

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Yearbook 2024

of the Deutscher Wetterdienst



2024 the warmest year since records began: Average temperature of 10.9 °C

The year 2024 has been confirmed to be the warmest year ever observed since the beginning of regular measurements — in Germany, Europe and globally. Each of the last three years rank among the top warmest on record for Germany. In 2024, the previous annual mean temperature record of 10.6 °C set in 2023 was exceeded by 0.3 degrees. Both the high frequency of new temperature records and the difference from previously set records are exceptional in Germany's climate history. After a series of years that were much too dry, the last two years brought very high precipitation of more than 900 litres per square metre (l/m²). The former record for 12-month precipitation totals was beaten repeatedly.

At an [average temperature of 10.9 °C](#), the year 2024 has been confirmed as the [warmest year on record](#) for Germany since systematic and area-wide weather observation began. It is only ten years back, in 2014, that an average temperature above 10 °C was first recorded. 2024 is now the seventh year to exceed this threshold.

February brought an anomaly of +6.2 degrees, which is the [highest monthly anomaly](#) ever observed in Germany. At an average temperature of 6.6 °C, it was the mildest February on record and also [the mildest winter month ever](#). December was the 27th successive month (October 2022 to December 2024) that was warmer than normal (compared to the reference period 1961–1990).

In 2024, the first 'summer day' (daily maximum temperature ≥ 25 °C) was observed on 5 April. Only one day later at Ohlsbach station, the daily maximum temperature rose to above 30 °C ('hot day'). [This is the earliest hot day ever observed](#).

While almost twice as many summer days were observed compared to the long-term average, the [number of hot days](#) nearly tripled.

The year 2024 was wetter than normal. At around 902 l/m², [total precipitation was 14 per cent higher](#) than the long-term annual figures for both reference periods, 1961–1990 and 1991–2020. This means a surplus of about 110 l/m².

Overall, the year 2024 saw an average of [1675.3 hours of sunshine](#), which is close to the long-term average for the 1991–2020 period. Compared to the international climatological reference period 1961–1990, there was an excess of around 130 hours (or 8.5 per cent).

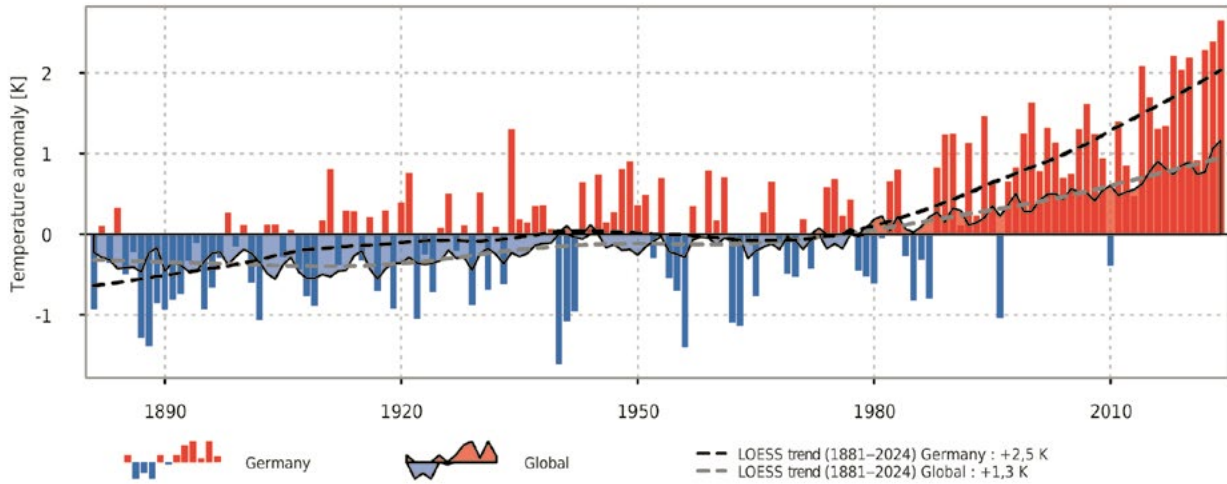
The annual average duration of sunshine over Europe showed a marked west-east contrast. Whereas western Europe experienced much duller conditions than normal (compared to 1991–2020), [eastern Europe recorded its sunniest year for 40 years](#), with ten per cent more sunshine than normal. In the long term, it has become sunnier in both western and eastern Europe.

Temperature, sunshine duration and precipitation in Germany in 2024

Temperature anomaly: Germany / Global

1881–2024

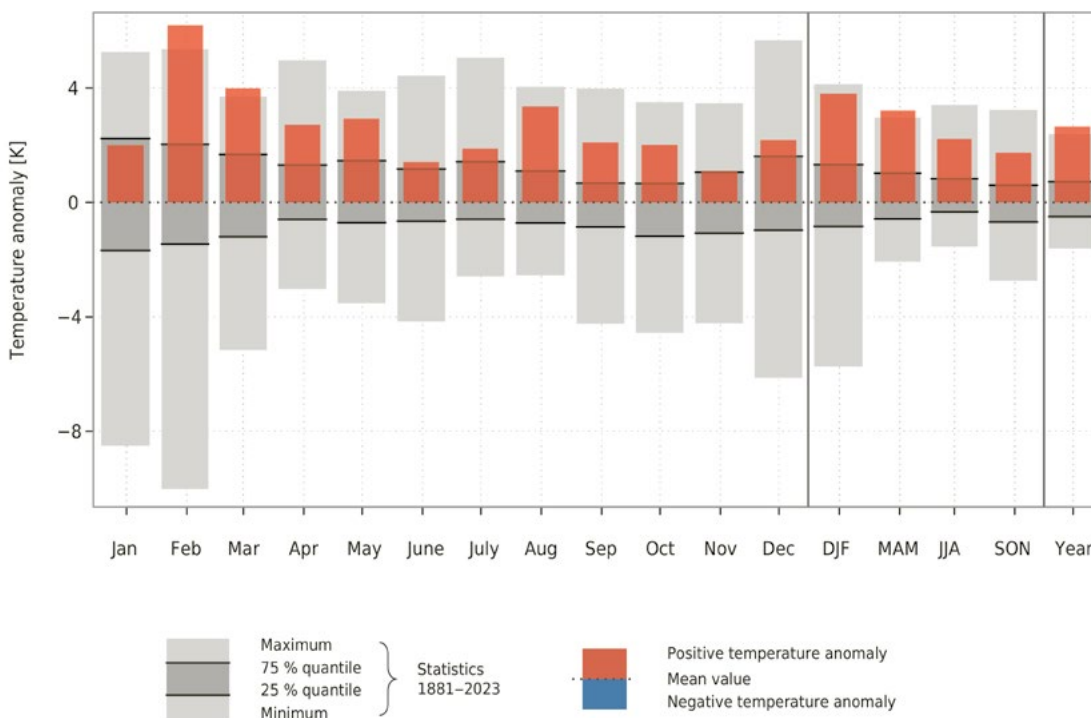
Reference period 1961–1990



Temperature anomaly

Monthly and seasonal averages for Germany, year 2024

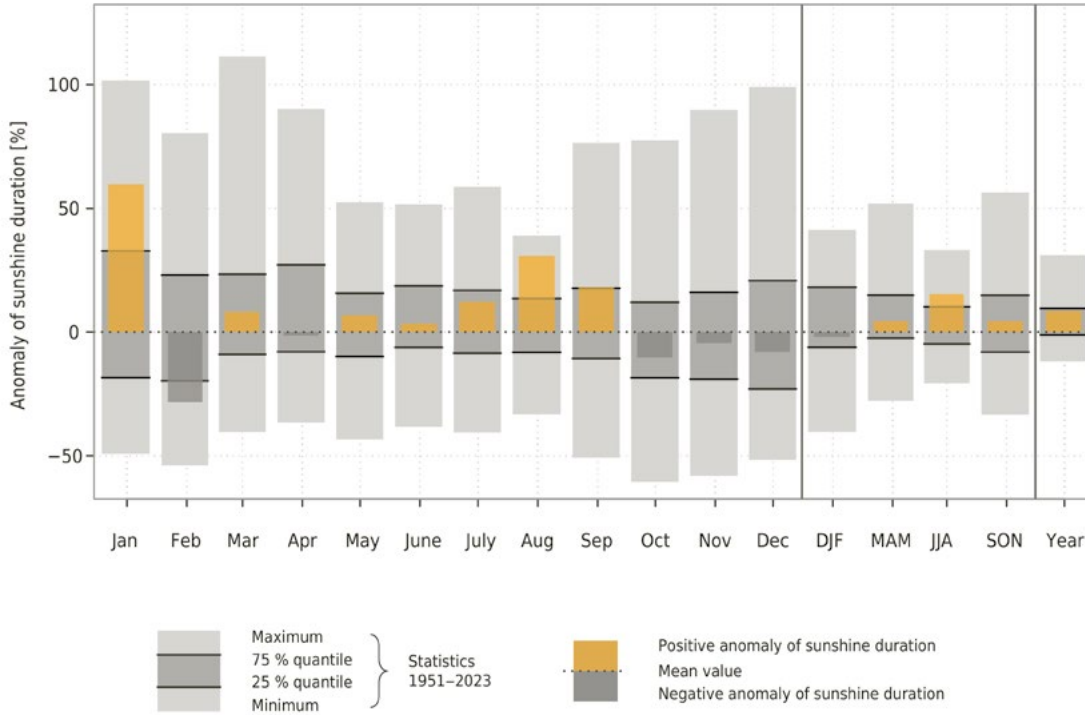
Reference period 1961–1990



Anomaly of sunshine duration

Monthly and seasonal averages for Germany, year 2024

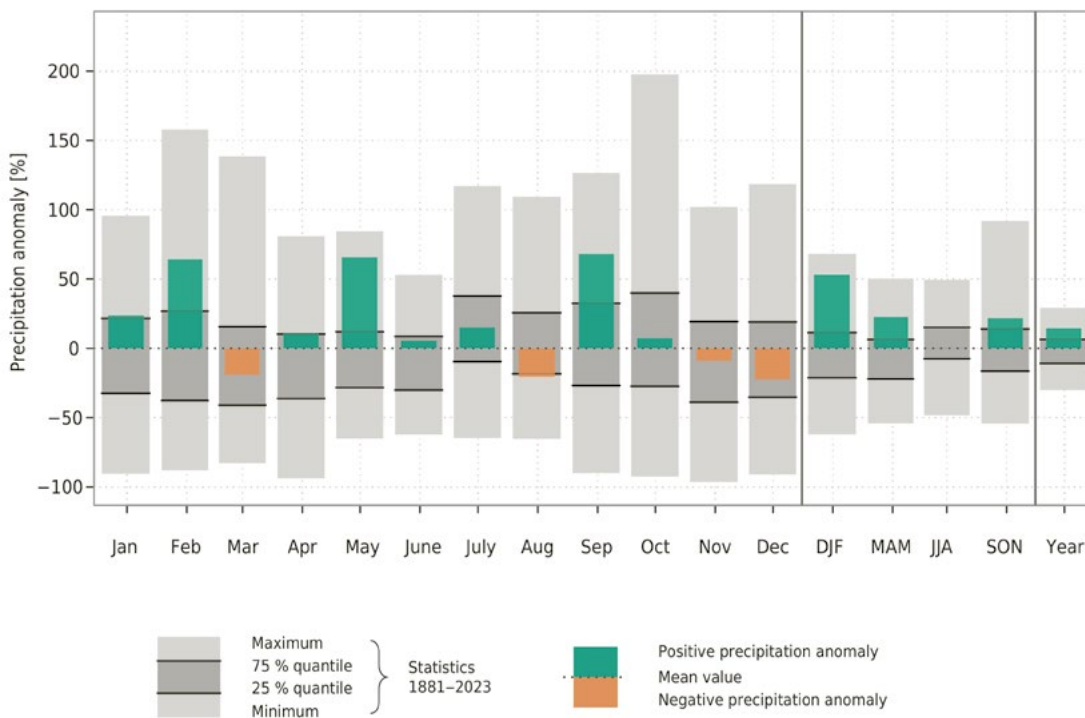
Reference period 1961–1990



Precipitation anomaly

Monthly and seasonal averages for Germany, year 2024

Reference period 1961–1990



Foreword

Dear readers,

Regardless of the external conditions where objective reporting is sometimes drowned out by loud voices, we as the German Meteorological Service can be relied upon to provide scientifically sound, high-quality information, products and services on weather, climate and climate change with all its global challenges.

Our special focus is on the benefits for society. A look back at 2024 illustrates how well we have achieved this — both directly (for example by expanding official warnings and presenting them in public spaces or by developing the Natural Hazards Portal) or indirectly. Based on our systematic observations, we supply policy-makers with informed advice. The research we do and the technology we use play an important role, among other things, in ensuring the safety of aviation. By continuously expanding our advisory services, such as the new soil moisture forecasts introduced in 2024, we not only support agriculture and forestry but also help disaster management organisations with the early assessment of potential hazards, such as floods.

In this context, I would like to thank Karl-Heinz Banse, President of the German Firefighters Association, for the interview in this yearbook. On the following pages, you can read about the potential that arises from the close interweaving of weather forecasting and civil protection — and in what ways we intend to further unlock it together.

How much in demand the DWD's services are can be seen in this year's photo series — the photos give an insight into the work of our colleagues from the Mobile Measurement Unit (MME). They deliver data for the development and validation of local climate adaptation strategies and to support weather warnings at special, critical locations.



Prof. Dr Sarah C. Jones

Photo: bundesfoto, Bernd Lammel

Like the yearbook as a whole, the insight into their work gives only a cross-sectional view of the diverse tasks of the MME and the DWD.

As an internationally esteemed cooperation partner of non-governmental educational and scientific institutions, we are a driving force in research. By offering open-source products and strengthening structurally weaker partners, we are contributing to further improving the global coverage of meteorological and climatological data and thereby increasing the quality and skill of forecasts and predictions — and through this the safety of all of us. In 2024, a key focus for us was to invest into our own infrastructure and innovative strength — and this we must continue in future.

I am delighted that you are taking the time to immerse yourself in the work of the DWD and also visit our website in search of more detailed information. Let me invite you to find out more about the DWD, even more than can be presented in this publication. We at DWD are looking forward to a direct exchange with you.

Yours sincerely,

Sarah C. Jones
President of the Deutscher Wetterdienst

»Even greater potential«

Interview with Karl-Heinz Banse,
President of the German Firefighters Association
(DFV)

DWD:

You have been engaged in firefighting for more than 50 years. As a child, what motivated you to join the fire brigade?

Karl-Heinz Banse:

Quite simple, my family: it was my father who founded the local youth fire brigade in Bad Lauterberg in Lower Saxony, which I joined at the age of eleven.

DWD:

Which of your missions is the most memorable for you?

Karl-Heinz Banse:

The two Elbe floods in 2002 and 2013 — what huge forces of nature they showed. The Elbe was felt to be as wide as the Amazon River. The total number of emergency responders on site was enormous, as huge as we have rarely experienced somewhere else. In 2002, there were about 7,500 of them present in a place normally inhabited by several hundred people only. They fought to protect the dyke at the eastern side of the Elbe.

DWD:

Since 2004, the DWD has been supporting the work of fire brigades by operating the FeWIS weather information system for disaster management. How do you see this long-standing intensive cooperation and where do you see potential for improvement?

Karl-Heinz Banse:

All feedback I have received is positive. The fire brigades are happy to have a high-quality tool at their disposal. With it, the DWD is more than well fulfilling its statutory mandate. However, I believe that there's an even greater potential that could be unlocked by targeted advertising. Many fire brigades have no knowledge of the system, and local self-governments could also make better use of it.

DWD:

People engaged in disaster control and civil protection can use the DWD's WarnWetter app for weather warnings free of charge. Well over 120,000 firefighters have already registered. Many of your colleagues do support us with weather reports on extreme weather situations, which they send via the WarnWetter app. Do you yourself use the WarnWetter app, and how useful do you think it is for your colleagues in their daily work?

Karl-Heinz Banse:

I do use the app and find it very helpful and up-to-date. It is great that the reports are sent automatically without having to be entered by someone. This also makes it easier for firefighters when assessing situations or preparing for missions.

DWD:

Our Customer Services are noticing an increasing need for training sessions for fire brigades. As human resources are limited, there is an increasing focus on online training and, in particular, on e-learning courses. What do you think of this trend and how could the German Firefighters Association support the DWD in this regard?

Karl-Heinz Banse:

The trend towards online training has increased in the firefighting sector, too — especially since the coronavirus pandemic. It is also ideal for volunteering as everyone can easily take part in a training course from home or from the fire station without having to travel to a seminar location after work or school. The DFV can help with the communication of available training measures.

DWD:

Across the firefighting community, we are seeing an increasing interest in topics relating to climate change and its effects. Where do you see a need for more informed knowledge and how can the DWD provide meaningful support?

Karl-Heinz Banse:

With its weather reports, the DWD already provides very good support to the fire brigades. It is vital that the 'language of weather' is translated in such a way that ordinary people understand it and can assess the consequences. The importance of this has become clear on the occasion of the Ahrtal flooding. What we need is to be able to assess and evaluate rather than to merely receive reports. For instance, it could be interesting for us if you offered (online) training courses for fire brigades and taught us how to 'read a weather report correctly', i.e. to understand the actual effects to be expected from the reported weather.



Photo: Katrin Neuhauser, DFV

Karl-Heinz Banse, President of the German Firefighters Association (DFV).

DWD:

In your opinion, how will climate change and the resulting increase in extreme weather conditions affect the work of the fire brigades?

Karl-Heinz Banse:

More and more of our firefighting operations are connected with climate change impacts: forest fires, flooding, storms. Such extreme situations are material-intensive, sometimes last for long time periods and require a high number of emergency forces as well as the replacement of these. This is what the firefighting system in Germany, which is largely built on volunteering, must be to withstand — which is why we need to keep strengthening it.

DWD:

Thank you very much for these insights.



Photo: Peter Füssel, DWD

Prof. Dr Peter Braesicke new head of Research and Development at DWD

Prof. Dr Peter Braesicke (above) took over as Head of the DWD's Business Area Research and Development on 1 September 2024, at the same time as being appointed to the Executive Board of the DWD. As Head of Research and Development, Peter Braesicke succeeds Prof. Dr Sarah C. Jones, who became President of the DWD on 1 August 2023. Peter Braesicke was born in Berlin in 1969. He studied meteorology at the Freie Universität Berlin (FU), graduated with a diploma and then obtained his PhD in 1998. In 2013, after 14 years of working as a scientist first at the University of Cambridge and then at the new National Centre for Atmospheric Science (NCAS), Braesicke changed to the Institute of Meteorology and Climate Research Atmospheric Trace Gases and Remote Sensing (IMKASF) at the Karlsruhe Institute of Technology (KIT). In his role as professor of Theoretical Atmospheric Physics, he first headed the Modelling section before being entrusted with the leadership of the institute in 2020.

2024: At times extremely wet

The year 2024 was a very rainy year, at times extremely wet with floods and inundations. Parts of northern Germany were hit by flooding already in the early days of the year. The federal states of Rhineland-Palatinate and Saarland had their turn in May, followed by Bavaria and Baden-Württemberg at the beginning of June. In September, unusually high amounts of rain fell in parts of eastern Central Europe, in particular in Austria, Poland and the Czech Republic. Eastern Spain saw extremely heavy rainfall at the end of October.

All these events were favoured by the ongoing unusually high sea surface temperatures in parts of the North Atlantic and the Mediterranean Sea. Attribution studies have provided preliminary indications that the likelihood of similar rainfall rates to occur in the affected regions has increased due to climate change. Against this backdrop, it is hardly surprising that, in 2024, Germany experienced its wettest continuous 12-month period since measurements began in 1881.

Subseasonal and seasonal soil moisture forecasts

March 2024 marked the launch of regular DWD soil moisture forecasts, published for the subsequent weeks and months. They serve as drought forecasts for agriculture and forestry and help disaster management units to assess flood risks at an early stage. For their production, global climate predictions from the DWD and the European Centre for Medium-Range Weather Forecasts (ECMWF) are downscaled statistically to a 5 km grid resolution for Germany. The resulting atmospheric data are then used in a soil water balance model to calculate the soil moisture at different depths of the soil and for different vegetation types. The DWD's website for climate predictions (www.dwd.de/climatepredictions) includes probabilistic predictions of the future occurrence of wetter-than-normal, normal or drier-than-normal conditions in the upper soil (0–60 cm) in comparison with the past. A traffic light system illustrates the reliability of the predictions and model simulations.

Integration of standardised automated soil moisture measurements

With the increasing occurrence of droughts and flooding, the availability of area-covering measurements and soil moisture forecasts is becoming increasingly important. Up to now, the DWD used to calculate the soil moisture using a model and validate the results based on in situ measurements. To further improve the base of data available for model validation and climate monitoring, the project IsaBoM (Integration of standardised and automatised soil moisture measurements in the DWD observation network) was started in 2024 under the DWD's research programme with the aim to prepare a Germany-wide soil moisture observation network consisting of a good twenty stations. In addition to using conventional in situ measurements, where the soil moisture is determined from a soil profile at a specific location, tests will be made to try out Cosmic Ray Neutron Sensing (CRNS). This innovative method detects the soil moisture over several hectares using ground-level measurements of naturally occurring neutrons, thus closing the spatio-temporal gap between in situ measurements and satellite-based data.



Legal foundation laid for the Natural Hazards Portal

On 11 April 2024, the legal foundation for a natural hazards portal for Germany to be developed and operated by the DWD was laid with the passage of an amendment to the Act on the Deutscher Wetterdienst. This amendment has authorised the DWD to issue early warnings, situation reports and information on prevention against natural hazards that go beyond the warning of severe weather. In addition to the issuing of official warnings, this explicitly means the provision of further information that is necessary to better understand the warnings, for example details about the risk of flooding during a heavy rain event.

Exactly one year later, on 11 April 2025, the first iteration of the Natural Hazards Portal for Germany was launched online. The portal provides early warnings as well as situation reports and guidance for preventive action. The warnings and related content are to be published centrally in a uniform and accessible format and should contain all the details necessary for understanding the warnings, reports and recommendations. In the first stage, the focus will be on the hazards and risks from weather and flooding. It is planned to gradually extend the content to the entire spectrum of natural hazards to also include the risks from forest fires or avalanches, for example.

Warnings via digital city information systems

In the summer of 2024, the DWD started a cooperation with the German media company Ströer. The aim of this cooperation: to deliver official weather warnings to the public in even more targeted ways and in real time. As part of the partnership, DWD warnings are displayed on digital city information systems across the whole of Germany. Such public screens are mainly placed at important traffic junctions and in city centres, where they can be seen by a large number of people.

An innovative component of this cooperation is the planned display of warnings in several languages to reach even more people. This strategic cooperation is another proof of the DWD's commitment to modern and citizen-oriented communication of dangers.

New hazard guidance and recommendations for action

In February 2024, the DWD introduced new hazard guidance and recommendations for action provided as an annex to the official warnings. The guidance and recommendations are based on a boilerplate system with preset text modules. The idea is to supplement meteorological warnings with easily comprehensible information about potential impacts and to provide recommendations for protective measures.

The new hazard guidance and recommendations for action are structured in a dual, modular and consistent manner, presented in two separate text blocks for more stringency. Depending on the warning parameter and warning level, various text modules are available to be assembled as needed for the specific event. The growing exposure to hazards and risks finds reflection in a uniform language that intensifies as the warning level increases. In order to use the warnings in an international context, the text modules are available in seven different languages.

The ball is round and a match lasts 90 minutes — Weather for EURO2024

For the DWD, the European Football Championship EURO2024 started already at the end of 2022 when an enquiry arrived from the German Federal Ministry of the Interior (BMI) asking whether the DWD could provide the upcoming football tournament with meteorological services. The DWD consented and began straight away with the planning.

The result was a large product portfolio, ready in time for the start of the tournament. It included meteorological briefings by telephone and daily video meetings with the DWD's Regional Meteorological Centre in Essen as well as access to self-briefings in FeWIS, the DWD's weather information system for disaster management. There, a dedicated page was provided, where the organisers at the venues and base camps could themselves assemble the weather information they needed (warning situation, radar images, meteograms). The DWD offered extensive training to help with the interpretation of the materials.

In numerous severe weather situations during the tournament, the DWD had many opportunities to demonstrate its capabilities. The interruption of the match Germany - Denmark as well as the evacuation of many fan zones were a direct consequence of the DWD's consultancy services — whose overriding always was everyone's safety.

Fully automated weather observation at regional airports

Under its AutoMETAR project, the DWD made preparations for the introduction of fully automated airport weather reports, such as the METeorological Aerodrome Report (METAR), in accordance with the standards of the International Civil Aviation Organization (ICAO) and the EU's Implementing Regulations for aviation. The aim was to enable automated weather observations at airports as well as the automatic generation of airport weather reports at international commercial airports and regional airports in Germany.

The first four regional airports, Oberpfaffenhofen, Braunschweig-Wolfsburg, Magdeburg-Cochstedt and Emden, were successfully approved for the production of fully automated airport weather reports in the last quarter of 2024. Since then, complete, fully automated airport weather reports have been generated there 24/7 in the automation class mode 'AWOS_Auto-Klasse 1'. Among other things, this innovation makes it possible for regional airports to implement remote tower solutions, allowing the operations at smaller airports to be monitored and controlled remotely.

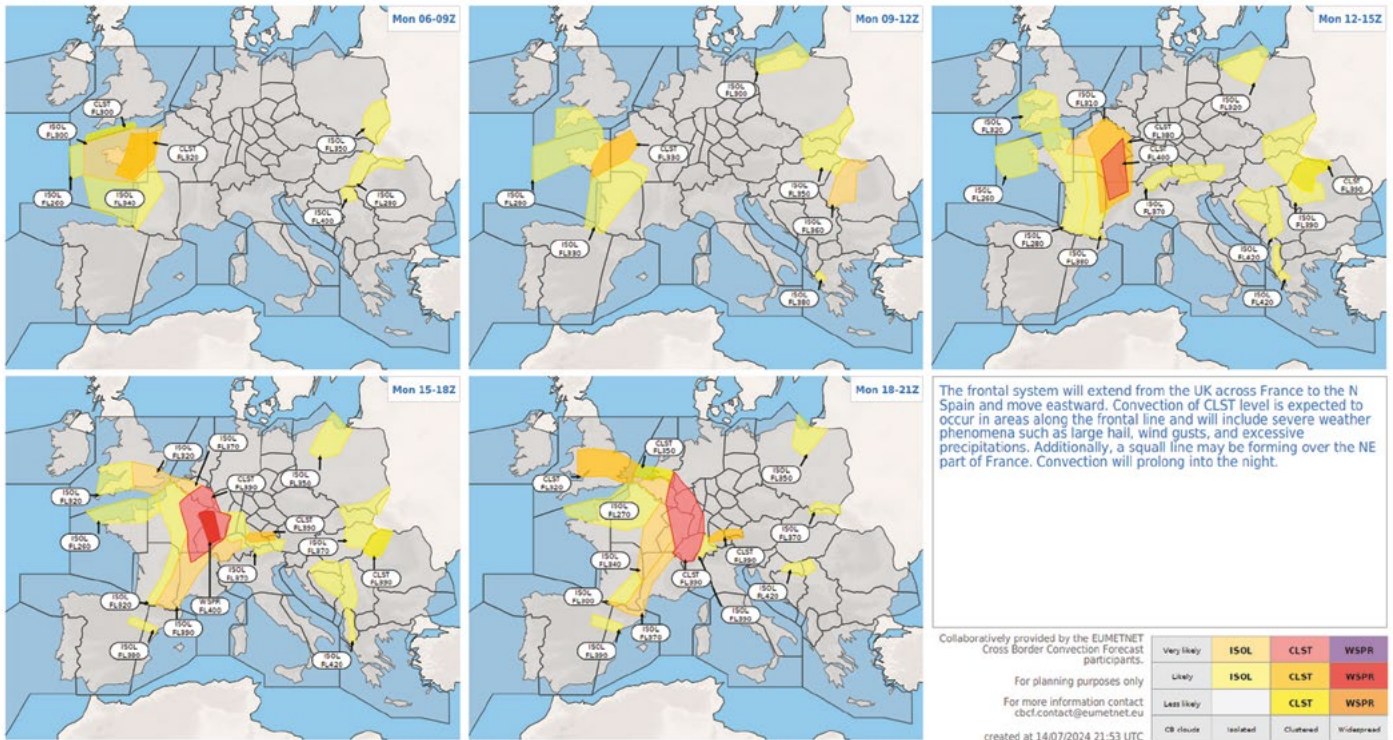
Successful test flights in the MEASURE project

Within the framework of the MEASURE project, run under the German Aviation Research Programme LuFo VI of the Federal Ministry for Economic Affairs and Climate Action (BMWK), successful flight tests took place at the Andøya test site (Norway) in the summer of 2024. The aim of the project is to develop a drone-based measurement system for in situ detection of volcanic ash and radioactivity. The modular design of the system allows flexible configurations for different application scenarios. The test involved the flights of two drones (RPAS) with integrated sensors for sampling and real-time data transfer; it was carried out jointly by enviscope GmbH, the DLR Institute of Air Transport, the DWD and Airbus DS. During one-hour missions, the two drones, launched by catapult and returning by parachute, were flown up to a height of 6,000 metres. The built-in sensors transferred the measured data almost in real time into the DWD's operational consultancy system. The test has demonstrated the potential for scalable, operational use of autonomous measurement platforms in situations that might be dangerous for aviation.



D-0 Cross Border Convection Forecast
issued 14/07/2024 22:00 UTC, valid 15/07/2024

Coordinated by:
Slovenia



European Forecast Collaboration System EuFoCS

The European Forecast Collaboration System (EuFoCS) is a cloud platform established by the DWD, which enables meteorological services in Europe to create collaborative web-based forecasting products. For instance, 25 European providers of meteorological air navigation services (MET ANSPs) collaborate in the Cross Border Convection Forecast coordinated by EUMETNET to interactively produce daily forecasts of convective events of aeronautical meteorological interest — with a perspective to also integrate partially automated forecasts.

Customers, such as air navigation service organisations and airlines, can access and further process the meteorological products through programming interfaces that comply with the Open Geospatial Consortium (OGC) standards. The forecasts are based on meteorological

data provided via the DWD’s GeoServer using the powerful NinJo data services. The NinJo-Batch system is used to create high-quality graphical end products.

The development of EuFoCS as a cloud-based collaboration platform promotes the collaboration among the European meteorological services and opens up new opportunities for the DWD to closely link research and practical application.

Investigating the climate: The DWD's mobile measuring unit

Weather monitoring in Germany is near seamless. The DWD takes measurements at 181 main and 1,697 secondary weather and precipitation stations. In addition, there are the data from 18 weather radars and from the various meteorological satellites. And yet: Specific scientific questions sometimes require additional in situ measurements of temperature, precipitation, etc. This is where the Mobile Measuring Unit (MME) of the DWD comes into play.



Taking measurements for an urban climate project in Darmstadt. Photo: VRM/Sascha Lotz



Parts of the instruments installed on the roof of the measuring van. Photo: VRM/Sascha Lotz

Based at the DWD branch offices in Potsdam, Essen and Munich, the MME operates across the whole of Germany. Its ten staff members are proficient in a wide range of methods for collecting meteorological data. In most cases, data for the following parameters are collected: air temperature and relative humidity, precipitation, wind direction and wind speed. From their specifically developed measuring van, which is equipped with sensors and a GPS system, the team can record profiles of horizontal temperature, air humidity and road surface temperature. The measuring van also carries the equipment necessary for mobile radiosonde ascents. A new, fully e-powered measuring vehicle is being designed and will in future allow emission-free trips through cities and other communities.



Radiosonde ascent training in the Inn Valley (bottom).

Photo: MME

Station maintenance at the coldest place in Germany, Lake Funtensee in the Berchtesgaden National Park (top).

Photo: Roland Chytra



Oliver Nitsche servicing the Karwendelbahn weather station (Karwendel cable car). Photo: MME

But where and why are such complementary measurements needed at all? A key objective is to further improve weather forecasts and warnings at critical locations, in particular at those where the geographical conditions do not allow for the establishment of a regular measuring station, but where, at the same time, the topography contributes to the development of an individual internal climate requiring monitoring at a high resolution. For example, the data from the mobile measuring stations at Forggensee, Magnetsried, Otterkring, Sachenbach, Seehausen, Gmund-Kaltenbrunn, Starnberg and Herrsching are all used for the forecasts by the DWD's storm warning service for the Bavarian lakes.

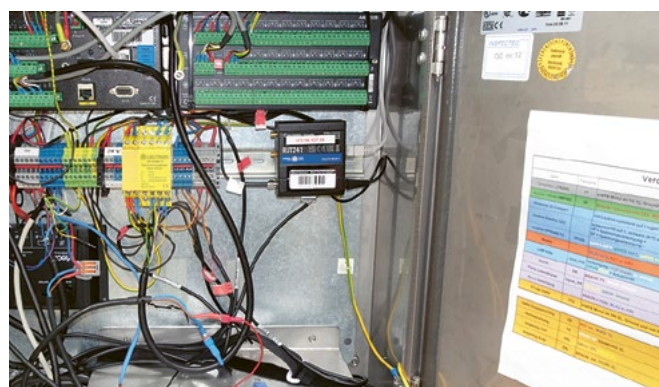
In addition, the MME has been operating climate stations in the Berchtesgaden National Park since the 1980s in order to document the climatic conditions and changes in the Alpine region. It also provides mobile weather stations in urban areas for various urban climate projects.



Marc Heinrich setting up one of the four weather stations for the RailVitalTree project.

Photo: MME

Using mobile measurement stations, data were collected at two locations in 2024 to make a contribution to improving the understanding of the impact of rail traffic on vegetation in nearby forests. For this purpose, the MME carried out comparative measurements on the edge of the forests right next to the railway tracks and at sites deeper inside the forests.



The inside of a mobile weather station. Photo: MME

The latest addition to the MME's equipment is a mobile wind lidar (Light Detection and Ranging). To this end, the technical support team at the DWD's Service and Logistics (South) division has installed a lidar on a car trailer and equipped it with an autonomous power supply. The MME team is now able to use the device on site over several weeks to collect continuous wind field data.



Profile measurement trip on behalf of the Federal Autobahn GmbH. Photo: MME

Back to the measuring van: On behalf of the Federal Autobahn GmbH, the MME monitors the measuring devices feeding the SWIS Road Weather Information System. This is done by driving the measuring van along defined motorway sections on a clear winter night, recording and documenting both air and road surface temperatures along the route. The Federal Autobahn GmbH uses the resulting data to optimise the siting of road ice warning systems.



Vertical urban greenery with MME measuring devices in the courtyard of Senckenberg Nature Museum in Frankfurt am Main. Photo: MME

Another focus of the MME's work is on supporting local or scientific initiatives to develop climate adaptation strategies. The data collected during MME measurement trips can, for instance, reveal urban heat islands. To this end, on a high summer day and during the following night, the team takes dynamic recordings of the air temperature and relative humidity at two altitudes, the road surface temperature and global radiation. The measurements are often supplemented by data from mobile weather stations in the city area. The results from both measurement methods are used to derive measures against overheating in inner cities or for the verification of urban climate models.



The MME staff with Daniela Hüber and Carsten Enskat from the technical support team at the Service and Logistics (South) division. *Photo: MME*

Slightly more than half of the MME's measurements at around 60 sites in 2024 were for external contractors. The service is free of charge for municipal, federal-state and federal authorities. All other measurements support the DWD's own forecasting, research and consultancy activities. A key task for the MME is to carry out replacement measurements during maintenance of full-time weather stations. Through its work, mobile and flexible, the MME makes an important contribution to fulfilling the DWD's statutory mandate to warn about weather hazards, monitor the climate in Germany and contribute to finding solutions to current and future challenges.



Experimental field site of Pillnitz (Dresden): MME instruments recording the microclimate at an agrivoltaic installation. *Photo: Karl Wild*

ICON published as open-source model

What if we could simulate the dynamics of the atmosphere down to the smallest detail? Our ICOSahedral Nonhydrostatic model (ICON) is a modern weather and climate model that aims to do just that: it is precise, flexible and globally usable. The ICON model, developed by the DWD, the Max Planck Institute for Meteorology, the Karlsruhe Institute of Technology (KIT), the German Climate Computing Centre (DKRZ) and a number of other partners, is based on a global icosahedral grid. It allows flexible simulations of the processes that shape our weather, climate and environment.

Since 2024, ICON has been freely available as an open-source model. The version includes modules for the atmosphere, oceans and land surfaces and offers interfaces to other systems. Thanks to its scalability, ICON is suitable for regional and global simulations. Researchers from all over the world can use, adapt and further develop ICON — as part of a global network that promotes transparency and cooperation in meteorology.

Foundation stone laid for the ECMWF site in Bonn

The foundation stone for the new site of the European Centre for Medium-Range Weather Forecasts (ECMWF) in Bonn was laid in June 2024 in the presence of the then Federal Minister of Transport Volker Wissing and all members of the Executive Board of DWD. The ECMWF is a world leader in medium-range global weather forecasts (up to ten days ahead) as well as in the provision of forecasts for the monthly and seasonal ranges (up to six months ahead). Its products are made available to the European national meteorological services and thereby complement, for example, the DWD's forecasts for Germany. The ECMWF, a key player in the European Union's Copernicus programme, provides quality-assured information on climate change, atmospheric composition, flooding and fire danger, etc. The Centre also plays a key role in the development of a digital twin of the Earth, an activity undertaken as part of the Destination Earth initiative of the European Union. In order to continue these tasks after Brexit, the ECMWF needed a new location on EU territory. To this end, a Europe-wide competition was held in 2020 and Germany won the contract.

HERZ: An innovative research consortium

By promoting the networking and collaboration of various German universities, research institutes and the DWD, the Hans Ertel Centre for Weather Research (HERZ), for the benefit of society, accelerates innovation of the weather, climate and environmental services of the DWD. Since 2011, HERZ has been committed to combining excellent research and training in the fields of atmospheric sciences and Earth system components in Germany. This close interlinking strengthens meteorological education and training and ensures future personnel development.

The current phase, which began in 2023, includes seven projects, all contributing their research to the DWD value chain. The topics range from the use of new measurement systems (such as drones and prototypes of remote sensing systems) and improvement of weather and climate prediction models (including using new AI methods and digital twins) through to optimising communication with society.

More information about the Hans Ertel Centre for Weather Research (HERZ) can be found at: www.hans-ertel-zentrum.de/en

DWD know-how for COP29, Madagascar and Sierra Leone

The DWD supported the German delegation to the 29th United Nations Climate Change Conference (COP29) in Baku by providing advice, in particular relating to research and systematic observation. As a member of the World Meteorological Organization (WMO), the DWD also contributes continuously and substantially to the data and evaluations on which the WMO bases its guidance to the Member States on, among other things, current climate change impacts and projections of the future trends of climate change.



Photo: Dr Audine Laurian, DWD

Another initiative supported by the DWD is the Systematic Observations Financing Facility (SOFF), a United Nations fund co-created by the WMO, the United Nations Development Programme and the United Nations Environment Programme to close gaps in the global observation network. SOFF helps the least developed WMO Member States to build up and consolidate their own monitoring capacities. In this context, the DWD is offering its scientific and technical know-how, currently as a peer advisor for Madagascar and Sierra Leone. The aim is to ensure that both countries can achieve the quality of weather and climate forecasts they need by sufficient supply of systematic observations.

WMO honours Prof. Dr Gerhard Adrian

The Executive Council of the World Meteorological Organization (WMO) has honoured Prof. Dr Gerhard Adrian, former President of DWD and of WMO, with its International Meteorological Organization (IMO) prize. The award was given to him for his pioneering role in particular in the WMO governance reform and the implementation of important global WMO programmes during his WMO presidency. In addition, the WMO praised Adrian's extraordinary and continuous commitment to the global free exchange of data. Adrian is only the fourth German to be awarded this prize, which is endowed with 10,000 Swiss francs. The other three who received this highest award of WMO before him were Prof. Richard Scherhag (1970), Prof. Hermann Flohn (1986) and Dr Tillmann Mohr (2013).

DWD achieves first fully AI-based integration of observational data into prediction models

In 2024, the DWD marked a major breakthrough in the field of research on the use of artificial intelligence (AI) in weather forecasting and climate analysis. For the first time in the world, prediction models and analysis processes were successfully fed with weather observation data by exclusively using AI. Data assimilation, i.e. the integration of observational data into computer-based weather models, has been a cornerstone of weather forecasting for decades. The AI-Var approach developed by the DWD now integrates the data assimilation process directly into a neural network, replacing traditional methods with innovative deep learning techniques. This reduces the computational costs significantly and speeds up analysis and forecasting processes. A study demonstrated the performance of AI-Var in various idealised and real-world test cases.

Our Department of Meteorological Analysis and Modelling is currently working on transferring AI-based data assimilation into an operational software framework. This is done in close coordination with the developments of the DWD's cross-functional AI Centre. Interacting with the extensions of the AI prediction model AICON, this will enable purely AI-based numerical weather forecasting in the DWD.

The value chain of satellites

Dr Phil Evans, Director-General of EUMETSAT, and Prof. Dr Sarah C. Jones, President of the DWD, welcomed around 500 guests from Germany and abroad to the EUMETSAT Meteorological Satellite Conference in Würzburg. The conference was held from 30 September to 4 October 2024. The main theme was the value chain of meteorological satellites as an essential source of data for meteorology, climatology and hydrology.

Evans stressed that, according to the latest studies, every euro invested in weather and climate services yields 33 times the benefit. It was therefore all the more important to strive for further improvements, in particular for the further development of satellite meteorology. Jones highlighted the multitude of applications of meteorological satellite data and how valuable these data were for weather forecasting, climate monitoring and research. She added that these data enabled the national meteorological services to fulfil their tasks for the benefit of societies.

In its role as co-host, the DWD contributed in manifold ways to the conference. This ranged from specialist lectures and the moderation of sessions and poster presentations through to holding a special session on international data centres.

DWD leads the way in climate monitoring

The DWD plays a key role in national and international climate monitoring and contributes significantly to the Global Climate Observing System (GCOS). For example, from its very start in 2008, the Lead Center of the GCOS Reference Upper-Air Network (GRUAN) has been hosted by the DWD's Lindenberg Meteorological Observatory — Richard Assmann Observatory (MOL-RAO). Since then, GRUAN has developed into a global network of over 30 stations where, on a daily basis, high-quality balloon-based reference soundings of temperature and water vapour are carried out up to a height of 35 kilometres.

For over 30 years now, the MOL-RAO has also been recording precise measurements of incoming short- and long-wave radiation fluxes for the Baseline Surface Radiation Network (BSRN). The BSRN is a GCOS-recognised network of nearly 50 stations that are taking measurements of radiation fluxes of the highest available accuracy for the purposes of atmospheric monitoring and validation of model data and satellite-based products.

International data centres at the DWD

The DWD operates several international data centres, two of which celebrated anniversaries in 2024: the World Centre for Precipitation Climatology (GPCC) for 35 years of service and the Satellite Application Facility on Climate Monitoring (CM SAF) established 25 years ago.

The GPCC not only holds the most extensive collection of station-based precipitation data in the world but also carries out the quality checks. Based on this data, gridded analysis products are generated that enable the monitoring of global precipitation events, for example climate phenomena such as El Niño and La Niña, as well as the derivation of multi-year climate trends. The products of the GPCC constitute an important part of international reports by the World Meteorological Organization (WMO).

From the observations provided by meteorological satellites, the CM SAF derives data sets on the energy and water cycles of the atmosphere, for example for cloud coverage, water vapour, precipitation and radiation. These data not only support our understanding of the climate system but also help to improve practical applications, for example for investigations on the potential yield of renewable energies.



Reinhard Spengler presenting Federal President Frank-Walter Steinmeier with a personalised birthday weather map. *Photo: DWD*

Digital transformation meets weather and climate: DWD at the Digital Summit

The Digital Summit of the Federal Government is the central platform facilitating exchanges on digital topics for the future. In 2024, the summit took place in Frankfurt am Main on 21 and 22 October under the motto 'Digital Germany — Innovative. Sovereign. International'. It brought together more than 1,800 representatives from politics, business, science and civil society.

The contribution submitted by the DWD at the invitation of the Federal Ministry of Digital and Transport (BMDV) was prominently placed in the programme. At four interactive stations, DWD experts presented digital weather and climate services for fact-based decision-making.

The focus was on applications such as heavy rain monitoring, soil moisture analyses and the WarnWetter app. The DWD also demonstrated how AI-based data processes, open-source approaches and international collaborations help to make society and infrastructure more resilient to weather and climate risks.

DWD at the Week of the Environment

In 2024, the German Federal Environmental Foundation (DBU) organised the Week of the Environment for the seventh time. The DWD participated for the first time, together with around 190 other exhibitors. The two-day event was held at the beginning of June on the invitation of Federal President Frank-Walter Steinmeier in the garden of his official seat at Bellevue Palace in Berlin. The Week of the Environment comprises a specialist lecture programme, panel discussions and exhibitions by political, scientific, research, business, social and technical organisations involved with environmental topics. The theme for 2024 was 'Together for climate neutrality'.

The DWD's presentations at its stand focussed on the soil moisture viewer, plant sighting reports in the WarnWetter app and ISABEL, the DWD's Internet-based agrometeorological consultancy system for the federal states. In numerous conversations, the visitors were informed about these topics and the DWD as a whole. Many discussions were more technical and here the DWD staff could demonstrate the advantages of the soil moisture viewer live on the screen. On his tour through the exhibition, the Federal President stopped at the stand and was presented with a personalised weather map for his birth date.



Upgrade of router infrastructure at secondary weather stations

In the summer half-years of 2023 and 2024, the routers installed at a total of 860 part-time weather stations underwent a comprehensive upgrade. All former routers had to be replaced with new models from the DWD's current mobile network provider. This ambitious project involved a number of challenges, first of all the coordination between the service technicians implementing the change on site and the colleagues at the data validity check unit, whose task it was to connect the new system in direct exchange with the technicians on site as soon as a new device was in place. Setting out from the seven sites where the DWD's technician teams are based, Hamburg, Potsdam, Leipzig, Oberschleissheim, Stuttgart, Offenbach and Essen, an average of 17 routers were converted per week and activated centrally from Potsdam. Thanks to the dedicated commitment of all the staff involved, the project was completed as planned.

Windshields retrofitted at 100 weather stations

Over a period of two years, the standard precipitation gauges at the 100 secondary weather stations situated at sites particularly exposed to wind were retrofitted with Tretyakov-style shields. The stations concerned are mostly located at higher altitudes, where the ombrometers, depending on the expected amount of snow, are sometimes mounted up to two metres above the ground. Tretyakov windshields protect the gauge in such a way that, on windy days, dynamic pressure does not cause precipitation to be blown away from the 200-square centimetre wide orifice of the ombrometer. Instead, precipitation ends up where it can be measured accurately and the data output recorded every minute. Support was given by the DWD workshops in Hamburg, Potsdam and Oberschleissheim, where, if necessary, special devices were built for a better fitting of the rings that hold the wind-breaking slats.

Under way: retrofitting of windshield at Ramsau near Berchtesgaden (left).

Photo: DWD, Wolfgang Große

DWD rents climate-neutral building

In the autumn, the DWD signed a lease agreement for an office area of 3,200 square metres in the LEIQ office building in Offenbach. Units from several DWD Business Areas as well as the DWD's Training Centre formerly based in Langen will move into the new building in 2025. This move reduces the office area that had to be rented before almost by half.


By renting this space in the LEIQ (the name is made up of the district's name KaiserLEI and IQ), the DWD has chosen a new building that meets all the sustainability criteria of the Federal Government. In addition, it is currently the only office building in Offenbach that can be operated in a climate-neutral manner. The LEIQ is located in the immediate vicinity of Offenbach's new 'Hafen' district and is very well connected to local public transport routes and the entire Rhine-Main region. There is also a direct connection to the cycle superhighway and a bicycle sharing station in front of the building. A mobility hub on the ground floor provides users with changing rooms and showers as well as charging facilities for e-bikes.

Enthusiasm for e-mobility

The electrification of the DWD fleet is progressing. On average, around ten per cent of the DWD vehicle fleet are renewed every year. Since mid-2024, the DWD has only been purchasing all- or semi-electric vehicles. However, when it comes to long-distance drives, such as trips to the measuring stations, the distance range of currently available electric vans is not always sufficient. This poses a challenge for the users, as their daily work leaves little room for additional charging stops.

'Enthusiasm — not frustration' is therefore the motto under which the DWD fleet management is now aiming to replace the vans that usually operate at distances of less than 250 kilometres with e-vans. Diesel vans no longer needed for the short trips can then be used for long-distance drives. It can be assumed that, by the time these vans need to be renewed, the industry will have found new solutions — as has been the case with the all-electric cars in use at the DWD since the end of 2024, now providing distance ranges of up to 690 kilometres.


Budget figures

 The DWD's total expenditure figures are as follows:

2023	2024
ca. €377 m	ca. €392 m

 Every citizen of Germany thus paid:¹

2023	2024
€4,07	€4,19

 The DWD's expenditure in 2024 was distributed as follows:

Appropriations/Subsidies:

€150.234 m
(external funds not included)

Personnel:


€139.392 m

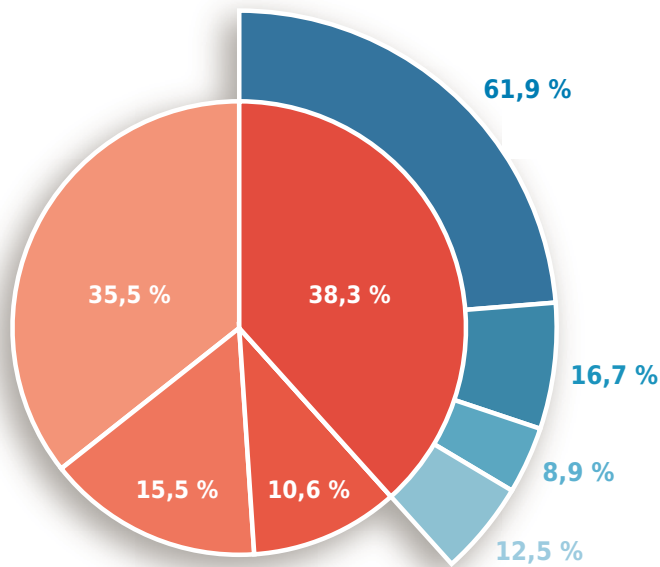
Expenditure on material:

€60.784 m

Investments:

€41.765 m

 The appropriations and subsidies went to the following organisations:
(including around €13.308 m from external funds)



EUMETSAT:

€101.251 m

ESA:

€27.332 m

ECMWF:

€14.585 m

EUMETNET, WMO, others:

€20.373 m

Staffing figures

 Number of established posts:

2023	2024
2,114.5	2,067.5

 Number of staff members:²

	2023	2024
	2,135	2,157
Women:	816	840
Men:	1,318	1,316

Germany spends around €4.19 per person on weather forecasts, warnings and climate monitoring

The DWD's overall budget in 2024 amounted to around 392 million euros, which is roughly 15.3 million euros more than in the previous year. However, the amount of funds needed by the DWD from tax money was actually much lower than the budget due to the fact that 10.7 per cent of it were already indirectly covered by revenues. Compared to the previous year, the DWD's requirement for public funds increased by around 6.3 million euros in 2024. This means that every citizen in Germany had to pay 4.19 euros for important federal tasks such as weather forecasting, severe weather warnings and climate monitoring.

The higher budget and need in public funds result mostly from an increase of around 9.2 million euros in the amount of subsidies paid to international organisations (around 13.3 million euros more to EUMETSAT plus a slight increase of around 0.8 million euros to ECMWF as opposed to around 6.2 million less to ESA and some other minor changes). This is offset by an increase in revenue of around 8.9 million euros. In addition, the DWD's own expenditure on investment fell by around 1.3 million euros compared to the previous year.

¹ Calculation: 83.6 m inhabitants according to the Federal Statistical Office as of December 2024

2023: €4.07 (according to estimates by the Federal Statistical Office: 84.6 m inhabitants at the end of September 2023)

2024: €4.19 (according to estimates by the Federal Statistical Office: 83.6 m inhabitants at the end of September 2024)

² The difference between the number of established posts and the total number of staff members is partly due to temporary or part-time employment.

DWD sites in Germany

1 

headquarters in Offenbach am Main

6 

major branch offices
(Hamburg, Potsdam, Leipzig, Essen,
Stuttgart, Munich), partly with more than
100 staff members

5 

regional climate offices providing
consultancy services in the field
of climate and environment

2 

meteorological observatories

3 

agrometeorological advisory offices

1 

Frankfurt Aeronautical
Meteorological Centre

1 

marine meteorological consultancy centre

181 

main automatic weather stations, of
which 15 are aeronautical meteorological
stations at international airports

4 

offices that also offer aeronautical
meteorological briefing (at airports
and branch offices)

1,838 

road weather stations in partner networks
(with automated quality assurance
every 15 minutes)

44 

aeronautical meteorological observation
stations at regional airports

1,697 

secondary weather and precipitation
stations, of which 814 are online stations
reporting every half-hour

2 

staffed main weather stations
aboard research ships

1,046 

phenological observation sites

8 

moored buoys in the North and Baltic Sea

8 

automated shipboard aerological stations

464 

ships at sea participating in the
voluntary observing programme,
of which 157 are equipped with
automatic shipboard weather stations

18 

weather radar sites in Germany

10 

upper-air stations with around
7,500 radiosonde launches per year

1 

special air mission unit
for volcanic ash measurements

9 

automatic greenhouse gas measuring
stations at high towers

49 

stations measuring radioactivity

3 

mobile measuring units
for 54 temporary measuring sites

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Weather hotline¹

Tel. +49 (0) 180 2 91 39 13
When calling our weather hotline you
will automatically be connected with
the closest DWD Branch Office.

¹ *€0.06 per call from German landlines; maximally
€0.42 per minute from German mobile networks;
otherwise availability and costs depending on foreign
telephone provider

Further telephone
and service numbers
www.dwd.de/kontakt

Important links

Current weather

www.dwd.de/wetter

App for weather warnings

www.dwd.de/app

Natural Hazards Portal

www.naturgefahrenportal.de/en

Climate information

www.dwd.de/climate

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Mobile profile measurements: The DWD's mobile measuring unit on tour in Darmstadt.



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