

# **Using ECMWF's Forecasts (UEF2024)**

## **Report of Contributions**

Contribution ID: 1

Type: **not specified**

## Opening

*Wednesday, 5 June 2024 09:00 (5 minutes)*

**Presenter:** Dr RABIER, Florence (ECMWF)

**Session Classification:** Forecasting and Research Updates

Contribution ID: 2

Type: **not specified**

## Housekeeping

*Wednesday, 5 June 2024 09:05 (5 minutes)*

**Presenter:** HEMINGWAY, Becky (ECMWF)

**Session Classification:** Forecasting and Research Updates

Contribution ID: 3

Type: **not specified**

## ECMWF progress and plans

*Wednesday, 5 June 2024 09:10 (50 minutes)*

This presentation will give a high level overview of recent progress and plans at ECMWF. Particular foci will include recent and forthcoming cycle upgrades, developments in machine learning and plans for the next generation of reanalyses.

**Presenters:** BROWN, Andy (ECMWF); Mr PAPPENBERGER, Florian (ECMWF)

**Session Classification:** Forecasting and Research Updates

Contribution ID: 4

Type: **not specified**

## Update on ECMWF Product Development

*Wednesday, 5 June 2024 10:10 (25 minutes)*

An overview of the latest advancements and ongoing developments in forecast products from ECMWF NWP systems. This update will highlight the key features of new IFS cycle 49r1 and introduce some product-related topics to be covered later during this UEF2024.

**Presenter:** CHEVALLIER, Matthieu (ECMWF)

**Session Classification:** Forecasting and Research Updates

Contribution ID: 5

Type: **not specified**

## News on ECMWF's forecast performance

*Wednesday, 5 June 2024 10:35 (25 minutes)*

An update is given on ECMWF's forecast performance across lead times and for a range of upper-air and surface parameters. We take a look at how ECMWF is doing relative to other global forecasting centres, identifying specific strengths and weaknesses. The model intercomparison will also include data-driven forecasts such as from the newly developed AIFS, and how these compare to those of other machine-learning models. With the help of ERA5 forecasts as a reference (being made by a 'frozen' forecasting system) one can separate the positive effects of the latest upgrade (48r1 in June 2023) from inter- and intra-annual variability. Among other changes, in 48r1 there has been an increase in the ENS horizontal resolution and in the number of ensemble members of the extended-range forecast, both of which have led to increased skill. On the seasonal timescale, the good performance with regard to the 2023 El Niño will be discussed, and to what extent this translated into enhanced predictive skill of near-surface temperature across the globe.

**Presenter:** HAIDEN, Thomas

**Session Classification:** Forecasting and Research Updates

Contribution ID: 6

Type: **not specified**

## **Copernicus: a brief overview on the latest user-oriented advancements**

*Wednesday, 5 June 2024 13:00 (15 minutes)*

A brief snapshot on the latest user-oriented advancements on CAMS and C3S, ranging from developments on ERA6, seasonal forecasts and CO2MVS to the new CDS engine, applications and new training plans.

**Presenter:** VERMOOTE, Stijn (ECMWF)

**Session Classification:** Copernicus and ECMWF Services Updates

Contribution ID: 7

Type: **not specified**

## The Copernicus Data Stores operated by ECMWF

*Wednesday, 5 June 2024 13:15 (15 minutes)*

ECMWF implements the data dissemination services on behalf of two of the Copernicus services: the Climate Change Service (C3S) and the Atmospheric Monitoring Service (CAMS). This is done via the Climate Data Store (CDS) and the Atmosphere Data Store (ADS), both of which share a common architecture which is currently being modernised.

The common architecture data store (CADS) is designed as a distributed system which has been informed by the lessons learned from deploying and maintaining the CDS and ADS instances for over 5 years to a user-base of over 130,000 users. Access to the broad spectrum of data is facilitated via a powerful, and flexible, service-based approach which ensures state-of-the-art performance and reliability. Following the FAIR (Findable, Accessible, Interoperable, Reusable) principles, the CADS uses standardised webAPIs to provide compatibility and synergy with other platforms and facilitates direct use of the data in external applications. Dedicated resources for evaluation and quality control provide users with the assurances required to use the data products available in operational systems.

Here we present the journey to the modernised data stores, from its design in response to user demands on the legacy systems through to the development and implementation of a modularised flexible system using state-of-the-art technologies. We highlight the new features available and guide the audience through how they can make use of the data and services on offer.

**Presenter:** COMYN-PLATT, Edward

**Session Classification:** Copernicus and ECMWF Services Updates



Contribution ID: 8

Type: **not specified**

## **Forecasting atmospheric composition at ECMWF: introduction to the Copernicus Atmosphere monitoring Service (CAMS)**

*Wednesday, 5 June 2024 13:30 (15 minutes)*

In 2014, ECMWF signed with the European Commission a contribution agreement on the implementation of the Copernicus Atmosphere Monitoring (CAMS) and Climate Change (C3S) monitoring services. For 10 years, now CAMS has been developed under ECMWF supervision to deliver operational forecasts, analyses, and reanalyses of the chemical composition of the atmosphere at the regional and global scales. Transport and chemical transformation of air pollutants in the troposphere, greenhouse gases fluxes and emissions and evolution of the ozone hole are predicted and analysed by the CAMS tools which result in a unique integrated approach based on Earth observations, in-situ monitoring networks and models. This presentation is a review of available forecast products and data, highlighting current and future stakes and challenges for ECMWF and its user communities.

**Presenter:** ROUIL, Laurence

**Session Classification:** Copernicus and ECMWF Services Updates

Contribution ID: 9

Type: **not specified**

## Copernicus National Collaboration Programmes at ECMWF

*Wednesday, 5 June 2024 13:45 (15 minutes)*

The National Collaboration Programme (NCP) is a dedicated scheme to support EU Member States and Copernicus Participating States, i.e., Norway, Iceland, and UK in extracting the maximum benefit from Copernicus Atmospheric Monitoring Service (CAMS) and Copernicus Climate Change Service (C3S) services. The NCP is an initiative of ECMWF, endorsed by the European Commission, and is based on a strong need for collaboration at national level detected over the past years.

With this initiative ECMWF supports national institutions and public administrations to improve their uptake and use of CAMS and C3S products in support of their national mandate. For CAMS NCP the focus is on air quality, pollen and dust monitoring objectives, monitoring and verification of CO<sub>2</sub> and other GHG emissions (<https://atmosphere.copernicus.eu/cams-national-collaboration-programme>). For C3S NCP the focus will be on climate adaptation and climate indicators for policy planning and response.

Both the programmes have the ambition to promote novel use of CAMS and C3S data through the development or the enhancement of national services, promote communication about our products and services and collect feedback from national users to improve our own services. The NCP is a key mechanism to realise these objectives as it aims to foster capacity building and co-development of services: the NCPs will support the countries in developing their own tools to respond to European and national policy needs.

As part of the national uptake action, an Atmosphere User Forum and a C3S NCP forum have been established, as two key platforms to facilitate exchange with and among Countries.

The CAMS and C3S NCPs runs until 2027 with tangible actions co-designed with national institutes in a thoroughly collaborative spirit.

**Presenter:** ANANASSO, Cristina

**Session Classification:** Copernicus and ECMWF Services Updates

Contribution ID: 10

Type: **not specified**

## ECMWF Open Data Programme

*Wednesday, 5 June 2024 14:10 (25 minutes)*

ECMWF recognises that open data is an essential tool in contributing to the development of new meteorological methods and analysis. Since 2020, ECMWF has been taking steps towards an open data policy. In 2023, we have seen a significant increase in the user uptake of ECMWF open data.

The data currently released as open data are a subset of ECMWF Real-time catalogue at a 0.25-degree spatial resolution, from both ECMWF Integrated Forecasting System (IFS) and Artificial Intelligence/Integrated Forecasting System (AIFS). ECMWF Open Data are being provided through different mechanisms, all of which have seen a notable growth in usage in the past year:

- Open Charts Service, which provides chart visualisations of ECMWF products. Some of the increased uptake can be attributed to the introduction of charts based on Machine learning products in mid-2023.
- The Open Data Portal (an FTP service) is available since January 2022 and shows a continuing increase in numbers of requests. ECMWF predicts even higher usage with the addition of new Open Data of IFS products at higher resolution and additional parameters, plus AIFS products (machine learning-based) in early 2024.
- WMO Essential and WMO Additional datasets (also provided via FTP service) are still increasingly popular. ECMWF will, in the future, optimise this provision.
- Since January 2022, ECMWF Open Data is also redistributed by 3rd parties. ECMWF has partnered with different cloud providers as part of their public dataset program (e.g. Amazon, Google and Microsoft), but the data has also started being provided by smaller independent users (e.g. Open-meteo.de) and in research archives (e.g. NCAR). The benefit is not only a good user uptake but also that data can be shared with a larger user community with no additional load on ECMWF systems.

ECMWF is committed to moving forward to achieve the goal of an open data policy during the next few years. Creative Commons licences will be applied to further datasets, while reducing and eventually removing the cost of data. The main objective of these changes is to continue to encourage collaboration, innovation and progress within the meteorological and climate science communities.

**Presenter:** KUILMAN, Maartje (ECMWF)

**Session Classification:** Copernicus and ECMWF Services Updates

Contribution ID: 11

Type: **not specified**

## Use and Verification of ECMWF Products in the Member and Co-operating States: Survey Results

*Wednesday, 5 June 2024 14:35 (25 minutes)*

ECMWF periodically gives Member and Co-operating States an opportunity to provide formalised feedback on ECMWF products, including verification thereof. This time we delayed sending out the request because of the introduction, in June 2023, of our first model cycle to exploit the new ATOS supercomputer in Bologna - 48r1. This had higher spatial resolution, and a very different configuration for the extended ranges. By delaying we hoped to gather some early feedback on that cycle.

The request, that went out in March 2024, allowed users to either respond to an online questionnaire, or create a text report in the classical way. We keep most of the questions the same - such as "what direct use do you make of ECMWF medium range products?" - but also adapt to the changing environment with new items. New questions this time related to CAMS and fire-related forecast outputs, data-driven AI models such as AIFS, and the good and bad points of cycle 48r1. This presentation will summarise the responses, including examples from particular weather events.

**Presenter:** HEWSON, Tim (ECMWF)

**Session Classification:** Copernicus and ECMWF Services Updates

Contribution ID: 12

Type: **not specified**

## Welcome back

*Thursday, 6 June 2024 09:00 (1 minute)*

**Presenter:** HEMINGWAY, Becky (ECMWF)

**Session Classification:** Machine Learning and the AIFS

Contribution ID: 13

Type: **not specified**

## Leveraging Large Language Models for Weather and Climate Information Retrieval

*Thursday, 6 June 2024 09:01 (39 minutes)*

Large Language Models (LLMs) have revolutionized the way we interact with data and information. We will examine the potential of LLMs in enhancing the interpretation of complex weather and climate datasets, as well as generating new insights through data processing and analysis. We will begin with an overview of LLMs, outlining fundamental approaches to developing systems that utilize them, such as chatbots. Subsequently, existing services and prototypes utilizing weather and climate data are discussed, followed by considerations of potential future services in this domain.

**Primary author:** KOLDUNOV, Nikolay (Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung (AWI))

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**Presenter:** KOLDUNOV, Nikolay (Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung (AWI))

**Session Classification:** Machine Learning and the AIFS

Contribution ID: 14

Type: **not specified**

## Machine Learning Activities at ECMWF: an overview

*Thursday, 6 June 2024 09:40 (20 minutes)*

Machine Learning (ML) is playing an increasingly significant role across ECMWF, both through hybrid approaches (helping to improve existing forecasting systems) and data-driven approaches (resulting in new models such as our data-driven forecasting system, AIFS). Within data-driven approaches, we are training from reanalysis/analysis datasets, whilst also exploring how to train models directly from observations, thus harnessing the wealth of information within them and developing a truly data-driven model.

ML is not only revolutionising our core activities but is also playing a key role in the development of the digital twins in Destination Earth. We are using ML to help us quantify uncertainty in km-scale models and to build new data-driven Earth System components which will complement the existing traditional Earth System model currently used. Furthermore, the portability of ML forecasting models offers the prospect of enhanced interactivity for users of the digital twins.

**Presenter:** CLARE, Mariana (ECMWF)

**Session Classification:** Machine Learning and the AIFS

Contribution ID: 15

Type: **not specified**

## **AIFS: a new ECMWF forecasting system**

*Thursday, 6 June 2024 10:10 (25 minutes)*

ECMWF has developed a data-driven forecast model, the Artificial Intelligence/Integrated Forecasting System (AIFS), which is now run in experimental mode alongside our NWP model IFS. AIFS's forecasts are highly skilful and now available to the public. The talk will describe the current state of AIFS, its architecture and framework, and discuss some of the design decisions. Furthermore, we will present future extensions of AIFS.

**Presenter:** LANG, Simon (ECMWF)

**Session Classification:** Machine Learning and the AIFS



Contribution ID: 16

Type: **not specified**

## Forecast evaluation of AIFS

*Thursday, 6 June 2024 10:35 (25 minutes)*

In this presentation we will give an overview of the evaluation work for AIFS, with a focus on different kind of extreme events. As for other machine-learning based weather forecasts, we see very good scores both in terms of surface and upper-air variables. We will explore if there is any pattern in the performance relative to IFS (seasonal, regional, etc.). Regarding extremes we will look at different cases to see the strength and limitations of ML-based forecasts.

**Presenter:** MAGNUSSON, Linus (ECMWF)

**Session Classification:** Machine Learning and the AIFS

Contribution ID: 17

Type: **not specified**

## Latest developments on ECMWF's graphical products and applications

*Thursday, 6 June 2024 13:00 (30 minutes)*

This talk will give an overview of latest developments on ECMWF's graphical products and applications (Opencharts and ecCharts) as well as outlining the plan for upcoming changes and new products. The talk also aims to have a Q&A session at the end to discuss user's feedbacks and issues.

**Presenter:** SAHIN, Cihan (ECMWF)

**Session Classification:** Speakers Corner –Updates on ECMWF forecast products

Contribution ID: 18

Type: **not specified**

## A new diagnostic for identifying cyclonic and anticyclonic regions and its application for combining ensemble

*Thursday, 6 June 2024 13:30 (20 minutes)*

This presentation introduces a new simple diagnostic, called CURV (Curvature Using Radial Variation), that identifies cyclonic and anticyclonic regions using surface pressure or geopotential height, over a range of scales (typically 500-4000km). CURV has been developed as part of work to assess the benefit of combining forecasts from the medium-range and extended-range ensembles.

The method for computing the CURV diagnostic will be shown in a pictorial way along with the rationale behind it, which will then be followed by real examples of what it looks like and reveals. Brief initial results using CURV to combine and verify ensemble forecasts will be provided before considering a variety of practical uses in operational weather forecasting.

**Presenter:** ROBERTS, Nigel (ECMWF)

**Session Classification:** Speakers Corner –Updates on ECMWF forecast products

Contribution ID: 19

Type: **not specified**

## Simulation of top-of-the-atmosphere visible reflectances

*Thursday, 6 June 2024 14:00 (20 minutes)*

The generation of near-real-time simulated satellite images has been further developed in the operational ECMWF's Integrated Forecasting System (IFS) Cycle 48r1 to include visible simulated images in addition to the existing infrared images. Following progress in the radiative transfer modelling for visible wavelengths, reflectances that would be seen in a visible channel (635 nm and 810 nm of SEVIRI on Meteosat-10, for example) are now computed during the model run from every grid point of the forecast model and available within the standard delivery times of all other ECMWF data and products. This presentation describes the assumptions and the methodology used in this development, highlighting the potential scientific and operational values of realistic satellite imagery products based on high-resolution Numerical Weather Prediction (NWP) output.

**Presenter:** LUPU, Cristina (ECMWF)

**Session Classification:** Speakers Corner –Updates on ECMWF forecast products

Contribution ID: 20

Type: **not specified**

## A new user-focussed approach for displaying extended range forecast maps

*Thursday, 6 June 2024 14:20 (15 minutes)*

Whilst the users and the uses of extended range forecasts are inevitably wide-ranging, a common, basic user requirement for map products is visualising these two factors: (i) where there is a shift in the distribution of the ensemble member forecasts, and what the sign and magnitude of that shift is, and (ii) how ensemble member forecast spread compares with climatological (reforecast) spread.

Currently available ensemble mean products, which use a statistical significance test, have their place, but do not fit these basic needs very well. This presentation will provide, with examples, an idea for an alternative approach, in which we show, on one map, both the ensemble mean anomaly, where it differs from some near-normal range, and a spread-related metric based on comparing the interdecile ranges of the forecasts and the reforecasts. Significance tests may not be needed. For most variables this overall approach should work well, although some difficulties are envisaged - for example for rainfall when rain is forecast in an arid climate. These difficulties will also be discussed. A key aim of this talk is to glean some early user feedback on these ideas.

**Presenter:** HEWSON, Tim (ECMWF)

**Session Classification:** Speakers Corner –Updates on ECMWF forecast products

Contribution ID: 21

Type: **not specified**

## New Extratropical Cyclone products related to "front density"

*Thursday, 6 June 2024 14:35 (10 minutes)*

Based on code ported from the Met Office, and as part of a collaborative effort connected to the Extratropical Cyclone product suite, ECMWF has been testing out a new set of medium range products related to the "density of fronts" across the ensemble. Products from each data time include the front density itself, and also a list of the "most representative member" for each lead time. Assignment of "most representative" is based on identifying the member whose fronts match up best with the front density fields. In addition, various graph-format products are available to highlight, for example, forecast confidence based on front density, and how representative the unperturbed run is, at the different lead times.

This short presentation will describe the products using examples, and discuss potential uses. We will also touch on the strengths and weaknesses of front-density-based products from different user perspectives.

**Presenter:** HEWSON, Tim (ECMWF)

**Session Classification:** Speakers Corner –Updates on ECMWF forecast products

Contribution ID: 22

Type: **not specified**

## **Final Q&A and Close of UEF2024**

*Thursday, 6 June 2024 14:45 (15 minutes)*

**Presenter:** HEMINGWAY, Becky (ECMWF)

**Session Classification:** Speakers Corner –Updates on ECMWF forecast products