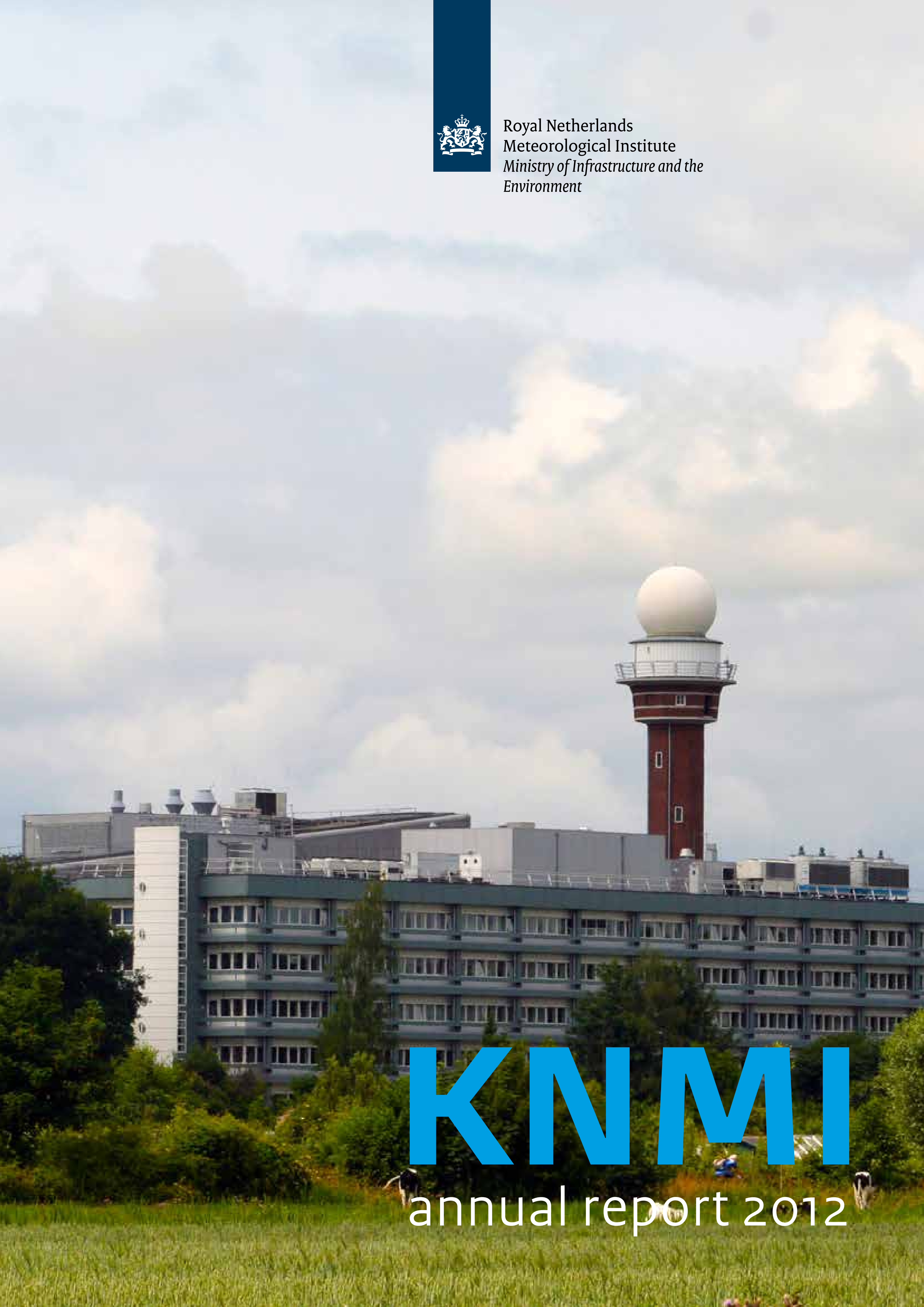
Royal Netherlands
Meteorological Institute
Ministry of Infrastructure and the Environment



KNMI
annual report 2012

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Foreword	Wilma Mansveld State Secretary for Infrastructure and Environment	2
KNMI is changing…	Frits Brouwer, Director General KNMI	4
01 January	A wet and stormy start to 2012	6
02 February	Cold wave in a mild winter	8
03 March	New supercomputer means increased capability	10
04 April	KNMI's general weather forecast reviewed	12
05 May	End of SCIAMACHY, but OMI continues	14
06 June	World's leading wind scientists gather in Utrecht	16
07 July	New weather satellite over Europe	18
08 August	Strongest earthquake recorded in the northern Netherlands	20
09 September	Simulation training for extreme weather	22
10 October	KNMI mast completes forty years of atmospheric observation	24
11 November	IPCC report on extreme weather events	26
12 December	KNMI Data Centre releases data	28
↘	Weather summary 2012	30
↘	Doctorates, prizes and appointments	32
↘	Scientific publications	34
↘	Web statistics	36
↘	HRM	37
↘	Finances	38
↘	Management	40

Foreword

Wilma J. Mansveld

State Secretary for Infrastructure and Environment

I cannot begin this foreword without first saying how proud I am of KNMI. I am acutely aware that my portfolio includes various icons of Dutch society, and the Royal Netherlands Meteorological Institute in De Bilt is one such. However changeable the weather may be, the knowledge and skill of KNMI remain constant and dependable. KNMI's knowledge and skill contribute to safety, access, economic development and environmental sustainability. Through its role as a mature public organisation at the heart of our community, the Institute provides services that benefit every one of us directly or indirectly.

Although the work done by KNMI's meteorologists and researchers is integral to our daily lives, many aspects of it are hidden from view. Nevertheless, the experts at KNMI play a vital role supporting governmental functions in the field of public order and safety. I firmly believe that protecting the public is one of a government's fundamental responsibilities. A national, independent and authoritative reference institute for weather, climate and seismology is therefore essential.

My pride in KNMI was reinforced when I was shown around the facilities at De Bilt shortly after taking office. What I saw was a dynamic organisation determined to enhance its understanding of the demand for knowledge and services in the Netherlands. KNMI is also an organisation that is developing rapidly and working to improve its position as an agency of the Ministry of Infrastructure and the Environment.

In other words, KNMI is committed to adapting to the needs of the future. This spring, I wrote to the Dutch House of Representatives reaffirming the status and role of KNMI as a national reference institute. KNMI remains an agency that helps government bodies to carry out their duties, throughout the kingdom, including the Dutch Caribbean. I am also a strong advocate of a level playing field on which KNMI and private weather companies can operate. It is my intention to leave the existing market relations unchanged as far as possible. Cooperation and innovation will be given every chance to thrive.

Significantly, in my view, KNMI is now generally held in high regard by its key stakeholders. The Ministry of Defence, Air Traffic Control the Netherlands and KLM have again stressed how they value the meteorological services that the Institute provides to the aviation industry as essential to safety and continuity. It is their express wish that the provision of such services should remain integral to KNMI's role. For that reason (and in view of our international undertakings and the importance of air safety), it is my intention that such services should remain within KNMI's remit. I additionally intend to assure KNMI's scientific independence in order to avoid any conflict of interests with between the Institute and the Ministry.

As this Annual Report demonstrates, KNMI performs its duties with great enthusiasm and energy and provides considerable added value for the community. I hope you enjoy reading the report as much as I have.

KNMI is changing...

dr. ir. Frits J.J. Brouwer

Director General KNMI

In her foreword, State Secretary Mansveld outlined her vision of KNMI's future position. KNMI is to remain an agency of the Ministry of Infrastructure and the Environment (I&M) and thus to continue as a reference institute governed by and serving the government in the field of weather, climate and seismology. Furthermore, in her letter to parliament of 28 March 2013, the State Secretary proposed that the existing KNMI Act, which defines KNMI's statutory responsibilities, should be replaced by a more general law on meteorology and seismology. Under the new legislation, the Minister of I&M is to be made responsible for the government's core functions in the fields of meteorology and seismology. KNMI's role as an agency tasked with discharging the minister's responsibilities would then be formalised by a ministerial decree.

Within KNMI, we refer to the collective body of challenges that influence what KNMI will look like in the future, both from the inside and from the outside, as the Change Project. Along with the issue of positioning, the Change Project covers two other important issues: scientific independence and economisation.

Scientific independence is an important consideration for KNMI, because the publication by KNMI personnel of conclusions based on their scientific knowledge is potentially at odds with the exercise of ministerial responsibility. The reason being that, under the Dutch constitution, the minister is politically responsible for everything that her civil servants do or do not do. However, science is predicated on the principle that a scientist publishes material, which other scientists then endorse or dispute. That principle and the principle of ministerial responsibility have not always been easily reconciled, particularly in the context of the climate debate.
It is accordingly proposed that the new law will state that the minister will not instruct KNMI with regard to its research or with regard to the reporting or publication of its research findings. The inclusion of such a provision will largely relieve the minister of responsibility for the scientific activities of KNMI personnel and thus protect the researchers' scientific independence.

Our last annual report acknowledged that KNMI could not escape the general requirement for spending to be reduced in order to bring the nation's finances under control. It has since been decided that, from now on, only KNMI's national basic functions will be funded from the Ministry of I&M's central budget (the so-called agency grant). National basic functions include activities such as publication of the general weather forecast (including weather hazard warnings), upkeep of the national meteorological and seismological metering network, providing climatology services for the Netherlands, presentation of national climate projections, fulfilment of international treaty obligations (e.g. those associated with membership of the UN's World Meteorological Organisation) and maintenance of the meteorological and seismological knowledge base.

Whereas the average agency grant has in recent years been approximately 30 million Euros, the funding provided under the new system will be about 20 million Euros: a cut of roughly 10 million. The products of basic functions are available to everyone at no more than the actual cost of provision. However, service users within government, such as Rijkswaterstaat (Public Works and Water Management Directorate), RIVM (National Institute for Public Health and the Environment) and the water authorities, which additionally require more specific services or information, will in future have to pay for non-basic products and services out of their own budgets. The Ministry of I&M implemented the new approach with effect from 1 January 2013; other service users within government will go over to the system from the start of next year. It will take both sides (KNMI and its service users) a while to adapt to the new market-based model. Nevertheless, experience in other countries (particularly the UK) provides reason to believe that, in the longer term, the model encourages the service provider (KNMI) to be more customer-focused, more efficient and more innovative and is therefore better for the service user. The way aviation meteorology is currently organised in the Netherlands also illustrates the potential benefits of a market-based model. A commercial but cooperative mechanism involving service buyers in the aviation sector (mainly KLM, Air Traffic Control the Netherlands and the Royal Netherlands Air Force) and KNMI has succeeded in delivering innovation and a good price-quality ratio, thus attracting international praise.

KNMI is currently in the process of a major internal reorganisation aimed at ensuring that, across the board, we meet the expectations of service buyers and service users within government. The main features of the reorganisation are: a new (senior) management structure, a product management model that translates customer requirements into assignments for individual meteorologists or climate research groups and enhanced operational arrangements. With the new legislation (which is expected to come into force on 1 July 2014) and the Change Project described above, KNMI is once again completely ready for what lies ahead.

The letter to Parliament from State Secretary Wilma Mansveld is available (in Dutch) through the Dutch government's website. Visit rijksoverheid.nl and search for "positionering KNMI".

01

Also at KNMI

Emergency advice

During hazardous weather events or in an emergency – when there is a major fire or gas leak, for example – it is important that the emergency services know how the weather is likely to develop. Which direction will the smoke drift? Is the wind likely to fan the flames? Is it safe for a planned event to go ahead if severe thunderstorms are expected? Will forecast heavy rainfall cause rivers to burst their banks?
As part of its statutory safety function, KNMI supplies meteorological data and provides advice to the regional safety boards and other government organisations. In crisis situations, emergency services such as the fire brigade and police can contact the weather room directly. Municipal authorities and mayoral offices also have direct access when the public order or safety is at risk.
KNMI also advises the National Crisis Centre (NCC), the Ministry of Infrastructure and the Environment's Departmental Crisis Control Coordination Centre (DCC) and is represented on the Environmental Incident Policy Support Team (BOT-mi). Within BOT-mi, the RIVM plays a lead role and stands at the ready to deliver weather information and dispersal models for relevant substances if an incident occurs that threatens the environment. Satellite-based instruments are used to determine the concentrations of various substances in the atmosphere.
KNMI gives meteorological advice and climate information to various national government coordination committees. The Institute is represented on the National Flood Threat Committee and produces graphs, maps and forecasts regarding precipitation shortfalls and surpluses for the National Water Distribution Coordination Committee (LCW). KNMI plays an active role in enabling the LCW to alert all the relevant bodies in good time when droughts are expected.
KNMI delivers bespoke services wherever possible and always seeks to keep lines of communication short. Information and advice is immediately made available to the relevant bodies. So, for example, water authorities receive specific warnings from KNMI, tailored to their individual risk profiles. A storm-force north-westerly combined with heavy precipitation has very different implications for the coastal province of North Holland than for the inland province of Limburg in the south-east.

▼ *Emergency dyke in Groningen holds back floodwater. Source: Jannes Wiersema*

January

20.01.12

KNAW Robbert Dijkgraaf, the President of the Royal Netherlands Academy of Arts and Sciences (KNAW), visited KNMI to talk about the importance to the nation of KNMI's metering network, research and other activities. The independence of KNMI's scientific staff was also discussed. Dijkgraaf praised all the good work that KNMI does for science. He made his visit after being asked by Siebe Riedstra (Secretary General for I&M) to advise on the position of KNMI and the research that the Institute undertakes.

23.01.12

Aviation EUROCONTROL, the European air safety organisation, agreed a contract with EUMETNET for research in the field of aviation meteorology. EUMETNET is the network of the national meteorology services in Europe. KNMI's contribution will involve innovative meteorological applications for Amsterdam's Schiphol Airport, such as the weather-dependent deployment of meteorologists, and the use of probability forecasts.

31.01.12

Wetterdienst KNMI Director General Frits Brouwer paid a visit to the Deutscher Wetterdienst (DWD). Each organisation visits its neighbour on a regular basis, and both attach great value to the arrangement. Recent developments were discussed, and Brouwer learnt how the DWD also faces budget cuts.

A wet and stormy start to 2012

The first week of 2012 was extremely wet and stormy. High winds with strong to severe gusts, thunder storms and heavy showers of rain and hail characterised the weather in the year's first few days. The north-east of the country was particularly hard hit by flooding caused by all the rain, with homes having to be evacuated in some parts.

Rapidly rising water levels, the threat of dyke failures, submerged roads and fields, flooded meadows, emergency pumps removing the surplus water. In the first week of 2012, extremely heavy rain caused a great deal of disruption and damage. The north-east of the country was particularly hard hit by floods, leading to the precautionary evacuation of vulnerable settlements. In the space of a week, the north-east had as much rain as normally seen in the whole month of January: between 70 and 90 mm. To make matters worse, the rain fell on saturated soil, following a very wet December, when precipitation was roughly twice the monthly average. The situation was further compounded by strong north-westerly winds, which drove the seawater against the coast, preventing the excess rainwater draining into the Waddenzee.

Teeming rain was accompanied on 3 and 5 January by storm-force winds. On Tuesday 3 January, the north and north-west of the country bore the brunt of the storm, where gusts in excess of 100 km/hour were recorded. In the night and morning of 5 January, a particularly active band of showers crossed the country, accompanied by strongly gusting winds, thunder and hail. The thunderstorms were particularly severe in the south-east of the country. KNMI issued additional warnings regarding the stormy weather. On both days, weather alerts with code orange were given for the coastal regions, especially in the north. The deep depressions also brought very stormy, wet weather to other European countries and snow to the Alps.

Strikingly, both December 2011 and January 2012 were not only very wet, but also unusually mild. In the first week of 2012, for example, the temperature was about five degrees higher than average. Higher temperatures lead to increased precipitation, because more water evaporates from the Atlantic and the warmer air facilitates the movement of moisture in the atmosphere. A westerly airflow then carries the wet air over the Netherlands, resulting in more precipitation.

▼ *Roads in Groningen on 5 January, flooded by extreme precipitation. Source: Jannes Wiersema*

02

▲ *Ice skating marathon on february 11 at Appingedam. Source: Jannes Wiersema*

February

10.02.2012

Deltaplan Delta Commissioner Wim Kuijken was updated on the new climate scenarios by KNMI. Director General Frits Brouwer and Climate Sector Director Hein Haak talked to the Delta Commissioner about what he could expect from KNMI, such as additional local and regional information and the application of actual weather cases.

Also at KNMI

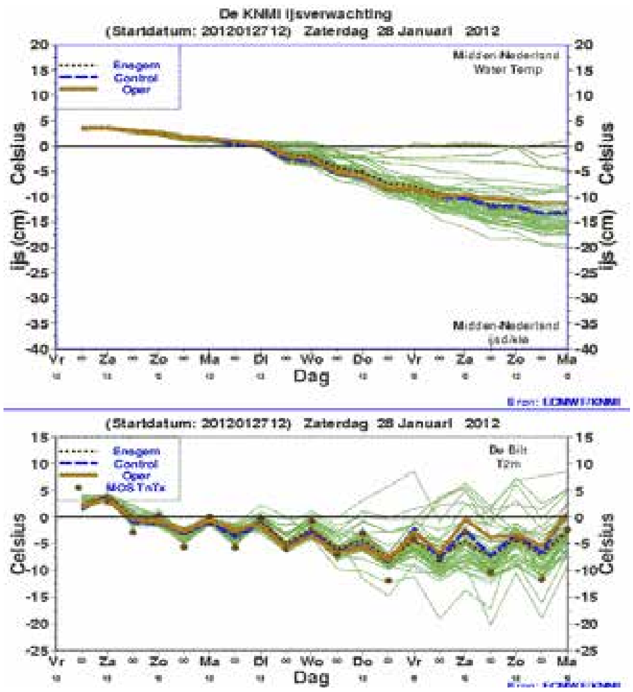
IJspluim predicts ice thicknesses

Whenever temperatures in the Netherlands fall below zero, people start thinking about when they'll be able to skate on natural ice. With a view to helping skaters, some years ago KNMI developed an ice development model, better known as the *IJspluim* ('ice plume', in reference to the shape of the graph). The model calculates the temperature of (or ice thickness on) a static body of water two metres deep. The calculations take account of factors that influence ice formation, such as air temperature, wind, evaporation, radiation and snow cover (relevant because of its insulating effect on the ice below). Although the model embraces all the factors that may influence ice formation, its predictions are not valid for all water bodies in the Netherlands, because there are too many local variables. The *IJspluim* therefore provides only a general indication of the way ice sheets are likely to develop in the Netherlands.

One special feature of KNMI's *IJspluim* is that it calculates fifty scenarios or possible outlooks for the longer term. Because minor errors in the data about weather conditions can have major implications for the calculations, errors are deliberately introduced to the model. By doing so, it is possible to reflect the uncertainties inevitably associated with the weather. Performing the calculations repeatedly results in fifty ice formation scenarios, covering the full range of possibilities. Each scenario is then depicted as a green line.
The further into the future they extend, the more varied and uncertain the scenarios become. The spread of the lines reflects the reliability of the forecasts. If the lines are close together, that means that there is less variation in the scenarios and the forecast is more reliable than when the lines are widely spread.

Whenever ice may develop in the Netherlands, the *IJspluim* is available on KNMI's website, www.knmi.nl. KNMI additionally produces a separate IJspluim for Friesland, so that the body that organises the *Elfstedentocht* has localised information about how ice cover is expected to develop. One KNMI meteorologist also has special responsibility for informing and advising the event's organising committee.

▼ *The IJspluim from just before the cold wave that began on 30 January 2012. On 28 January, the ice formation model was already forecasting strong ice formation. Source: KNMI*



Cold wave in a mild winter

It was February of 2012 before any true winter weather arrived. After two mild and changeable winter months, the Netherlands found itself in the grip of severe frosts, snow showers and ice. The bitter weather lasted long enough to qualify as a national cold wave.

The cold wave from 30 January to 8 February 2012 was the thirty-third since 1901 and the first for fifteen years. A national cold wave is a sequence of at least five 'ice days' (days when, for the whole twenty-four hour period, the temperature at De Bilt remains below freezing), including at least three days of severe frost (below minus 10 degrees). The previous cold wave was in 1997 and lasted twelve days.

Unfortunately, the frosts of 2012 were neither sufficiently hard nor sufficiently prolonged for the event to be held. Nevertheless, the cold wave provided good ice for skating in many places around the country. There were even opportunities to skate in the sun. Indeed, February was a very sunny month. In the first ten days, there were 62 hours of sunshine at De Bilt – the most ever recorded for the period. On the morning of Friday 3 February, heavy snow spread from the north to complete the wintery scene. In some places, more than 3 centimetres of snow fell in the space of an hour. Across large parts of the Netherlands, the depth of the snow cover averaged 5 centimetres, but some local accumulations were twice as deep. With winds reaching force 5 to 6, there was also a lot of windblown powder snow. Alerting the nation to the imminent snowfall, KNMI issued orange warnings for a number of provinces.

It is unusual to have a significant number of ice days within a short period during what is otherwise a relatively mild winter. In the space of three weeks, there were twelve days at De Bilt when the temperature was below freezing for the whole twenty-four hours. In an average winter (December to February) there are seven ice days. The winter of 2012 was therefore characterised by an unusual change from mild winter weather to a late cold wave, involving severe frosts and a considerable number of ice days. The coldest night was that from 3 to 4 February. The lowest temperature was recorded at Lelystad, when the mercury fell to minus 22.9 degrees above freshly fallen snow. At De Bilt there were 18.9 degrees of frost – the lowest temperature recorded there since February 1956.

Also characteristic of February's cold spell were the low perceived temperatures, brought about by the combination of frost, wind and a low humidity. The biting easterly wind meant that the temperature sometimes felt like less than minus 25 degrees. The effect was greatest on 7 February, when the perceived temperature was minus 28.6 degrees.

So, what caused the mild winter of 2011-2012 to abruptly deliver so many days of ice, snow and skating? Most of the time, the Netherlands enjoys mild maritime air: during the winter, oceanic depressions are the prevailing meteorological phenomenon, bringing mild but wet winter weather. Sometimes, however, the Netherlands is hit by cold and snowy winters, when the country is chilled by a cutting east wind. That happens when there is an area of high pressure to the north or north-east of the Netherlands. An area of high pressure is surrounded by clockwise winds, meaning that the flow of mild maritime air is cut off and cold air from Siberia is drawn across the country. Such atmospheric blockages hold at bay the depressions that develop above the Atlantic. Long periods of extreme weather, such as cold waves and heat waves are always associated with blockages.
Within a few days, a very large and strong area of high pressure above western Russia brought ice days and moderate to severe overnight frosts. The location and strength of the high-pressure area were decisive in the development of persistent frosts. By 12 February, the severe weather was at an end and the rest of the month proved to be mild or very mild for the time of the year.

No Elfstedentocht event despite severe frosts

Despite the cold wave, with its severe frosts, the special skating event Elfstedentocht could not take place in February 2012. The ice formation model suggested that conditions were cold enough for 20 centimetres of ice to develop under ideal circumstances. However, circumstances did not prove ideal and the 15 centimetres of ice necessary on Friesland's lakes and drainage channels did not materialise. One of the reasons was the mild weather in December and January. Prior to 30 January – the day that the freeze started – there had been hardly any frost and conditions had been warm for the time of year. As a result, it was a long time before the water bodies had cooled sufficiently to allow ice formation to begin in earnest. Although the strong easterly wind initially hastened cooling and therefore ice formation, it subsequently caused many ice sheets to crack. The amount of sunshine was also a problem. As the weather became sunnier, the water below the ice warmed up, hampering further ice formation.
However, perhaps the most significant of the factors that conspired to stop the event going ahead was the snow, particularly in Friesland. On Friday 3 February, a depression over the Netherlands brought 4 to 10 centimetres of snow, from which Friesland did not escape. The timing of the snowfall was very unfortunate: it was early in the cold wave, when the ice was still relatively thin. The insulating effect of the snow meant that ice development was slow, despite the severity of the frost. Although the Elfstedentocht could not be run, it was possible to skate on natural ice in many places around the country, and various events that don't depend on the formation of very thick ice did go ahead.

03

Also at KNMI

Meteorology lessons for schools

Because it affects everyone, the weather is a topic of daily conversation. Especially in the Netherlands, with its changeable climate. It's no surprise, therefore, that many young people do weather-related projects in school and turn to KNMI for help. In response, KNMI has developed a Dutch-language meteorology lesson package. On 19 March 2013, the material was presented at the annual introductory day for the international educational programme, GLOBE. About 75 young people visited KNMI for meteorology workshops and to do their own research with satellite data.

As part of the GLOBE programme, KNMI meteorologists Petra Kroes and Marco van den Berge devised the meteorology lessons for youngsters between the ages of twelve and fifteen. The aim was to make the material as accessible and as broad as possible, so that it could be used for pupils of all secondary education levels. So, for example, there is a lot of practical material concerned with measurement, but there are also theory elements that go into greater depth and require more from the pupil. The package is also very flexible: each lesson can be used on its own, or several can be used in any order.

The series is designed to encourage young people to think and investigate independently. The great thing about meteorology is that it brings together geography, physics and mathematics in the form of a very practical discipline. By performing their own measurements, making their own weather maps and doing their own tests, pupils are able to put theory into practice.

Each element of the lesson series has three levels. Answers to the basic-level questions can be found in the study material itself. At the intermediate level, a greater understanding of the subject matter is required. Finally, there are more challenging questions that test the pupils' insight. This layering of the material means that teachers can use it for various year groups and various educational pathways.

The lesson series and teachers' guide, plus various PowerPoint presentations for use in the lessons can be downloaded free from www.knmi.nl/educatie. KNMI provides only the digital material. Instruments and other resources have to be provided by the schools themselves.

March

08.03.12

Climate atlas The members of the Parliamentary Standing Committee on Infrastructure and the Environment asked to hear the story of the Bos Climate Atlas from KNMI. A series of short presentations were made, outlining the contents of the Climate Atlas and taking related questions. TV weather forecaster Helga van Leur explained why the atlas was important for her as a professional user.

16.03.12

GLOBE As part of the GLOBE educational programme, 75 pupils and teachers from all around the country visited KNMI. The youngsters attended workshops, visited the instrument station and talked to the scientists. The aim of the programme – developed by Wageningen University, Netherlands Space Office, Science Center NEMO, RIVM and KNMI – is to boost young people's knowledge and understanding of nature and the environment and to actively involve them in climate science research.

22.03.12

World water day On World Water Day, the board of the Youth Water Management Organisation toured the Netherlands to draw attention to the work of the Dutch water sector. The tour included a visit to KNMI by the twenty young people aged between 13 and 17, each representing a water authority region in the Netherlands. The water authorities' young people's think tank had plenty of questions for KNMI: about the relationship between the water authorities and KNMI, whether KNMI used data collected by water authorities, how much we could believe about climate change and what training you need to get a job at KNMI.

New supercomputer means increased capability

On 16 March, the Ministry of I&M's Secretary General Siebe Riedstra gave the formal go-ahead for KNMI's new computer centre. The additional computational capacity will translate into enhanced forecasting and climate research capabilities for KNMI.

With a working memory of 9.5 terabytes and a processing speed of 58.2 teraFLOPs, enabling it to perform 60,000 billion calculations per second, KNMI's new supercomputer is one of the fastest and most powerful computers in the Netherlands. On the international stage too, the BullX B500 high-performance computer will allow KNMI to keep pace with the best.

For the collection and storage of data and the creation of weather and climate models, KNMI needs computers. The new system from ICT supplier Bull is more efficient and forty times faster than KNMI's old computer system, which, after five years in use, no longer offered sufficient computational capacity to meet the organisation's ever-increasing needs. The BullX B500 opens the way to faster, more accurate and more complex forecasting and climate modelling.

Water cooling makes the new supercomputer very energy-efficient. Furthermore, KNMI's Richardson Computer Centre – named after meteorologist Lewis Fry Richardson (1881-1953), who pioneered numeric weather forecasting – has been designed and built with sustainability, energy conservation and safety in mind.
The supercomputer and ancillary systems use a great deal of energy, which is converted into heat. The heat has to be taken away by cooling systems, which themselves use energy. In order to make the whole installation energy-efficient and sustainable, KNMI has opted for an integrated thermal storage system deep below ground, linked to a roof-mounted air cooling installation.

An ingenious system of pipes in, under and on the KNMI building conveys cooling water from the computer centre to be re-cooled and re-circulated. In winter, 'used' cooling water carrying heat from the computer centre is led up to the roof-mounted air cooling system, where the heat is dissipated. The re-cooled water is then stored underground. In summer, groundwater drawn from a depth of 60 metres is used to cool the new centre. The Richardson Computer Centre's sustainable cooling system uses a concept recommended by consulting engineers DHV, who acted as project managers. The computer centre was designed and built by TES Installatietechniek Utiliteit BV.

Every detail of the computer centre has been considered, with a view to maximising the comfort, convenience and safety of the sealed, dust-free, climate-controlled computer room. The floor is made up of floating, removable tiles, with fire warning sensors beneath them. Instead of running across the floor, all the cables for the equipment are routed via ceiling ducts. Almost everything is designed to allow scope for expansion so that the computer centre will remain viable well into the future. Most provisions have been realised in duplicate or even triplicate, because in ICT the adage is 'one is none': without a backup, you risk losing everything. A diesel generator is available to provide an emergency power supply in the event of an outage, so that weather forecasts, data collection and data exchange remain guaranteed.

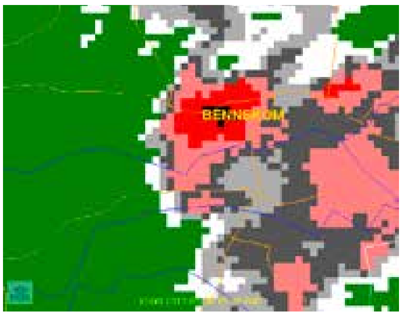
▼ *KNMI's new supercomputer BullX B500. Source: KNMI*

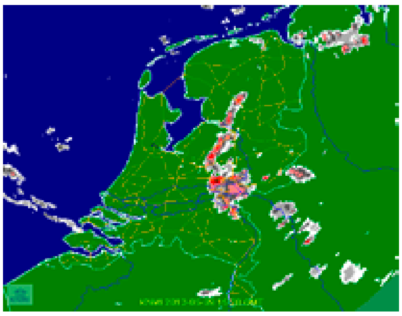
04

Also at KNMI

Reporting weather damage by smartphone

With a view to helping KNMI to get a better and swifter picture of the impact that weather conditions are having, since 2012 it has been possible for the public to report severe weather damage and problems by smartphone. Using the Damage Project's specially developed smartphone and tablet app, anyone can submit a photo or written details illustrating the effects of phenomena such as wind gusts, snow or heavy downpours.
In 2012, KNMI received about a thousand reports, including nearly three hundred photos of weather-related situations. Naturally, most submissions are linked to extreme or photogenic weather phenomena, such as snow, thunder clouds and lightning.
The highest number received on a single day was 177. That was on 3 February, when KNMI issued an warning code orange in connection with the forecast snow. On 21 June, there were also over a hundred reports, prompted by the thunder showers. On that day, more than fifty thousand users logged on to the Damage Project server. Incoming reports are recorded in a central processing unit at KNMI. For the time being, the reports and photos are not published on the KNMI website in order to prevent abuse. However, in appropriate circumstances, KNMI can consider posting a report on www.knmi.nl, maybe accompanied by a photo. Receiving reports from around the country means that the KNMI's meteorologists can quickly build up a picture of prevailing weather conditions and see what their local impact is. As a result, it is easier to judge whether a warning needs to be upgraded, for example. Damage Project reports therefore support the evaluation of weather warnings. In the long term, they may even lead to revision of the warning criteria if that is considered appropriate.





▲Receiving reports from around the country means that meteorologists can build up a picture of the impact that extreme weather is having. The radar images show heavy rain showers, with the town of Bennekom represented by a black dot. Alongside is a photo sent to KNMI, illustrating what conditions were like on the ground. Source: KNMI

April

02.04.12

Historical data From 2 to 5 April, the Indonesian meteorology service BMKG and KNMI together presented the results of the Didah Project at a workshop in Bogor, Indonesia. The two institutes have been inventorying and digitising historical data on the Indonesian climate in order to preserve it for posterity. Recorded by Dutch people during the colonial era, the data are useful in the context of climate research, for example. More information can be found at www.didah.org.

11.04.12

Earthquake At 14:38 local time, a strong earthquake measuring 8.6 on the Richter scale occurred beneath the Indian Ocean, on the same latitude as North Sumatra. No tsunami warning was given, because the movement in the earth's crust was largely horizontal. The main quake was followed by numerous aftershocks, the biggest measuring 8.1.

13.04.12

Roermond Twenty years ago, the province of Limburg was shaken by the most severe earthquake ever recorded in the Netherlands. Centred on the town of Roermond, the quake occurred during the night of 13 April 1992 and registered 5.8 on the Richter scale. Damage valued at about 100 million euros was caused. The cause of the earthquake was movement along the Peelrand fault, 17 kilometres below the surface.

25.04.12

Gas quake At 19:25, Sappemeer was affected by an earthquake 3 kilometres below ground. The tremor measured 2.0 on the Richter scale.

KNMI's general weather forecast reviewed

In 2012, with a view to gauging the quality of the general weather forecasts published on www.knmi.nl, the KNMI Council asked for a verification study to be performed. The study involved comparing forecast conditions for the period March 2011 to June 2012 against the actual conditions.

The study focused on two elements of the general weather forecast published on the KNMI website: the map on the homepage, showing the forecast for today and tomorrow, broken down into six regions, and the six-day table on the Forecasts page, which shows forecast averages for the country as a whole. Both forecasts are posted on the website each day by the safety meteorologist on duty in the KNMI weather room. The six-day table is generated automatically using weather models and statistical routines. The duty meteorologist refines the forecast for day 1 only. By contrast, the forecast map is produced by the meteorologist personally. For the verification exercise, both the meteorologist's forecasts and the automatic forecasts were examined.

The study showed that the meteorologists were better at forecasting day 1 of the six-day period than the automated systems. The difference in performance was most evident where national average minimum and maximum temperatures, higher wind speeds and precipitation levels were concerned. The automated systems did better with low wind speeds. The added value provided by a meteorologist was most evident when it came to estimating high levels of precipitation in the near future. The meteorologists also proved better at predicting dry days and were more confident than the weather models about saying that it wasn't going to rain.

For almost all regions, the forecast maximum temperatures shown on the map were more accurate than the minimum temperatures. The percentage of correct predictions for summer days in the various regions was greater than the percentage for frost days. Where national average temperatures were concerned, that picture was reversed: the forecast minimums were more reliable than the forecast maximums. Of the regions on the forecast map, the south-west (South Holland, Zeeland and West Brabant) fared worse than the other regions where forecast temperatures were concerned. However, verification was based on observed data from the Vlissingen weather station only. Those data are not considered to be properly representative for the region. In future, observed data from other stations will be included, which should facilitate quality assessment of the forecasts.

The conclusion of the exercise was that KNMI satisfied the national standard: the average deviation between the forecast and actual temperatures given on the 'Tomorrow' map has to be less than 0.5 degrees per year, as calculated for the central region (De Bilt). However, when all the regions were considered individually, the deviation for some regions was found to exceed 0.5 degrees per year. Following on from this first verification study of KNMI's general weather forecast, the exercise will be extended to enable more data and forecasts to be reviewed. The differences between the meteorologists and the automated forecasting systems have been evaluated and working methods amended where necessary. Elements of the general weather forecast will also be modified to increase the quality of the published information.

Vooruitzichten
Onbestendig. Maxima rond 20 graden. Vooral vrijdag vrij veel wind.

	Di	Wo	Do	Vr	Za	Zo
Zonneschijn (%)	70	20	30	40	30	40
Neerslagkans (%)	20	90	90	90	80	70
Neerslaghoeveelheid (mm)	0/1	1/17	3/8	1/9	1/4	1/6
Minimumtemperatuur (°C)	7/9	13/14	12/14	11/13	11/12	10/12
Middagtemperatuur (°C)	20/22	17/20	19/22	16/18	16/18	16/19
Windrichting	VAR	NO	ZO	ZW	W	W
Windkracht (bft)	2	3	3	5	4	3

Uitgifte: 18/06/2012 07.06 uur LT

▲ *Left: the web map that shows the forecast temperature, cloud cover, precipitation, wind direction and wind force for each region. Centre: the regions on the web map. Right: the six-day table with forecast average statistics for the Netherlands as a whole. Source: KNMI*

05

Also at KNMI

KNMI on the BES islands

Since Bonaire, Sint Eustatius and Saba became part of the Netherlands with special municipality status, KNMI has been responsible for meteorology and seismology on the islands. KNMI has delegated its responsibility for the BES islands to the Meteorological Department Curacao (MDC). KNMI and MDC work together closely on weather forecasting and maintenance of the observation network in the Caribbean part of the Netherlands. One of the MDC's fields of activity is aviation meteorology for the islands. With a view to assuring the quality of the MDC's meteorological services, KNMI assists the MDC on technical matters and with staff training. The MDC is a member of the World Meteorological Organisation (WMO) and for hurricane reporting makes use of data provided by the National Hurricane Center in the United States. MDC forecasts are published on www.meteo.an.

During the hurricane season (June to December), the Caribbean region is frequently affected by tropical storms and hurricanes. These extreme weather events involve strong winds and heavy rain, which often cause high seas, floods, mudslides and destruction. KNMI is closely involved with issuing warnings and advises bodies such as the National Crisis Centre (NCC) at the Ministry of Security and Justice. Aruba and Sint Maarten have their own meteorological services.

The MDC also produces seasonal forecasts on the basis of predictions regarding El Niño, a period in which an area of warm water extends across a large part of the Pacific, roughly level with the equator. Temperature developments in the ocean have a major influence on the tropical climate of the Caribbean. Because the Antillean islands lie in an earthquake zone, KNMI also carries out various seismology activities in the Caribbean. The Institute has seismometers on Sint Maarten, Sint Eustatius and Saba, enabling it to monitor seismic activity in real time, just as in the Netherlands. In addition, KNMI has a volcanism monitoring system on Saba and Sint Eustatius, which keeps a weather eye on activity at sites such as Mount Scenery, an 877-metre dormant volcano with four craters.

▼ *The Meteorological Department Curaçao. Source: MDC*

May

16.05.12

Aviation LVNL Director of Operations John Schaap and KNMI Director General Frits Brouwer signed the new partnership agreement between KNMI and LVNL. LVNL is one of the main consumers of KNMI's aviation weather information. Cooperation between the two organisations has a long history.

20.05.12

Earthquake Northern Italy was hit by an earthquake measuring 6.0 on the Richter scale, with its epicentre 36 km north-west of Bologna. The shock was discernible by KNMI's instruments in the Netherlands.

24.05.12

ENVISAT After ten years in service, the European environmental satellite ENVISAT stopped sending data back to earth. One of the instruments on board was SCIAMACHY, a joint project by the Netherlands, Belgium and Germany. From 2002 to 2012, SCIAMACHY provided a flow of information about the ozone layer, air quality, aerosols and greenhouse gases.

27.05.12

OMI The ministries of EA&I and I&M approved continuation of the Dutch-Finnish OMI Project up to the end of 2015. The Ozone Monitoring Instrument is carried by the NASA climate satellite EOS-Aura, from which it measures the ozone layer, air pollution, aerosols and clouds. KNMI is the OMI Project's Principal Investigator. Continuation of OMI is important because the ENVISAT satellite recently stopped working and the launch of its successor TROPOMI is not scheduled to take place until 2015.

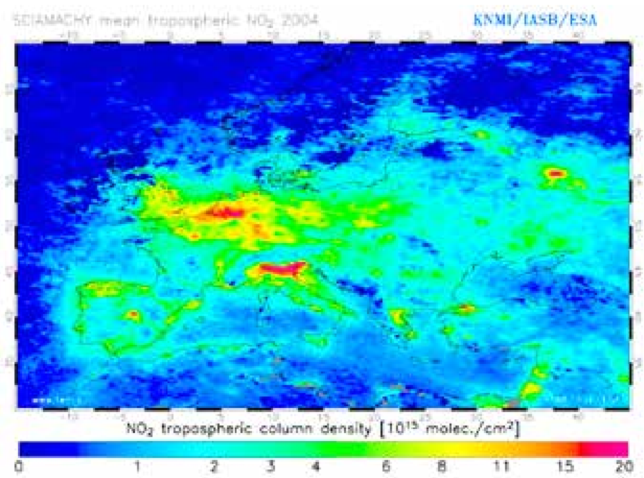
29.05.12

Earthquake On 29 May, there were two more major seismic events in northern Italy, an area prone to seismic activity. The earthquakes occurred roughly 10 km below ground and registered 5.8 and 5.6 on the Richter scale. They were followed by dozens of aftershocks, the most severe measuring 4.7.

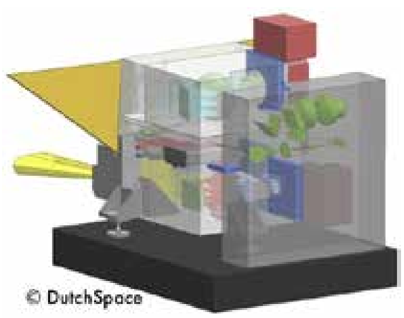
End of SCIAMACHY, but OMI continues

After ten years of measuring the ozone layer, aerosols, clouds and air pollution, the satellite-borne SCIAMACHY instrument system was abandoned in April 2012. Fortunately, the Dutch-Finnish Ozone Monitoring Instrument (OMI) Project was extended the very next month. Continuation of the OMI Project ensures that satellite monitoring will continue until the SCIAMACHY's successor (TROPOMI) is launched in 2015.

In May 2012, the European Space Agency (ESA) formally abandoned Europe's largest scientific satellite, ENVISAT. After ten years of monitoring the atmosphere, land and sea with a suite of ten instruments, ENVISAT stopped sending data back to earth on 8 April. All attempts to re-establish communications with the environmental satellite failed. ENVISAT had actually far exceeded expectations, remaining in service five years longer than its designers intended.
Launched on 1 March 2002, ENVISAT carried various instruments, including SCIAMACHY: an important source of atmospheric information for KNMI. For a decade, SCIAMACHY provided a homogenous body of data on the ozone layer, air pollution, greenhouse gases and aerosols. In the context of climate research, it is important to have continuous sequences of data obtained in the same way and covering as long a period as possible. Without such sequences, variations and trends cannot be reliably discerned and different periods cannot be properly compared.
SCIAMACHY (Scanning Imaging Absorption Spectrometer for Atmospheric Chartography) was built by a consortium of three countries: the Netherlands, Germany and Belgium. It was a spectrometer that accurately measured the spectrum of the sunlight reflected by the earth's atmosphere. Every gas in the atmosphere has its own characteristic absorption pattern. As a result, the extent to which the various colours in sunlight are absorbed by the atmosphere varies, depending on the amount of each gas present. Therefore, by measuring the spectrum of the reflected light, it is possible to map the presence and concentrations of atmospheric gases. KNMI collected, analysed and studied the data sent down from the satellite.
SCIAMACHY has provided some unique scientific successes. Accurate measurements of the ozone layer, from which three-dimensional images are produced, have increased understanding of the processes by which ozone is broken down, creating the ozone hole. Satellite images from SCIAMACHY have shown the distribution and seriousness of air pollution above Europe, as well as global hotspots, such as East China and North America. Worldwide emissions of the greenhouse gas methane have been mapped using data from SCIAMACHY, as have the spread of desert sand, volcanic ash and smoke from forest fires. Scientific understanding of aerosols and their role in global warming has also increased greatly, thanks to SCIAMACHY's monitoring. The device has provided new insight into clouds as well: cloud heights vary a lot from season to season, with low clouds predominating.
SCIAMACHY is to be replaced by a new satellite-borne instrument called TROPOMI, which is currently under construction. It is scheduled for launch in 2015, on board the European ESA satellite Sentinel-5 Precursor. To ensure that satellite monitoring of the atmosphere continues in the interim, the ministries of EA&I and I&M authorised continuation of the Ozone Monitoring Instrument (OMI) Project in May 2012. Extension of that Dutch-Finnish project means that data on ozone and air pollution will continue to be sent back from space without interruption. OMI has been operating since 2004, on board the NASA climate satellite EOS-Aura. KNMI is the OMI Project's Principal Investigator and is responsible for processing the satellite data.



▲ *The well-known SIAMACHY image that shows the air pollution above Europe in 2004. Source: KNMI/IASB/ESA*



◀ *The new measurement instrument TROPOMI. Source: KNMI*

06

Also at KNMI

Optimising energy production using weather data

Weather data are very valuable to the energy sector. During cold autumn and winter months, the demand for heat is greater. Energy companies therefore rely on climatological data, weather forecasts and current temperature data to estimate how much energy their customers will require. Appropriate production capacity can then be deployed to ensure that supply and demand remain in balance.

Wind and insolation data can also be utilised to optimise the output of solar and wind energy plants. To calculate a solar plant's energy output, information about total radiation levels is needed. Total radiation is the sum of direct solar radiation and diffuse radiation, such as that reflected off clouds. At KNMI weather stations, total radiation is measured on a horizontal plane. The readings are often referred to by energy producers and solar panel owners interested in calculating their systems' outputs, which depend on the bearing and angle of the panels.

The identification of potential sites for offshore or onshore wind power plants requires climatological data concerning the winds at particular locations, and preferably concerning the winds some distance above the surface. Using such data, it is possible to work out how much power could be generated and exactly where the individual turbines should be placed. The amount of energy that a wind turbine generates depends almost entirely on the strength and duration of the wind. Those variables are expressed in the form of the windex: the energy content of the wind, relative to the long-term average. Statistics Netherlands calculates the windex from the production data for turbines, again using data collected by KNMI.

In the Netherlands, more and more wind turbines are being installed, and the average turbine height and capacity are increasing all the time. The latest wind turbines have longer blades, enabling them to produce more electricity from the wind. KNMI climate data are freely available from the KNMI website and many companies and other organisations consult the weather information, which is constantly being updated. KNMI provides basic data only; the applications of weather information or more specific weather data is left to commercial service providers.

▼ *Wind park in Groningen. Source: KNMI/Jannette Bessembinder*

June

05.06.12

Climate scenarios Representatives of the Netherlands Environmental Assessment Agency (PBL), Knowledge for Climate, Meteo Swiss, Météo France, the Bundesanstalt für Gewässerkunde and the Norddeutsches Klimabüro visited KNMI to advise on updating the KNMI's climate scenarios for the Netherlands. The members of this Advisory Board were impressed by the scientific approach and professional interaction with the users.

07.06.12

Whirlwind Montfort, a village south of Roermond in the province of Limburg, was hit by a small, short-lived whirlwind just before half past eight in the evening. The shower complex that gave rise to the phenomenon had already triggered a similar event at Tongeren, Belgium, about an hour earlier. At Montfort, a trail of damage a kilometre long and fifty metres wide was left through the middle of the village.

21.06.12

Indonesia Led by Director General Sri Woro Harijono, a delegation from the Agency for Meteorology, Climatology and Geophysics of the Republic of Indonesia (BMKG) visited KNMI. The delegation's purpose was to sign a Memorandum of Understanding (MoU), in which the BMKG and KNMI formally expressed their intention to continue working together. Collaboration between the two organisations has already yielded two projects: the Didah Project and the Joint Cooperation Programme (JCP).

25.06.12

MP-visit Christian Democrat MP Marieke van der Werf paid a working visit to KNMI. After attending the parliamentary briefing about the Climate Atlas, Van der Werf wanted to know more about KNMI's work. She watched presentations on weather warnings, climate research and the climate debate, as well as visiting the weather room.

World's leading wind scientists gather in Utrecht

Wind data are vital for weather forecasting and for providing weather warnings. Over sea, wind speeds and directions are nowadays measured mainly from satellites. From 12 to 14 June 2012, KNMI hosted an international congress in Utrecht, at which wind scientists from around the world gathered to exchange information about the latest developments.

On the opening day, congress participants – members of the International Ocean Vector Wind Science Team – were received in the Central Museum by Director General Frits Brouwer. In his welcoming address, Brouwer emphasised Utrecht's historical link with meteorology. It was in the city's cathedral tower that Buys Ballot began his famous meteorological observations, and KNMI was founded in Utrecht in 1854.

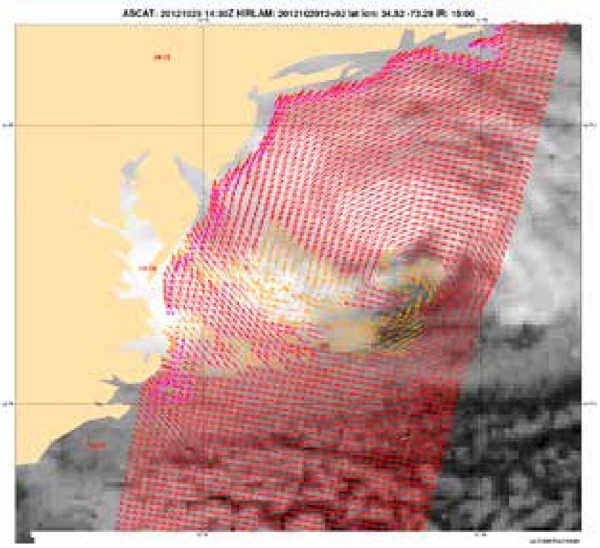
The gathering was organised to give the world's foremost experts in the measurement of sea winds the opportunity to discuss developments in their field. KNMI acted as host because of its role in the EUMETSAT Satellite Application Facilities.

At the congress, processing standards for international satellite data were also agreed, so that wind data can be used in the same way all over the world. The satellite programmes of Europe, the United States, China, Japan and India will all be harmonised so that wind scientists everywhere can utilise each other's observations and knowledge.

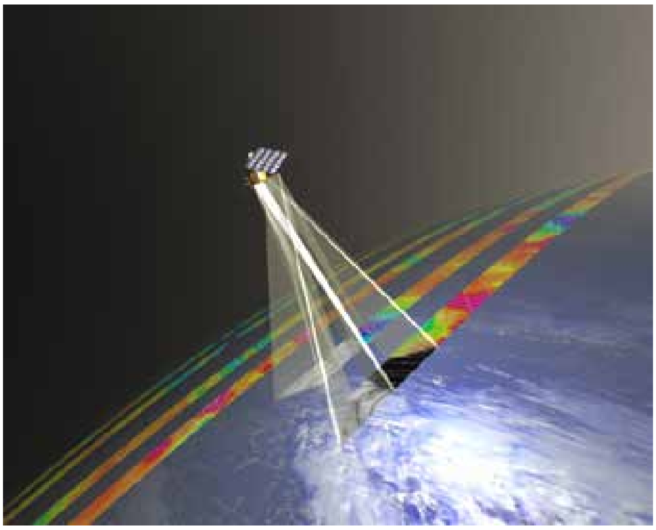
KNMI plays a key role in the field of satellite-based wind observation. Within Europe, KNMI is responsible for the ASCAT instruments (Advanced SCATterometer) carried by EUMETSAT's MetOp-A and MetOp-B polar satellites. The ASCAT instruments measure wind speeds and directions above the oceans. Development, processing and analysis of the observation data are handled by KNMI. ASCAT data are used not only as a basis for numeric weather forecasts and warnings to shipping, but also as input for ocean circulation models, climate research and climate analysis.

The International Ocean Vector Winds Science Team is very diverse. Its members include instrumentation experts from organisations such as NASA's Jet Propulsion Laboratory, meteorologists from the National Hurricane Centre and elsewhere, oceanographers from leading universities and experts from the energy sector. The IOVWST meeting was funded by NASA, the Municipality of Utrecht and KNMI, and co-organised by Florida State University.

▼ *Image of superstorm Sandy (October 2012) with ASCAT-measurements. Source: EUMETSAT/KNMI*



▼ *ASCAT measures repeatedly in two strips of 550 kilometre the atmosphere. Source: ESA*



07

Also at KNMI

National Data Centre for CTBT

The Comprehensive Nuclear Test-Ban Treaty (CTBT) prohibits all the world's nations from performing nuclear tests in any environment. The treaty was adopted by the UN in 1996; the Netherlands became a signatory that same year and ratified the treaty in 1998. KNMI is the Netherlands' nominated National Data Centre (NDC). An NDC's role is to advise its National Authority (in the Netherlands, the Ministry of Foreign Affairs) about explosions that occur around the world. The treaty has so far been signed by 183 countries and ratified by 159. However, it will not become effective until all 44 countries that possess nuclear reactors (the so-called Annex II countries) have ratified it. Of those countries, 36 have so far proceeded to ratification.

The CTBT provides for an elaborate verification system, known as the International Monitoring System (IMS). The purpose of the IMS is to monitor the earth's land, seas and atmosphere for nuclear and other explosions. As the Dutch NDC, KNMI analyses measured data from the IMS. Those data take the form of seismological observations for the land, hydro-acoustic observations for the seas and infrasonic observations for the atmosphere. In addition, atmospheric concentrations of radioactive particles and noble gases are measured with a view to securing 'smoking gun' evidence. In the Netherlands, those data are analysed by the RIVM.

Although the treaty is not yet legally effective, its influence is apparent. Between 1945 and 1996, more than two thousand nuclear tests were performed; since 1996 there have been just a handful. Pakistan and India last carried out tests in 1998; North Korea did so in 2006, 2009 and 2013. As well as serving its intended verification function, the unique global IMS network is used in connection with disasters, such as the earthquake and tsunami that hit Japan in 2011, and for scientific research. KNMI's Dr Hein Haak chairs working group B, the CTBT organisation's verification working group.

Measuring instrument IS49 on Tristan da Cunha in the South Atlantic. Source: CTBTO Public Information

Measuring instrument IS18 is the infrasound array in Greenland. Source: CTBTO Public Information

July

KNMI's added value for the nation studied

The benefits of weather and climate information easily outweigh the cost of obtaining it. That was the central conclusion of a report by the Rebel Group consultancy, which was commissioned by KNMI to investigate the Institute's added value for the nation.

Completed in summer 2012, the Rebel report underlines the great importance of meteorological, climatological and seismological information to government, the business community and the general public. International research provides a basis for making a preliminary estimate of the potential value of such information to the Dutch nation. Studies from Europe, Australia and the United States have previously sought to place a value on weather and climate information. Although the studies differed in terms of their methodology, their level of detail and the sectors studied, the findings yield a consistent picture. The benefits far outweigh the cost. Indeed, the cost-benefit ratios for weather and climate services are extremely high.

The value derives mainly from the prevention of human injury and property damage, and from improving efficiency. Transport, agriculture, construction and the public sector are the biggest beneficiaries of good weather information. However, private individuals and private-sector users also benefit from being able to use weather information in their day-to-day lives. Finally, savings can be secured by adapting to climate change.
From the cost-benefit ratios presented in the various national studies and the overall production cost of KNMI's output (approximately 70 million euros), the benefit of weather and climate information to the Netherlands was estimated. The outcome was a figure in the range 338 million Euros to almost 3,000 million Euros. The calculated range was very wide because much depends on what is included within the definition of value to the nation.

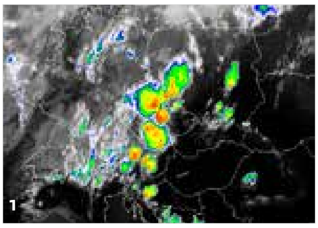
New weather satellite over Europe

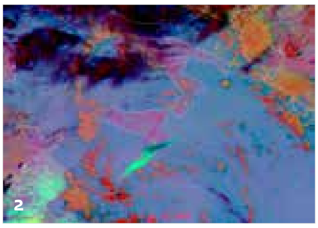
The new Meteosat-10 weather satellite was successfully launched on Thursday 5 July 2012. Meteosat images of the atmosphere over Europe and Africa are used on a daily basis in TV and internet weather bulletins. Meteosat-10 assures the continuity of meteorological observations from space until 2020.

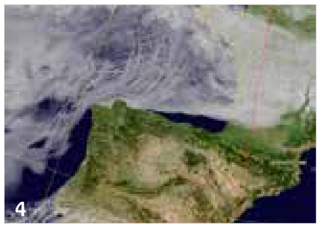
Following a successful test period, Meteosat-10 has been fully operational since December 2012. EUMETSAT, Europe's weather satellite operator, commissioned the new satellite to take over from Meteosat-9, which had reached the end of its working life. For two months, the two satellites sent back simultaneous meteorological observations, before Meteosat-10 took on the role of primary image provider. The overlap allowed users to prepare for the switch.
Satellite observations have appreciably improved the reliability of weather forecasts down the years. Information from space is particularly useful for providing early warnings of extreme weather events such as hurricanes and heavy showers. However, KNMI uses Meteosat data for purposes such as mapping mist banks as well. Information from Meteosat-9 also played an important role in monitoring the dispersal of ash from Iceland's Eyjafjallajökull volcano in spring 2010.

Meteosat-10 has a geostationary orbit and is located 36,000 kilometres above the Gulf of Guinea. Because its position is fixed in relation to the earth, Meteosat-10 is able to observe Europe twenty-four hours a day.
Measuring 3.8 metres by 3.2 metres, the satellite weighs 2035 kilos. It was developed and built by ESA and is operated by EUMETSAT. Operation involves controlling the satellite itself, plus data communication and data processing.

Meteosat-10 is the third of what will ultimately be four European weather satellites built under the Meteosat Second Generation (MSG) Programme. The first of the four satellites – Meteosat-8 – was launched in 2002 and now serves as a backup. KNMI nevertheless continues to use images from Meteosat-8 for weather and climate research. Meteosat-9 is also still in use for the Rapid Scan Service, which provides images of just Europe every five minutes, instead of every quarter of an hour. The expectation is that the two older weather satellites will remain in service for several years, even though they have already been operating for considerably more than their five-year design life.







▲

1. Heavy thunderstorm with lots of rain over central Europe on July 1, 2012.
2. Eruption of Mount Etna in Sicily on January 5, 2012
3. Distribution of Sahara sand (marked with pink) on June 27, 2012
4. Trails of shipping routes in the Atlantic.
Source/Copyright: EUMETSAT

◀

A. Finishing the European weather satellite Meteosat-10
B. Launch of ESA Ariane 5 with MSG3-weather satellite on board.
Source/Copyright: ESA/CNES/ Arianespace/Optique Video du CSG

08

Also at KNMI

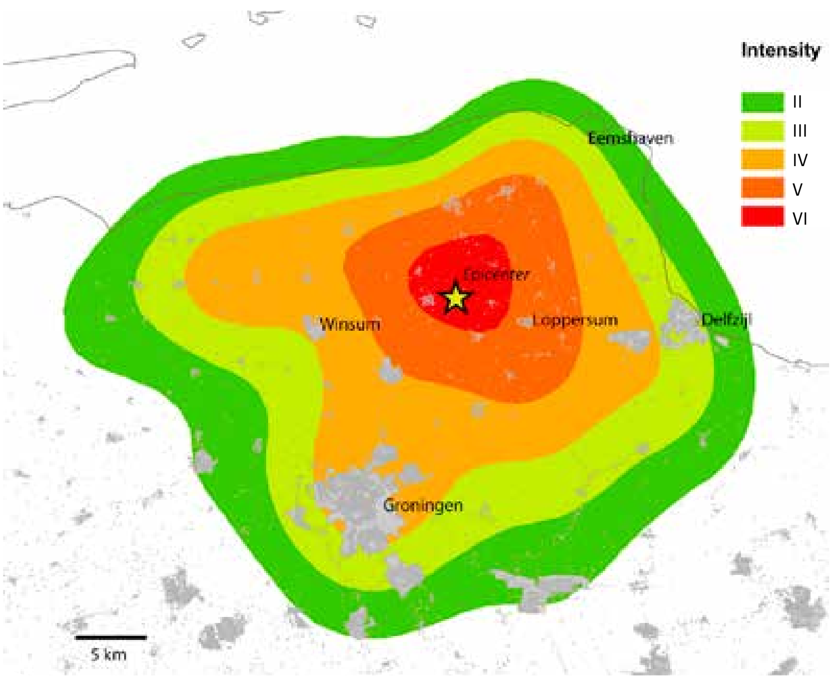
Risk analyses for infrastructure projects

It is practically impossible to predict the location or timing of earthquakes. Nevertheless, the risk can be estimated and generalised hazard forecasts can be made. Using observation data and statistical models, KNMI is able to calculate the likelihood of seismic activity exceeding a particular threshold in a given location and time interval.

Using its observation network and its unique store of knowledge and data concerning the Netherlands, KNMI acts as seismic risk analysis reviewer for the Dutch government. All KNMI's data and studies are transparent and verifiable.

In risk analysis, it is important that the chance of an earthquake is neither underestimated nor overestimated. Overestimation leads to unnecessary precautions and thus avoidable expense, while underestimation increases the risk of damage or injury due to unpreparedness. By reflecting the margins of uncertainty associated with seismic event probability calculations, KNMI helps governments and the business community to build a clearer picture of the risks, as a basis for informed decision-making.

It is increasingly common for government bodies and businesses to have seismic risk analyses performed, so that, if necessary, they can take precautions. For the last decade or so, seismic risk analyses have also been compulsory in the context of oil and gas extraction projects. In recent years, KNMI has carried out analyses for the new power plants in the Eemshaven (Groningen), for the nuclear power plant at Borssele, for the motorway tunnel in Maastricht, for the Liquid Natural Gas tanks on the Maasvlakte and for other projects. The likelihood of seismic hazards and similar events is also calculated when dyke works are planned and when water levels are high.



August

04.08.12

Downburst The heavy thunder showers that crossed the Netherlands on 4 and 5 August were accompanied by strong localised gusts of wind, or downbursts. The collapse of the main marquee at the Dicky Woodstock festival in Steenwijkerwold, in which a number of people were injured, was probably caused by one such downburst.

15.08.12

Earthquake At 21:17, Leermens in the province of Groningen was affected by a seismic event measuring 2.4 on the Richter scale. The shock originated three kilometres below the surface and was linked to gas extraction activities in the area.

16.08.12

Earthquake The village of Huizinge in Groningen was shaken by a further readily perceptible earthquake at 22:31. This tremor was attributable to gas extraction north-east of Groningen and registered 3.6 on the Richter scale.

18.08.12

Tropical In the weekend of 18 and 19 August, many parts of the Netherlands basked in tropical temperatures. Thermometers all over the country reached 30 to 35 degrees, and in the Limburg town of Ell, the temperature peaked at 36.7 degrees on the Sunday. The RIVM's National Heatwave Plan was activated to warn people about the heat and provide advice.

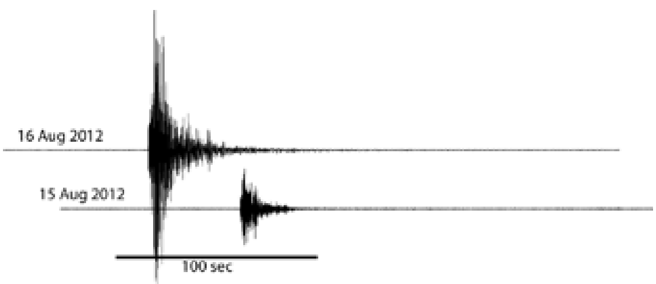
◀ *Indication of the strength of the two earthquakes that shook the municipality of Loppersum in August 2012. The intensity of the events varied from minor damage, falling objects and people being alarmed (red, VI) to barely discernible (II). Source: KNMI*

Strongest earthquake recorded in the northern Netherlands

On 15 and 16 August, two earthquakes struck the area north-east of Groningen. The shock that centred on the village of Huizinge was particularly significant, measuring 3.6 on the Richter scale. That made it the strongest earthquake so far recorded in the northern Netherlands.

The earthquake that hit Huizinge at 22:31 on Thursday 16 August was felt across a wide area. It registered 3.6 on the Richter scale, making it the strongest shock ever recorded in the north of the Netherlands. KNMI received a record number of reports via its website: 1350 members of the public contacted the Institute about the shock. There had been a discernible seismic event north-east of Groningen the previous day as well. At 21:17, the village of Leermens was shaken by a lighter shock than the Huizinge tremor: 2.4 on the Richter scale. Like the following evening's event, its source was three kilometres below ground. KNMI received fifty reports of the incident.

Because of its force and the number of (damage) reports received, the Huizinge earthquake was analysed in more detail. Following initial calculation of the local magnitude shortly after the event, the moment magnitude was also calculated. The local magnitude is an expression of the maximum movement of the earth at the observation site, while the moment magnitude reflects the total amount of movement. Usually, the two calculated magnitude values are the same (allowing for the relevant margin of error). However, where the Huizinge event was concerned, there was a clear discrepancy between the local magnitude (3.4) and the moment magnitude (3.6). After further analysis, KNMI concluded that the strength of the Huizinge earthquake was in fact 3.6, rather than 3.4 as originally reported.



▲ *Seismograms from the earthquakes in Leermens (August 15) and Huizinge (August 19). Source: KNMI*

The number of seismic events recorded in the northern Netherlands by KNMI varies from year to year. The total number of earthquakes attributable to gas extraction registered in the region during 2012 was 103.
Most earthquakes are not discernible by people at ground level, but are picked up by KNMI's instruments and then analysed. KNMI's seismic metering network is designed to register all earthquakes with a magnitude of 1.5 or greater. People are able to feel tremors measuring 1.8 or higher.
Since 1995, KNMI has had a network of seismic instruments set up in the north of the Netherlands to measure earthquakes. The network has gradually expanded over the years to enable more data to be collected and different types of measurement to be made, in order to build up a more complete picture of the seismic activity associated with gas extraction.

In the Groningen field – the Netherlands' largest gas field and the location of the shocks recorded on 15 and 16 August – the number of tremors has been increasing. That is probably associated with the acceleration in extraction. When gas is released from below the ground, the pressure within the relevant part of the earth's crust is reduced, making it more likely that movement will occur along existing faults. KNMI advises and informs the Ministry of Economic Affairs, the State Supervision of Mines (SodM) and mining companies about the earthquake risks associated with gas extraction.
During detailed analysis of the Huizinge event, it became clear that it was not possible to use statistics to estimate the maximum potential magnitude of an earthquake in the Groningen field. Further research is required, using geological data and geomechanical models.

Registration of Dutch earthquakes abroad

Earthquakes that occur in the Netherlands may be detected in other countries. Instruments set up in seismic observation stations outside the Netherlands record events inside Dutch borders, just as KNMI's seismometers record shocks further afield.
Many of the observations made in other countries are automatically posted on the internet and in bulletins, such as that published by the European-Mediterranean Seismological Centre (EMSC). The data in question are from initial calculations; as such, they do not distinguish between regions and they are much less accurate. For precise data, therefore, the EMSC always refers readers to the national institute of the country where the earthquake occurred. In view of the need for precision, KNMI does not publish automated calculations on its website, but analyses earthquakes manually.

09

Also at KNMI

Including health information in weather forecasts

Both heat waves and cold waves can have health implications. Sunshine also has the potential to affect health. To make sure that people get timely, appropriate warnings about the health risks associated with the anticipated weather, KNMI provides forecasts for particular weather aspects. The forecasts are developed in association with other institutes or organisations with expertise in the relevant health risks. So, for example, hay fever forecasts are produced with the help of the Pollen Information Service at Leiden University Medical Centre. KNMI has for some years been providing short-term forecasts for hay fever sufferers. Certain types of weather are particularly conducive to the dispersal of certain allergenic pollens.

KNMI issues a sun strength forecast (UV index) to let people know roughly how long they can safely remain in the sun. To produce the forecasts, KNMI works with RIVM and the Dutch Cancer Society. Account is taken of the angle of the sun, the distance between the sun and the earth and the anticipated ozone concentration in the atmosphere. Forecasts are then developed for both clear and overcast skies. KNMI's sun strength forecast is available on page 708 of broadcaster NOS's teletext service, from the end of April to the start of autumn. It is also published on the websites of KNMI, RIVM and the Dutch Cancer Society.

In collaboration with the RIVM and TNO, KNMI has developed an air quality forecast, which predicts how the weather is likely to influence the concentrations of air pollutants. In stable winter weather pollution often remains close to the ground, leading to considerable concentration build-ups. In summer, when the temperatures are high and the skies clear, rapid chemical reactions take place in the atmosphere, potentially leading to smog formation. KNMI's air quality forecasts are published on www.rivm.nl.

Whenever there is a strong possibility of a hot spell, the National Heat Plan comes into effect. KNMI's weather forecast serves as the basis for triggering activation of the plan. The RIVM's Heat Plan describes things that people can do to prepare for hot weather. During extreme cold periods, KNMI reports perceived temperatures in its weather forecasts. Perceived temperatures are calculated by combining air temperature and wind speed. The windier it is, the colder it feels. When persistent frost is expected, KNMI warns the health and emergency services so that they can take steps such as providing shelter for homeless people.

Source: KNMI ▶

September

04.09.12

North Pole The area covered by the northern polar ice sheet is now under four million square kilometres: less than at any time since records began in 1979. The previous record minimum was set in 2007. As recently as 1990, the minimum area covered by the ice in mid-September was still eight million square kilometres.

06.09.12

WMO WMO Secretary General Dr Michel Jarraud met KNMI Director General Frits Brouwer in the Netherlands. Among the topics of discussion was the position of the Antillean islands in the WMO. Jarraud recognised the quality of Dutch meteorological research with the second successive WMO Research Award for Young Scientists.

27.09.12

Certification The annual external audits that are carried out in connection with KNMI's ISO 9001 certification and the Single European Sky aviation scheme were extended in 2012 to include aviation services for the BES islands. All the year's external audits yielded positive outcomes.

Summer heat guidelines

KNMI contributed to the municipal health authority guidelines on hot weather health hazards by providing climate data and advice. The guidelines, which were published at the end of 2012, were developed by the RIVM in collaboration with the municipal health authorities, KNMI and TNO. Municipal health authority personnel use the guidelines to give clients appropriate information about the risks they face during high summer and about what they can do to mitigate those risks. The guidelines are broader than the RIVM's National Heat Plan.

Simulation training for extreme weather

Being operational twenty-four hours a day, the KNMI weather room uses numerous procedures and carefully defined working methods to ensure the proper delivery of meteorological services. With a view to assuring the quality of weather room operations, KNMI began an annual simulation training programme for its meteorologists in 2012.

An individual KNMI meteorologist is unlikely to have to deal with an extreme weather event while on duty in the weather room. Extreme weather does not occur often and, because the weather room has to be staffed round the clock, the team of meteorologists that works there has about forty members. As a result, there is little chance of very unusual weather occurring while any one of them is working. Nevertheless, an extreme event is always possible, so the meteorologists need to be prepared. Therefore, to enable its meteorologists to get realistic practice handling unusual situations, KNMI provides simulation training.
Using historical information about extreme weather conditions, a simulator is used to realistically familiarise the participants with the relevant working methods, procedures and forms of interaction with other departments and external stakeholders. The only unrealistic aspect is that events are accelerated, partly to acclimatise meteorologists to working under pressure, and partly to cover an entire extreme weather scenario in a much shorter period of training.
The training sessions show how the meteorologists cope with pressure and how they perform in extreme situations. At the same time, the simulations put KNMI's procedures to the test. The rationale is that, if people have encountered extreme situations in training, they will respond more quickly and more appropriately to unexpected real life events. Individual differences between meteorologists are also brought to light, because participants have to cope with the simulated situations on their own, which would not be the case in practice.
The meteorologists are assessed on their powers of estimation, their procedural knowledge, their ability to explain things to others and their attitude. During the post-simulation debriefing, the participants learn how their colleagues handled the situation. In addition, the lessons of the exercise are identified, in order that the meteorologists can respond to a similar situation more effectively in the future.
Despite all the computers, weather models and meteorological data involved, giving weather warnings remains a task for humans. Moreover, there is increasing emphasis on a KNMI meteorologist's advisory function. Service users, such as Rijkswaterstaat, Schiphol Airport and the emergency services increasingly expect KNMI to provide bespoke, detailed weather information of the highest quality. A meteorologist consequently needs to be more versatile and more professional than ever. Ensuring that its staff are appropriately qualified is therefore a priority for KNMI. Against that background, qualification requirements will shortly be defined for aviation meteorologists, for example. Simulation training will be used in that context as well.
The innovative simulation training programmes that KNMI has developed in recent years have attracted a lot of interest from abroad. Delegates from the national weather institutes of Ireland, Belgium and Luxemburg have visited KNMI to see how the training is organised and delivered. The Royal Netherlands Air Force has also expressed an interest in the simulation exercises.

Crown Prince Willem-Alexander pays a working visit to KNMI

Accompanied by the Advisory Committee on Water (AcW), Dutch Crown Prince Willem-Alexander (as he then was) visited KNMI on the afternoon of Tuesday 25 September. He was updated on the new KNMI climate scenarios and the Delta Programme. Naturally, the Prince also looked in on the KNMI weather room.
The AcW advises the State Secretary for Infrastructure and Environment on the implementation of national water policy. The visit to KNMI also provided Delta Commissioner Wim Kuijken with an opportunity to meet the AcW and talk about the current position with regard to the Delta Programme – a package of measures designed to protect the Netherlands against flooding and to assure the availability of fresh water.

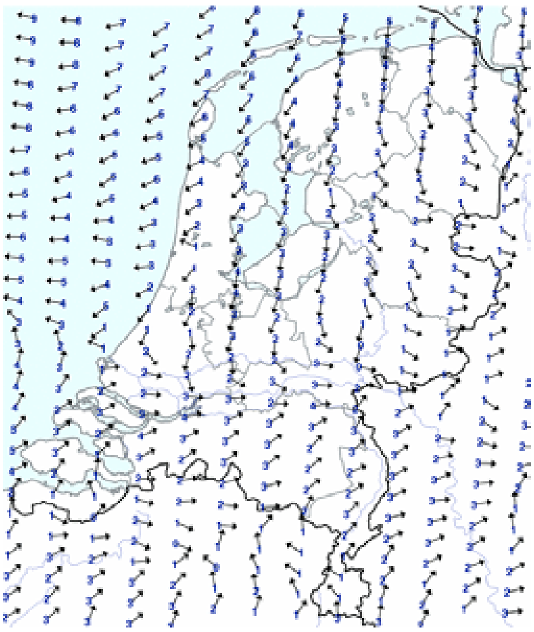
▲ *Willem-Alexander in the KNMI weather room.*
Source: Patricia van der Kooij/KNMI

10

Also at KNMI

Ballooning weather forecast

Ballooning is the most weather-sensitive form of air sport, so reliable and specific weather information is vital for safety. Using the special KNMI Aviation Weather website luchtvaartmeteo.nl, KNMI provides current, specific weather forecasts for balloon pilots. Balloonists can also contact the KNMI weather room directly. A meteorologist there has the task of monitoring the ballooning forecasts, modifying them as necessary and adding significant weather data. In ballooning, the single most significant weather factor is the wind. It is the wind that carries the balloon and determines its speed and direction. Details of the wind conditions at the start and at the landing site are particularly important. The stronger the wind, the harder the landing. The ballooning forecasts on KNMI Aviation Weather take the form of maps showing wind strengths and directions at various times and heights, at selected locations around the Netherlands. Using the information, balloonists can accurately assess whether it is safe to make a flight and where they should start. It isn't possible to fly, for example, if the wind speed immediately above the ground is more than eight knots (about fifteen kilometres an hour).
The ballooning forecast graphics published on the site are generated directly from weather model output. The models are run eight times a day and both morning and evening forecasts are published. On account of the thermal currents, balloon flights are made only during the two hours after sunrise and the two hours before sunset. During the course of the day, a KNMI meteorologist adds regional forecasts to the evening forecast. The basic wind statistics are supplemented not only with more specific wind data, but also with information about the chance of precipitation, temperatures, cloud cover and visibility.
The supplementary weather information is particularly important during periods of unstable or changeable weather. Balloonists can't fly when it is raining, because the balloon canopy would become too heavy. The weight of the canopy is critical, because the sport involves careful management of the balance between the weight of the balloon, the temperature inside the canopy and the temperature outside. The higher the ambient temperature, the less difference there is between the temperatures inside and outside the canopy and the less weight the balloon can carry. Visibility data are also very useful to balloonists. They need to be able to see for at least five kilometres, and a passenger flight is unlikely to be successful if the people in the gondola cannot see at least eight to ten kilometres.



◀ *Ballooning forecast map, showing wind strengths and directions. Source: KNMII*

October

03.10.12

Knowledge Month On 3 and 5 October, about 150 secondary pupils visited KNMI as part of their October Knowledge Month activities. They were able to participate in workshops and were given guided tours of the KNMI's facilities.

03.10.12

Air Force This spring, Lieutenant-General A. Schnitger was appointed Commander of the Dutch Air Forces. In his new capacity, the Lieutenant-General paid an introductory visit to KNMI. He had previously been the Air Force representative on the KNMI Programme Council.

03.10.12

EUMETNET KNMI hosted the autumn meetings of EUMETNET's Scientific and Technical Advisory Committee and Policy and Financial Advisory Committee. The autumn meetings were held in preparation for the bi-annual EUMETNET Assembly meetings in November.

09.10.12

ECMWF Alan Thorpe, Director General of the ECMWF (the European weather modelling centre, based in Reading, UK) visited KNMI. After fifteen months in office, Mr Thorpe felt it was time to get to know KNMI better and to consolidate the traditionally strong ties between KNMI and ECMWF.

29.10.12

BORI The backup facility for the Back Office Radiological Information (BORI) was officially opened. For use in emergency situations, the new facility is housed in the old bunker beneath the KNMI building. BORI is normally based at the RIVM in Bilthoven.

29.10.12

Hurricane The eastern US seaboard was badly affected by hurricane Sandy. Hurricane-force winds were accompanied by more than 200 mm of rain in places, plus floods that submerged many roads, tunnels and metro lines. Sandy also brought snow storms to the Appalachian Mountains.

KNMI mast completes forty years of atmospheric observation

The KNMI observation mast at Cabauw has been collecting data on the Dutch atmosphere for forty years. On Friday 26 October, the anniversary of the mast's opening was celebrated with a symposium on the Cabauw observation site, attended by an international gathering of the scientists who use the facility.

Forty years ago, the Cabauw observation mast was erected in response to rising levels of air pollution. Scientists wanted further insight into the quality of the atmosphere, and specifically data on conditions at various heights and at greater elevations than had previously been monitored. It was also anticipated that the new mast's observation data would improve weather forecasting. On 26 October 1972, the 213-metre structure was opened by Roelof Kruisinga, then State Secretary for Transport and Water Management.

From that day to this, the instruments mounted on the mast have measured temperature, wind, humidity, radiation and aerosols in the lowest 200 metres of the atmosphere. That is the part of the atmosphere in which the most significant processes for the weather, air quality and climate research take place. After forty years of close observation, it is also the most studied column of air in the Netherlands.

With its instrumentation and research facilities, and its location in a rural but well-populated lowland area, KNMI's observation mast attracts a lot of interest from scientists at other knowledge centres in the Netherlands and other countries. It plays an important role in various national and international cooperative initiatives relating to climate research and air quality. CESAR – Cabauw Experimental Site for Atmospheric Research – is the most significant of those initiatives. CESAR is a joint undertaking by RIVM, TU Delft, TNO, ECN, Wageningen University, Utrecht University, Alterra, ESA and KNMI. The consortium members all have instruments installed on the site, share data, participate in European projects collectively and organise joint observation campaigns.

Since 1995, there have been twenty-two observation campaigns on the Cabauw site. The most recent was the European PEGASOS campaign in 2012. That initiative involved using an airship to measure aerosols over large parts of Europe. In May 2012, the vessel flew over the Netherlands, and the Cabauw mast played a key role in the activities. The instrumentation on KNMI's observation mast includes a Lidar system and Drizzle Radar equipment. Lidar data proved extremely useful for tracking and measuring the ash cloud from the Iceland's Eyjafjallajökull volcano, which forced the closure of European airspace in April 2010. Developed by TU Delft, the Drizzle Radar system is a highly sensitive precipitation radar installation, capable of observing fine drizzle within a radius of thirty kilometres.

▲ *The KNMI observation mast at Cabauw. Source: KNMI*

iSPEX wins Annual Academic Prize for 2012

Leiden University's iSPEX Project won the Annual Academic Prize for 2012, awarded by the Ministry of Education, Culture and Science. iSPEX is a device that attaches to a smartphone, enabling the user to measure particulate concentrations. Using technology adapted from astronomy and space science, iSPEX was developed by researchers and students from Leiden University, RIVM, the Dutch Research School for Astronomy, SRON and KNMI. KNMI helps to collate and analyse data gathered by iSPEX users. The prize money – 100,000 Euros – will be used to manufacture ten thousand iSPEX devices for smartphones. Anyone who is interested can order a gadget and start making their own particulate measurements. The Lung Foundation is now a partner in realisation of the iSPEX Project. In 2013, there will be a national observation day, when everyone with an iSPEX will attach it to their smartphone, point it at a patch of clear sky and take a measurement. The iSPEX smartphone app will automatically relay the readings to a KNMI-managed central database for analysis and interpretation. The collated observations will be used to produce a map showing the distribution of particulates across the Netherlands. The exercise will be one of the biggest civil science projects ever organised in the Netherlands.

11

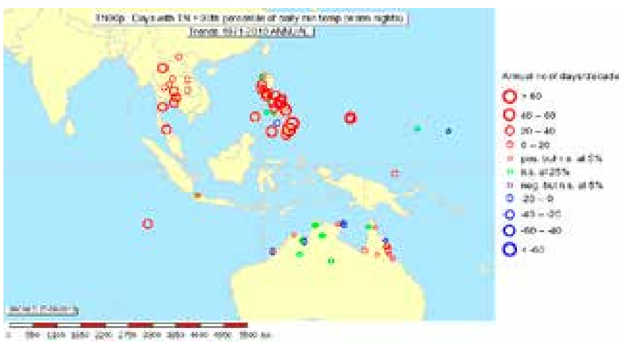
Also at KNMI

Global climate services network

With a view to minimising the risks associated with natural disasters and food safety, as well as improving water management and health, the World Meteorological Organization (WMO) is setting up the Global Framework for Climate Services (GFCS). The new structure should be operational by 2018.
KNMI is to play an active role in the GFCS by sharing knowledge and data. As the national weather and climate institute, KNMI represents the Netherlands within the WMO. One of the GFCS's tasks will be managing the exchange and dissemination of current and historical climate data. By ensuring the general availability of such data, the WMO hopes to enable individual countries to prepare for climate fluctuations and global warming.

An example of successful data sharing is the DiDaH (Digitisasi Data Historis) Project, in which KNMI and Indonesia's weather institute BMKG are collaborating. The DiDaH Project has led to historical data recorded in paper archives in Indonesia being made available in digital form. The climate service SACA&D (Southeast Asian Climate Assessment & Dataset) was also born out of the project. SACA&D is modelled on the European Climate Assessment and Dataset (ECA&D), which KNMI set up in conjunction with various other European meteorology services. Both are web-based information systems that bring together series of climate observations from the relevant regions. Special software processes the observations and extracts a range of useful regional climate information, such as trends (does it rain more or less often and more or less heavily than in the past?), extreme statistics (how often do storms occur here and how heavy are they?), anomalies (the heat waves in Western Europe in summer 2003) plus numerous climate indexes, such as a drought index, degree days or the start of the rainy season.
As part of the DiDaH Project, KNMI trained four BMKG staff members to set up and run such a system for Southeast Asia. SACA&D now receives data from twenty-two participating institutes in thirteen countries and contains climate data from 1203 meteorological stations around Southeast Asia.

By creating the GFCS, the WMO is emphasising the importance of accumulating knowledge regarding the climate question. The international climate services network is intended to ensure that climate information is readily available to all, so that individual nations are empowered to protect themselves. The initiative is significant for water management, public health, agriculture and food and water supplies. Countries that are vulnerable to the direct impact of climate change stand to benefit particularly from the availability of reliable climate information and advice.



◄ *Annual average number of warm nights (period 1971-2010) in Southeast Asia. Source: SACA&D*

November

05.11.12
Ministers A new cabinet was formed in the Netherlands, with Melanie Schultz van Haegen-Maas Geesteranus (Liberal) as Minister of Infrastructure and the Environment. Wilma Mansveld (Labour) became State Secretary, with KNMI in her portfolio.

07.11.12
Water Crown Prince Willem-Alexander (as he then was) and Minister Schultz van Haegen officially opened the Netherlands Water Management Centre (WMCN). The WMCN is a Rijkswaterstaat facility that serves as a single access point for all water information products and services. KNMI has two workstations at the new centre.

08.11.12
Satellite images KNMI has developed a new website, on which satellite images of clouds, sunlight and precipitation can be viewed live. The images are compiled using observations from Meteosat, a satellite stationed at a fixed point above the equator, which takes pictures of the earth every quarter of an hour during daylight hours. See http://msgcpp.knmi.nl

13.11.12
Platform KNMI, PBL and science journalist Marcel Crok launched a digital platform called ClimateDialogue.org: an international blog site, where scientists are invited to discuss climate issues. ClimateDialogue.org was created at the request of the Dutch parliament.

16.11.12
Wind data KNMI started global distribution of the wind data that the Institute calculates using observations from India's OceanSat-II satellite. The move was the result of an agreement made between EUMETSAT and the Indian Space Research Organisation (ISRO). With the addition of OceanSat-II, KNMI now receives wind data from three satellites for processing and global distribution. The oceanic wind data are calculated using observations from scatterometers carried on the satellites. KNMI is responsible for these data.

IPCC report on extreme weather events

The IPCC's special report on extreme weather events and adaptation was the first authoritative document to address the climate question on an integrated multidisciplinary basis. By considering the impact of extreme weather events from the perspectives of climatology, adaptation policy and risk management, the international expert panel produced an overview that will enable societies to become stronger and more resilient.

A number of highlights from the Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX) are presented below.

Central conclusions

Improved climate models are yielding more reliable projections and the scientific community now has more regional insight into the relationship between extreme weather events, the risks and the uncertainties. In the coming twenty to thirty years, the increase in extreme weather events is expected to be small in relation to natural variability. Since 1950, the overall number of extreme weather events has increased, but there have been considerable regional differences. The postponement of reductions in greenhouse gas emissions is likely to result in more frequent extreme weather events this century. Temperature rises – particularly heat waves – are problematic mainly for urban areas.
The main factors determining whether extreme weather is liable to escalate into a disaster are the exposure and vulnerability of populations. Better living conditions, good infrastructure, education, reliable information, increased prosperity, good government, disaster planning and the organisational capability to implement disaster plans all reduce the risks associated with extreme weather.

Trend in extreme weather events

In all probability, maximum and minimum temperatures will continue to become more extreme in the course of this century. Heat waves are likely to be more frequent and more extreme; so are periods of heavy precipitation and drought. However, wide inter-regional differences are anticipated. Extreme precipitation is likely to be more common in the United States, for example, but less common in West Africa, West Asia and Australia. The probability of heavy tropical cyclones increasing in number and seriousness is thought to be small. On the other hand, the frequency of very high sea levels is liable to rise.
The SREX trends are not valid for individual countries, because there are insufficient measured data and the models are not sufficiently detailed. The IPCC report divides the world into twenty-three regions. The Netherlands is close to the boundary between two regions: Northern Europe and Central Europe. It is very likely that both regions will experience accelerated warming over the course of this century, accompanied by an increased probability of heat waves and droughts. In winter, heavy precipitation is expected to occur more frequently.

Value of SREX for the Netherlands

Dutch climate adaptation policy utilises KNMI climate scenarios, which are in line with SREX. In the Delta Act, the Netherlands has a robust policy for protecting itself against sea level rises and maintaining fresh water supplies. The IPCC report emphasises that water should be one of the central focuses of government policy. Analyses of extreme weather events confirm the urgency of Dutch and European mitigation policies. The international climate panel also states that it is probable that human activity has contributed to global warming and to the increased frequency of heavy precipitation and high sea levels.

▲ *Tropical storm Isaac has wreaked havoc in Haiti on August 25. Source: UNPhoto/Logan Abassi*

▲ *Flooded market in Haiti's largest city Port-au-Prince after hurricane Sandy on October 25. Source: UNPhoto/Logan Abassi*

12

Also at KNMI

Meteorological advice for the aviation industry

Accurate and reliable weather information is essential for safe and efficient air transport. The aviation sector applies strict rules and procedures, in which meteorology plays a key role. Weather information is particularly important for an airport such as Schiphol, with its complex runway arrangement and the changeable Dutch weather. Mist, strong winds, thunderstorms, ice and turbulence can all cause problems for aircraft.

At its Schiphol centre, Air Traffic Control the Netherlands (LVNL) receives daily assistance from KNMI's Schiphol Meteorological Advisor (MAS). The MAS is a KNMI meteorologist who attends operational briefings whenever required so that the air traffic controllers have immediate access to all the weather information they need. The regional airports are provided with specific weather information and advice by an aviation meteorologist based in the KNMI's weather room in De Bilt.

Because aviation is a global industry, the safety rules and the associated meteorological data requirements are internationally harmonised and defined by international treaties. The various countries' meteorological services work together to make sure that air traffic controllers and pilots are as well informed as possible. Europe's weather institutes also cooperate closely on the development and refinement of aviation meteorology products and techniques.

KNMI uses sophisticated computation systems to produce specific weather data and forecasts for the aviation sector. All Dutch airports have KNMI weather stations and additional instrumentation. At Schiphol, there is a KNMI weather observatory in the control tower. Aviation professionals have direct access to both historical and real-time weather data. The historical data are important in the event of an accident, since the prevailing conditions always have to be considered by accident investigators.

▼ *KNMI provides LVNL daily meteorological advice at the Dutch airport Schiphol. Source: KNMI*

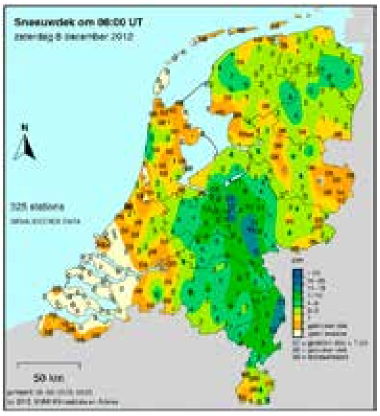
December

06.12.2012

COP18 At the Doha climate conference, Dutch State Secretary for I&M Wilma Mansveld called for decisive action on climate change. It had to be recognised, however, that countries differed in their circumstances and capabilities, she said. The aim should be to equip societies to cope with change. Mansveld was satisfied with the outcome of COP18: extension of the Kyoto Protocol to 2020 and agreements over climate funding.

10.12.2012

Iceness Snow and ice meant a wintery start to December 2012. The fluctuations in temperature and precipitation were particularly marked. On Friday and Saturday, much of the Netherlands had snow, which, together with a strong wind, caused a lot of problems. On Saturday evening, it started to thaw, creating a treacherous combination of black ice and rain.



▲ *Snowpack on December 8.*

12.12.2012

Observation centre KNMI, RIVM and RWS agreed to work together more closely on data collection and management. Although the three organisations are concerned with different data, their processing and management of data are the same. The National Environmental Observation Centre (NWCL) is intended to increase the efficiency of the observation networks used to monitor air, water and soil.

KNMI Data Centre releases data

On 14 December, the KNMI Data Centre (KDC) was officially opened with a mini-symposium on open data. The KDC will harmonise all KNMI data, so that there is a single web portal, through which it is easy to identify and download the datasets available from KNMI.

The new KNMI Data Centre is intended to provide public access to the KNMI's many datasets. Its creation supports the Dutch government's policy of providing free and simple access to data. The KNMI datasets include both observations and modelling data. The data vary from empirical measurements, through individual scientists' research findings, to data linked to KNMI climate scenarios.

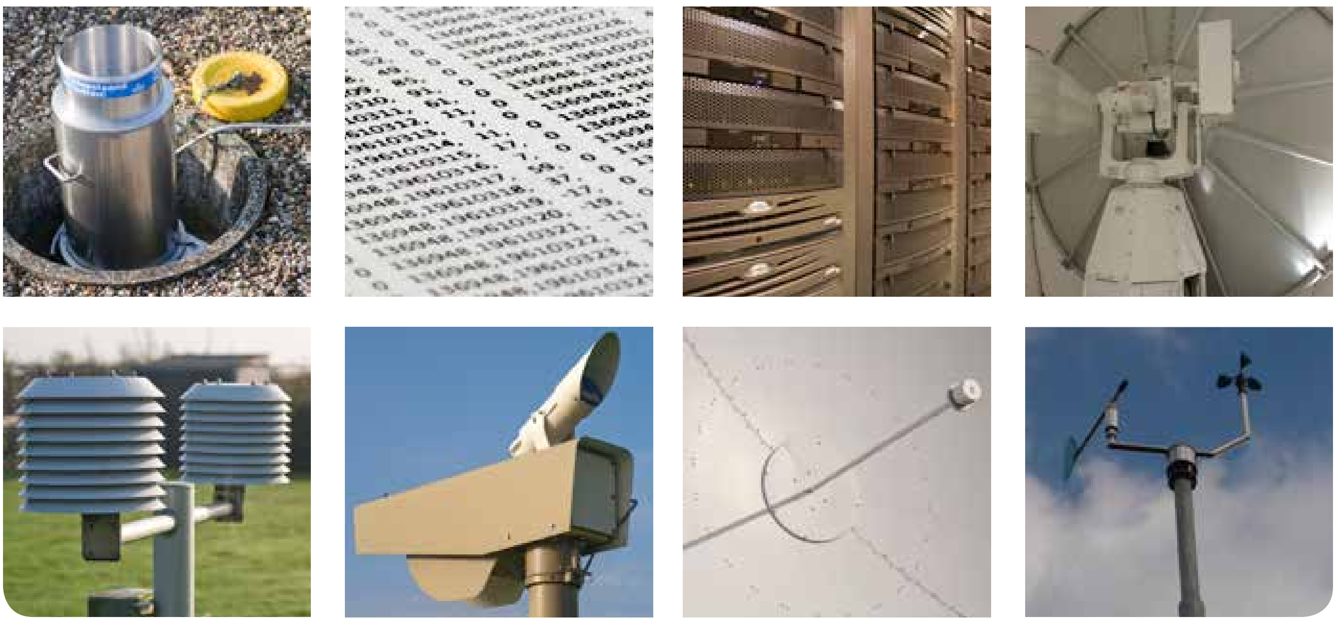
As well as making KNMI data more accessible, the KNMI Data Centre (KDC) will serve to prevent the fragmentation of knowledge and data management. The meteorological, climatological and seismological data have previously been maintained using a variety of techniques, sites and management environments. By harmonising the KNMI data and providing access via a single web portal, the KDC will make accessing data more convenient for users. The KDC portal is accessed via data.knmi.nl, where filters can be used to search for particular observations and model output. The Data Centre is intended mainly for professional users, scientists and amateur weather enthusiasts, but is open to anyone with an interest in the data. It is assumed, however, that users are reasonably familiar with meteorological terminology.

Data standardisation and visualisation are increasingly commonplace, and that increases the scope for utilisation. KNMI data are often therefore of interest to and available to people active in fields other than meteorology and climatology. The ability to combine and collate different types of data is opening up attractive new possibilities, as illustrated by the precipitation radar and satellite images. Other examples include the visualisation of climate modelling data from EC Earth and the temperature maps published on klimaatatlas.nl.

In recent years, KNMI has acquired considerable experience with web services such as the visualisation and downloading of geo-information. As the custodian of large volumes of geo-data, KNMI can offer numerous applications in the field of geo-information. The KDC catalogue has also been linked to other (government) catalogues such as the National Georegister, data.overheid.nl and the INSPIRE GeoPortal.

Satellite data have a special place in the KDC. The Satellite Data Platform (SDP) handles the production and archiving of satellite data from ESA, EUMETSAT and NASA. The KDC's role is to visualise and provide access to the large volumes of satellite data reaching KNMI.

▼ *KNMI data sets consist of measurements and model data. Source: KNMI*



Weather summary 2012

Weather in 2012

Normal	2012		
8	13	Freezing days	(max. temp. below 0,0 °C)
58	50	Cold days	(min. temp. below 0,0 °C)
85	77	Warm days	(max. temp. of at least 20,0 °C)
26	24	Summery days	(max. temp. of at least 25,0 °C)
4	2	Tropical days	(max. temp. of at least 30,0 °C)

	Monthly average temperature (°C) De Bilt			**Total sunshine duration (hours) De Bilt**			**Monthly precipitation amount (mm) De Bilt**		
	normal	differ.	2012	normal	differ.	2012	normal	differ.	2012
jan	3,1	1,8	4,9	62,3	4,7	67,0	69,6	15,0	84,6
feb	3,3	-2,5	0,8	89,1	15,0	104,1	58,1	-38,2	19,9
mar	6,2	2,1	8,3	121,6	44,8	166,4	66,8	-46,7	20,1
apr	9,2	-0,8	8,4	173,6	-52,3	121,3	42,3	5,2	47,5
may	13,1	1,4	14,5	207,2	1,8	209,0	61,9	22,5	84,4
jun	15,6	-0,7	14,9	193,9	-35,6	158,3	65,6	25,5	91,1
jul	17,9	-0,6	17,3	206,0	-6,0	200,0	81,1	10,2	91,3
aug	17,5	1,0	18,5	187,7	30,8	218,5	72,9	19,3	92,2
sep	14,5	-0,3	14,2	138,3	24,5	162,8	78,1	-21,2	56,9
oct	10,7	-0,2	10,5	112,9	-3,7	109,2	82,8	19,9	102,7
nov	6,7	0,1	6,8	63,0	-3,5	59,5	79,8	-39,0	40,8
dec	3,7	1,3	5,0	49,3	-14,2	35,1	75,8	71,0	146,8
	10,1		**10,3**	**1604,9**		**1611,2**	**834,8**		**878,3**

Code orange and red

(Weather Alerts)

03.1.2012	**code orange**	Extreme wind gusts
05.1.2012	**code orange**	Extreme wind gusts
13.2.2012	**code red**	Black ice
03.2.2012	**code orange**	Snowfall and iceness
23.5.2012	**code orange**	Heavy thunderstorms
21.6.2012	**code orange**	Heavy thunder-storms with rain
07.12.2012	**code orange**	Heavy snowfall
08.12.2012	**code orange**	Black ice
14.12.2012	**code orange**	Black ice
21.12.2012	**code orange**	Black ice

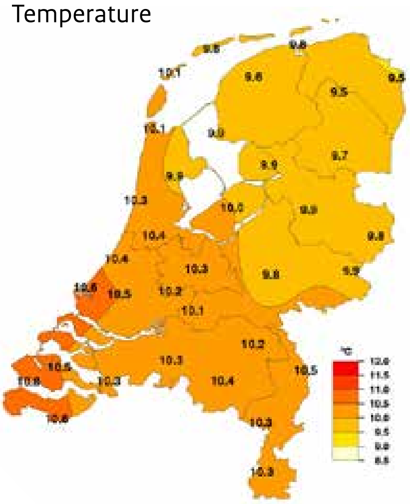
code orange: Warning for severe weather. Be prepared.

code red : Weather alert. Take action.

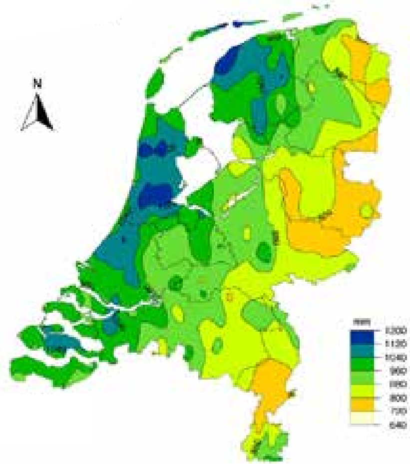
← Please note: 2012 was a leap year. The normals for February deviate from the figures of a non-leap year.

Averages in the Netherlands for 2012

Temperature



Precipitation



Sunshine

Cold wave and a cool start to summer in an otherwise unexceptional year

2012 was a sunny but relatively wet year with a normal average annual temperature. The most striking feature of the year's weather was a cold wave at the end of the winter and a changeable, cool start of the summer. The average annual temperature at De Bilt was 10.3 degrees, which was very close to the long-term average of 10.1.

The year began with a continuation of the mild, wet winter weather seen in December 2011. With an average temperature of 4.9 degrees, January was mild in comparison with the norm of 3.1 degrees. At the end of January, however, freezing weather set in, the precursor of an extreme cold spell during the first ten days of February.
From 30 January to 8 February, the country was gripped by a cold wave, the thirty-third in the Netherlands since 1901. A cold wave is a sequence of at least five 'ice days' at De Bilt, including at least three days of severe frost. With an average temperature of minus 6.9 degrees, the first ten days of February were the coldest period of that length at De Bilt since records began. In various places, there was a very severe frost on five days in February. In Lelystad, a minus of 22.9 degrees was recorded on 4 February. Indeed, a bitter easterly wind caused the perceived temperature to dip below minus 25 degrees at times.

On 12 February, the cold weather came to an end and the rest of the month was mild to very mild for the time of year. That mild weather continued in March, when the average temperature was 8.3 degrees, well above the long-term average of 6.2 degrees. March 2012 was ultimately the equal third mildest March in more than a century (alongside March 1957). On 22 and 23 March, some places in the south of the country reached 20 degrees or more, which is very unusual for the time of year.
By contrast, April was quite cold. It was 30 April before the temperature at De Bilt reached 20 degrees for the first time that month. However, May 2012 registered an average of 14.5 degrees: more than a degree warmer than the long-term average.

Summer 2012 was fairly normal in terms of temperature, but started extremely changeable and cool. No June for fifteen years has been so cool. July too was largely a wet, cool and overcast month. The weather in August was hot, however, so that the summer was ultimately a good one. On 18 and 19 August, it was more than 30 degrees at De Bilt; these were the only tropical days in 2012. The hottest temperature of the year was recorded at Ell in the province of Limburg, where it was 36.7 degrees on the nineteenth.
During the autumn months, temperatures were close to the long-term average. December began cold with snow showers and freezing rain, but then turned very mild.

Wet 2012

With a national average of 876 mm, 2012 was wetter than the long-term average of 849 mm. The Leeuwarden weather station was the wettest of all the KNMI's stations, recording 1043 mm of precipitation. The driest parts of the country were the east and south-east. The first five days of 2012 were particularly rainy. In that brief spell, national average rainfall was roughly half the monthly norm: 47 mm. Indeed, some parts of the north received 80 mm of rain. Because the ground was already saturated by the wet December weather, the rain showers led to flooding. By contrast, February and March were both dry months. The most striking precipitation event was the snowfall on 3 February, associated with a low-pressure area that crossed the Netherlands from north to south. Many places had between 3 and 10 cm of snow, or even more.
The year ended as it had begun, with heavy precipitation. In the final month, there was a national average of 130 mm of precipitation: far more than the long-term average of 80 mm. December was consequently the wettest month of the year. Of particular note was the snowfall of Friday 7 December: a belt stretching from Limburg to Gelderland received 10 to 15 cm of snow. Another feature of the December weather was the black ice that created treacherous conditions on several days, particularly in the north. The greatest problems were experienced on the evening and night of 8 and 9 December, on the morning of 14 December and on the evening and night of 21 on 22 December.

Sunny 2012

2012 was a sunny year, with a national average of 1730 hours of sunshine, compared with the long-term average of 1643 hours. The Wadden area and the IJsselmeer coast of Friesland were the sunniest parts of the country. The KNMI weather station at Stavoren recorded 1894 hours of sunshine. The Veluwe region had the most cloud cover: the KNMI weather station at Deelen managed only 1560 hours of sunshine. Notably, February was unusually sunny: there was a national average of 113 hours of sunshine, compared with the normal eighty-eight. During the very cold spell in particular, the sun often shone all day. The first ten days of February were actually the sunniest in more than a hundred years and accounted for more than half of the total number of hours of sunshine seen during the month. On the other hand, the first ten days of May were unusually overcast, with just thirty-one hours of sunshine. At De Bilt, there were just twenty-four hours of sunshine: the second most overcast in more than a century. The second half of December was very overcast as well, with a national average of just fifteen hours of sunshine.

Doctorates, prizes and appointments

Doctorates

Using cloud and precipitation properties for climate monitoring

In his thesis '*Satellite cloud and precipitation property retrievals for climate monitoring and hydrological applications*', **Erwin Wolters** demonstrated that cloud and precipitation properties derived from satellite observations were sufficiently accurate and viable for use in climate monitoring and hydrology. Wolters received his doctorate from Utrecht University.

Clouds play an important role in the earth's radiation balance and water cycle. In order to ascertain whether cloud and precipitation properties change over time in a changing climate, very accurate data from around the world are required. Such properties can be determined from satellite measurements of reflected solar radiation. The Spinning Enhanced Visible and Infrared Imager (SEVIRI) measures reflected solar radiation above Europe and Africa every quarter of an hour. Developed at KNMI, the Cloud Physical Properties (CPP) algorithm is used to establish clouds properties, such as cloud phase, effective particle size, integrated water path and precipitation intensity. Comprehensive daily descriptions of cloud and precipitation phenomena make the datasets a valuable tool for the evaluation of climate models.

Satellite observes mixing of surface water and deep sea water

Sea height measurements obtained from satellites can reveal where and to what depth the deep mixing of sea water has taken place. That was the central finding of research undertaken by **Renske Gelderloos,** which earned her a doctorate from Utrecht University. In the winter, the surface water in the Labrador Sea (between Canada and Greenland) mixes with the heavier water beneath it to a depth of 200 to 2400 metres. Deep vertical mixing occurs in only a few locations and is the only rapid interaction between the deep ocean and surface waters. The process plays a critical role in oceanic circulation and has major potential implications for the climate. It is therefore important to understand and monitor the variations in the strength of the mixing. Using satellites to monitor this process is an attractive proposition, because harsh winter weather makes it very difficult to collect data on location.

New calculation method facilitates air pollution source mapping

KNMI researcher **Bas Mijling** has developed a new calculation method for tracing satellite-observed air pollution back to source. On the basis of his research, he was awarded a doctorate by Eindhoven University of Technology.

Mijling's method can be used to monitor emission sources of nitrogen dioxide (NO_2) around the world and the effectiveness of air quality measures can be evaluated. The new approach utilises daily observations from the OMI and GOME-2 satellites and meteorological data. Because global NO_2 concentrations have been monitored from space since the nineties, it is possible to accurately trace the development of emission sources down the years. In Western Europe, for example, concentrations of the pollutant have declined in recent years, due to a combination of air quality controls and economic recession. In China, by contrast, rapid economic growth has been reflected in increased atmospheric NO_2 concentrations.

Prizes

Weather researcher **Marcel Molendijk**'s 'More eyes and ears' idea was recognised both by the Ideas Committee of the Ministry of Infrastructure and the Environment and by the KNMI ideas campaign. 'More eyes and ears' is a smartphone app that members of the public can use to submit location-specific extreme weather reports.

Ronald van der A, a researcher at the Earth Observation Department, won an award from the European Space Agency (ESA) and its Chinese equivalent, the NRSCC, for his work on the MOST/ESA DRAGON Project. The project developed an air quality forecasting method for China, which makes use of observations from the GOME-2 and OMI satellites.

Reinout Boers, Marijn de Haij, Wiel Wauben, Henk Klein Baltink, Bert van Ulft and Mark Savenije secured the Väisälä Award for their research into the measurement of degrees of cloud cover. This Väisälä Award is an annual prize given by the World Meteorological Organisation (WMO) for pioneering research into meteorological observation methods and instruments.

This year, the WMO started honouring countries and individuals who have given outstanding service to the WMO. KNMI was one of the organisations recognised, for the contribution that its staff made to the work of the Basic Systems Technical Commission, which concerns itself with all matters relating to the collection, processing and distribution of measured data. Individual certificates of merit went to KNMI personnel **Aline Kraai**, **Jan Willem Noteboom** and **Jitze van der Meulen** and their former colleague Frank Grooters, for their vital expert input.

The WMO's Norbert Gerbier-MUMM International Award 2012 was made in respect of an article entitled 'Climate control of terrestrial carbon exchange across biomes and continents'. The article explored the relationships between climate and carbon exchange in ecosystems. Knowledge of such relationships is important for the estimation of future atmospheric CO_2 concentrations. The study described in the article was conducted by 150 researchers using data series from a large number of observation sites around the world. KNMI's F**red Bosveld** was one of the article's co-authors, having provided data from Cabauw (one of several Dutch contributions).

Appointments

Sybren Drijfhout of the Global Climate Department was appointed Professor of Climate Physics at the University of Southampton, with effect from 1 January 2012. He will be researching the role of the ocean in the climate system at the National Oceanography Centre Southampton, which is affiliated to the university.

At the start of December, **Jan Barkmeijer** of the Weather Research Department was elected Chairman of the ECMWF Council's Scientific Advisory Committee (SAC) for the next three years. The SAC, on which nine countries are represented, monitors and advises on the quality of the scientific research that the ECMWF conducts.

Pieternel Levelt, head of the Earth Observation Department, was elected to the IO3C (International Ozone Commission) at the Quadrennial Ozone Symposium in Toronto. The IO3C promotes research into the condition of the ozone layer.

Speeches

Bram Bregman, Senior Advisor at KNMI's Climate Data and Consultancy Department, delivered his inaugural lecture as Professor of Sustainability at the Radboud University Nijmegen on 13 January 2012. Entitled 'Everything must be supported by policy', the lecture was devoted to climate change and the relationship between science and government.

Wilco Hazeleger, Head of the KNMI's Global Climate Department, accepted his appointment as Special Professor of Climate Dynamics at Wageningen University on 19 January 2012. His inaugural lecture 'Future weather stories' focused on climate dynamics and climate scenarios.

Pieternel Levelt, Head of the KNMI's Earth Observation Department, gave her inaugural lecture as Professor of Remote Sensing of the Earth's Atmosphere at TU Delft on 31 October 2012. Under the title 'Considering climate and air quality', she spoke about the complex relationship between climate and air quality.

Scientific publications

In 2012, KNMI had 114 articles on its research published in scientific journals. All the publications in question are peer-reviewed, meaning that their articles are subject to critical examination by experts in the relevant fields. Most of the articles appeared in Nature, Science, Geophysical Research Letters and Climate Dynamics. A selection of the published KNMI studies is presented below.

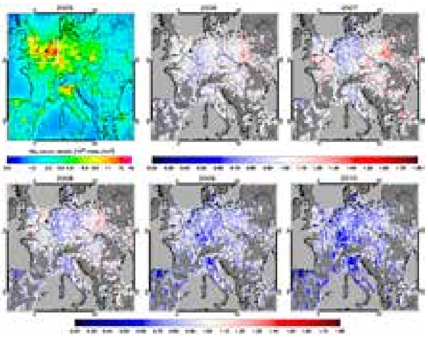
Bushfire smoke clouds over southern Australian on 7 February 2009. Source: MODIS/NASA

Smoke cloud illustrates the nuclear winter process

Because of its dark colour, the soot in a smoke cloud absorbs a lot of sunlight and thus generates heat, causing the cloud to rise rapidly to a height of up to 20 kilometres within a few days. KNMI researchers demonstrated the process by analysing data from the large smoke cloud that developed over Australia on 7 February 2009 following a spate of serious bushfires. A smoke cloud's self-elevating behaviour is comparable to that postulated for dust clouds from nuclear explosions, upon which nuclear winter scenarios are predicated. Developed in the eighties, nuclear winter scenarios assume that, in a nuclear explosion, large quantities of dust would be thrown into the atmosphere and would rise to great heights. A thick layer of particulate material could continue to float high in the atmosphere for years, blocking out sunlight. That in turn would bring about a substantial cooling of the climate, referred to as a nuclear winter.

However, the belief that nuclear dust would display such behaviour was based entirely on model calculations, because the process foreseen by the scenarios cannot easily be observed in reality. By analysing the satellite data on the smoke cloud that formed above Australia on 7 February 2009, the KNMI researchers have finally provided empirical evidence to support the scenarios.

A solar escalator: Observational evidence of the self-lifting of smoke and aerosols by absorption of solar radiation in the February 2009 Australian Black Saturday plume, J. de Laat, R. Boers, D. Stein en O. Tuinder, Journal of Geophysical Research, 17-02-2012



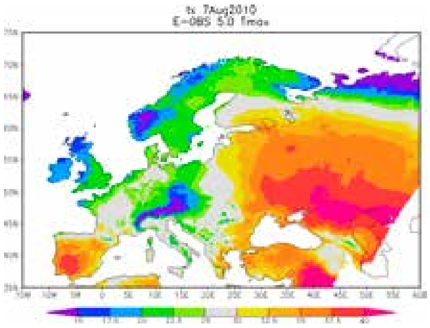
Annual maps of NO2 measurements from OMI from 2005 until 2010. Source: KNMI

Cleaner air due to environmental controls and recession

The concentration of nitrogen dioxide (NO_2) in the air over Europe fell sharply between 2004 and 2010 – by as much as 50 per cent in some places. In the Netherlands, the concentration fell by up to a quarter, according to KNMI research. The study team put the fall down to two equally influential factors: controls on NO_2 emissions and the economic recession of 2009.

Using satellite data from the Dutch ozone instrument (OMI), Patricia Castellanos and Folkert Boersma produced a series of annual NO_2 concentration maps of Europe's atmosphere. From the maps, it is clear that NO_2 concentrations differed year on year from 2004 to 2010. The six-year data series also demonstrates that the development of this form of air pollution is erratic, not linear as had previously been assumed.

Reductions in nitrogen oxides over Europe driven by environmental policy and economic recession, P. Castellanos, F. Boersma. Scientific Reports van Nature, 16-02-2012

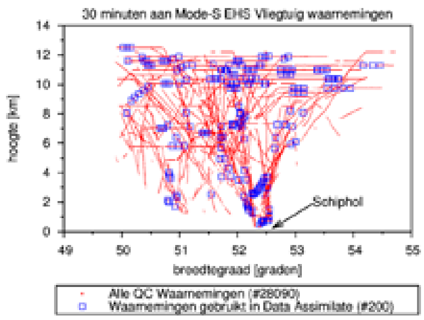


Maximum temperature on 7 August 2010. Source: KNMI

Russian heat wave was a natural phenomenon amplified by warming

The intensity of the extreme heat wave in western Russia in 2010 was attributable partly to the natural variability of the weather. However, the likelihood of such phenomena increases as the earth's climate becomes warmer. A study by scientists at KNMI, the University of Oxford and the UK's Met Office demonstrated that the exceptional nature of the heat wave was due to a combination of natural and anthropogenic climate factors.
During the Russian heat wave in summer 2010, temperatures remained well above the previous record values for more than a month. During that period, it was sometimes more than 40 degrees: twelve degrees above normal. This extreme weather was blamed for 55,000 deaths and more than ten billion Euros worth of damage. Although such an extreme heat wave is a consequence of natural factors, the probability of such an event is clearly increased by global warming, the researchers stated. As in the Netherlands, summer temperatures in western Russia have risen roughly twice as quickly as the global average. When heat waves occur, they are on average consequently hotter than in the past.

Reconciling two approaches to attribution of the 2010 Russian heat wave, G.J. van Oldenborgh (KNMI),) R. Jones (Met Office), F. Otto, N. Massey, M. Allen (University of Oxford), Geophysical Research Letters, 21-02-2012

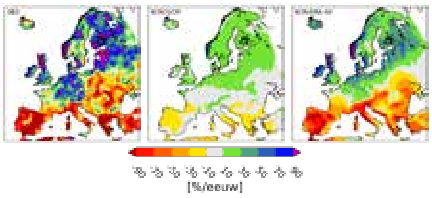


Example of available aircraft observations, observed in 30 minutes. All quality observations shown with the red dots; the blue plotted points represent the selection of which is used in the model. Source: KNMI

Aviation industry provides meteorological data

Meteorology is critically important to the aviation industry, but conversely meteorology also has much to gain from aviation. A transponder on Schiphol gathers data every four seconds from all the aircraft within range. And its range extends as far as Copenhagen, London and Paris, thus including much of the airspace that is of primary meteorological interest to KNMI. The aircraft data include the speed vector relative to the ground and the movement of the aircraft relative to the air. By combining those data, it is possible to extrapolate the wind speed at the craft's location. Wind data are of course important for definition of the initial weather conditions for weather modelling. The more accurately the initial weather conditions are defined, the more reliable the wind projections and therefore the weather forecast will be. The KNMI article presented evidence to show that data from aircraft do indeed contribute to more accurate weather forecasting. A study by Air Traffic Control the Netherlands (LVNL) demonstrated that the prediction of aircraft arrival times can be considerably improved by incorporating aircraft data from Schiphol into the calculations and feeding the weather model's wind projections back to Schiphol.

Hindcast experiments of tropospheric composition during the summer 2010 fires over western Russia, V. Huijnen, H. J. Eskes (KNMI), J. Flemming, J. W. Kaiser, A. Inness, A. Benedetti (ECMWF), J. Leitão (Institute of Environmental Physics, University of Bremen), M. G. Schultz (Forschungszentrum Jülich), J. Hadji-Lazaro (UPMC University Paris), G. Dufour, and M. Eremenko (LISA), Atmospheric Chemistry and Physics, 21-05-2012



Observed and modelled precipitation trends in winter semester in Europe (1961-2000). Left: observed trend. Middle: trend according to regional climate models. Right: trend according to ensemble of observed atmospheric circulation and regional climate models. Source: KNMI

Precipitation change greater than models predict

For large parts of Europe, climate models appear to systematically underestimate the precipitation change during the twentieth century, according to a KNMI research team. Over the last century, winter precipitation levels rose across large parts of north-western Europe, but fell in the southern half of Europe. Summer precipitation increased mainly down Europe's western seaboard. In the Netherlands, both winter precipitation and summer precipitation were higher. The KNMI study considered how well climate models were able to simulate such changes. The team found that the discrepancies between the observed data and the model predictions were too great to be attributable to natural variability.

SST and circulation trend biases cause an underestimation of European precipitation trends, R. van Haren, G.J. van Oldenborgh, G. Lenderink, M. Collins en W. Hazeleger, Climate Dynamics, 10-07-2012

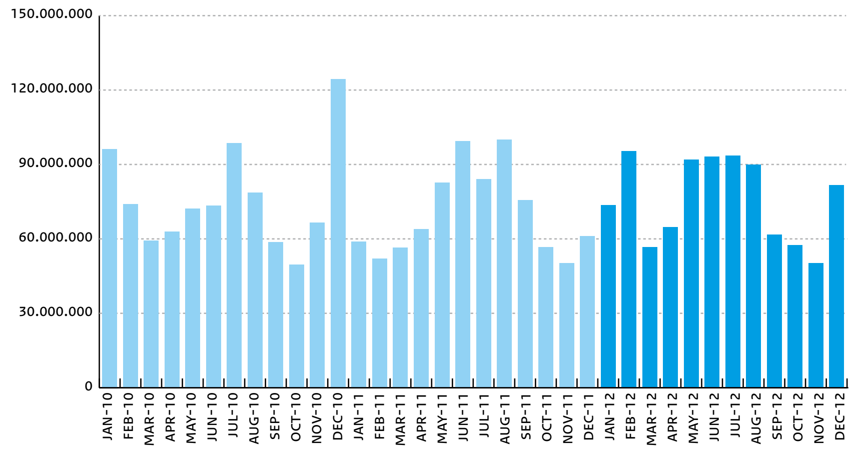
Web statistics

Visits to knmi.nl

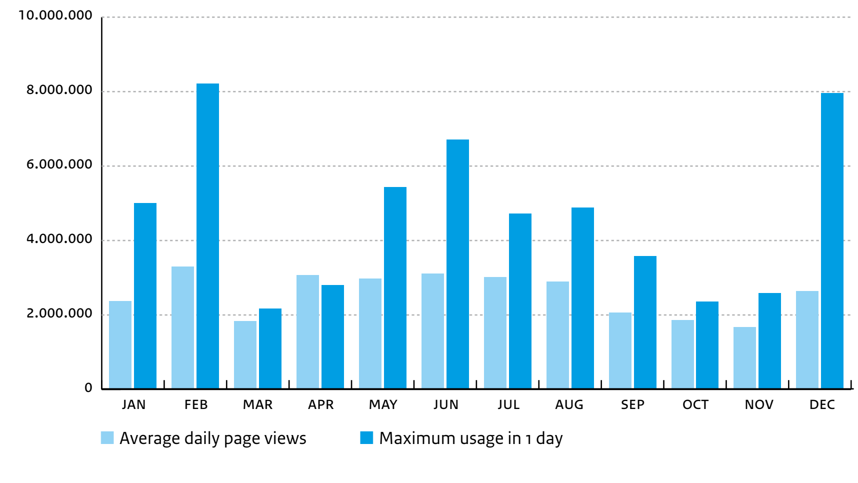
In 2012, the weather was once again the main reason for visiting the KNMI website. A daily average of roughly 2.5 million page views was registered by knmi.nl. The average number of unique visitors was about 1.5 million per month. In 2012, the website attracted most visitors in February, June, July and August. The number of page views varied in those months, from more than 93 million in May to nearly 96 million in February. The website received fewest visitors in November, but more than 50 million page views were nevertheless recorded.

Hazardous and extreme weather clearly brings a marked rise in traffic on the site. The period in which extreme weather warnings were issued in connection with snow showers caused the greatest spike in visitor numbers.
The busiest day of all was 3 February, when 8,219,172 page views were registered. That was the day that KNMI issued an Code Orange for the coastal provinces in connection with the snow showers. On 6 December there was a similar peak, when 7,957,228 pages were viewed; again, that was a day that KNMI issued an Code Orange regarding the snow showers with strong winds.
The warnings about thunder showers issued in the spring and summer of 2012 also resulted in a lot of site traffic. On 21 June, for example, KNMI had 6,705,134 page views when an Code Orange was given ahead of the anticipated heavy thunder showers, hail and wind gusts. Similarly, on 23 May, another Code Orange about extreme weather affecting almost the whole country resulted in 5,438,659 page views.

Page views per month 2010 – 2012



Page views 2012



HRM

Long-term employability

With a view to ensuring that it can adapt decisively to ongoing and anticipated developments, KNMI plans to place further emphasis on maximising the long-term, flexible employability of all its staff. Flexibility is important if KNMI's vital functions are to be assured in a period of workforce contraction. Broader employability is required both to enable KNMI to respond to its service users' needs and to strengthen employees' position on the employment market.
KNMI personnel are given the opportunity to actively work on their personal development. By helping staff to identify with the organisation and its aims, e.g. by involving them in the formulation of annual plans, KNMI encourages its personnel to consider ways in which they might improve or initiatives that they might take, and how such action can support their personal development. A strategic personnel analysis tool (SPA) was developed to provide insight into possible development pathways. Agreements about the practical action to be undertaken are then made at an annual meeting, which each staff member has with his/her manager.

1 per cent programme

In 2012, under the 1 per cent programme, KNMI provided temporary employment for six benefit claimants who had lost touch with the labour market.

Integrity

During the year, the Ministry of Infrastructure and the Environment organised an integrity survey. The findings showed that KNMI has a sound integrity policy, but that more attention could be given to the issue of awareness. Various activities were suggested in that context, including the discussion of integrity dilemmas.

KNMI Staf

31 dec 2012	Men	%	Women	%	Total
Number of staff	318	77,6 %	92	22,4 %	410
Average age	49,2 year		45,3 year		48,3 year
Number of part-timers	49	15,4 %	58	63,0 %	107
Average working hours	34,9 hours		28,7 hours		
Rate of absence					3,5%

31 dec 2011	Men	%	Women	%	Total
Number of staff	322	77%	96	23,4%	418
Average age	48,8 year		44,9 year		47,9 year
Number of part-timers	61	18,9%	59	61,5%	110
Average working hours	35,1 hours		29,5 hours		
Rate of absence					3,6%

SWO-KNMI Staf*

31 dec 2012	Men	%	Women	%	Total
Number of staff	22	66,7%	11	33,3%	33
Average age	36,2 year		33,4 year		34,8 year
Number of part-timers	5	22,7%	3	27,3%	8
Average working hours	34,2 hours		33,8 hours		
Rate of absence					3,7%

31 dec 2011	Men	%	Women	%	Total
Number of staff	20	69,0%	9	31,0%	29
Average age	35,7 year		32,2 year		34,6 year
Number of part-timers	6	30,0%	2	22,2%	8
Average working hours	33,0 hours		35,1 hours		
Rate of absence					1,9%

* Because of the cutback of the Balkenende IV government the Foundation for Scientific Research (SWO) KNMI was revitalized, designed to provide a temporary employment to researchers working on externally financed projects.

Finance

In 2012, KNMI recorded a positive financial result of €1.27 million. The result was a relief following the loss of €1.2 million in 2011, but was attributable mainly to a number of incidental positive factors. For example, during the year, a new settlement method was introduced for KNMI's services to the aviation sector. In addition, several externally funded projects were concluded and yielded surpluses.

Over the year, KNMI achieved a reduction in its staffing costs, as reported in the profit and loss account, under 'Personnel'. €0.2 million less was spent than in 2011. The reduction was not as great as anticipated, because in 2012 more was spent on hiring temporary personnel and the employer's contributions payable to the pension fund and health insurance scheme rose considerably.

Income from KNMI's parent ministry was greater than in 2011, due to higher earnings from earth observation, the Delta Plan and infrastructure, and to various incidental contributions. KNMI has performed its mainstream activities on a contracting budget. The amount spent on earth observation increased by €1.0 million in 2012. In the profit and loss account, the cost of earth observation is included under 'Contributions'.

Depreciation costs rose by €0.4 million, commissioning of the Richardson Computer Centre being a substantial contributory factor. From 2012, this cost is being accounted for exclusively under depreciation.
The income from third-parties is made up of income from the aviation sector (€9.5 million), income from projects (€9.6 million), income from the Ministry of Defence and Rijkswaterstaat (€1,3 million), data income (€0.5 million) and a number of small income items (€0.4 million).

The reduction in the costs associated with the Weather sector and the rise in the costs associated with the Climate sector reflect a reallocation due to the introduction of a new cost pricing model with effect from 1 January 2012.

Balans sheet*

Assets	31 dec 2012	31 dec 2011
Fixed assets	14.126	16.217
Work in progress	1.137	1.497
Account receivable	4.180	3.535
Liquid funds	19.081	17.129
Total Assets	**38.524**	**38.377**

Liabilities	31 dec 2012	31 dec 2011
Equity	611	1.801
Results	1.266	-1.190
Provision	1.188	656
Accounts payable	35.459	37.110
Total liabilities	**38.524**	**38.377**

Profit and loss account*

Income	2012	2011
Agency contribution	42.814	39.488
Third-party revenue	21.404	19.180
Interest received	25	115
Extraordinary revenue	3	77
Total income	**64.246**	**58.860**

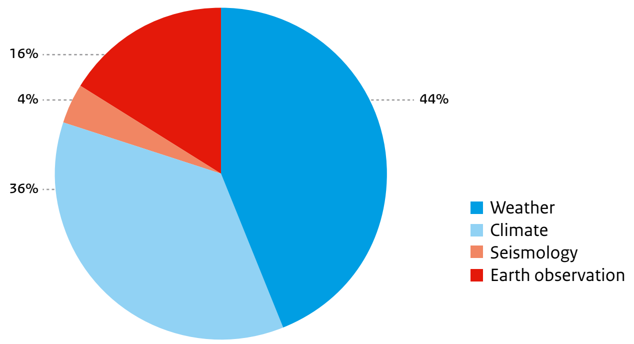
Expenditure	2012	2011
Staff	32.980	33.206
Material		
• Outsourcing	1.034	984
• Maintenance and operation	4.028	4.282
• Rent and lease	3.358	3.288
• Contributions	13.071	11.998
• Remaining	5.486	3.764
Interest	278	210
Depreciation	2.745	2.318
Total expenses	**62.980**	**60.050**

Cost per product group*

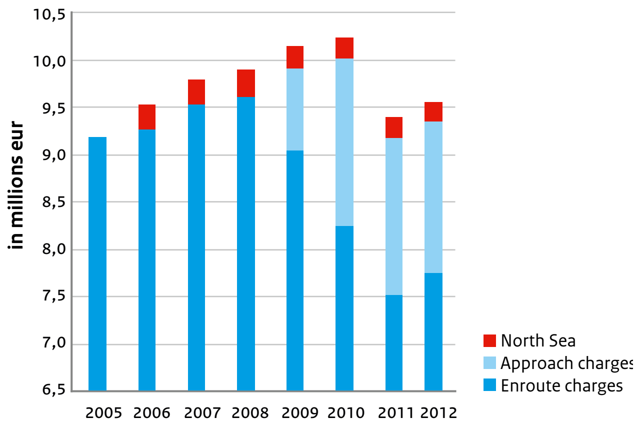
Product group	2012	2011
Weather	27.330	30.279
Climate	22.496	17.646
Seismology	2.419	1.998
Earth observation	10.110	9.127
Extraordinary expenses	625	
Total costs	**62.980**	**60.050**

* Amounts in 1000 euro

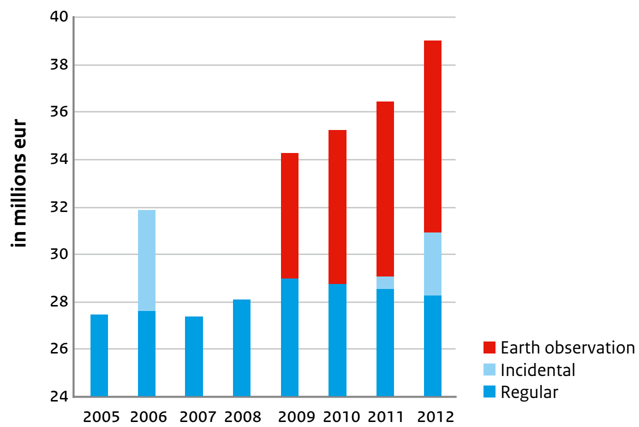
Income per product group



Aviation income



Agency contribution



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Management

- **Director-General**
  dr. ir. F.J.J. Brouwer
  - **Weather Service**
    F. Hanneman MSc (acting)
    - **Product- and Process Innovation**
      ir. J. Landman (acting)
    - **Forecasting**
      A. van Loy
    - **Research and Development**
      ir. J. Landman (acting)
    - **Stakeholder and Contract Management**
      drs. F. Hanneman
  - **Climate and Seismology**
    dr. H.W. Haak
    - **Climate Observations**
      prof. dr. P.F. Levelt
    - **Global Climate**
      prof. dr. ir. W. Hazeleger
    - **Regional Climate**
      dr. R.F. van Oss
    - **Chemistry and Climate**
      prof. dr. P.F. Levelt (acting)
    - **Climate Services**
      dr. A.J. Feijt
    - **Seismology**
      dr. B. Dost
  - **Information and Observation Services and Technology**
    ir. W.J. Nieuwenhuizen
    - **R&D Information and Observation Technology**
      dr. G.H.J. van den Oord
    - **Information and Process Management**
      P.H. van Noort
    - **IT Systems and Network Systems**
      P.H. van Noort (acting)
    - **Observations Systems Operations**
      ing. J. Rozema
  - **Director Change-Management KNMI**
    ing. C.M. Moons
  - **Operational Management**
    J.F.J.M. de Bel LLM
  - **Strategy and Services**
    C.J. Molenaars (acting)
    - **Services**
      J.M. Mei
  - **Executive Secretary**
    drs. R. van Hattem

Colophon

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DBF Communicatie B.V.

Design
Sanne Asselman, VijfKeerBlauw

With the cooperation of
Rob Sluijter, Fenny Vriese

Copies 400 | **Print** VijfKeerBlauw

KNM-615250

This is a publication of
Royal Netherlands Meteorological Institute

P.O. Box 201 | 3730 AE De Bilt | The Netherlands
T +31 30 2206 911 | www.knmi.nl