payables	1 413 361.31		1 272 230.15	
Transactions between accounting offices	564 314.37		546 784.21	
Items to be forwarded for payment	460 574.20		399 482.36	
Accrued liabilities	4 543 742.24		4 349 397.68	
Other current liabilities	226 198.90	8 767 615.62	352 160.45	8 439 382.01
TOTAL		8 767 615.62		8 439 382.01
TOTAL LIABILITIES		**11 413 001.88**		**11 299 493.59**

Vision

THE FINNISH METEOROLOGICAL INSTITUTE – CUTTING-EDGE EXPERTISE IN EUROPEAN ATMOSPHERIC KNOW-HOW

Mission statement

THE FINNISH METEOROLOGICAL INSTITUTE PRODUCES HIGH-QUALITY OBSERVATIONAL DATA AND RESEARCH FINDINGS ON THE ATMOSPHERE. THE INSTITUTE USES ITS EXPERTISE EFFECTIVELY TO PROVIDE FIRST-RATE SERVICES BENEFITING PEOPLE AND THE ENVIRONMENT.

The Finnish Meteorological Institute

- **observes the physical state, chemical composition and electromagnetic phenomena of the atmosphere**
- **produces information about the past, present and future states of the atmosphere**
- **conducts high-standard research in the fields of meteorology, air quality, space physics, earth observation and geomagnetism**
- **carries out competitive commercial activities, based on expert services, both in Finland and abroad**
- **takes an active part in national and international cooperation**
- **actively disseminates information about matters associated with the atmosphere**
- **foresees changes and responds quickly to changes in the environment and to changing expectations.**

Strategic goals 2008–2011

The Institute's scientific and methodological competence will be among the foremost in the world, and will produce increasing value added for the Finnish society.

The Institute's know-how and the new services developed are ever more effective in reducing economic losses caused by dangerous weather and natural phenomena, and help enhance internal security in Finland.

Overall productivity will increase by about 2% per year during the period.

The Institute is a competitive employer ensuring an environment where individuals develop their skills actively and are satisfied with their work. Cooperation with both internal and external partners is fruitful. The Institute's performance represents the highest level in Finland and internationally.

Values

- **Expertise**
- **Courage**
- **Fair play**

Organisation 1.1.2008

DIRECTOR GENERAL

Weather and Safety

- Weather and Safety Centre
- Commercial Services
- Development of Services
- ICT Management Services
- Observation Services

Research and Development

- Climate Change
- Air Quality
- Meteorology
- Earth Observation
- Arctic Research
- Kuopio Unit
- Consulting Services

ADMINISTRATION

Board 1.1.2008

Sitting in the front, from the left: Sirkka Haunia, Pentti Partanen, Sabina Lindström and Reetta Meriläinen.
Back row, from the left: Markku Kulmala, Petteri Taalas, Joanna Saarinen, Veijo Mäkelä, Marja Happonen, Marko Viljanen and Sakari Kulmala.

Director-General
Pentti Partanen
Ministry of the Interior
Department for Rescue Services
Chairman

Director
Sabina Lindström
Ministry of Transport and Communications
Vice Chairman

Director
Sirkka Haunia
Ministry of the Environment

Director
Sakari Karjalainen
Ministry of Education

Academy Professor
Markku Kulmala
University of Helsinki

Editor-in-Chief
Reetta Meriläinen
Helsingin Sanomat

Director, Human Resources
Marja Happonen
Vaisala Oyj

Senior System Analyst
Veijo Mäkelä
Finnish Meteorological Institute
Representative of the personnel

Management Group 1.1.2008

Front row, from the left: Eeva-Kaisa Heikura, Petteri Taalas and Joanna Saarinen.
Back row, from the left: Marko Viljanen, Juhani Damski, Tuija Pulkkinen, Yrjö Viisanen and Heikki Juntti.

Director General
Petteri Taalas

Director
Yrjö Viisanen
Research and Development

Director
Juhani Damski
Weather and Safety

Director
Marko Viljanen
Administration

Head of Unit
Heikki Juntti
Weather and Safety Centre

Head of Unit
Tuija Pulkkinen
Earth Observation

Communications Manager
Eeva-Kaisa Heikura
Communications

Senior System Analyst
Veijo Mäkelä
Representative of the personnel

Executive Assistant
Joanna Saarinen
Secretary

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