



Royal Netherlands
Meteorological Institute
*Ministry of Transport, Public Works
and Water Management*

2008 Annual report

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Hans Bol]| 40 years old

Weather, climate and me



'I ask myself whether the changing climate is really a direct result of human actions. After all, there have been other extreme climate changes throughout the centuries. As far as the future of my two children Nick (7) and Anouk (9) is concerned, I'm not particularly worried about the climate. Although I certainly do make an effort to teach them about the environment: don't waste heat, don't litter, close the door behind you...'

Foreword

On 16 October 2008, the State Secretary of Transport, Public Works and Water Management sent the Cabinet's position on the assessment of the KNMI Act to the Lower House of Parliament. Its position is clear, and I see it as a compliment to KNMI for the products and services it has delivered in recent years.

As of this writing, the date of the debate in the Lower House has once again been postponed. It remains unclear whether the House will follow the Cabinet's lead in this matter. The most pressing point is probably the separation between market and government, particularly with regard to aviation meteorology. That much is clear according to the hearing organised by the Standing Parliamentary Committee on Transport, Public Works and Water Management in January 2009.

At the same time, it's clear that virtually everyone involved, including private weather companies, recognises the crucial role that KNMI plays in extreme weather warnings in the event of dangerous weather (which, by the way, was also the theme of our last annual report). The steps toward a policy of free access to data described in the Cabinet's position are also widely supported. Accordingly, at the start of 2009, KNMI began releasing certain data, such as the precipitation radar data and 'daily data'.

Against this background, last year, KNMI established a multi-year policy plan for 2009-2011, which was recently published. I would like to draw your attention to two aspects. The first is the strengthening of the KNMI's international position. This involves both a more prominent position for KNMI in various European projects, in connection with EUMETNET or EU collaborations, for instance, and a more active role for KNMI in making professional contributions in countries with developing economies. This goes hand in hand with the intentions of the Dutch Cabinet to give an international dimension to the National Water Plan.

A second aspect of the multi-year policy plan concerns a strategic orientation in terms of products and services for customers in the water, traffic and health care sectors, with respect to the KNMI Act of course. It's our conviction that it is precisely in these social sectors that we can achieve the greatest added value with the innovation that is planned at KNMI. The various interviews in this annual report illustrate this clearly.

Speaking of this annual report...you will have noticed that this year's report is presented differently from last year's

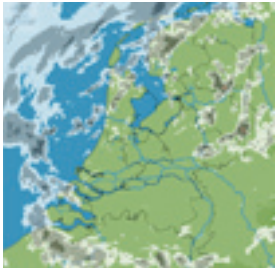


edition. For the first time, we are incorporating the new government house style. We have also decided for production-related reasons to publish the Dutch and English language versions separately. This approach and as a result of several other measures, we were able to cut several months off the time required for publication. I'm sure you will appreciate this.

I'm convinced that the 2008 KNMI annual report once again provides a good overview of our institute's activities. As was the case last year, I trust that you after reading the report will share my view that –once again – KNMI fulfilled its mission (the top national institute for climate, weather and seismology) and lived up to its core values (professional, reliable, entrepreneurial and cooperative)!

Dr. ir. Frits J.J. Brouwer, *KNMI Director-General*

Annual report 2008 |



January

High-resolution images from the KNMI precipitation radar made available, which are even sharper and make it possible to follow current weather conditions in even greater detail. With an average of 6.5°C in De Bilt, January is the second mildest January since observations began in 1706. January 2007, was even milder (7.1°C). Globally, the decade 1998-2007 is the warmest since observations began in 1850. The global average temperature for 2007 also ranks high in the list.



February

Prime Minister Balkenende receives the first copy of the brochure *De Staat van het Klimaat 2007* (The State of the Climate 2007). Climate change creates opportunities for innovation, both in terms of reducing greenhouse gas emissions and anticipating the consequences. Read more on page 16. The European Environment Agency (EEA) is now an official user of European air quality forecasting, which is based on measurements from space and from the ground, as well as on three models for air quality. In connection with this, KNMI is working in partnership with the National Institute for Public Health and the Environment and the Netherlands Organisation for Applied Scientific Research on Dutch air quality forecasting. KNMI researcher and recently appointed professor of climate modelling and climate analysis at Utrecht University's Faculty of Geosciences, Nanne Weber, holds her inaugural address with the title *Kan men tweemaal in dezelfde rivier stappen?* (Can you step twice into the same river?) Read more on page 38. On 19 February, KNMI measures a new low temperature record of -87.2°C in the ozone layer at an altitude of 21.5 kilometres. KNMI began measurements in the upper atmosphere using weather balloons more than half a century ago.



March

The Netherlands enjoyed a white Easter, with heavy snow at times and accumulations up to 10 centimetres in some locations. Never before has so much snow fallen on Easter in the Netherlands. Easter Sunday and Monday were also the coldest since 1964. In 2008, KNMI issued just one extreme weather warning on 12 March due to extremely intense wind gusts. In 2007, there were five. The KNMI women's network - DIVA - was launched. By means of various activities, DIVA intends to help female KNMI staff to achieve their ambitions to a greater extent than currently is the case. To this end, DIVA increases the visibility of women within KNMI and strengthens their position.



April

Meteorologist Edward Norton Lorenz dies at age 90. Lorenz was the father of chaos theory, which is also known as the butterfly effect. In May 2004, he received the Buys Ballot Medal from the Royal Netherlands Academy of Arts and Sciences during a ceremony at KNMI in De Bilt.



May

Cyclone Nargis strikes Myanmar on 2 May. Intense winds, heavy rainfall and waves exceeding four metres caused more than 100,000 fatalities. With wind speeds exceeding 200 km/h, Nargis fell into the second strongest storm category. KNMI researcher Rob Roebeling is awarded a doctoral degree. The most recent satellite measurements of clouds could be used to improve climate models for the future. Read more on page 39. During the past ten years, substantial increases in air pollution above East Asia have been observed. During the same period, air pollution above portions of Europe and North America has declined. These conclusions are drawn from data collected by Sciamachy, a satellite instrument for which KNMI and SRON are responsible for the scientific management. The middle of the province Sichuan in central China was hit by an intense, shallow and destructive earthquake on 12 May 2008. Measuring 7.8 on the Richter scale, the earthquake's epicentre was at a depth of 10 kilometres. The earthquake claimed 70,000 lives. It was the most destructive quake in China since 1976. KNMI researcher Siebren de Haan is awarded a doctoral degree. GPS is not only useful as a navigation aid for cars, ships and airplanes, it also provides useful meteorological data. Read more on page 38. May was exceptionally warm. The average temperature in De Bilt was 15.7°C, compared to the normal 12.7°C. The first ten days were the sunniest ever. In addition, there was little rain. It was particularly dry in the northern part of the Netherlands. International cloud and particulate matter measurement campaign in Cabauw. The observations provide more insight into particulate matter and clouds. Read more on page 31.



June

KNMI's updated and improved visibility product for Schiphol officially deployed. Read more on page 17. A heavy lightning storm with nearly 50,000 lightning discharges put an end to the far too early beginning of the summer. The Jason-2 satellite was launched successfully on 20 June. The satellite is very important to our country because Jason-2 will provide more detailed information on sea level rise than previously available. Read more on page 30. KNMI researcher Láslo Evers wins the newly established prize for the 2007 'KNMI article of the year'. The winning article, *A seismoacoustic analysis of the gas-pipeline explosion near Ghislenghien in Belgium*, appeared in the February 2007 issue of the Bulletin of the Seismological Society of America. The jury assessed both scientific quality and social relevance.



July

The biennial employee satisfaction survey revealed that the general satisfaction of KNMI personnel has remained virtually unchanged compared to 2005. Aspects yielding high scores include the relationship with colleagues, work content, social relevance of the work, work place and fringe benefits. These aspects are key elements in employee satisfaction. State Secretary Tineke Huizinga is presented with the first copy of the five-yearly report *De toestand van het Klimaat in Nederland* (The State of the Climate in the Netherlands). This report clearly presents the facts concerning rising temperatures and offers an explanation for heavier rainfall along the coast. Read more on page 17. KNMI logs new Internet record. The number of visitors to the site continues to grow steadily. During the month of July, nearly 37.6 million page views were recorded on www.knmi.nl. The Audit Service of the Ministry of Transport, Public Works and Water Management conducted an interim evaluation of the reorganisation that is part of the KNMI Innovation Programme and yielded predominantly positive results. KNMI develops a website for the NOC*NSF with information on the air quality and weather conditions of the locations in China where the Olympic and Paralympic Games were held.



August

The KNMI Council concludes that the self-evaluation of KNMI research in 2004-2006 was completed with the utmost care, that the quality and productivity of the research is satisfactory and that KNMI is performing the continual process of quality improvement in an adequate manner. August was disappointing in terms of summer temperatures and sunshine. The weather was influenced by depressions throughout the month. The associated weather pattern was extremely variable, with precipitation on many days. In a warmer climate, precipitation extremes will increase. Research by KNMI, published in Nature Geoscience, reveals that the relationship between temperature and precipitation extremes is even greater than previously believed.



September

During the first half of September, the Caribbean hurricane season gets off to a strong start. Following Gustav, which struck New Orleans, Hanna and Ike spread death and destruction. KNMI employee Ad Stoffelen participates in the survey flights through these hurricanes. Read more on page 28. KNMI researcher Alwin Haklander is awarded a doctoral degree. His research reveals that the increasing temperature difference between the tropics and the North Pole caused by the intensified greenhouse effect may lead to more rapid recovery of the ozone layer. Read more on page 40. The latest knowledge on climate change and the manner of adaptation is the main theme during the European EMS/ECAC climate conference co-organised by KNMI in Amsterdam. Read more on page 18. The website Meteoalarm.eu, to which KNMI made significant contributions, receives the EMS Outreach & Communication Award. The Meteoalarm.eu site provides information about hazardous and extreme weather in more than 20 European countries. The Delta Committee report is published. The Committee presents recommendations to the Cabinet on how the Netherlands can ensure flood protection in the face of the consequences of climate change over the long term. The recommendations are partially based on KNMI data. Read more on page 19.



October

Based on the assessment of the KNMI Act conducted by KPMG, the Cabinet concludes that during the past years KNMI has properly performed the tasks defined in the Act. This reconfirms the KNMI's position as national knowledge and data institute. The Lower House of Parliament will discuss the market and governmental aspects of the KNMI Act in 2009. The extent of Arctic sea ice nears the record low set in 2007. At the start of September, while both the northeast and northwest passages of the Arctic Ocean were almost entirely ice-free, the North Pole as a whole was still far from being entirely free of ice. KNMI signs a collaboration agreement with the Waterdienst (Water Agency) Directorate-General for Public Works and Water Management. This umbrella agreement facilitates KNMI and Waterdienst in arranging specific research projects or the operational exchange of data, agreements or contracts. This is a key step towards more intensive collaboration.



November

KNMI employee Ad Stoffelen is one of the seven nominees for the prestigious Royal Netherlands Academy of Arts and Sciences prize for Science & Society for his research into measuring wind from space. The winner on the evening of the Science & Society event in the Ridderzaal, however, was Prof. T.H.M. Rasing who investigated how light can make a computer 10,000 times faster. [Many seamen were in De Bilt on 10 November for the presentation of medals and awards to captains, steersmen and radio operators of the merchant navy and the Dutch Royal Navy for their accomplishments in the field of meteorology. Read more on page 28.](#) In St. Petersburg, KNMI employee Wiel Wauben receives the Väisälä award from the World Meteorological Organisation (WMO) for co-authoring the best publication in the field of meteorological observation. [The Cabinet allocates €78 million for Tropomi. ESA approves the associated space mission. The Tropomi satellite instrument is of great importance for air pollution measurements and climate research. Read more on page 20.](#) KNMI researcher Láslo Evers is awarded a doctoral degree. Evers improved the entire process of infrasound measurement, analysis and interpretation. Infrasound can be used, for instance, to detect nuclear weapon tests. [Read more on page 40.](#) [The hurricane season \(July to November\) sets numerous records. No fewer than six successive storms and hurricanes \(i.e. Dolly, Edouard, Fay, Gustav, Hanna and Ike\) landed on the US mainland. This has never happened before.](#)



December

KNMI Director-General Frits Brouwer is elected as chairman of EUMETNET, the collaborative association of 24 national meteorological institutes in Europe. [Read more on page 29.](#) [The quality management system of KNMI's Information and Observation Services and Technology department is certified. According to Det Norske Veritas Certification B.V., it is in compliance with the most recent ISO standard \(ISO 9001:2008\).](#) An international team of scientists, including a large number of KNMI researchers, completes a scientific assessment of the plausible high-end climate change scenarios. The study was commissioned by the Delta Committee. [The State Secretary for Defence and State Secretary for Transport, Public Works and Water Management sign a declaration of intent for more intensive collaboration, for the measurement network's management and for the weather room. Read more on page 30.](#) The Dutch government launches a uniform house style to make government more recognisable and approachable for private individuals and companies. KNMI will also make this transition in the coming years. The first change could be seen on the annual year-end gift: a storm-resistant umbrella in the new house style. [KNMI researcher Thijs Heus is awarded a doctoral degree. Improved cloud data is made possible by combining airplane measurements with detailed computer simulations. Read more on page 41.](#) [Substantial preparations have already been made for personnel allocation. Starting on 1 January 2009, for instance, ten permanent financial department and HRM positions will be transferred to the Shared Service Organisation \(SSO\) of the Ministry of Transport, Public Works and Water Management.](#) Never has December been so sunny. It was also the coldest since 1996.

Jopie van Aalst]]

78 years old

Weather, climate and me



'We used to have cold winters and hot summers. These days, it seems like autumn all year round. Sure there was an occasional downpour during my youth, but nowadays it seems like the rain never stops. I also miss those beautiful winters when we could skate for days on end. Although there was a bit of skating again this year, how many years have passed since the last time? Whether this is the result of climate change, I don't know, but I don't worry about that sort of thing too much anymore...'

Water]|

and weather

Weather and climate are both closely linked to water. Tides, rivers, flooding, changes in sea levels, wave action, precipitation... all are included in the research undertaken by KNMI the results of which form an essential part of its products and services.

The Netherlands are world famous not merely so far as the battle against the sea is concerned. The experience and expertise of Dutch engineers and scientists are also unrivalled in the field of water management in general. This in particular is an area where KNMI contributes to progress globally through its innovative products, services and knowledge.

A close-up portrait of a woman with short, wavy, light brown hair and blue eyes. She is smiling slightly and looking directly at the camera. She is wearing a dark, pinstriped jacket over a dark top, and a necklace with large, round, orange and red beads. The background is dark and out of focus, with a warm light source visible in the upper right corner.

Interview]| The power of water

Annemieke Nijhof was appointed Senior Advisor for a Sustainable Living Environment at the Ministry of General Affairs in 2005. Prior to that, she served as Deputy Director of the External Safety Directorate of the Ministry of Housing, Spatial Planning and the Environment and as coordinator for technical and engineering sciences at the Ministry of Education, Culture and Science. Nijhof studied Chemical Technology at the University of Twente and completed the MBA programme at TSM Business School.

‘There is nothing in the world more soft and weak than water, and yet for attacking things that are firm and strong, there is nothing that can take precedence of it’

Annemieke Nijhof, Director-General of Water Affairs

The climate is changing. The sea level is rising, the land is subsiding, it is raining harder and more often, and there is more meltwater. In the years to come, we will be inundated with so much water that technological measures (e.g. raising the height of the dikes) will no longer be effective in preventing flooding and minimising damage. Making better use of knowledge, clearly establishing responsibilities, committing more resources and collaborating more effectively are essential, according to Annemieke Nijhof, Director-General of Water Affairs and chair of the KNMI Programme Council.

‘There is nothing in the world more soft and weak than water, and yet for attacking things that are firm and strong, there is nothing that can take precedence of it’

Although these words of Chinese philosopher Laozi date back to 600 BC, they are perhaps more relevant today than ever before – certainly the second part. Water has not presented such a threat in a long time, and this is a direct result of climate change. Just several years ago, the political establishment was as yet insufficiently aware of this fact; today, however, the situation has changed, assesses Annemieke Nijhof. This can partly be attributed to Al Gore’s contribution. Nijhof: ‘The approach he took in his film *An Inconvenient Truth* to explain climate change in words and - in particular - images, has in my opinion had a tremendous effect in raising awareness of the issue, certainly among the political circles of The Hague. Although the debates continue concerning how quickly and to what degree the climate is changing, the fact that it is changing is now accepted as fact by politicians.’

High degree of optimism

‘However, that does nothing to alter the fact that we often require a crisis to effect the change we want,’ continues Nijhof. ‘Look at the past...substantial changes in water policy were implemented after floods.’ The North Sea closure dike, for instance, was built in response to the Zuider Zee flood,

the Oosterschelde storm-surge barrier to the 1953 North Sea flood in the province of Zeeland. The current policy programme, Room for the River, only attracted interest after a serious threat of dike collapses arose in 1994 and 1995.

According to Nijhof, this can be attributed to the fact that ‘humans naturally possess a great measure of optimism’. ‘That’s also the reason why so many of us purchase lottery tickets. Despite the extremely small chance of winning a prize worth millions, we continue to believe in it. On the other hand, as the potential of being hit by a huge fire is something we can’t imagine, we are extremely careless when it comes to the batteries in smoke detectors. It’s pure psychology. You can do your everything to change that, but it remains a fact.’

This is why Nijhof doesn’t believe in scare tactics. ‘Trying to convince people that the Netherlands can become completely inundated is pointless. We achieve much more by emphasising the positive aspects of the story. The Netherlands is a fantastic country, due precisely to its location on the water. That substantially benefits the quality of our country’s landscape and our lives, for example, the many recreational opportunities offered by water. Rich or poor, leftist or right wing, we all enjoy the benefits. That is the side of the story we need to emphasise. We have to clearly communicate that water must remain our friend - not become

our enemy. That is far more effective and will have greater impact than a story about death and destruction.’

And now on to a completely different matter. As regards water, we – the Dutch – remain almost naturally ahead of the curve, whether we are talking about the struggle against water, the cleanest drinking water or the latest water management technologies and innovations. Does this impression still hold true today?

Nijhof: ‘Certainly in terms of image. Wherever I travel, people always want to speak with the State Secretary for Water Management. When that’s not possible, the Director-General of Water Affairs will do. In short, the Netherlands is a country of great interest throughout the world when it comes to water management issues. While this certainly has to do with the wonderful things we have built in the past, it’s also due to our organisational approach, including our system of water boards.

Nonetheless, there are certain areas in which we are lagging behind. For example, the Netherlands has always made substantial investments in prevention. A question we have asked ourselves less often is what we would do if these failed. It is only since the flooding of New Orleans in August 2005 that we have begun to catch up in that respect. That disaster got us thinking. How would we respond? How quickly would the necessary emergency assistance be in place? Are we capable of evacuating a large number of people in a timely manner? For

me, as DG of Water Affairs, such questions really go against the grain. We don't want things to go wrong and to do everything possible to prevent that from happening. But things can always go wrong, and we shouldn't close our eyes to that fact. That's why it's also good to learn from other countries, particularly countries with well developed emergency assistance and other related systems. We must not think we are above that. When you have been at the cutting edge of water management for so many years, there is a danger you will begin to overestimate yourself... we can't afford to become complacent. We must continue to go out into the world with an open mind and learn from what other countries are doing, just as we must also seek collaboration with other countries. This is something I stress continually.'

Shortly after you became DG of Water Affairs in February 2008, the Delta Committee presented its advisory report 'Working with Water'. That must have been like a gift from heaven for you.

Nijhof: 'Absolutely. That report serves as a wonderful overture to a new policy agenda for the coming decades. Furthermore, and even more importantly as far as I'm concerned, the Committee succeeded in creating an enormous impulse for solidarity. The water hasn't reached our doorstep yet, but we have to get to work and we have to do so now in order to ensure that such a disaster never takes place. The Committee has conveyed this message in a masterly manner.'

How will you respond to the Committee's recommendations?

Nijhof: 'Develop them into policy! Our Ministry is working diligently to do just that. In December, for instance, we presented the National Water Plan, which describes measures that must be taken to ensure the Netherlands remains safe and maintain quality of life for future generations as well and to take advantage of the opportunities water offers. We are going to launch efforts to reinforce our coastal foundation, for instance. There are also certain matters we can address over a longer period, such as expanding the size of the stream bed of



the rivers in the Netherlands. While failure to take immediate action does not mean the area will be inundated tomorrow, it would be prudent to begin now with the purchase of strategically important land. We shouldn't wait until the problem has become critical before acting, just as we shouldn't build on land that will later be required for river widening efforts.'

Reinforcing the coastal foundation, purchasing strategically important land...considering the credit crisis, I can easily imagine that these are politically sensitive subjects at the moment.

Nijhof: 'Despite the crisis, no politician will still say: "That can be put on hold." As I already said, the message has finally taken hold in The Hague that the time is ripe for certain measures. It may be, however, that the political process will take more time for certain measures and that a more critical look will be taken while establishing priorities.'

Haven't we already spent enough time doing that for these issues?

'That's always a risk. The credit crisis simply demonstrates how sensible it is to set aside money for flood protection on a structural basis. If we had established a fund 15 years ago and had put aside a billion euro a year, State Secretary Tineke Huizinga would now have 15 billion euro to spend on ensuring a minimum level of flood protection in the Netherlands, credit crisis or not. There's good reason why one of the key recom-

mendations of the Delta Committee is that money may never be an obstacle when it comes to our safety.'

Is the Ministry now going to start setting aside money for this?

Nijhof: 'I will do everything possible to keep this in the political spotlight. In ensuring flood protection, our horizon must be longer than it is now. Our current task is to map out the problems. Once we have a complete picture, we can look for funding to address them. This must be done in a different, more structural manner, comparable to the way we address our infrastructure, which often involves planning 20 years in advance and structurally releasing funds over the long term. We have to transition towards a similar approach to flood safety. For me, continuing to stress this point is a crucial task.'

Lastly, what role do the KNMI's climate scenarios play in the Ministry's policymaking and which of the four scenarios is being used as the starting point

Nijhof: 'Those scenarios – all four – play a very essential role. We don't simply choose one and disregard the others. Doing so would demonstrate a lack of understanding of the scenarios' function. The fact is that any one of them could come true. That also makes it extremely complicated. It would therefore be very helpful if KNMI were eventually able to not only describe the consequences, but also indicate which is

the most likely. The need for such information is tremendous, and I – as chair of the Programme Council – will certainly try to encourage efforts to make it possible. The report from the Veerman Commission also reiterates this need. KNMI should strive to respond to it.'

Delta Committee

The Dutch government asked Delta Committee to make recommendations to protect the Netherlands against the consequences of climate change. This includes such issues as what needs to be done in the Netherlands to ensure that – even in the distant future – the country is climate resistant and protected against floods while remaining an attractive place to live, work, play and invest.

The government also specified that the analysis' scope should go beyond safety and flood protection issues. For this reason, the vision also addresses living and employment, agriculture, nature, recreation, landscape, infrastructure and energy. Safety and sustainability serve as the strategy's two pillars for the coming centuries. In addition to flood protection, the recommendations also emphasise and specify opportunities for Dutch society.

Room for the River

The aim of the programme Room for the River is to create more room for water to more effectively protect the area around the rivers against floods. This is necessary, because the climate is changing and we have to be prepared for wetter winters. One consequence is increased river discharge, which increases the risk of flooding.

Raising the height of the dikes alone is not a sustainable solution. A new approach is needed: the rivers must be given more room by, for example, relocating dikes or lowering flood plains. The programme Room for the River consists of 40 measures to more effectively protect the Rhine basin in the Netherlands and a stretch of the Maas (downstream of Hedikhuizen near Den Bosch) against flooding.

Programme Council

The establishment of the influential Programme Council in 2005 literally brought the outside world into KNMI. Including representatives of KNMI's largest clients, this Council is by no means merely another layer of bureaucracy. Its responsibilities include assessing on an annual basis and making changes to the KNMI's operational plans. For instance, if the Council feels the interest in a particular study is lacking, it can cancel the programme. The Council can also compel KNMI to investigate an issue that was not on the agenda. With this arrangement, agencies that make use of the KNMI's products and services have gained an exceptional amount of influence on the institute's undertakings – limited, of course, to the scope of the KNMI Act. The Programme Council members are closely involved with KNMI and include representatives from the Ministry of Housing, Spatial Planning and the Environment, Ministry of Defence, Dutch universities, research institutes (TNO), the sector organisation of meteorological companies and international organisations of meteorological institutes. Delegates from the Directorate-General for Public Works and Water Management, Directorate-General for Water Affairs and Directorate-General for Civil Aviation and Maritime Affairs represent the Ministry of Transport, Public Works and Water Management on the Council.

A good climate for innovation

PRESENTATION OF REPORT ON THE STATE OF THE CLIMATE

‘Climate change creates opportunities for innovation, both in terms of reducing greenhouse gas emissions and anticipating the consequences.’ That’s the position of climate scientists represented by the Platform Communication on Climate Change (PCCC) in *De Staat van het Klimaat* (The State of the Climate).¹ Every year, the PCCC assesses the state of affairs and new developments in the field of climate research and climate policy.

Prime Minister Balkenende received the report *De Staat van het Klimaat* on 19 February 2008. The Prime Minister praised the Dutch scientific community and the climate research that is at the international forefront: ‘I am proud that in our country the climate researchers are so successful in their efforts to collaborate, assisted by government incentives. Due to your collective efforts, the Netherlands is among the leaders in international climate research. Our research community is well organised and that is yielding

nise positive policy developments at the national, European and global levels. To temper climate change, Europe is focusing on greater energy efficiency, a greater share for renewable energy and the strengthening of the emission trading system.

Even if the emission of greenhouse gases is greatly reduced, climate change will continue. The various sectors in the Netherlands must prepare for this. *De Staat van het*



KNMI Director-General Frits Brouwer with Jan-Peter Balkenende, Prime Minister of the Netherlands, at the presentation of the report *De Staat van het Klimaat*

results. We have a good name - not only as water management experts, but also as developers of climate models and measurement systems. We also have a strong voice in the complex discussion about the sustainability criteria for biomass.’

De Staat van het Klimaat is an annual review of new scientific knowledge and new climate policy, intended to contribute to the broad social debate of this topic. The authors recog-

Klimaat includes a discussion of new developments in water management, managing increased risks of flooding and a more climate-resistant natural environment.

The PCCC is a collaborative venture of Dutch research institutes, Netherlands Environmental Assessment Agency, KNMI, Wageningen UR, Energy Research Centre of the Netherlands, VU University Amsterdam, Utrecht University and Netherlands Organisation for Scientific Research.

¹ Dorland, R. van, B. Jansen and W. Dubelaar-Versluis, *De Staat van het Klimaat* 2007. 2008, De Bilt/Wageningen, PCCC.

Better perspective on poor visibility

KNMI PROVIDES VISIBILITY FORECASTS FOR SCHIPHOL

In 2008, KNMI implemented a clear improvement to the statistical model for aviation visibility forecasts. Compared to the old model, the number of 'hits' (correct forecasts of poor visibility) has increased, while the number of 'false alarms' (poor visibility forecast that did not occur) has declined. This saves the aviation sector many millions of euro. KNMI is the legally designated supplier of general aviation meteorological services.

Visibility forecast

The product is also better tailored to user preferences. A reliable and accurate forecast is of essential importance to Schiphol in order to enable personnel to anticipate changing visibility conditions in an effective and efficient manner. Poor visibility reduces considerably take-off and landing capacity at Schiphol.

KNMI provides the visibility prognosis in the form of a probability forecast. This form conveys the degree of uncertainty. For the user, this offers the advantage of presenting all possible scenarios. Based on this information, various Schiphol stakeholders can make their own risk assessments and take the measures they deem necessary, based on both safety and cost considerations.

The principal for this project was the Knowledge and Development Centre (KDC), a joint venture of KLM, Air Traffic Control the Netherlands (LVNL) and Mainport Schiphol, with support from the Directorate-General of Civil Aviation and Maritime Affairs of the Ministry of Transport, Public Works and Water Management. The updated and improved visibility product for Schiphol was officially deployed on 2



Ype de Haan (KLM) and Evert Westerveld (KCD) transmit the first specific visibility forecast

June. This concluded the project's first phase. During the second phase, more innovative developments will be examined, such as new measurement technologies and very high resolution models. KNMI will also play a prominent role in this follow-up study.

The Netherlands warming up twice as fast

THE RAPPORT THE STATE OF THE CLIMATE

Climate warming in the Netherlands is progressing much faster than the global average. In De Bilt, the average temperature today is 1.5°C higher than in around 1950. This is double the rise of the global average temperature. The region that is warming faster stretches out over a large portion of Europe.

'That is made clear in the KNMI climate report *De Toestand van het Klimaat in Nederland 2008* (The State of the Climate in the Netherlands 2008).¹ State Secretary Tineke Huizinga of

the Ministry of Transport, Public Works and Water Management received the first copy at the end of July. The news from the report *De Toestand van het Klimaat* (i.e. the climate

in the Netherlands is warming faster than the rest of the world) confirms that it's necessary to make drastic choices, because the Netherlands must also remain a prosperous and safe country in the long term, with sufficient clean water for people and nature. That means we will have to be prepared for climate change, however uncertain the consequences may be,' said the State Secretary.

Almost every season was warmer than normal during the past five years. Some were even the warmest in at least the past three centuries. Temperatures during the spring and summer have risen primarily due to increased hours of sunlight and a warmer southern wind. During the winter, the wind came much more often from the mild southwest direction. A cold easterly wind was hardly seen at all. The warmer climate also leads to more precipitation in the coastal region. The annual quantity of precipitation in the Netherlands has increased by 18% in the past century.

In the Netherlands, climate warming has led to exceptional phenomena in recent years. The outdoor cafés were sometimes opened as early as February, there were days in April when people were lying on the beaches, and home heating systems could be switched off more often. Heat waves, however, form a health risk for certain groups, such as the

elderly, chronically ill and obese persons. A warmer climate also more frequently produces conditions that can cause summer smog. Climate change is therefore a key factor affecting future air quality.



State Secretary Tineke Huizinga receives the first copy of the KNMI climate report from Hein Haak, director of Climate and Seismology

The KNMI climate report is published once every five years.

¹ Kattenberg, A. *De Toestand van het Klimaat in Nederland 2008*. De Bilt, 2008.

Science, policy and line services

EUROPEAN CLIMATE CONFERENCE

Scientific, policymaking and line service groups met in Amsterdam in the autumn. Not only were the latest scientific findings on climate change discussed, ways in which society can be well prepared for a warmer and wetter climate were also examined. The latest knowledge on climate change and how to adapt were the primary themes during this European climate conference. KNMI served as host.

State Secretary for Transport, Public Works and Water Management Tineke Huizinga opened the European Conference on Applied Climatology (ECAC). In her opening speech, she discussed the changing climate. There was also a special session about how climate information and knowledge is disseminated to policymakers, politicians, line agencies and private individuals. This generated lively discussion.

Participants from various countries and fields of work spoke about how the world can adapt to the changing climate. The question was examined from various perspectives in order to reach potential solutions.

KNMI organised the ECAC in collaborative partnership with the EUMETNET network of European Meteorological Services and the European Meteorological Society (EMS).

Recommendations to keep the Netherlands safe

KNMI SUPPORTS DELTA COMMITTEE

The Dutch delta and the hinterland must remain a safe area to live, work and play, both now and in the distant future. In September 2008, at the request of the Dutch government and led by former-Minister Veerman, the Delta Committee presented its recommendations on how the Netherlands can address flood safety and the impact of climate change.

Scenario's

The Committee's recommendations emphasise responding to climate change and other ecological processes concerning coastal protection, the area around the major rivers, the IJsselmeer region, etc. Its implementation will increase the Netherlands' ability to withstand the effects of climate change and create new opportunities.

The Delta Committee received scientific support from various sources, including Dutch experts on flood safety and water management, as well as a group of national and international authorities affiliated with the IPCC, including KNMI. In December 2008, the latter group provided supplementary information to facilitate the interpretation of the climate scenarios and new estimates of the potential extremes.^[voetnoot]

KNMI made key contributions to the work of the Delta Committee, supplying data on global and regional sea level rise, changes in wind conditions above the North Sea and developments in precipitation resulting in changes in the discharge volumes of the major rivers.

Particular attention was given to future sea level rise. An upper limit of 0.65 to 1.30 metres in 2100 and 2 to 4 meters in 2200 must be taken into account. The impact of subsidence has also been factored into these figures. These values represent the plausible upper limits, and it would be sensible to take them into account to ensure the long-term effectiveness of the taken based on what the Netherlands may face in the future.



The members of the Delta Committee; in the centre is former-Minister Veerman

¹ Vellinga, P., C.A. Katsman, A. Sterl en J.J. Beersma (eds), *Onderzoek naar bovengrensscenario's voor klimaatverandering voor overstromingsbescherming van Nederland: een internationale wetenschappelijke beoordeling*. KNMI and Wageningen UR (Alterra, Earth System Science and Climate Change Group), 12/2008, p178.

Tropomi headed for space

FUNDING FOR NEW SATELLITE INSTRUMENT

The Dutch satellite instrument Tropomi will be aboard a European Space Agency (ESA) satellite scheduled for launch in 2014. This was decided in November at the ESA Conference of Ministers in The Hague. Minister Van der Hoeven of Economic Affairs, representing the Netherlands, made a heartfelt appeal in support of the Tropospheric Monitoring Instrument (Tropomi). Tropomi will provide scientists with valuable data for research into air pollution and climate change. KNMI employee Pieter Levelt is the principal investigator for Tropomi.

78 million euro

The ESA will build the satellite as part of the European Commission's Global Monitoring for Environment and Security programme. The instrument is part of the satellite payload. The Dutch Cabinet has allocated €78 million for Tropomi. During the conference, the decision was made that the ESA member states will contribute the rest of the required funding for the satellite and the launch expenses.

Satellites are of enormous value because they can provide data on the entire atmosphere within several days. They are valuable for scientific research and also show whether implemented environmental measures are effective. A key aspect of this is that the satellite instruments must be able to detect the relevant polluting gases or greenhouse gases with the highest possible level of detail. In these areas, Tropomi will represent a significant advance over its predecessors Sciamachy and OMI. The instrument will also be capable of scanning the atmosphere between the clouds and it will even be able to distinguish the emission of air pollutants at the level of cities and suburban areas.

Tropomi is a collaborative effort of KNMI, SRON Netherlands Institute for Space Research, Netherlands Organisation for Applied Scientific Research and Dutch Space, under direction of the Netherlands Agency for Aerospace Programmes. Together with SRON, KNMI will bear responsibility for Tropomi's scientific management. Dutch Space in Leiden will supervise the team that will build the instrument. The Ministry of Economic Affairs, Ministry of Education, Culture and Science, Ministry of Transport, Public Works and Water Management and Ministry of Housing, Spatial Planning and the Environment are financing Tropomi.



Principal investigator for Tropomi, KNMI-scientist Pieter Levelt

Willem Bezemer]| 54 years old

Weather, climate and me



'I really shouldn't say it, but global warming is a godsend for our football players. This year, by chance, we had a cold winter again, but in the previous years there were never so few postponements. The only problem is that we have to spray our fields more often in the summer because of the high temperatures. Besides that, I like it just the way it is. Although I do realise we have to work together to do something to turn the tide again.'



Ed Nobel]| 43 years old

Weather, climate and me



'When I started in this trade twenty-six years ago, there were intense winters and comfortable, warm summers. You knew exactly what you could expect. For years now, though, it's been all or nothing with the weather. This is the first winter in a long time that I bought special window washer's gloves for instance. I didn't have them on for a day or two. I wore them week after week. This winter I also applied for temporary unemployment benefits for my personnel in connection with weather that prevented us from working. It's been years since I did that too...'



Traffic] |

and weather

Weather plays a vital role in every aspect of society: on land, on sea or in the air. Contributing to traffic safety when extreme weather is expected is one of the main tasks carried out by KNMI.

The Dutch are always on the move, so KNMI issues a warning whenever adverse weather threatens to disturb traffic. These warnings are available to all Europeans via www.meteoalarm.eu.

A close-up portrait of Guido van Woerkom, a middle-aged man with thinning grey hair and blue eyes, wearing a dark pinstripe suit, white shirt, and a red tie with a white grid pattern. He is smiling slightly. The background is dark and out of focus.

Interview] Detailed work

Guido van Woerkom is Managing Director of ANWB, an organisation with more than 3,800 employees. Van Woerkom studied law in Leiden. Prior to his appointment at ANWB, he held various positions with Albert Heijn and served as managing director of the communications firm Signum.

‘When our rush-hour alarm leads KNMI to further its efforts concerning short term forecasts, society will have achieved a lot. It is up to KNMI to rise up to that challenge.’

Guido van Woerkom, ANWB Managing Director

The rush-hour alarm issued by the Royal Dutch Touring Club ANWB at the end of November 2008 created a bit of a storm. The criticism voiced by various parties is that it not only may have devalued the effect and resulted in confusion, it was also irresponsible. ANWB did not and does not agree. ANWB Managing Director Guido van Woerkom: ‘Based on the KNMI information and our own calculations, we felt it was our task to warn the public by issuing a rush-hour alarm. We have moved beyond the stage in which we only collect traffic data.’

It’s Monday morning and about two centimetres of snowfall are forecast. On Sunday evening, 23 November 2008, this combination led ANWB to fear the worst: extremely heavy morning rush-hour traffic. To help drivers avoid this, the association called upon motorway travellers to depart earlier or later the next morning. This was the inception of the rush-hour alarm.

However, while ANWB feared a morning rush hour with at least 500 kilometres of traffic jams, the total never exceeded 295, which is less than on a normal Monday morning.

This was in part – or perhaps primarily – a result of the fact that the precipitation ultimately fell in the form of rain, not snow. Panic about nothing, you could say.

‘Absolutely not,’ responds Guido van Woerkom. ‘We are here to serve the interests of the road users. From that perspective, 500 kilometres of traffic jams is enormous. At that length, a quarter of all motorways are at a standstill. This is also the reason we very deliberately chose the word “alarm”. We issue rush-hour warnings every day. Drivers don’t give a second thought when they hear that anymore.’

Social responsibility

Considering the KNMI forecasts on that particular Sunday afternoon, it was not a strange or arbitrary decision either,’ continues Van Woerkom. ‘Based on that information and our own calculations, we felt it

was our task to warn the public by issuing a rush-hour alarm. That the initial KNMI forecasts would prove incorrect was something we couldn’t have foreseen. ANWB has moved beyond the stage in which it only collects traffic data. We want to offer the road user the option to make timely decisions based on certain developments.’

As an example, Van Woerkom reminds us of New Year’s Eve 2007/2008. ‘Extremely dense fog was forecast for that night. Together with the fireworks, that results in life-threatening situations on the roads. To stay a step ahead of that, ANWB warned and advised the public at that time.’ That advice included the tip that people with plans to spend the evening with family or friends would be smart to take an overnight bag in the event it seemed wiser to stay until morning. ‘With such tips and warnings, we hope to prevent accidents. ANWB is a reliable organisation that possesses extensive knowledge and expertise in the field of traffic safety. Obviously, sharing this knowledge and expertise is one of our key tasks. Another example is the warnings we issue for the “Black Saturdays” that occur at the end of July. These are the busiest days for holiday traffic in France, renowned for the dozens and sometimes hundreds of kilometres of traffic jams, as well as many accidents.’

Van Woerkom continues: ‘Similar inconvenience arises on a smaller scale in the Netherlands on warm, sunny days. Experi-

ence shows that on these days many people head for the beaches along the Dutch coast, with all the associated consequences for traffic. How about the various ice skating tours organised in early 2009? They led to exceptionally heavy traffic on the roads leading to and from the ice. We anticipated that and we also issued warnings. Naturally, traffic management is not our task. That’s the responsibility of the Department for Traffic Information and Traffic Management (VCNL). By providing the public with additional, reliable information, however, ANWB can make a significant contribution to more smoothly flowing traffic. On that front, ANWB recognises a very important task it can fulfil. That’s a role we certainly want to fulfil more effectively in the future.’

The rush-hour alarm is a prime example of ANWB ‘new style’?

‘Based on our responsibility to society, we have taken it upon ourselves to provide such an alarm, once again with the intention of influencing people’s behaviour and thus prevent accidents.’

This was an initiative that various agencies - to put it mildly - did not appreciate. The Directorate-General for Public Works and Water Management responded, for example, by saying that yet another alarm - in addition to the extreme weather and road safety warning - could devalue the effect and result in confusion. This opinion was also shared by the Traffic Information

Service (VID), which is the direct competitor of ANWB. KNMI was also 'not amused' by ANWB's 'independent action'. For its part, ANWB called them 'sour responses'. Van Woerkom: 'Again, I am convinced that the rush-hour traffic would have been many times worse if we hadn't issued the alarm. It wasn't until Sunday evening around 11 a.m. that it became clear that the snow showers forecast would largely fall as rain. Several hours earlier, the forecast looked much worse. However, we had to make our announcement at around 8 a.m. After all, you have to give the road user time to consider the options. If you wait until 7 a.m. in the morning to issue a warning about slippery roads, the ability to consider alternatives is extremely limited.'

Detailed work

That brings Van Woerkom to the subject of KNMI. 'While it is exceptionally capable of producing accurate forecasts for the longer term, we at ANWB are interested in very accurate forecasts for a period of, say, twelve to fourteen hours – the detailed work. When we know that a snow storm will be passing over the west of the country the following morning at around 8 a.m., this not only enables us - but also a party such as the VCNL - to be better able to provide optimal service to road users in the Netherlands.

This also reduces the chance of issuing weather, traffic or rush-hour traffic alarms unnecessarily.

I can imagine it's an enjoyable challenge for KNMI to further develop the accuracy of its short-term forecasts. Moreover, this will strengthen the institute's social position. When our rush-hour alarm and the discussion surrounding it lead KNMI to further its efforts concerning those forecasts, ANWB - or rather, I should say, all of society - will have achieved a lot. It is up to KNMI to rise up to that challenge.'

ANWB

The Royal Dutch Touring Club ANWB is an association that serves its members in the areas of transport, leisure and holidays through a mix of behaviour change and service activities. In conjunction with that work, ANWB seeks to make a contribution to the sustainable development of the community. ANWB's behaviour change activities mainly pertain to politics and government. The interests of members can also give reason to establish contact with companies, branch organisations and other interest groups. The main service areas are roadside assistance, travel planning, insurance, publishing, signposting, advice and information

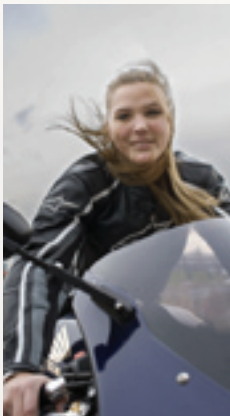


ANWB RUSH-HOUR ALARM NOT SHELVED

When weather turns bad, weather and traffic services can seldom expect praise. If they say nothing and chaos erupts on the roads, everyone wonders why there was no warning. If they issue a warning and it turns out to be business as usual, they are criticised for creating panic about nothing. Following the rush-hour alarm of 23 November 2008, ANWB knows all about this. That, however, will not prevent the organisation from issuing an alarm again in a similar situation. Van Woerkom: 'Following the rush-hour alarm of November 2008, there were two additional situations that led us to consider issuing a rush-hour alarm. After extensive internal discussions, we decided not to. The criterion was simply that all the available data showed that our "magic number" of 500 kilometres of traffic jams would not be exceeded. When everything indicates that that length will be reached, we will certainly once again warn road users in the form of a rush-hour alarm.'

Kim Stander]| 23 years old

Weather, climate and me



'Al Gore's movie, *An Inconvenient Truth*, really got me thinking. What awaits us? What will my future look like or more importantly that of my children? I'm quite concerned about that. Since I saw the movie, I am much more conscious of the things I do. Now I think twice, for example, before printing an e-mail. I still ride my motorcycle though. That's my passion. I check the weather every day: teletext, weather radar, online...they only time I don't ride my motorcycle is when heavy rain is expected.'

Eye to eye with Ike

SURVEY FLIGHTS THROUGH A HURRICANE

‘Lingering in the eye of a hurricane is a magnificent experience. First, you are violently shaken every which way, then you emerge from a wall of clouds more than ten kilometres high into a relatively clear and calm area in which you are surrounded on all sides by a tall wall of clouds. It’s fantastic!’

That’s how KNMI researcher Ad Stoffelen described his flight through Hurricane Ike. In 2008, he flew through Hanna and Ike five times to calibrate correctly the ASCAT scatterometer, which is a radar instrument on board a weather satellite. It measures wind direction and speed at the ocean surface. In order to properly interpret the data from the scatterometer, it’s necessary to make a comparison with airplane measurements close to the ocean surface. The National Hurricane Centre is highly interested, because the wind data offers unique information, even under the thick mantle of clouds and rain. Obviously, that’s important for predicting the hurricane’s path and intensity.

Hurricanes develop in the Caribbean region every year. The US National Hurricane Centre provides the forecasts for that region. Under contract with EUMETSAT, KNMI processes the data from the European scatterometer and supplies it to the Hurricane Centre.

According to Ad Stoffelen, the first two flights through Ike were the most intense: ‘At that time, Ike had reached category 4 proportions. At a certain moment, it seemed as though the plane was grabbed out of the air and slammed down some distance away. The ocean that is normally such



Ad Stoffelen seen taking his place in the cockpit briefly

a peaceful shade of light blue is churned into something that looks like asparagus soup - the bottom is apparently stirred up and mixed with the salty water. It was a truly special experience that I will cherish for a long time to come.’

Extra motivation for seamen

ROYAL HONOURS

Many seamen were on shore at KNMI for the ceremony for volunteer maritime observers. On 10 November, State Secretary Tineke Huizinga of the Ministry of Transport, Public Works and Water Management presented around 40 medals and awards to captains and steersmen of the merchant navy and the Dutch Royal Navy for their accomplishments in the field of meteorology. For years, the decorated officers have voluntarily sent KNMI weather observations taken at sea.

Automate

In addition to meteorological data from satellites, airplanes, radar and automatic observation stations, observa-

tions from ships are essential for weather forecasts and climate research. In the future, KNMI will increasingly automate this type of observation.

Safety and economics

Sailors, shipping companies and offshore companies consult the weather forecasts and storm warnings for which they provide data. They not only do so for safety, but also for economic reasons. Ship crews use forecasts and wind data to determine the most economical navigation route.

Motivation

One of the decorated sailors is Captain Leo Versteeg, who works for the shipping firm Hapag Lloyd. After conclusion of the ceremony he told us how happy he is with his silver medal: 'I've been doing this for KNMI since 1980. That's a long time. You know it's important, but the words of Director-General Brouwer and State Secretary Huizinga really made clear to me today why those observations are so essential. With respect to climate changes in particular, the meteorological institutes of the world need the observations taken at sea now more than ever. That's extra motivation to keep providing them!'



European leadership

FRITS BROUWER EUMETNET CHAIRMAN

In December, KNMI Director-General Frits Brouwer was elected as chairman of EUMETNET, the collaborative association of 24 national European meteorological institutes, which is associated with the World Meteorological Organisation. Brouwer succeeds his Austrian colleague Prof. Neuwirth.

Brouwer considers the two-year appointment as EUMETNET chairman a 'great honour'. 'It's a challenge given the task the institutes have in connection with the changing climate and because so much is going to change in the way aviation meteorology is organised due to the implementation of Single European Sky. Europe on the whole faces tremendous challenges: How are we going to collaborate with respect to aviation meteorological services? What form of legal person will EUMETNET assume so the organisation can operate independently under EU contract?'

Frits Brouwer previously served as EUMETNET vice-chairman. He will serve as chairman in addition to his role as KNMI General-Director.



Frits Brouwer, KNMI Director-General and chairman of EUMETNET

Declaration of intent for collaboration

MINISTRY OF DEFENCE AND KNMI MODERN PARTNERS

In December, State Secretary Jack de Vries of Defence and State Secretary Tineke Huizinga of Transport, Public Works and Water Management signed a declaration of intent for more intensive collaboration between the Ministry of Defence and KNMI regarding meteorological services. The meteorological service of the Royal Netherlands Air Force, the Hydrographic Service of the Royal Netherlands Navy and KNMI have already worked together for quite some time. It was, however, deemed necessary to modify the collaboration agreement in response to developments in the field of meteorology.

Sharing

The collaborative partnership is key to both ministries as they not only make joint use of the weather observation data, but also of each other's equipment, personnel and training programmes. KNMI also supports operations in Afghanistan. Meteorologists from the Royal Netherlands Air Force use special KNMI computational models in developing accurate weather forecasts for the mission areas.

Quality

Conducted in 2006, the preliminary study, *MeteoLogica*, revealed that collaboration between the Ministry of Defence and KNMI could be broader in scope, more intensive and more efficient. According to Director-General Frits Brouwer, *MeteoLogica* is extremely valuable. 'It could lead to more efficient public meteorological services for the Netherlands. The aim of the proposed - intensified - collaborative partnership is to further improve the provision of



The declaration was signed in the presence of representatives of KNMI and the Ministry of Defence. KNMI was represented by Director-General Frits Brouwer, the Ministry of Defence by Director of Air Force Operations Command Commodore Schnitger.

unambiguous, high-quality products and services to clients of both the Ministry of Defence and KNMI. This qualitative improvement will benefit all organisations involved.'

Jason monitors sea level rise

SATELLITE TRACKS RISING SEA LEVELS

Certainly in the Netherlands, the rising sea level is one of the biggest concerns to arise from the changing climate. That the sea level is rising and will continue to rise is a fact, but scientists want to quantify more precisely the rise in all parts of the world. Like its predecessors, the new Jason satellite will monitor changes in the sea level to an extreme degree of accuracy, perhaps even greater accuracy than in the past.

Jason-2 uses highly precise radar technology known as altimetry, which measures with millimetre accuracy peaks and valleys over the highly dynamic surface of the ocean. Such oceanographic data, which also provides information about the interaction between the oceans and the atmo-

sphere and about ocean currents, is essential for climate research. This also applies to weather and seasonal forecasts and the observation of such phenomena as El Niño. KNMI researchers and meteorologists in De Bilt are going to make maximum use of the data collected by this satellite.

The European organisation EUMETSAT, represented in the Netherlands by KNMI, is now involved in the Jason pro-gramme for the first time. Launched on 20 June 2008, the

Jason-2 satellite will be put into service by EUMETSAT in close collaboration with France's CNES and the US' NOAA.

Measurement campaign has IMPACT

INTERNATIONAL CLOUD AND AEROSOLS MEASUREMENT CAMPAIGN

In May 2008, airplanes and a helicopter filled with measurement equipment flew nearly daily around the 200-metre KNMI measurement mast in Cabauw. Long-distance flights were also made. Depending on the direction of the wind, they flew from Western Europe to Eastern Europe and from Finland to the south of France. Cabauw served as the middle point of the international cloud and aerosols measurement campaign IMPACT.

Measurements were taken for a full month, both from the air and on the ground. The measurement data compiled, which is of tremendous importance for climate research, has provided additional insight into aerosols and clouds. The campaign also provided a better understanding of the interaction between aerosols and clouds.

Between 500 en 3000 meter

Aerosols play a key role in cloud formation and also determine the type of cloud cover. As a result, they have indirectly influence precipitation and temperature. 'The cloudless days were of no threat to the research,' according to KNMI researcher Gerd-Jan van Zadelhoff, IMPACT project manager. 'This type of weather is perfect for measuring aerosols and to see levels present in the air.'

The measurements around Cabauw were made using two airplanes. The plane of Météo France, French counterpart of KNMI, took off from Zestienhoven airport. The measurement airplane from the British Natural Environment Research Council (NERC) flew over from Oxford. The helicopter from Leipzig, Germany, departed from Hilversum. They took measurements while flying at altitudes of 500 to 3,000 metres.

International summerschool

During this campaign, European students and scientists attended an international summer school on airplane measurements and the use of this data at the KNMI. In addition to KNMI, numerous other parties were involved in the IMPACT measurement campaign, including Netherlands Organisation for Applied Scientific Research, National Institute for Public Health and the Environment, Energy Research Centre of the Netherlands, European Space



The 200-metre high KNMI data measurements mast in Cabauw, near Lopik

Agency, Delft University of Technology and Utrecht University. Institutes in Finland, Germany, England, France, Italy, Norway and Poland also participated in the project, which received financial support from the EU.

Imo van Vliet]| 55 years old

Weather, climate and me



'When I look outside and it's pouring, it's a lot more difficult to get motivated to get to work than on a nice, sunny day. Cold temperatures, like we had this winter, are not so bad. You can adjust your clothing accordingly. Rain is a nightmare for every postman. Not only do you get soaked, it's also hard to keep the post dry, particularly when it's really pouring. It seems to do that more than usual these days...'

Health]|

and weather

The links between weather and health are inextricable. KNMI provides special forecasts when extreme heat is expected, as well as UV-data and satellite measurements of air quality.

The data collected by KNMI provides a better understanding of the relationship between climate change and public health.

A close-up portrait of a middle-aged man with thinning brown hair, wearing black-rimmed glasses, a dark suit jacket, a white shirt, and a colorful geometric tie. He is looking slightly off-camera with a serious expression. The background is a soft-focus green and blue.

Interview || Surviving the heat

A researcher at TNO Defence, Security and Safety, Hein Daanen is a professor of thermophysiology at VU University Amsterdam's Faculty of Human Movement Sciences. He researches the effects of temperature on the human body. His work includes a study of how military personnel can adapt to extreme weather conditions, for example.

‘Humans are not at home in colder regions. We feel best in a region with a warm climate. There’s good reason why many Dutchmen spend the winter in countries like Spain and Portugal.’

Prof. Dr. Hein Daanen, Professor of thermophysiology TNO

Fierce forest fires, wide-scale flooding, melting glaciers and unprecedented heat waves: the consequences of global warming are becoming increasingly visible. According to calculations, the average temperature on Earth will increase by approximately 1.1°C to 6.4°C this century. What specific effects will this have on the human body?

Professor of thermophysiology Hein Daanen can answer this question. ‘When viewed from a purely scientific perspective, it is not plausible to presume that the death rate in the Netherlands will increase as a result of temperature increases.’

Hardly a matter of debate anymore, climate change is a slowly developing certainty. As a result, heat waves will more be the rule than the exception in the future. Many may consider this to be a change for the better, given their association with sidewalk cafes, sultry evenings and trips to the beach. For some, however, prolonged periods of heat are a serious health threat. For example, in July 2006 – the warmest July ever in the Netherlands – there were 500 to 1,000 more deaths than usual.

Nevertheless, humans are better able to withstand prolonged exposure to heat than to cold, explains Hein Daanen. ‘People have several mechanisms to survive in the various climates seen on Earth. Looking at those mechanisms, we have determined that humans are better suited for life in the tropics than at the poles. This is also in line with the idea that the first humans originated in Africa. During a reasonably warm period, we spread out across the rest of the world. During the following glacial age, we remained where we were. This can be attributed primarily to the fact that we had by then developed a geographically determined culture and tend to be highly attached to home. In principle, however, humans are not at home in colder regions. We feel best in a region with a warm climate. There’s good reason why many Dutchmen spend the winter in countries like Spain and Portugal.’

Helpless creatures

‘In the cold, we are fairly helpless creatures,’ continues Daanen. ‘Cold climates also present many more risks than warm climates. Consider, for instance, the freezing of body parts – particularly the hands and feet. The last thing we feel before freezing is nothing. We have absolutely no warning system for that.’

The number of health problems also increases significantly during periods of extreme cold, Daanen explains. Cardiovascular and pulmonary diseases are good examples. Daanen: ‘While those illnesses and diseases also develop in warm climates, the risk is greater in cold climates. When exposed to the cold, the blood vessels in our skin contract to maintain body temperature. As a result, our blood pressure quickly increases. This rapid rise in blood pressure leads to certain health risks.’

While humans degenerate to helpless beings in extremely cold situations, we have an extremely powerful mechanism for dealing with heat, explains Daanen. That mechanism is called transpiration. ‘The big problem with heat arises when that mechanism no longer functions or functions improperly. The latter occurs, for instance, when you play sports in raingear that prevents perspiration from evaporating. There are also those who cannot sweat – anhydrosis. During prolonged periods of extreme heat, they face a serious problem. Because they cannot eliminate body

heat, their body temperature quickly rises. Obviously, that can’t continue indefinitely without consequences.’

That does nothing to change the fact, however, that more people die in the Netherlands during prolonged periods of cold than during periods of extreme heat. Daanen substantiates this assertion with a mortality statistic, which shows that in the Netherlands the fewest deaths occur at an ambient temperature of 16.5°C. Any warmer or colder and the number of deaths increases. Daanen: ‘Taking the climate in the Netherlands into account, relatively more people die in the Netherlands as a consequence of cold than heat. After all, the temperature in our country is more frequently below than above 16.5°C. The fact that people generally think otherwise can be attributed to the fact that during the summer we often hear or read news of people who die from the heat. During the winter, however, there are far fewer stories in the media about people dying from the cold.’

Does that imply that global warming will ultimately result in fewer deaths in the Netherlands? Assuming, of course, we only consider the change in temperature.

Daanen: ‘Yes. As it becomes less cold, the number of deaths due to the cold will also decline. However, the number of heat-related deaths will increase. The decline in deaths due to cold, however, exceeds the increase in heat-related deaths. In short,

the net effect will be positive, but, no, that won't make much of a difference.

The idea that the number of deaths increases substantially due to rising temperatures is a misconception, and I try to set that right when and where I can.'

That warrants the following question: Why is there a Dutch national heat-wave response plan (see inset), but not a cold-weather response plan?

Daanen: 'The municipal health service is working diligently on such a plan and are currently mapping out the aspects of such cold-weather situations. This not only includes the risks, but also what we can do to minimise those risks.'

All this talk about cold make me think of Wim Hof (aka Iceman), who has broken numerous cold endurance records. Taking into account what you said, he must be completely mad?

Daanen: 'Not really. He may do things you and I wouldn't do, such as swimming under polar ice or sitting in a tub of ice for an hour, but he's not at all mad – quite the opposite in fact. Wim Hof's extremely high cold tolerance is unusual. He is what we could describe 'hardened'. Although he's physically no different from us, he is exceptionally well trained and has an extraordinary ability to concentrate. As I said, he's no different from anyone else, even though that suggestion is sometimes made. When we sit in a tub of ice, our body temperature rises during the first few minutes. That is a normal mechanism, as part of which our blood vessels constrict to conserve body heat. We then begin to move (i.e. shiver), which also produces heat. This combination warms us during the first few minutes. Wim Hof is no different in that regard. Although some say it's a miracle, it is in fact a normal physiological mechanism.'

What you're saying then is that any healthy person can follow Wim Hof as he dives through a hole in the ice?

Daanen: 'That may be taking it a bit too far, but it's ridiculous to think it will kill you. Wim Hof shows that it's possible to withstand extreme cold. It may be exceptionally unpleasant, but you can train your tolerance. If you take a cold shower at the end of every day, for instance, the natural shock



reaction and the hyperventilation gradually decrease. It remains uncomfortable, but you get used to it. I also take a cold shower every day.'

That sounds like the occupation-related idiosyncrasy!

Daanen, laughing: 'I wouldn't call it that. For me, it's a very interesting experiment. After reading that your response becomes less severe if you take a cold shower every day, I wanted to see the proof. It is indeed ice cold the first time, but by the second day the feeling is a bit less intense, and ultimately you can tolerate it without much trouble at all.'

TWO environmental test chambers

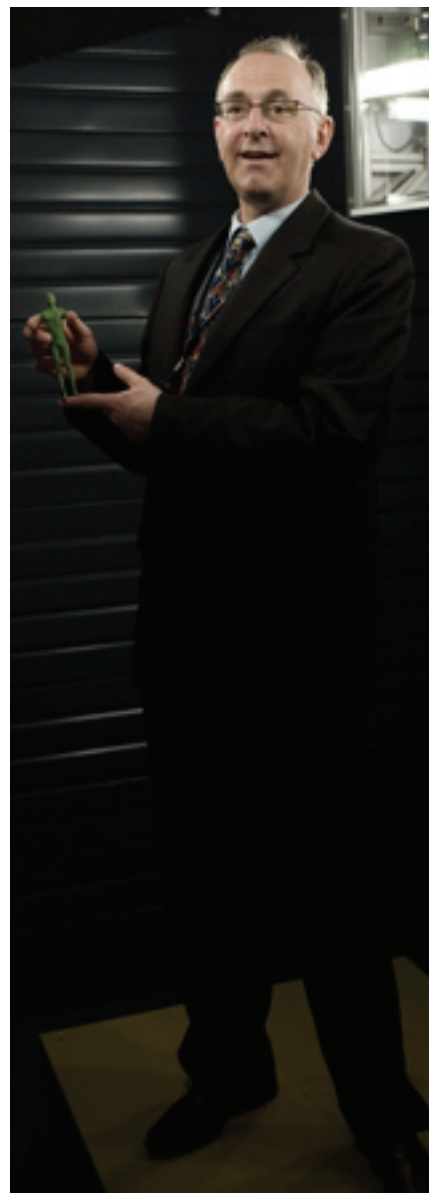
Human beings are warm-blooded mammals that can only function well when the core temperature is maintained within narrow limits. When we produce more heat than we can eliminate for a prolonged period, our body temperature rises, resulting in hyperthermia. The opposite results in hypothermia. The great challenge we face is to remain within the temperature limits, even in extreme climates.

Key indicator

We usually greatly emphasise the 'climate' factor, given our ability to measure it accurately. Ambient temperature in particular is viewed as the key indicator of heat stress. Hein Daanen: 'Although it's obvious that climate is a key influencing factor on the heat balance, other aspects can also play an important role in our level of heat stress. There is, for example, the intense exertion experienced while wearing protective clothing (e.g. military personnel and fire fighters often face this combination). For this reason, it's essential when heat stress estimates take factors other than climate into account.'

Climate scenarios

In the TNO environmental test chambers, it is possible to simulate the vast majority of climates found throughout the world: temperatures from -30°C to +60°C, winds up to force 5, intense sunlight, and humidity from 5 to 95%. We will have to be prepared for such extreme conditions in the future climate. The chambers are large enough to perform measurements on six people at the same time. The studies concern such questions as: how well does a particular type of clothing protect against cold, how do people adapt to heat (acclimatisation), and what is the effect of wind chill on dexterity. Treadmills or bicycle ergometers are often used to subject test participants to physical stress.



National heat-wave response plan

The heat-wave response plan was developed in collaboration with a long list of partners: Ministry of Health, Welfare and Sport, Netherlands Red Cross, National Institute for Public Health and the Environment, KNMI, ActiZ sector organisation of care providers and GHOR national medical and emergency aid disaster response service. The plan focuses on all vulnerable groups in society and aims to provide an extremely diverse range of care at various locations to these vulnerable groups. In the short term, the plan strives to 'increase problem awareness and offer treatment perspectives'. Health care institutions must now take the initiative to develop their own heat wave response programmes. For tips, questions or problem areas, both care providers and private individuals can contact their regional health service. In addition, the National Institute for Public Health and the Environment and KNMI have developed a phased warning system. In the long term, it involves heat-resistant construction methods, climate control in health care institutions and the development of expertise. In addition to development of the plan, a panel of experts has been assembled. When the Netherlands experiences a heat wave, these experts, including Hein Daanen, can be consulted.

History doesn't repeat itself

INAUGURAL ADDRESS BY NANNE WEBER

'The climate changes continuously, and the same climactic conditions never recur. Unfortunately, climate researchers sometimes use this as an argument to not to look back at the climate of the past at all. That's a mistake. Although there are no analogous situations in the past, the past does provide suitable exercise material. Do we understand why the climate changes and which mechanisms are involved in those processes?'

This is the question Prof. Dr. Nanne Weber asks rhetorically in her inaugural address, entitled *Kan men twee keer in dezelfde rivier stappen?* (Can you step twice into the same river?). The Utrecht University appointed Nanne Weber as holder of the endowed chair of climate modelling and climate analysis at the Faculty of Geosciences. She held her inaugural address on 29 February. In addition to her professorship, Nanne Weber works as a senior researcher at KNMI where she is primarily involved in the study of climate change over long periods of time.

The question is: How good are the current models being used to predict the future climate? According to Weber, periods from the distant past, such as the middle Holocene period, are suitable for testing the reliability of these models. In her speech, Nanne Weber discusses at length why certain periods from the past are suitable for testing a climate model. The comparison of model simulations for these periods with reconstructions based on natural climate archives has provided much information about which aspects of the climate system are well understood and where there are gaps in our knowledge.

'For a time, there was a lot of interest in the search for analogous periods. The main hope was that it would be



possible to learn much about the regional climate response in a changing climate by looking at a period such as the middle Holocene, for instance. Today, this idea has been abandoned. According to Weber, Greek philosopher Heraclites said: "You cannot step twice into the same river, for other waters and yet others go ever flowing on. They go forward and back again." Although the future climate will be, without a doubt, unique in geological history - if for no other reason than the impact of man - the past does offer climate scientists material for 'practice'.

¹ Weber, S.L., *Kan men twee keer in dezelfde rivier stappen? Klimaatverandering door de tijd* Oratie. Universiteit Utrecht, 2008, 1-25

GPS for weather forecasting

DOCTORAL DEGREE SIEBREN DE HAAN

The Global Positioning System (GPS) is not only useful as a navigation aid for cars, ships and aircraft, according to KNMI researcher Siebren de Haan, GPS water moisture measurements also have meteorological applications

Variations in atmospheric moisture and pressure cause inaccuracies up to several metres in the ability of simple navigation systems to determine position. To correct this,

a national network of 35 advanced GPS receivers performs measurements of atmospheric disturbances every 15 minutes. This network generates data on atmospheric pressure

and total water vapour amounts above the receivers. De Haan investigated whether these moisture and pressure measurements can be applied in weather forecasts.

Since 1947, KNMI has measured the atmospheric moisture profile by releasing weather balloons, currently done twice each day at De Bilt. With 35 measurement locations and a high observation frequency (i.e. every 15 minutes), the GPS measurements serve as a valuable source of information. The significant disadvantage in comparison to the weather balloon is that GPS only measures the total moisture volumes, while a weather balloon gathers data every 50 metres. Despite this, De Haan concludes that the GPS measurements can be useful for weather forecasts. Detailed examples in his thesis show, for instance, that GPS data can be used to very accurately predict a heavy lightning storm an hour in advance.



On Tuesday, 27 May, Siebren de Haan received a doctoral degree from Wageningen University for his dissertation *Meteorological applications of a surface network of Global Positioning System receivers*.

Clouds more effectively factored into climate models

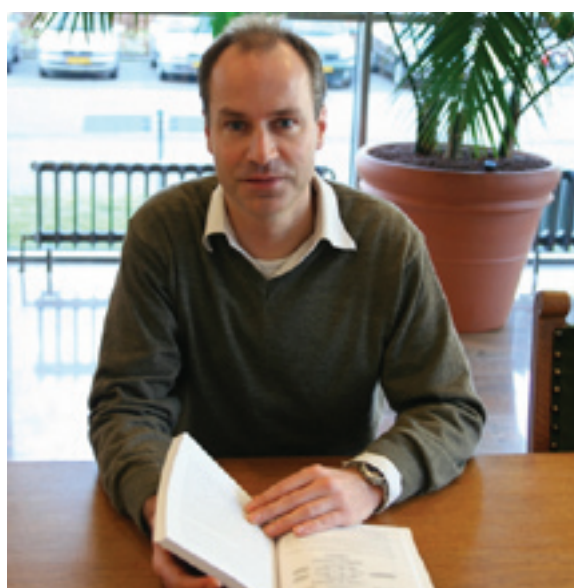
DOCTORAL DEGREE ROB ROEBELING

More cloud measurements and research are needed to better understand the effect of clouds on our climate. Clouds have a strong regulating effect on the energy balance of the Earth, having either a cooling or a warming effect. This depends on the composition, quantity and time of day of cloud cover. A cloudy sky during the day has a cooling effect, while at night it serves to retain the Earth's heat.

KNMI researcher Rob Roebeling analysed data from EUMETSAT's Meteosat Second Generation (MSG) satellite, which has registered measurements every 15 minutes since 2004, and used this data to study the spatial variations and time development of cloud characteristics. Launched in 2002, the MSG satellite makes it possible for the first time to accurately measure both the composition and the time-dependent development of clouds.

Roebeling demonstrated that it is possible to derive an accurate and precise set of data of cloud characteristics from satellite measurements. He used the satellite measurements to study the daily progression of cloud characteristics in a climate model.

One of the outcomes is that current climate models are based on an exaggerated daily progression of cloud cover and cloud thickness in southern Europe. Furthermore, Roebeling has shown that, compared to clouds observed by satellite, the simulated clouds in the model are too thick and the extent of coverage too low.



On 25 April, Rob Roebeling received a doctoral degree from Wageningen University for his dissertation *Cloud Properties Retrieval for Climate Studies using SEVIRI and AVHRR data*.

Intensified greenhouse effect restores ozone layer

DOCTORAL DEGREE ALWIN HAKLANDER

The intensified greenhouse effect enables the ozone layer to recover more quickly. The ozone layer can only recover once ozone depleting substances, specifically chlorofluorocarbons (CFCs), are removed from the atmosphere. These substances are broken down at high altitudes by UV radiation, which is strongest there. CFCs enter the upper layers of the atmosphere by means of the Brewer Dobson circulation.

The Brewer-Dobson circulation model explains how air and residual gases are transported from the troposphere to the stratosphere and back again. Motion is driven by large-scale fluctuations in air currents at high altitude. This phenomenon drives air in the northern hemisphere upward at the equator during winter and carries it northward where it descends again at the North Pole.

Conducting research into the effect of increased greenhouse gas concentrations, KNMI researcher Alwin Haklander discovered that the Brewer-Dobson circulation strengthens, due to the increasing temperature difference in the upper atmosphere between the tropics and the polar regions during winter. The strength of the wave driving forces intensifies as temperature differences become greater. Due to the intensified greenhouse effect, the temperature at altitudes of 15 to 20 kilometres above the tropics increases, while decreasing at the same height over the poles.

On Tuesday, 23 September 2008, Alwin Haklander received a doctoral degree from Eindhoven University of Technology



for his thesis *The Brewer-Dobson circulation: interannual variability and climate change*.

Inaudible sound

DOCTORAL DEGREE LÄSLO EVERS

Infrasound can be used to enhance our understanding of the upper atmosphere. The primary challenge is distinguishing between the sounds and identifying the sources. KNMI researcher Láslo Evers improved the entire process of infrasound measurement, analysis and interpretation.

Measuring inaudible sound makes it possible to, for instance, detect nuclear weapon testing. Infrasound (i.e. frequencies below 20 Hz) is inaudible to humans and is measured using series of extremely sensitive microbarometers.

The key application of Evers' work is the detection of above-ground nuclear tests. KNMI assists in the enforcement of

the 1996 Comprehensive Nuclear-Test-Ban Treaty. Dozens of microbarometers are currently active at five locations in the Netherlands for research.

According to Evers, more knowledge about the interaction between the atmosphere and infrasound is required to fur-

ther refine the analytical methods. Currently, temperatures and wind speeds at altitudes of 50 to 100 kilometres can distort the results. Evers wants to apply infrasound data to generate a more accurate picture of the upper atmosphere. He will conduct research in this field, also as assistant professor for the chair of Acoustic Remote Sensing chair of Delft University of Technology's Faculty of Aerospace Engineering.

On 4 November 2008, Láslo Evers received a doctoral degree from Delft University of Technology for his PhD-dissertation *The inaudible symphony: on the detection and source identification of atmospheric infrasound*.



In higher spheres

DOCTORAL DEGREE THIJS HEUS

The interaction between clouds and the environment occurs indirectly via a shell-like buffer layer. Climate models currently do not take this shell layer into account. KNMI researcher Heus shows that the shell primarily results from horizontal mixing. 'What happens at the top of the cloud has little influence on the underlying layers.'

Knowledge of clouds and the interaction between clouds and the environment is essential to reliably predict changes in the climate. Heus measured such variables as cloud velocity, temperature and duration. Cumulus clouds have long been one of the greatest challenges in science. A cloud is generally described as an entity in which air rises, compensated by air descending all around the cloud.

In his study, Heus demonstrated that the air far from the cloud hardly moves at all. Most of the compensating downward flow of air takes place in the direct vicinity of the cloud – in a shell of descending air. This shell develops because air from the cloud mixes with the environment, causing moisture to evaporate. This cools the air and causes it to descend.

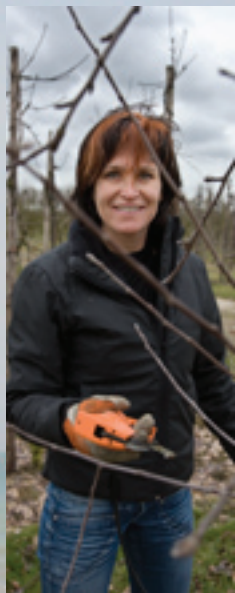
Horizontal mixing also affects the cloud's behaviour over time: the air in a cloud appears not to rise continuously, but rather in the form of 'bubbles'. By visualising this in a virtual environment, Heus was able to study this phenomenon in a reliable manner for the first time ever.

On 9 December, Thijs Heus received a doctoral degree from Delft University of Technology for his dissertation *On the edge of a cloud*.



Dorien van Rooijen || 35 years old

Weather, climate and me



'In the fruit growing industry, it's easy to see there haven't been any real winters in recent years. You especially see that now, after – for a change – a prolonged period of freezing temperatures. Compared to previous years, the trees were still completely dormant in February. During warm winters, when the trees are already budding, you have to be alert for night frost. Then I have to get out of bed at night to turn on the sprinklers. That creates a layer of ice around the fruit, preventing them from freezing. I don't complain about it much. I'm a real outdoors person. It's just the way things are...'



Overviews]|

and more

With every Annual Report, a number of overviews covering human resources and financial matters are presented. And, more specifically, an Annual Report published by KNMI provides meteorological, climatological and seismological summaries.

Annual weather summary

2008: TWELFTH WARM YEAR IN A ROW; THE YEAR WAS ALSO VERY SUNNY

Despite the occasional colder weather, 2008 also proved to be a warm year, ranking ninth in the list of warmest years stretching back more than a century. Moreover, the year was wetter and also sunnier than normal. Never before was December so sunny. It was the coldest since 1996.

Temperature

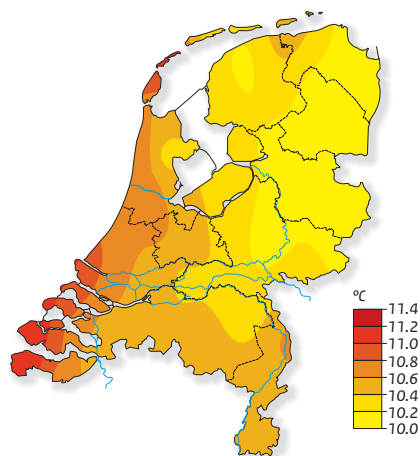
The average annual temperature in De Bilt came out to 10.6°C, compared to a long-term average of 9.8°C. That made 2008 the twelfth warm year in a row. The year ties for ninth place of warmest years since 1901.

With the exception of September, October and December, the average temperature in every month was above the long-term average.

The months January and May were particularly warm. With an average monthly temperature of 6.5°C, compared to the normal 2.8°C, January 2008 ranked second in the list of mildest January months since regular observations began in 1706. May, the flowering month in the Netherlands, was the warmest in more than a century, with an average monthly temperature of 15.7°C in De Bilt, while the normal average is just 12.7°C.

On 31 December, the temperature at Twente Air Force Base dropped to -12.5°C – the lowest temperature in the country during the past year. The warmest temperature (34.3°C) was recorded on 2 July in Eelde in Goningen.

Mean annual temperature 2008



Sunshine

The year 2008 was an extremely sunny year, logging a national average of 1,794 sunshine hours compared to the normal 1,527 hours. Of the KNMI stations, De Kooy was sunniest with 2,007 sunshine hours. In the past hundred

years, only two years were sunnier at this station. Arcen in Limburg had the least number of sunshine hours: 1,561. In De Bilt, 1,735 sunshine hours were recorded compared to the normal 1,527.

May was not only warm, but also took the prize this year in terms of sunshine: no fewer than 274 sunshine hours, far above the usual 209. The first ten days of May were the sunniest in at least a century. The month of December was also very sunny. With a total of 85 sunshine hours in De Bilt, it was the sunniest December month since 1901.

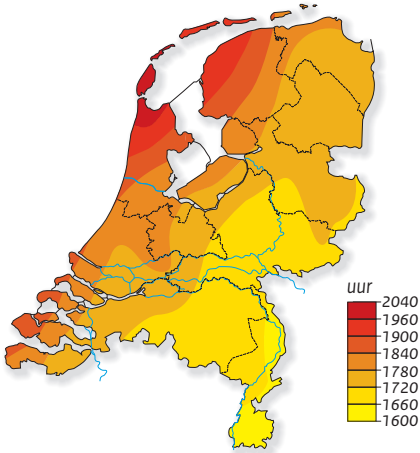
Precipitation

With a national average of 828 mm, there was slightly more precipitation than the long-term average of 797 mm. Leeuwarden registered the most precipitation (999 mm). The least precipitation fell in the southeast of the country – KNMI station Ell recorded just 685 mm. The annual total at De Bilt came to 881 mm, whereas 795 mm is normal.

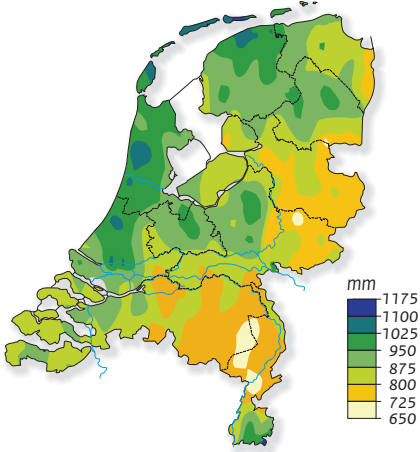
	Monthly average temperature °C De Bilt		Total sunshine duration hours De Bilt		Monthly precipitation amount mm De Bilt	
	Normal	2008	Normal	2008	Normal	2008
Jan	2.8	6.5	52.4	50.1	67.0	96.3
Feb	3.0	5.1	82.0	127.8	49.4	39.2
Mar	5.8	5.9	113.7	116.6	65.4	91.9
Apr	8.3	8.9	158.2	184.7	44.5	33.9
May	12.7	15.7	203.7	259.5	61.5	32.7
Jun	15.2	16.5	186.5	232.5	71.7	39.7
Jul	17.4	18.1	196.1	181.6	70.0	126.8
Aug	17.2	17.4	192.0	163.4	58.2	113.7
Sep	14.2	13.6	132.8	146.7	72.0	100.0
Oct	10.3	10.1	105.6	133.7	77.1	91.5
Nov	6.2	6.9	59.9	53.5	81.2	90.5
Dec	4.0	2.4	44.2	84.9	76.8	24.3
	9.8	10.6	1527.1	1735.0	794.8	880.5

De Bilt collected the following statistics:			
Year 2008	Normal		
3	(8)	Freezing days	(max. temp. lower than 0,0 °C)
55	(58)	Cold days	(min. temp. lower than 0,0 °C)
95	(77)	Warm days	(max. temp. 20,0 °C or higher)
26	(22)	Summery days	(max. temp. 25,0 °C or higher)
1	(3)	Tropical days	(max. temp. 30,0 °C or higher)

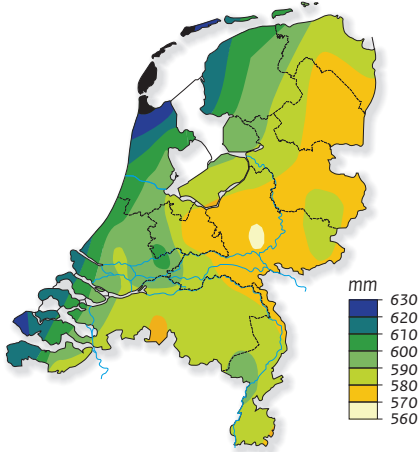
Total sunshine duration 2008



Total precipitation 2008



Potential reference crop evaporation 2008



Notable weather events in 2008

Winter 2007/2008 was very mild

With an average temperature of 5.1°C in De Bilt, compared to the normal 3.3°C. Since 1901, there have been just six winters that were milder. The winter of 2006/2007, by the way, was the mildest in at least three centuries. The winter of 2007/2008 once again lacked a period of ice and snow for winter recreational activities.

White Easter

In the period leading up to Easter, the wind became northerly and the temperature gradually dropped to a low point of approximately 5°C below the long-term average on Easter Day. Snow also fell, making it a white Easter at some locations. A thin layer of snow made the first workday following Easter the second busiest morning rush hour ever, with nearly 900 kilometres of traffic jams and many train cancellations.

Intense wind gusts

During the morning and afternoon of 12 March, intense wind gusts of around 110 km/h occurred throughout the country. A force 9 storm raged for a time along the coast.

Spring was late in arriving, but May was summery

Mild spring weather was a long time in coming this year. It was not until 20 April that the temperature rose above 15.0°C in De Bilt. Since 1901, it only occurred twice previously that the first day of pleasantly warm temperature came so late in the year. The warmer weather came quickly. The month of May was the warmest in more than a century. There were 19 warm days instead of the normal nine, equalling the record in the year 1917. May was not only warm, but also very sunny. It had not been so sunny during the first ten days of May in at least a century. A total of 125 sunshine hours were measured in De Bilt during this period, far exceeding the old record of 110 hours set in 1909.

Exceptionally dry spring in the north of the country

Little rain fell in the north of the country during April, May and June. As a result, the precipitation shortfall (precipitation minus evaporation) rose to approximately 220 mm. That is exceptionally high for the time of the year and primarily impacted the germination and development of the agricultural crops and bouwgewassen.

2 June: heavenly fireworks

During the night of 2-3 June 2008, there was an exceptionally severe lightning storm in the middle of the country. More than 49,000 lightning discharges were registered. At certain moments, the discharges were so frequent that the sky was almost continuously lit.

22 June: hailstones as large as chicken eggs

On 22 June, heavy showers accompanied by lightning, strong wind gusts and hail passed over the east of the country. Many trees blew over and the hail, with stones reaching 5 centimetres in diameter in some places, caused trouble, as well as damage to crops and automobiles.

Holiday period full of wet weather

Despite the fact that the average temperature of 17.3°C was slightly higher than the normal 16.6°C, the summer lacked an extended period of warm and pleasant summer weather. The weather during a large portion of the holiday period in July and August was also very unstable and wet. In July, there were only five days that were dry throughout the country, August had just three completely dry days.

5 October: deluge in the province of Noord-Holland

An active and very slowly moving depression resulted in profuse rainfall that day, particularly in the northwest of the country. In some places, 80 mm or more fell in 18 hours, resulting in flooding and water logging. Such a large quantity of precipitation at any given location is equalled or exceeded less than once every century.

24 November: treacherously slippery

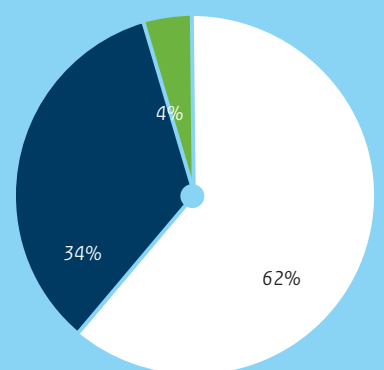
Light rain at a temperature of around the freezing point and freezing ground temperatures caused locally treacherous icy conditions, particularly in the central and southern regions of the country. Dozens of accidents occurred, resulting in four serious injuries. In some areas, riding a bicycle was impossible.

Year ends with skating pleasure

During the Christmas holiday of 2008, was an abrupt transition to cold winter weather. Through the end of the year, there were moderate freezing temperatures at nights and in some areas temperatures remained below zero even during the day. Outdoor skating was possible in several areas.

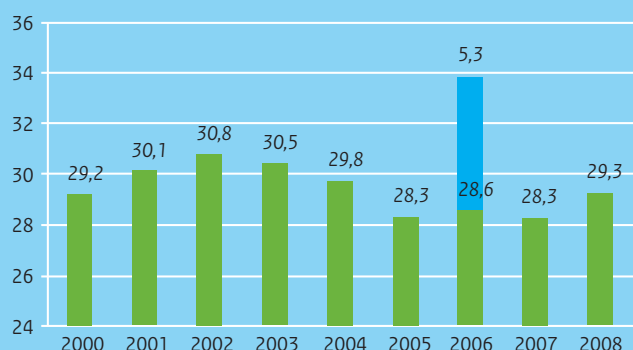
Financial

At the time of printing, the financial data presented in this report was yet to be verified by the Algemene Rekenkamer (The Netherlands Court of Audit).



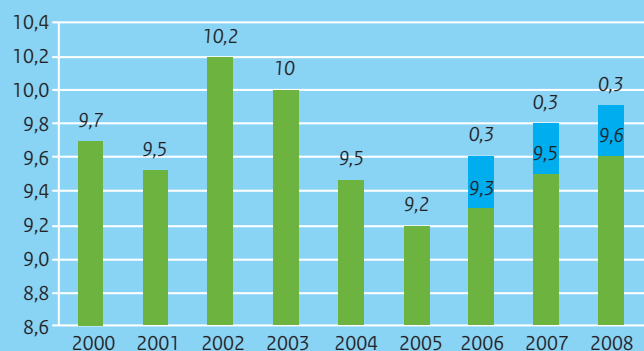
Total product group costs

Weather
Climate
Seismology



Agency contribution

Regular
Incidental



Aviation income

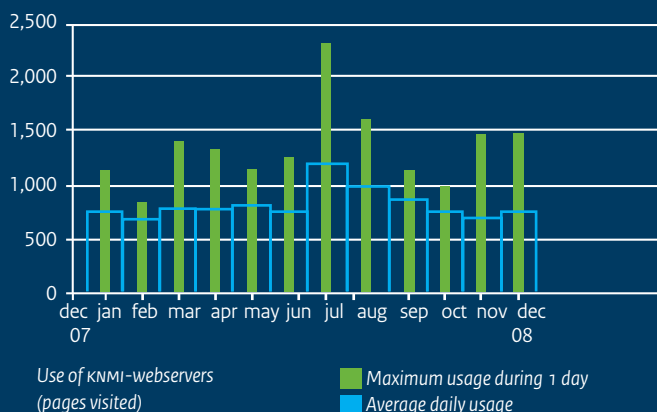
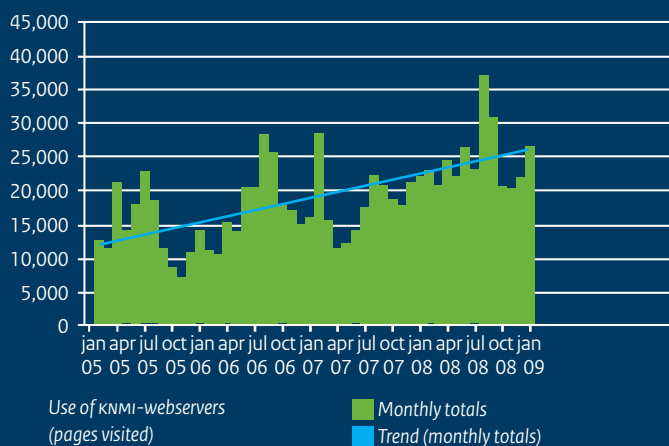
Aviation
North Sea

Balance sheet *)		
Assets	31 dec 2008	31 dec 2007
Fixed Assets	6,176	6,644
Work in progress	2,808	2,386
Accounts receivable	3,714	4,923
Liquid funds	2,700	3,439
Total assets	15,398	17,392
Liabilities	31 dec 2008	31 dec 2007
Reserves	1,718	1,882
Results 2007	-327	-164
Equalisation account	91	182
Provision	2,512	3,169
Accounts payable	11,404	12,323
Total liabilities	15,398	17,392
Profit and loss account *)		
Income	2008	2007
Agency contribution	29,311	28,304
Third-party revenue	18,658	18,873
Interest received	94	102
Extraordinary revenue	91	97
Total Income	48,154	47,376
Expenditure	2008	2007
Staff	33,033	31,233
Material		
- Outsourcing	1,583	2,118
- Maintenance and operation	4,102	4,811
- Rent and lease	3,236	2,970
- Contributions international	2,403	2,305
- Remaining	1,911	2,002
Interest	108	77
Depreciation	1,987	1,738
Donation reserves	64	283
Extraordinary expenses	54	3
Total Expenses	48,481	47,540
Costs per product group *)		
Product group	2008	2007
Weather	29,611	29,723
Climate	16,612	15,748
Seismology	2,140	1,783
Total costs per Productgroup	48,363	47,254

*)Amounts in euro 1.000

Web Statistics

The highest single-day count in 2008 (i.e. nearly 2.3 million page views) was measured on 2 July, a day with tropical temperatures.^[voetnoot] Even so, it was less than half the record established on 18 January 2007. Other days on which the website attracted many visitors were 7 August and 31 December. On both days, approximately 1.5 million pages were requested.



No single-day record

On 12 March, the only weather alarm of 2008 was issued due to intense wind gusts. Only moderate use was made of KNMI information. The number of accessed pages that day amounted to 1.4 million, hardly more than on a 'normally' busy day. There is not always a correlation between the issuance of warnings and extreme weather warnings and higher website use.

New total-month record

In July 2008, a new total-month record (i.e. 37.3 million page views) was set – the heaviest ever for a single month. In addition to the spike on 2 July, the usage pattern on all days was higher than in other months, probably due to the highly unstable and wet weather during the holiday period. The previous record dated from January 2007, when a total of more than 29 million pages were viewed, due to two extreme weather warnings for heavy storms. That was slightly higher than the previous record from July 2006 of just under 29 million. In that month, by the way, it wasn't a storm, ice or mist that attracted visitors, but a heat wave.

The average daily use for all of 2008 was approximately 860,000 pages, representing an increase of more than 35% compared to 2007.

Because the peaks in usage still continue to increase significantly, an entirely new IT platform for the web services was deployed in mid-2008. With this system, KNMI once again possesses technology that is quick and reliable enough to meet public demand.

¹ The use of the web service has traditionally been measured in terms of page views. Since visitors to the KNMI site are not registered, it's not possible to determine the number of visitors.

Scientific publications

As a scientific institute, KNMI produces many publications. In 2008, more than 700 doctoral theses, presentations, articles, scientific reports, technical reports and internal reports were published. These publications are available via the searchable database on the KNMI website.

More than 90 scientific articles by KNMI employees appeared in peer reviewed journals in 2008, five of which were published in either Nature or Science. We briefly outline two of the articles below, as they also received considerable media attention:

- Lenderink, G. and E. van Meijgaard, *Increase in hourly precipitation extremes beyond expectations from temperature changes*, *Nature Geoscience*, 1 (2008), pp. 511-514.

Geert Lenderink and Erik van Meijgaard investigated the relationship between precipitation per hour and temperature in the KNMI's observation series and in the KNMI's regional climate model. Both the observations and the model reveal that during heavy precipitation the volume of precipitation rises by 14% for each degree of temperature increase. This phenomenon is due fairly equally to the fact that warmer air contains more water vapour and that at higher temperatures the air rises faster, causing the water vapour to condense more rapidly. In warmer climates, the precipitation extremes will therefore be greater.

- Sterl, A., C. Severijns, H. Dijkstra, W. Hazeleger, G.J. van Oldenborgh, M. van den Broeke, G. Burgers, B. van den Hurk, P.J. van Leeuwen and P. van Velthoven, *When can we expect extremely high surface temperatures?*, *Geophys. Res. Lett.*, 35 (2008), L14703

Andreas Sterl et al. researched the increase in the annual maximum temperature near the ground in the future climate with a higher concentration of greenhouse gases. They found that the annual maximum temperature increases at a higher rate than the average annual temperature. For a large number of tropical and subtropical regions, the model predicts that annual maximum temperatures will exceed 50°C before the end of this century. In other words, extremely high temperatures rise more quickly than average ones!

Human Resources

In 2008, KNMI employees had the opportunity to provide feedback about KNMI as an employer in a satisfaction survey. This survey is conducted every other year. The outcome in 2008 was outright positive in a number of areas, such as the quality of the buildings and fringe benefits. The survey also provided good insight into the manner in which employees experienced and coped with the 2006 reorganisation. It was also encouraging to see that KNMI compares favourably to other branches of the Ministry of Transport, Public Works and Water Management. Based on the survey, a list of points for improvement has also been compiled. A key point for personnel is the expansion of career development opportunities, both within and outside of the organisation.

Career and mobility

Mobility opportunity was a key aspect of the 2006 reorganisation. In 2008, KNMI took additional steps to give permanence to the results achieved during the reorganisation. That is the task of the Committee on Internal Mobility, which works proactively to identify opportunities for employees and simultaneously establishes recognition of mobility as a normal and desirable element of career development. A management working group supports this activity with proposals for increasing employee career perspectives.

Result and quality-oriented performance review

The KNMI job descriptions fit within the framework of the job description structure of the Ministry of Transport, Public Works and Water Management, which involves a more generic set of job descriptions. This facilitates employees' ability to recognise opportunities in other parts of the organisation and to take advantage of those opportunities. Development, career and mobility are discussed annually between each employee and his/her supervisor during a result and quality-oriented performance review. In addition to the guidance provided via these HRM tools, KNMI makes a particular effort to convey to every employee the necessity of taking responsibility for his/her own career.

Personnel allocation

Like other government organisations, KNMI has also been told by the Cabinet to reduce its number of personnel. KNMI is trying to respond in a flexible manner by making optimal use of the annual organisational development cycle. In addition, choices must be made about the tasks the organisation must continue to perform, as well as how to prepare for future developments. Looking into different arrangements for hiring temporary employees is a good example.

Diversity

In 2008, the women's network 'DIVA' got off to a running start. This network by and for KNMI women is being given the freedom to strengthen the position of female KNMI employees. They are becoming better equipped to develop their careers. The network can also advise management, upon request or of its own initiative, on the role and position of women in the organisation. A great number of activities took place in 2008, including lunch meetings, presentations and peer reviews. In addition, the network has been successful in initiating collaboration with women's networks from other organisations in the immediate area.

Culture

During the past year, the culture working group made three informative trips to organisations in the Netherlands and abroad to learn from the manner the work culture has been given form there. Based on these visits, the KNMI management team receives recommendations about how the core values of the organisation (professional, reliable, entrepreneurial and cooperative) can be further strengthened. In the meantime, a management working group has begun work on the core value 'professionalism', giving us a concrete reference point for use in discussions.

Centralisation

A large number of administrative tasks previously handled by the Control and HRM departments were transferred to the Shared Services Organisation (SSO) of the Ministry of Transport, Public Works and Water Management on 1 January 2009. For twelve employees, this meant transferring to The Hague or a move to a new job.

Year 2008	Male		Female		Total
Employees	387	78%	110	22%	497
Avg. age	46.1		42.0		45.2
Part-time employees	68	18%	76	70%	29%
Avg. hours per week	34.67		27.67		33.12
Absence due to illness					3.21% ¹

¹ Once again a slight decline. In 2007, it was 3.4%.

Seismological overview

In 2008, KNMI recorded 64 earthquakes in the Netherlands. Of these, 15 took place in Limburg and the remaining 49 in Groningen and Drenthe. The earthquakes in Limburg were caused by natural tectonic forces. The earthquakes in Groningen and Drenthe were associated with gas field development.

As far as is known, none of the earthquakes in Limburg were felt. Of the quakes in Groningen and Drenthe, reports were received for eight tremors. Three of the eight made the news:

- *On the night of 5 August in Emmen, two kilometres south of the epicentre, magnitude 2.0 on the Richter scale*
- *On the morning of 30 October, Westeremden, 20 kilometres north-east of Groningen magnitude 3.2 on the Richter scale*
- *On the evening of 7 November, Garsthuizen in Groningen, magnitude 3.2 on the Richter scale*

Not in the news, but also felt:

- 2 April, Eleveld, 2.5
- 18 May, Garsthuizen, 2.2
- 19 May, Loppersum, 1.9
- 10 July, Holwierde, 2.5
- 26 August, Eleveld, 2.3

Worldwide

Thousands of earthquakes take place each year worldwide. A number were in the news or are of interest in the Netherlands for another reason.

- *On 14 and 27 January, there were four earthquakes near Saba. The earthquakes took place approximately ten kilometres northwest of the island and measured 3.8, 3.9, 3.6 and 3.7 on the Richter scale, respectively. Since November 2006, the KNMI has had three seismometers on the Netherlands Antilles as part of a project to better monitor volcanoes, tsunamis and earthquakes along and in the immediate vicinity of the islands.*
- *On 14 February, two earthquakes occurred near Greece measuring 6.7 and 6.1. They took place approximately 50 kilometres off the coast to the south of the Peloponnesos. These quakes occurred in the subduction zone between Europe and Africa, where Africa slowly descends beneath Europe. This makes this region very seismically active.*
- *On 27 February, an earthquake measuring 5.2 on the Richter scale shook England. The location of the earthquake was 200 kilometres north of London and 50 kilometres south of Hull. Earthquakes of this magnitude occur in England every 30 years on average and*

usually take place offshore. This was the strongest in England since the earthquake in Wales in 1984, which measured 5.4.

- On 12 May, the middle of the province Sichuan (central China) was hit by an intense, shallow earthquake measuring 7.8 on the Richter scale, occurring at a depth estimated to be 10 kilometres, which is not deep for such an intense earthquake. As a result, it caused extensive damage.
- On 29 May, an earthquake measuring 6.2 rattled Iceland. The earthquake was easily felt in the southwest of Iceland and caused damage there. Earthquakes on Iceland are caused by Iceland's location atop the Mid Atlantic Ridge, where the European plate and the North American plate are pulling apart from each other.
- On 15 July, an earthquake measuring 6.4 on the Richter scale took place beneath the Greek island of Rhodes. Many holidaymakers and residents felt the quake.

Infrasound

At 9:15 p.m. on 19 March, KNMI received reports of shaking windows and doors in Friesland and Groningen. While such vibrations can be caused by earthquakes, in this case, the cause was an acoustic source in the atmosphere. At the reported time, the infrasound arrays in De Bilt and Exloo measured signals coming from the atmosphere. The source of the vibrations was very likely in the air to the north of Friesland and Groningen and may have been a supersonic airplane.

At 9:30 p.m. on 1 December, loud bangs and vibrations were observed across the province of Zuid-Holland. In total, there were three sonic booms, as observations from the KNMI's acoustic (infrasound) measurement instruments showed. Here, again, people heard windows rattling violently and doors shook. Most thought they were experiencing an earthquake. The infrasound was most likely caused by airplanes breaking the sound barrier above the North Sea.



The red asterisks on the map indicate where six especially notable earthquakes occurred in 2008

Management Team

The KNMI Management Team (MT) consists of the director-general, the directors of the three departments (Weather Service, Climate and Seismology, and Information and Observation Services and Technology), the head of Strategy and Services and the executive secretary. The head of Human Resource Management and the head of Management Accounting also participate in the MT meetings when necessary.



Management Team in the rain. Upper row: Jupp de Bel (Management Accounting), Hein Haak (Climate and Seismology), Frits Brouwer (Director General), Piet de Wildt (Strategy and Services). Lower row: Bram Anker (Human resource Management), Marlie Collet-van Laere (Secretary), Wouter Nieuwenhuizen (Information & Observation Services and Technology), Remco den Besten (Weather Services)

The KNMI MT meets every Tuesday. A formal meeting is held every other week, and on alternating weeks there is an informal lunchtime gathering during which information is exchanged and a presentation on a specific subject or department is made.



Organisation sheet 2008]|



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dr. R. den Besten

Product and Process Innovation
dr. J. Verbeek

Forecasting
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Research and Development
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Stakeholder and Contract Management
F. Lantsheer (acting)



Climate and Seismology
dr. H.W. Haak

Climate Observations
dr. R.F. van Oss

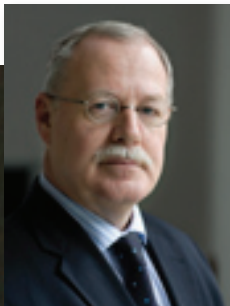
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dr. R. Boers

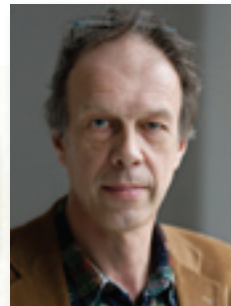
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