

ECMWF ROADMAP TO 2030



The strength of a common goal



ECMWF: a roadmap to 2030

The European Centre for Medium-Range Weather Forecasts (ECMWF) is an independent intergovernmental organisation, founded in 1975 by a group of European nations coming together to pool their resources and collectively benefit from improved numerical weather prediction.

ECMWF vision:

ECMWF produces cutting-edge science and world-leading weather predictions and monitoring of the Earth system in close collaboration with the members of the European Meteorological Infrastructure, for a safe and prosperous society

ECMWF's primary role is to continue to advance medium-range weather forecasting and to provide numerical weather predictions to its Member and Co-operating States and other users around the world. To this end, ECMWF develops, and operates on a 24/7 basis, global models and data assimilation systems for the dynamics, thermodynamics and composition of the Earth's fluid envelope and interacting parts of the Earth system.

In recent years, ECMWF has also been a key player in the European Union Copernicus programme, offering quality-assured information on climate change, atmospheric composition, flooding and fire danger to its users in Europe and the rest of the world. This collaboration is now evolving to include further work towards the EU's Green Deal, with

the next phase of Copernicus (including new efforts on carbon dioxide emissions in support of the global stocktake) and the development of prototype digital twins of the Earth as part of the EU's Destination Earth.

Scientific developments at ECMWF are structured around a ten-year strategy, developed in close partnership with its Member States.

The implementation of this new Strategy will see ECMWF truly become a multi-site organisation. The new data centre located in Bologna, Italy, will be up and running in 2021, and ECMWF's new offices in Bonn, Germany, will gradually be set up, starting in 2021. These two new poles, complementing ECMWF's headquarters in Reading, United Kingdom, will offer even more opportunities for what has been key to the Centre's success, global collaboration.

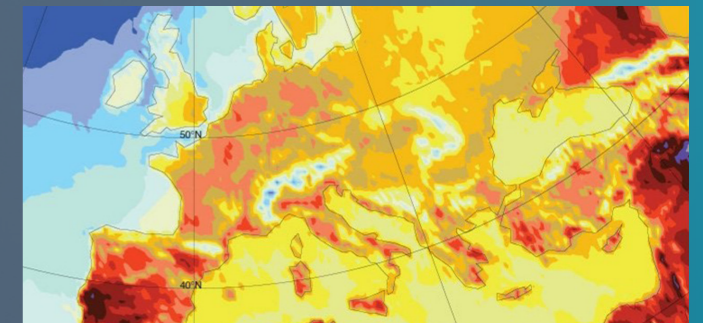
This latest strategic update comes as the world faces an unprecedented situation in contemporary history due to the COVID-19 pandemic, which will no doubt have repercussions for ECMWF and the national meteorological services of its Member States.



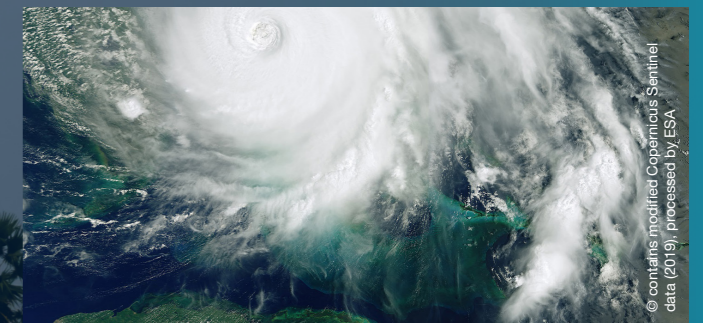
▲ ECMWF Council

ECMWF's previous Strategy formalised the primacy of ensemble forecasting and further established the Earth system approach as the way to improve forecasts seamlessly across all time ranges. The direction taken at that time led to an extremely successful period of ECMWF science.

Advances in Earth system modelling allowing coupling between atmosphere/land/ocean and sea ice for all forecasts at all ranges, the delivery of a more continuous data assimilation making 4D-Var even more resilient, and results of the first phase of the Scalability Programme highlighting not just its potential but also its necessity are all advances that the Centre plans to build upon.



▲ Aeolus satellite (I.); code adaptation as part of Scalability Programme; ECMWF temperature chart; Hurricane Dorian



Science and Technology

The Centre will work towards overcoming challenges in the initialisation of ever more sophisticated Earth system components in its Integrated Forecasting System (IFS). It will do so through enhancing the consistency of the assimilation approach and optimal coupling between the various components of the Earth system and through advanced use of observations.

The Earth system model will be improved by driving down model biases and including more realism in water, energy and carbon cycles.

Improving use of observations

- Accurate initialisation of global forecasts using a convection-permitting model
- Enhanced consistency of assimilation approach and optimal level of coupling between the various components of the Earth system.
- Step change in information extracted from satellite data over land, snow and sea ice
- Efficient use of MTG, EPS-SG and Sentinel satellite data

Improving seamless Earth system models

- Science developments to deliver operational 3–4 km convection-permitting ensemble forecasts
- Extensions to breadth, consistency and accuracy of Earth system representation with demonstrated benefit for reanalysis and forecasts

Using HPC science and machine learning

- Operational prediction system implemented on heterogeneous GPU/CPU HPC architectures
- Prototyped next-generation model and programming architecture on future world-leading HPC systems in support of Digital Twins.
- Machine learning throughout the whole numerical weather prediction chain.

Impact

Activities in extended-range weather forecasting and Earth system monitoring will be intensified. By exploiting synergies with major European initiatives, such as the Copernicus Programme and the European Green Deal, ECMWF and its Member States will be able to provide consistent weather and wider environmental information. This includes reanalyses and re-forecasts of the Earth system, covering air quality, floods, fire, droughts and climate monitoring.

To maximise the impact of ECMWF products and partnerships, ECMWF will provide world-class delivery services. A key role will be played by federated cloud platforms, such as the European Weather Cloud. A move to open data will also maximise the benefits of data.

Meeting users' needs

- Economically and societally valuable forecasts of high-impact weather events well into the second week
- Skilful predictions of extreme temperature anomalies and hydrological impacts such as droughts up to three weeks ahead on average
- Integrated global reanalyses and re-forecasts of weather and environmental hazards to monitor changing patterns and predictability of high-impact events from 1950 onwards
- Skilful subseasonal-to-seasonal multi-model outlooks

Flexible platforms and policies

- Operational flexible compute and storage cloud infrastructure to enable value-added exploitation of data.
- Relevant datasets provided through an open data policy

Organisation and People

ECMWF will strengthen its structure in a multi-site context, improve its environmental sustainability and promote a flexible working environment fostering diversity and collaboration.

On our way to 2030

During the period covered by this Strategy, ECMWF will turn 50, an age of maturity by all accounts – 50 years of learning how to collaborate most effectively with the Member States, understanding user requirements through active engagement, and serving its community through mutually beneficial schemes.

The Centre will deliver a working environment with the attributes that allow it to remain attractive to the best in the world; it will explore state-of-the-art heterogeneous HPC technology, cloud structures and artificial intelligence to fit its specific requirements; and it will continue to investigate a combination of a larger ensemble and increased vertical and horizontal resolution across the Earth system components. The advent of artificial intelligence and machine learning in the world of meteorology will deliver a well-balanced combination of atmospheric and computational sciences.

Over the next decade, ECMWF will seek to optimally combine the most appropriate concepts and technical resources needed to achieve its goals. A focus will continue to be put on close collaboration with the European Meteorological Infrastructure, the World Meteorological Organization, the European Commission, and the European Space Agency among others.

Together, these elements will build a canvas on which ECMWF's talented staff can use their expertise to further advance weather science. They will be guided by the ambition to continue to deliver the best numerical weather predictions possible to the Member States in order to protect life and property. For more information about the ECMWF ten-year Strategy, please visit: <https://www.ecmwf.int/en/about/what-we-do/strategy>



▲ ECMWF offices, Reading UK, Bologna Italy, Bonn Germany and ECMWF staff

▲ SAPP workshop with representatives from Member and Co-operating States and Florence Rabier, Director-General

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#OneECMWF

