ECMWF

European Centre for Medium-Range Weather Forecasts

ANNUAL REPORT 2025

www.ecmwf.int

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Copernicus and Destination Earth

ECMWF is a key player in Copernicus, the Earth Observation component of the EU's Space programme, implementing the Copernicus Atmosphere Monitoring Service (CAMS) and the Copernicus Climate Change Service (C3S), and contributing information on flooding and fire danger through the Copernicus Emergency Management Service (CEMS).

ECMWF is one of three Entrusted Entities delivering Destination Earth (DestinE), the EU's ambitious initiative to create a digital twin of the Earth system, together with the European Space Agency (ESA) and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), under the leadership of DG Connect.

Foreword

Dr Florian Pappenberger
ECMWF Director-General, June 2026

2025 was a landmark year for ECMWF: our 50th anniversary and the start of our new Strategy. ECMWF was founded on a simple idea: European countries can achieve more together than any one country could achieve alone. Fifty years later, that idea still defines who we are.

This Annual Report can only give a snapshot of the year. But I hope it shows clearly what makes ECMWF special: excellent science, reliable operations, world-class computing and data infrastructure, and above all, close collaboration with our Member and Co-operating States, European partners and the wider international community.

2025 was a year of major scientific and technological progress. Following upgrades to our physics-based Integrated Forecasting System, we delivered one of the most significant improvements in medium-range forecast skill in recent years. At the same time, we made a major step in AI-enabled forecasting with the operational launch of the Artificial Intelligence Forecasting System. Initiatives such as Anemoi and the AI Weather Quest competition also showed how open tools and shared expertise can accelerate innovation across our community.

Another important milestone was the opening of our full real-time data catalogue. This was a significant step for open science, innovation and resilience. It also reflects a simple principle: ECMWF data and products have the greatest value when they are trusted, usable and able to support decisions in Member States and beyond.

Our work with the European Union through Copernicus, Destination Earth and other programmes, and with satellite and space agencies, continued to push the boundaries of science and operational delivery. These partnerships strengthen Europe's collective capability and bring value back to our Member and Co-operating States.

None of this would have been possible without our staff. Much of the work that makes ECMWF successful is highly visible; much of it is not. Both matter. Forecasts, data, services, science, computing, administration, communications and support all have to come together for ECMWF to deliver. That is easy to say, but difficult to do every day, and I am very grateful to colleagues across the Centre for making it happen.

As we look back on 2025, I also want to recognise three people who have shaped ECMWF profoundly. Florence Rabier and Penny Endersby stepped down from their roles as Director-General and Council President at the end of the year. Andy Brown also concluded his time as Director of Research. I have been fortunate to work closely with all three. ECMWF has benefited greatly from their leadership, judgement, kindness and commitment.

Looking ahead, my priority is to build on this trust: listening carefully, working practically, and ensuring ECMWF remains a Centre that delivers with and for its Member and Co-operating States.

2025 at a glance

2025 was a milestone year: ECMWF's 50th anniversary. Throughout the year, we remembered a half-century of achievements while strengthening our foundations for an even better future. Over these 12 months, there were many remarkable innovations in technology and forecasting, and a continued commitment to open data and international collaboration.

Clockwise from top left: groundbreaking ceremony for new HQ in Reading; participants at workshops in Bologna; Florence Rabier (right) and Florian Pappenberger; Annual Seminar participants in Bonn; signing of the Strengthening Early Warning in Africa agreement.

JAN

ECMWF signed the Strengthening Early Warning in Africa agreement under the Africa–EU Space Partnership Programme. With EUMETSAT and the African Union Commission, ECMWF will facilitate peer-to-peer engagement between European meteorological services and African partners to develop impact-based forecasts and related training, in line with UN Early Warnings for All goals.

FEB

The launch of AIFS Single marked a major breakthrough as the first operational machine learning weather forecasting model. It showcases how AI can complement traditional numerical weather prediction by delivering accurate forecasts up to 1,000 times more energy-efficiently.

MAR

ECMWF launched the AI Weather Quest to advance sub-seasonal forecasting using AI and machine learning. The competition invited participants to improve forecasting methods over longer time ranges, fostering innovation in the field.

APR

The European State of the Climate (ESOTC) report highlighted 2024 as Europe's warmest year on record. Produced by ECMWF, which implements the Copernicus Climate Change Service (C3S), and the World Meteorological Organization (WMO), it provided critical insights into climate trends.

'Forecasting in a changing climate' was the focus of the ECMWF Annual Seminar in Bonn, Germany, bringing together experts to explore how forecasting science must evolve to address climate variability and change.

MAY

JUN

AIFS ENS became operational, providing an ensemble of 51 forecasts to capture the full range of possible scenarios. It provides faster, more energy-efficient predictions while maintaining high skill. It marks another major step in integrating AI into weather prediction.

Construction work on ECMWF's new HQ in Reading, UK, was marked by a groundbreaking event attended by the UK's Science Minister, Lord Vallance. The new HQ represents a long-term investment in infrastructure to support scientific and technological advances.

JUL

ECMWF began operational use of Arctic Weather Satellite data from the European Space Agency (ESA), the first centre to do so. These new observations will enhance forecast accuracy, especially in data-sparse polar regions.

AUG

The High-Performance Computing workshop in Bologna, Italy, brought together experts from national weather centres, academia and industry to share advances and explore the transformative role of supercomputing for weather forecasting applications. Joint sessions with the Destination Earth Annual Meeting and ECMWF's user workshop allowed crossover topics to be explored.

SEP

ECMWF's Code for Earth innovation programme showcased collaborative projects that apply Earth science data to real-world challenges. It emphasised cross-sector innovation and ECMWF's commitment to open, impactful science.

OCT

ECMWF made its entire real-time data catalogue free and open to all, hugely expanding access to high-quality weather data. This supports wider scientific research, innovation, climate resilience, and decision-making worldwide.

NOV

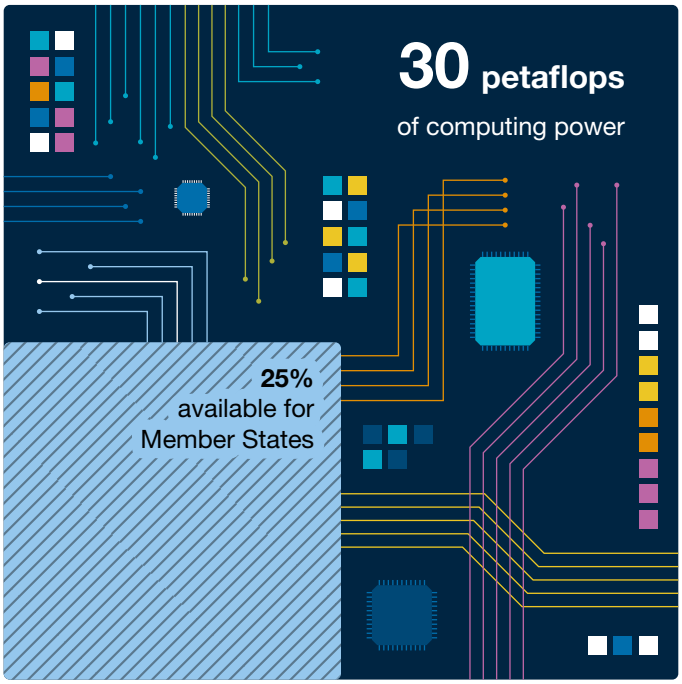
ECMWF and the Copernicus Atmosphere Monitoring Service (CAMS) co-organised the Clean Air Forum with the European Commission at ECMWF in Bonn, fostering dialogue between scientists and policymakers to improve air quality across Europe.

DEC

ECMWF concluded its 50th anniversary year in Reading, UK. Florence Rabier retired as Director-General, passing the baton to Florian Pappenberger to take up the post from January 2026.

Facts and figures 2025

High-performance computing facility

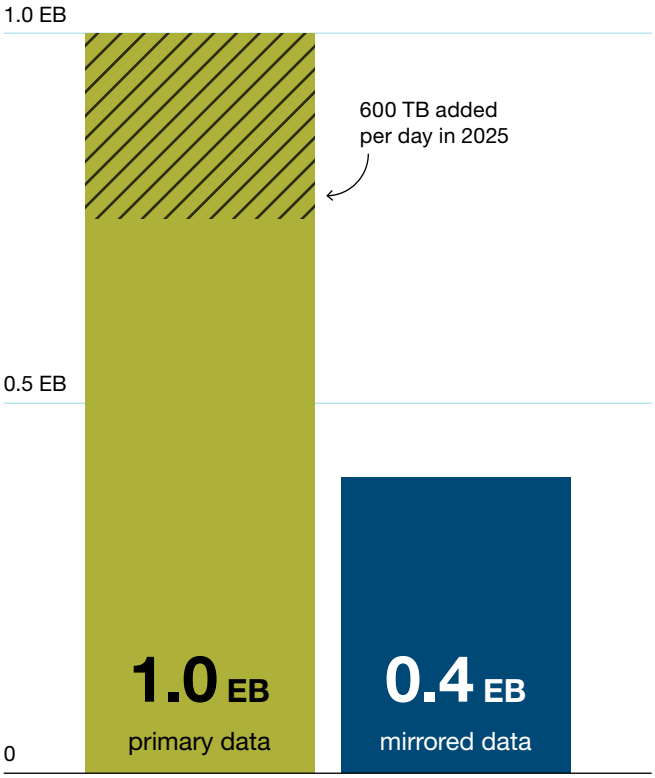


30 million billion
calculations per second

900,000
daily jobs submitted to HPCF

Archive and retrieval service

1.4 exabytes
total data holdings



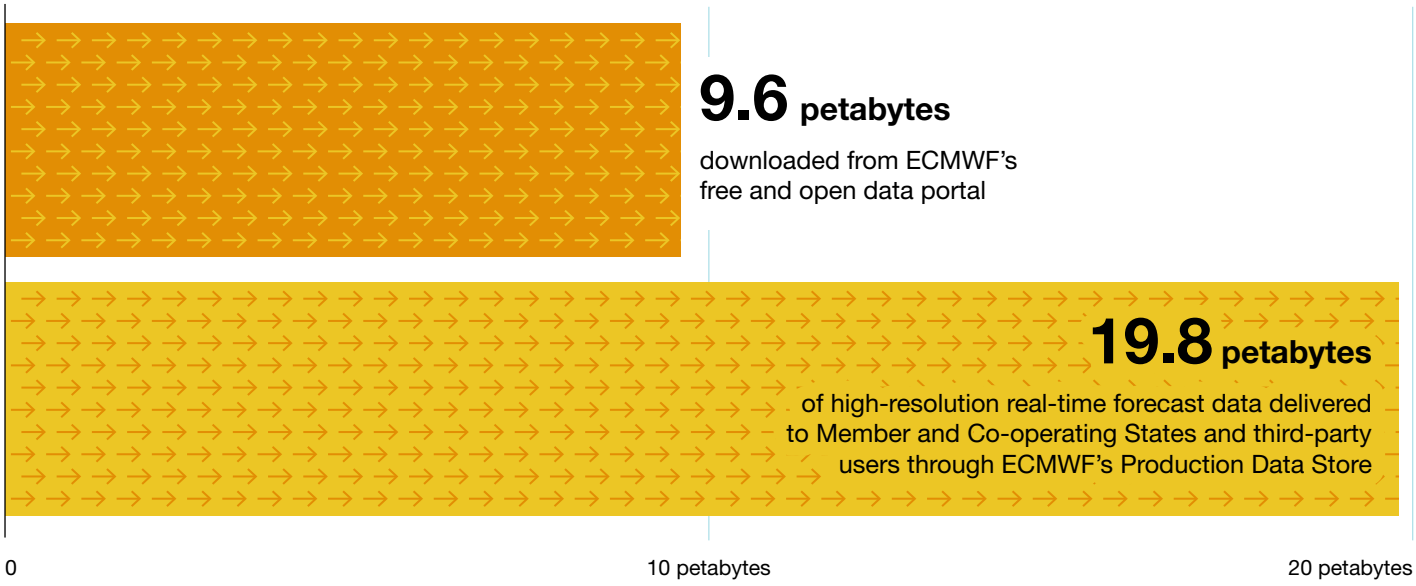
Knowledge sharing and engagement

3,900 registrations
for participation at hosted/co-hosted workshops and events for ECMWF, Copernicus and Destination Earth

1,967 training attendees
from Member and Co-operating States on forecasting, numerical weather prediction and computing training courses

11 liaison visits
to meteorological services in Member and Co-operating States

Forecast data dissemination



Collaborative research

66 active projects

49 funded by Horizon Europe
17 funded by other external partners (ESA, EUMETSAT, Mercator, WMO)

8 ECMWF Research Fellows

of which 3 appointed in 2025

EU programmes

Copernicus Services

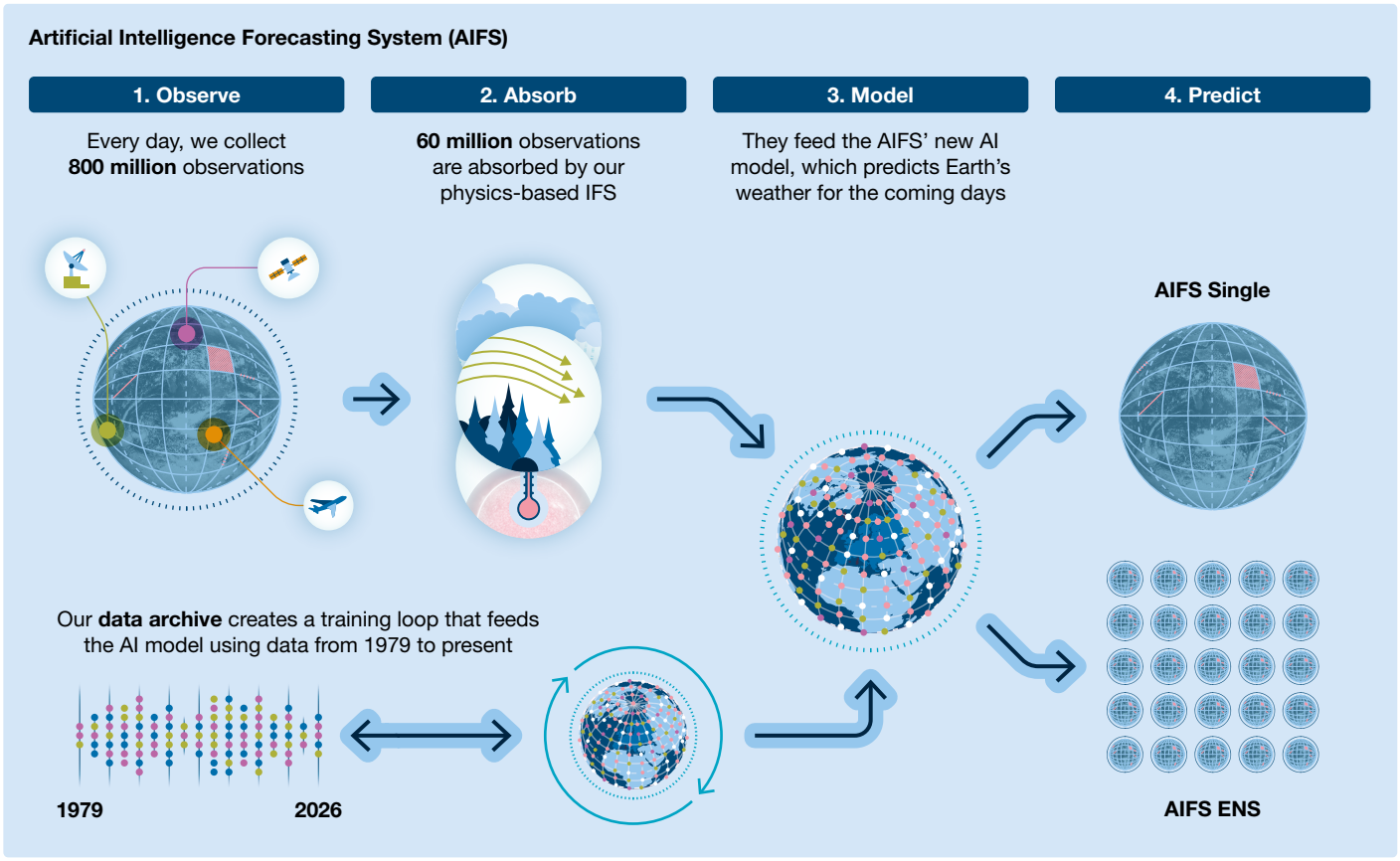
- Implement Climate Change Service and Atmosphere Monitoring Service
- **319 contracted/subcontracted entities** across Europe
- **23 countries** involved in the Copernicus National Collaboration Programmes (end of 2025)
- Contribute to Emergency Management Service

Destination Earth

- Deliver digital twins on Climate Change Adaptation and Weather-Induced Extremes
- Deliver Digital Twin Engine
- **105 contracted/subcontracted entities** across Europe

Science and technology

This was an incredibly exciting year for ECMWF's science and technology, underscoring the need for investment in both physics- and AI-based numerical weather prediction.



New observations, new possibilities
We significantly expanded our observational sources in 2025, particularly from space-based platforms and aircraft.

New satellite data from the Arctic Weather Satellite (ESA), MTG-I (EUMETSAT) and additional GPS Radio Occultation datasets (NOAA) are already leading to improved forecasts.

Meanwhile, Global Mode-S aircraft data from the Royal Netherlands Meteorological Institute and the UK Met Office continued to strengthen the in-situ observing network.

We also began trialling the first operational assimilation of observations from the ESA EarthCARE mission, as well as acquiring early test samples from the newly launched MTG-S and EPS-SG (A) satellites. These new observing systems will deliver measurable improvements to forecast accuracy.

Strengthening the Integrated Forecasting System
During 2025, a range of developments in data assimilation and modelling were progressed to prepare for the May 2026 upgrade of our physics-based Integrated Forecasting System.

They include a more consistent and integrated approach to forecasting the atmosphere's interactions with the ocean through fully coupled data assimilation. Modelling improvements bring a more accurate representation of how sea ice affects

the power of waves and the interactions between waves and ocean currents, often at play in rougher seas.

Another key change is a better representation of convective precipitation, which causes heavy rainfall and violent thunderstorms but is hard to predict because it occurs at smaller scales.

These developments are to contribute to more realistic coupled forecasts, better use of observations and reduced computational cost.

Operational AI forecasting
We successfully transitioned AI forecasting into operations with the introduction of both deterministic and ensemble versions of the Artificial Intelligence Forecasting System, AIFS Single and AIFS ENS.

Commended as "world-leading achievements" by the ECMWF Technical Advisory Committee, these systems represent a major step forward in the use of machine learning for operational weather prediction and complement existing physics-based approaches. They are trained on the ERA5 reanalysis and use the Anemoi framework developed by ECMWF and many of its Member States.

The new ensemble model outperforms state-of-the-art physics-based models for many measures, including surface temperature, with gains of up to 20%. It currently works at a lower resolution (31 km) than the physics-based ensemble system (9 km), which remains indispensable for high-resolution fields and coupled Earth-system processes.

NEXHub accelerates IFS innovation
The introduction of the Numerical Experiment Hub (NEXHub) marked a big step forward in how ECMWF manages and develops numerical experiments.

Designed to operate seamlessly across ECMWF's computing infrastructure and EuroHPC systems, NEXHub enables faster testing, iteration and collaboration.

By streamlining workflows and reducing technical barriers, the platform will accelerate the evolution of the Integrated Forecasting System and support a more agile development environment.

Implementing digital twin technology
In 2025, substantial progress was made in Destination Earth in implementing digital twin technology across distributed EuroHPC supercomputers, through close collaboration between ECMWF and over 100 institutions across Europe.

Work advanced on operationalising the flexible simulation frameworks of the Climate and Extremes Digital Twins, enabling "what if" scenario analysis and the production of consistent, high-resolution Earth system and impact-relevant information.

AI modelling was also expanded beyond the atmosphere, with prototype models for ocean, waves, land, sea ice and hydrology developed with promising results.

These advances complement existing capabilities and support the development of next-generation Earth system modelling systems and the underpinning software and data infrastructure of the European Meteorological Infrastructure.

International awards highlight ECMWF impact
ECMWF scientists and collaborations received several major awards in 2024–2025.

Tim Hewson and Fatima Pillosu won the Royal Meteorological Society's Hugh Robert Mill Award for precipitation research.

Florence Rabier received the European Meteorological Society Silver Medal for her leadership in numerical weather prediction. The Anemoi Framework, a European collaboration to create machine learning (ML) weather forecasting systems, earned the society's Technology Achievement Award.

Anemoi also won the HPCwire Readers' and Editors' Choice Award for 'Best Use of AI Methods for Augmenting HPC Applications', highlighting ECMWF's leadership in both forecasting and AI innovation.

Impact

Each year, ECMWF's world-leading forecasts make a real difference. And 2025 was no different. Through the European Meteorological Infrastructure (EMI) and national agencies, our information helped societies to thrive and stay safe.

Improvements in forecast performance
We evaluate the accuracy of our forecasts with annual results reviewed by ECMWF's Technical Advisory Committee. Two highlights stood out in 2025.

Now based on model Cycle 49r1 for a full year, the Integrated Forecasting System (IFS) showed dramatic improvements to medium-range forecast skill in the extratropics. In fact, it was the largest improvement in upper-air ensemble forecast (ENS) scores from a single upgrade since 2011.

The AIFS Single (operational since February 2025) and AIFS ENS (since July 2025) outperformed their IFS counterparts for most upper-air and surface parameters, as well as for almost all lead times. Error reductions in the medium range are typically of the order of 5–15% for most upper-air and surface parameters, and tropical cyclone track predictions are improved as well.

Entire real-time catalogue open to all
In October, ECMWF opened its entire real-time data catalogue under a permissive licence (CC-BY-4.0), completing a major step in our strategy to promote open science, global collaboration and climate resilience. This supports initiatives like the UN's Early Warnings for All and helps societies better prepare for extreme weather.

Open access has increased the global use and impact of ECMWF data across a growing range of industries and countries. To improve consistency, licences for Copernicus datasets were also updated to CC-BY-4.0, enhancing data accessibility and reuse, with key ECMWF open data platforms achieving high FAIR scores (findable, accessible, interoperable, and reusable).

Real-time datasets are also benefiting developing countries through the UN Systematic Observations Financing Facility (SOFF), with active use in regions such as Tanzania, Bangladesh, and the Caribbean. Supported by new data-sharing systems introduced in 2025, additional observations are being shared by SOFF countries in Africa and the Caribbean Islands and processed in ECMWF systems.

Championing an EMI data space for weather and climate
As Europe builds its data-driven future, the meteorological community plays a leading role.

At the request of its Member States, ECMWF joined forces with EUMETSAT and EUMETNET for a series of workshops exploring how the Common European Data Spaces model might improve data sharing, interoperability

and service provision across the European Meteorological Infrastructure (EMI) and the wider community.

Expanding the European Weather Cloud
The European Weather Cloud (EWC) saw steady growth in users and applications across ECMWF and EUMETSAT infrastructures.

It now supports over 150 tenancies of ECMWF and EUMETSAT Member and Co-operating State users, providing a flexible environment for data access, collaboration and the development of AI and machine learning workflows.

Improvements included a community platform for sharing applications and pre-configured environments for common AI tasks.

The EWC also supported short-notice international training activities, highlighting its growing role in enabling collaboration across the global meteorological community.

Pilot projects with Member States
Collaborative pilot projects with Member States have been highly successful and extended beyond 2025: Internet of Things observations for numerical weather prediction (NWP); Adaptation to emerging technologies (ELEMENT); and Machine learning.

Here we highlight achievements for ELEMENT, which is enabling a shift in operational meteorology from traditional, centrally processed NWP workflows toward distributed, cloud-native, and AI-enabled data ecosystems.

Launched in late 2022 under the coordination of MeteoSwiss, the initiative is designed to modernise how ECMWF forecast data are accessed, processed and integrated within Member State infrastructures, aligning with broader European programmes such as Destination Earth. Tools and software developed in the project allow meteorologists across Europe to quickly retrieve only the data they need and integrate them into their own systems.

Events, training and workshops
Bringing the meteorological and wider scientific community together for knowledge sharing, ECMWF hosted and co-hosted 20 events in 2025, including the CAMS (Prague) and C3S (Valencia) General Assemblies, Destination Earth workshops and Annual Meeting, and numerous topical workshops such as High-Performance Computing, Using ECMWF Forecasts, Annual Seminar, and the Clean Air Forum.

ECMWF delivered a diverse training programme aimed at strengthening expertise among Member and Co-operating States, partners and the meteorological community.

ECMWF and Copernicus
Our proactive management of the Copernicus Climate Change Service (C3S) continued to support climate decision-making with monthly bulletins, alongside key reports such as the Global Climate Highlights and the European State of the Climate.

Several new digital tools further improved access to and use of our data. The ERA Explorer is a web app that enables users to easily visualise ERA5 reanalysis data using a fast, cloud-optimised data archive. Thermal Trace is an interactive tool that monitors global heat and cold stress from 1940 to near real time, helping assess health-related climate risks. The Interactive Climate Atlas was updated to offer an even richer set of climate projections, with new datasets, indices and improved tools.

In 2025, our work raised the profile of the Copernicus Atmosphere Monitoring Service (CAMS), whose role in monitoring air quality was highlighted at international meetings such as the WHO Global Conference on Air Pollution and Health.

The Methane Hotspot Explorer app was well received, enabling users to visualise major methane plumes and identify emission sources.

With major fires across North America, and Europe suffering its worst fire emissions in decades, 2025 was an intense wildfire year. CAMS continued to track global wildfire emissions, offering insights into fire intensity and atmospheric impacts.

The State of Wildfires 2024–2025 report, co-led by ECMWF, highlighted the growing environmental impact of wildfires, including increased emissions, degraded air quality and risks to ecosystems and human health. The report featured data from both the Copernicus Emergency Management Service (CEMS) and CAMS and reinforces evidence that climate change is increasing the frequency and intensity of extreme wildfire events globally.

As the computational centre of CEMS, ECMWF introduced a new generation of hydrological seasonal and sub-seasonal products in the European and Global Flood Awareness Systems (EFAS and GloFAS). These upgrades provide more reliable and accessible long-range high and low flow guidance.

Organisation and people

Every year, we strengthen ECMWF's structure to enhance our performance, our resilience and our effectiveness in a multi-site, sustainable and enabling working environment.

In 2025, ECMWF had 578 staff in three duty stations

During the year, three external scientists were appointed as new Fellows to collaborate on research projects at the Centre. In addition, ECMWF hosted:

- **1** WMO Fellow from Indonesia (from October 2025)
- **1** WMO Fellow from Ecuador (October 2024–September 2025)
- **3** EUMETSAT Fellows
- **4** new early-career DWD Step Up Fellows

Launched in November, the new Mutual Mentoring scheme paired junior and senior staff to boost intergenerational awareness and career learnings within the Centre.

Recruitment diversity: 42.5% of job offers in 2025 were made to women, compared with 29% in 2015.

A major review of cybersecurity strengthened our information security, with training sessions and phishing simulations to educate staff on cyber risks. Other training available to staff ranged from language classes to training and development for managers, recruitment training, and first aid and fire safety courses.

We continued working with our host nations on the construction of new state-of-the-art facilities in Reading (UK) and Bonn (Germany).

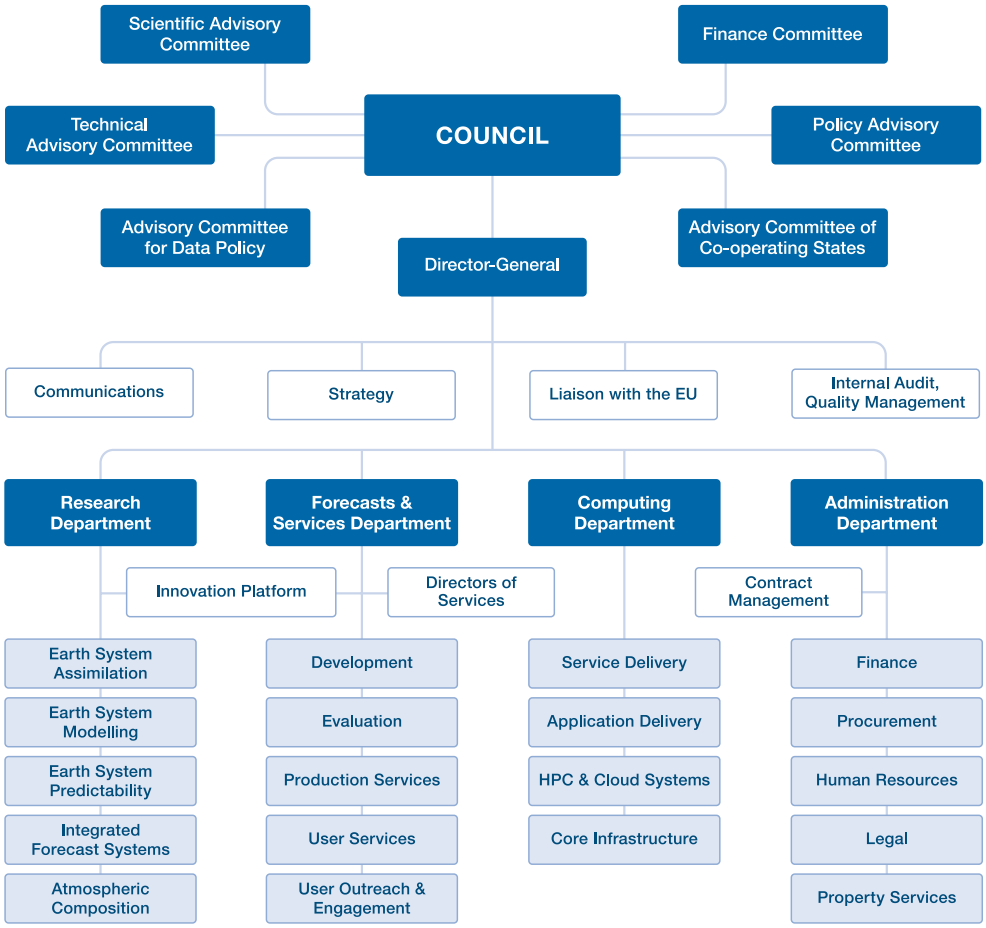
Our ambitious environmental strategy was further developed, with the aim of becoming carbon neutral by 2030 and reaching net-zero by 2050.

The financial accounts for 2025 were audited by the Turkish Court of Accounts, in line with International Standards of Supreme Audit Institutions (ISSAI) and the Financial Regulations of ECMWF.

How we work

ECMWF was created by a Convention that came into force on 1 November 1975 and was amended on 6 June 2010. The governing bodies are the Council, the Director-General, and the Council's advisory committees, whose functions are defined in the Convention.

Organisational structure in 2025



ECMWF governance in 2025

Council President Prof. Penny Endersby CBE FREng, Chief Executive, UK Met Office
Council Vice-President Dr Roar Skålin, Director-General, Norwegian Meteorological Institute
Director-General Dr Florence Rabier
Finance Committee Chair Mr Lukas Schumacher, Switzerland
Policy Advisory Committee Chair Ms Virginie Schwarz, France
Technical Advisory Committee Chair Ms Anne-Cecilie Riiser, Norway
Advisory Committee of Co-operating States Chair Mr Ilian Gospodinov, Bulgaria
Advisory Committee for Data Policy Chair Ms Monika Koehler, Austria

Scientific Advisory Committee members and experts
Prof. Dr Thomas Jung (Chair), Dr François Bouyssel (Vice-Chair), Dr Louise Nuijens, Dr Henk Eskes, Dr Oliver Fuhrer, Dr Christina Köpken-Watts, Dr Selime Gürol, Prof. Richard E Turner, Dr Isabel Trigo, Prof. Simon Vosper, Prof. Thomas Spengler, Prof. Dr Nedjeljka Žagar

Notes: From December 2025, Roar Skålin became Council President and Virginie Schwarz became Vice-President. In July 2025, the Council transitioned the ACDP to an ad-hoc committee, convening only at the request of the Council to address topics requiring specific expertise. The ACDP will have no permanent chair or members.

Celebrating half a century

Since its creation, ECMWF has made remarkable achievements in weather prediction science, built on close relationships with its Member and Co-operating States, as well as other partners around the world.

In 2025, we celebrated five decades of scientific innovation, international collaboration and leadership in weather prediction.

As we reached this half-century milestone, there was so much to remember, so many people to thank and so much to share with the global community.

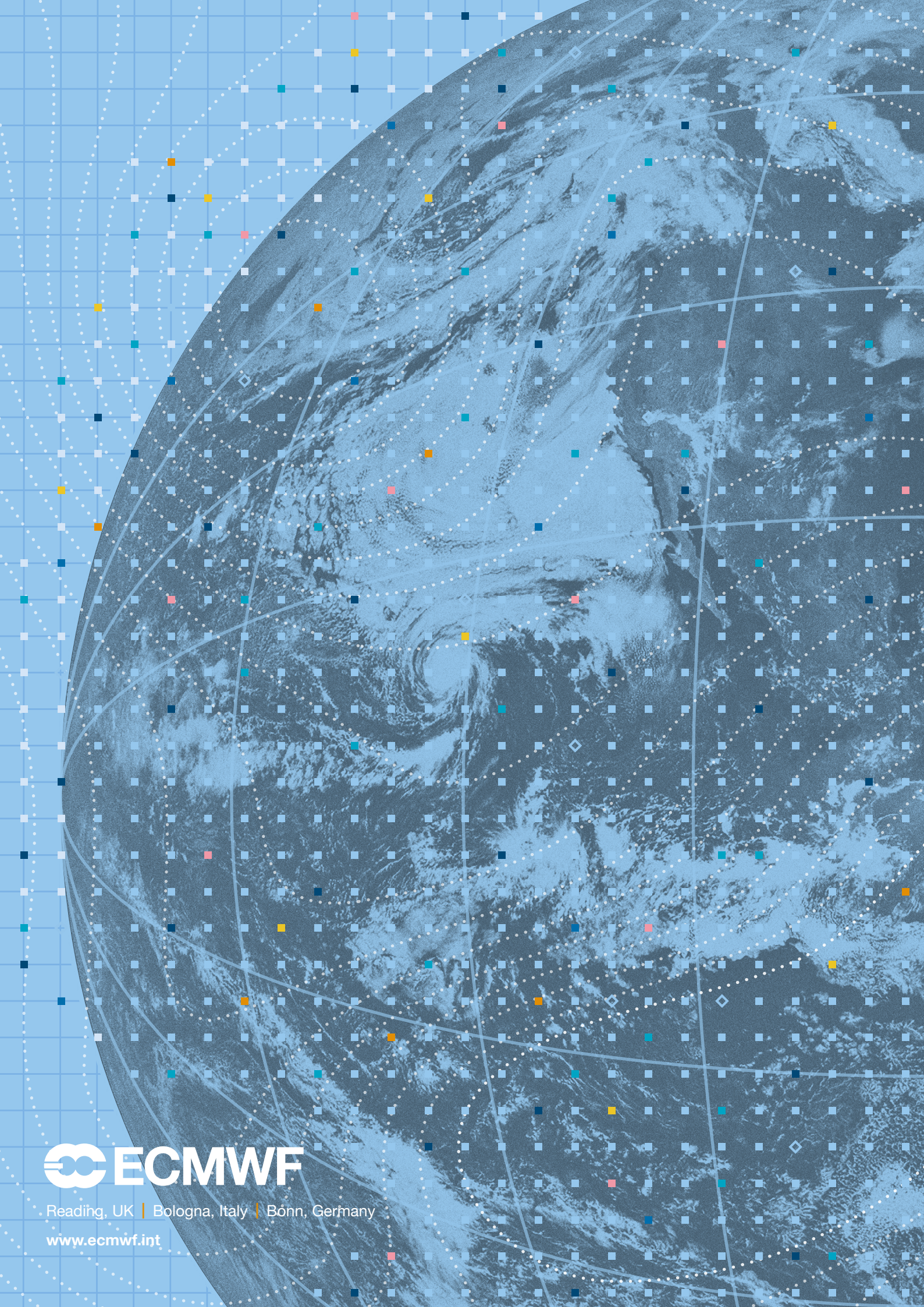
Our celebrations brought together Member States, partners and the wider meteorological community through a programme of events, publications and outreach activities across Europe and beyond.

These celebrations reflected on ECMWF's achievements over the past 50 years and highlighted our evolving role in tackling future challenges such as climate change, extreme weather and data-driven forecasting.

- A collection of six thematic publications was released throughout the year, showcasing scientific advances, partnerships and impact. These were compiled into a commemorative anniversary book.
- We marked our anniversary globally through a strong presence at major events, including the American Meteorological Society Annual Meeting, ESA's Living Planet Symposium, and the European Meteorological Society Annual Meeting, featuring dedicated booths and anniversary-themed activities.
- Special anniversary weeks were held across our three duty stations (Bonn, Bologna and Reading), reinforcing our pan-European identity. Staff, partners and stakeholders came together to celebrate our past, present and future through wide-ranging workshops, discussions and events focused on scientific progress and collaboration.

Meeting users at anniversary events in Bologna (top); Member State representatives and guests (middle) and Roar Skålin, Director General of the Norwegian Meteorological Institute and ECMWF Council President (bottom), at the gala evening in Reading.

European Centre for Medium-Range Weather Forecasts, Shinfield Park, Reading, RG2 9AX, UK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