

# ECMWF open data: real-time forecasts from IFS and AIFS

Find out how to access ECMWF real-time open data

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ECMWF has recently deployed an updated version of the IFS Open Data at 0.25 degrees, with additional parameters to enable limited area model and machine-learning initialisation.



The existing 0.4 degree data will be deprecated in 3 months time. We encourage all users to transition to the new 0.25 degree resolution data as soon as possible. All python packages have been updated, accordingly.



See important licence and attribution information regarding open data on [our datasets page](#).

## Where to find the real-time open data

This page documents the access to ECMWF [IFS open data](#) and the [AIFS Machine Learning Data](#).

You can use the [ECMWF link](#) to browse the list of files.

Currently, ECMWF open real-time data are available from these locations:

- ECMWF, with ROOT set to <https://data.ecmwf.int/forecasts>
- Microsoft's Azure, with ROOT set to "<https://ai4edataeuwest.blob.core.windows.net/ecmwf>"
- Amazon's AWS, with ROOT set to "<https://ecmwf-forecasts.s3.eu-central-1.amazonaws.com>"

See [file-naming convention](#) below for an explanation of ROOT.



Sign up for an open data mailing list, a joint project with EUMETSAT, Met Norway and DWD to share new and updated open datasets, and relevant resources, conferences and articles.

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## File format

The files are in GRIB edition 2 format, except for trajectories which are in BUFR edition 4 format. We recommend using [ecCodes](#) version 2.24.2 or newer to manipulate the GRIB and BUFR files.

## File-naming convention

The files are provided with the following naming convention:

```
[ROOT]/[yyyymmdd]/[HH]z/[model]/[resol]/[stream]/[yyyymmdd][HH]0000-[step]
[U]-[stream]-[type].[format]
```

where:

- [ROOT] is the top-level URL of one of the sites hosting the data. See the [above](#) for possible values.
- [yyyymmdd] is the reference date of the forecasts (base date).
- [HH] is the reference time of the forecasts. Values are 00, 06, 12 and 18.
- [model] is the production model (IFS or AIFS). **Note: IFS and AIFS have different options, so please be review dataset pages to see what is available.**
- [resol] is the horizontal resolution of the data. **Options include: 0p25 or 0p4-beta**
- [stream] is the forecasting system that produces the data. Values are:
  - oper - [high-resolution forecast](#), atmospheric fields
  - enfo - [ensemble forecast](#), atmospheric fields (not applicable for AIFS model)

- `waef` - ensemble forecast, ocean wave fields, (not applicable for AIFS model)
- `wave` - wave model, (not applicable for AIFS model)
- `scda` - short cut-off high-resolution forecast, atmospheric fields (also known as "high-frequency products") (not applicable for AIFS model)
- `scwv` - short cut-off high-resolution forecast, ocean wave fields (also known as "high-frequency products") (not applicable for AIFS model) and
- `mmsf` - multi-model seasonal forecasts fields from the ECMWF model only (not applicable for AIFS model).
- `[step]` is the forecast time step expressed in units `U`
- `[U]` is the unit used for the time step. Values are `h` for hours and `m` for month. The latter is only valid for seasonal forecasts (`mmsf`).
- `[type]` is once of `fc` (forecast), `ef` (ensemble forecast), `ep` (ensemble probabilities) or `tf` (trajectory forecast for tropical cyclone tracks).
- `[format]` is `grib2` for all fields, and `bufr` for the trajectories.

The valid combinations of the above are:

```
format=bufr, type=tf
HH=00/12
    stream=enfo/oper, step=240h
HH=06/18
    stream=enfo, step=144h
    stream=scda, step=90h
format=grib2
HH=00/12
    stream=enfo/waef
    type=ef, step=0h to 144h by 3h, 144h to 360h by 6h
    type=ep, step=240h/360h
    stream=oper, wave
    type=fc, step=0h to 144h by 3h, 144h to 240h by 6h
HH=06/18
    stream=enfo/waef
    type=ef, step=0h to 144h by 3h
    stream= scda /scwv
    type=fc, step=0h to 90h by 3h
HH=00
    stream=mmsf, type=fc, u=m, step=1m to 7m
```

## Access real-time open data with Python package `ecmwf-opendata`

A Python package called `ecmwf-opendata` is available from [PyPi](#) that greatly facilitates the access to this dataset. In addition, a series of [Jupyter Notebooks](#) have been developed to demonstrate the use of this package.

## Examples of how to access real-time open data with `wget` or `curl`

In the following examples, `[ROOT]` should be replaced by one of the [locations](#) specified above.

Although all of the examples provided here use `wget`, `curl` can similarly be used to download the products.

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## Examples using wget for products based on the Atmospheric Model high-resolution (HRES) forecasts

In the following examples, [ROOT] should be replaced by one of the [locations](#) specified above.

Although all of the examples provided here use wget, curl can similarly be used to download the products.

### HRES direct model output

For direct model output from the Atmospheric model high-resolution (HRES) forecast time 00 and 12 UTC, **stream=oper** and **type=fc** should be used.

The steps available are 0h to 144h by 3h and 150h to 240h by 6h. The file format is **grib2**.

The example shows how to download the file containing all of the parameters available at step=24h from the 00UTC HRES forecast run on 25 January 2022:

```
wget [ROOT]/20240301/00z/ifs/0p25/oper/20240301060000-24h-oper-fc.grib2
```

For direct model output from the Atmospheric model high-resolution (HRES) forecast time 06 and 18 UTC, **stream=scda** and **type=fc** should be used.

The steps available are 0h to 90h by 3h only. The file format is **grib2**.

The example shows how to download the file containing all of the parameters available at step=24h from the 06 UTC HRES forecast run on 25 January 2022:

```
wget [ROOT]/20240301/06z/ifs/0p25/scda/20240301060000-24h-scda-fc.grib2
```

### HRES Tropical Cyclone track products



Tropical cyclone tracks products are only available when there are tropical cyclones observed or forecast.

For the Tropical Cyclone track products from the Atmospheric model high-resolution (HRES) forecast time 00 and 12 UTC, **stream=oper** and **type=tf** should be used.

Products are provided only at **step=240**. The file format is **bufr**.

The example shows how to download the file containing all of the TC Track products from the 00 UTC HRES forecast run on 25 January 2022:

```
wget [ROOT]/20240301/00z/ifs/0p25/oper/20240301060000-240h-oper-tf.bufr
```

For the Tropical Cyclone track products from the Atmospheric model high-resolution (HRES) forecast time 06 and 18 UTC, **stream=scda** and **type=tf** should be used.

Products are provided only at **step=90**. The file format is **bufr**.

The example shows how to download the file containing all of the TC Track products from the 18 UTC HRES forecast run on 25 January 2022:

```
wget [ROOT]/20240301/18z/ifs/0p25/scda/20240301060000-90h-scda-tf.bufr
```

#### See also

[ECMWF Service Status](#)  
[ECMWF Real-time Catalogue](#)  
[ECMWF Archive Catalogue](#)  
[ECMWF Open Charts](#)

#### Get help

## Support level for these datasets

Both datasets are provided as a 'self-serve' dataset - documentation is provided, but no support service.

However, if the data seems broken or corrupt, please report it via our support portal and we will respond during normal office hours.

[Report a problem](#)

#### Contents of this space

[Expand all](#) [Collapse all](#)

## Examples using wget for products based on the Wave Model high-resolution (HRES-WAM) forecasts

### HRES-WAM direct model output

For direct model output from the Wave model high-resolution (HRES-WAM) forecast at time 00 and 12 UTC, **stream=wave** and **type=fc** should be used.

The steps available are 0h to 144h by 3h and 150h to 240h by 6h. The file format is **grib2**.

The example shows how to download the file containing all of the parameters available at step=06h from the 12 UTC HRES-WAM forecast run on 25 January 2022:

```
wget [ROOT]/20240301/12z/ifs/0p25/wave/20240301060000-12h-wave-fc.grib2
```

For direct model output from the Wave model high-resolution (HRES-WAM) forecast at time 06 and 18 UTC, **stream=scwv** and **type=fc** should be used.

The steps available are 0h to 90h by 3h only. The file format is **grib2**.

The example shows how to download the file containing all of the parameters available at step=18h from the 06 UTC HRES-WAM forecast run on 25 January 2022:

```
wget [ROOT]/20240301/06z/ifs/0p25/scwv/20240301060000-18h-scwv-fc.grib2
```

## Examples using wget for products based on the Atmospheric Model ensemble (ENS) forecasts

### ENS direct model output products

For direct model output from the Atmospheric model ensemble (ENS) forecast at all times 00, 06, 12 and 18 UTC, **stream=enfo** and **type=ef** should be used.

- At **time=00** and **time=12**, the steps available are 0h to 144h by 3h and 150h to 360h by 6h.
- At **time=06** and **time=18**, the steps available are 0h to 144h by 3h only

The file format is **grib2**.

The example shows how to download the file containing all of the parameters available at step=24h for all 50+1 ensemble members from the 00UTC ENS forecast run on 25 January 2022:

```
wget [ROOT]/20240301/00z/ifs/0p25/enfo/20240301060000-24h-enfo-ef.grib2
```

### ENS Tropical Cyclone track products



Tropical cyclone tracks products are only available when there are tropical cyclones observed or forecast.

For the Tropical Cyclone track products from the Atmospheric model ensemble (ENS) forecast time 00 and 12 UTC, **stream=enfo** and **type=tf** should be used.

Products are provided only at **step=240**. The file format is **bufr**.

The example shows how to download the file containing all of the TC Track products from the 00 UTC HRES forecast run on 25 January 2022:

```
wget [ROOT]/20240301/00z/ifs/0p25/enfo/20240301060000-240h-enfo-tf.bufr
```

For the Tropical Cyclone track products from the Atmospheric model ensemble (ENS) forecast time 06 and 18 UTC, **stream=enfo** and **type=tf** should be used.

Products are provided only at **step=144**. The file format is **bufr**.

The example shows how to download the file containing all of the TC Track products from the 06 UTC ENS forecast run on 25 January 2022:

```
wget [ROOT]/20240301/06z/ifs/0p25/enfo/20240301060000-144h-enfo-tf.bufr
```

## ENS Probability products

For the probability products from the Atmospheric model ensemble (ENS) forecast at all times 00, 06, 12 and 18 UTC, **stream=enfo** and **type=ep** should be used.

Products are available at **time=00** and **time=12** only.



There are no ENS probability products for time=06 or time=18.

The steps available are 0h to 144h by 3h and 150h to 360h by 6h. The file format is **grib2**.



The name of the file to be downloaded depends on the step. Use:

- **step=240h** in the file name for products at forecast steps 0h to 144h by 3h and 150h to 240h by 6h
- **step=360h** in the file name for products at forecast steps 246h to 360h by 6h

For probability products from the time=00 and time=12 ENS forecasts for for steps 0h to 144h by 3h and steps 150h to 240h by 6h, use **step=240**. The example is for the 00 UTC ENS forecast run on 25 January 2022:

```
wget [ROOT]/20240301/00z/ifs/0p25/enfo/20240301060000-240h-enfo-ep.grib2
```

For probability products from the time=00 and time=12 ENS forecasts for steps 246h to 360h by 6h, use **step=360**. The example is for the 12 UTC ENS forecast run on 25 January 2022:

```
wget [ROOT]/20240301/12z/ifs/0p25/enfo/20240301060000-360h-enfo-ep.grib2
```

## Examples using wget for products based on the Wave Model ensemble (ENS-WAM) forecasts

For direct model output from the Wave model ensemble (ENS) forecast at all times 00, 06, 12 and 18 UTC, **stream=waef** and **type=ef** should be used.

- At **time=00** and **time=12**, the steps available are 0h to 144h by 3h and 150h to 360h by 6h.
- At **time=06** and **time=18**, the steps available are 0h to 144h by 3h only

The file format is **grib2**.

The example shows how to download the file containing all of the parameters available at step=24h for all 50+1 ensemble members from the 00UTC ENS-WAM forecast:

```
wget [ROOT]/20240301/00z/ifs/0p25/waef/20240301000000-24h-waef-ef.grib2
```

## ENS-WAM Probability products

For the probability products from the wave model ensemble (ENS) forecast at all times 00, 06, 12 and 18 UTC, **stream=waef** and **type=ep** should be used.

Products are available at **time=00** and **time=12** only.



There are no ENS-WAM probability products for time=06 or time=18.

The steps available are 0h to 144h by 3h and 150h to 360h by 6. The file format is **grib2**.



The name of the file to be downloaded depends on the step. Use:

- **step=240h** in the file name for products at forecast steps 0h to 144h by 3h and 150h to 240h by 6h
- **step=360h** in the file name for products at forecast steps 246h to 360h by 6

For probability products from the time=00 and time=12 ENS-WAM forecasts for for steps 0h to 144h by 3h and steps 150h to 240h by 6h, use **step=240**. The example is for the 00 UTC ENS-WAM forecast run on 25 January 2022:

```
wget [ROOT]/20240301/00z/0p4-beta/waef/20240301000000-240h-waef-ep.grib2
```

For probability products from the time=00 and time=12 ENS forecasts for steps 246h to 360h by 6h, use **step=360**. The example is for the 12 UTC ENS-WAMforecast run on 25 January 2022:

```
wget [ROOT]/20240301/12z/0p4-beta/waef/20240301120000-360h-waef-ep.grib2
```

## Download a single field with wget

All of the examples above download a single file containing all of the parameters for that dataset at the specific forecast step or steps.

It is also possible to download of a single field using the HTTP [Byte-Range request](#) feature.

To download only the 2m temperature at step=24h from the 00 UTC HRES forecast on 25 January 2022, first download the associated [index file](#) by substituting the '.grib2' extension with '.index' in the URL:

```
wget [ROOT]/20240301/00z/0p4-beta/oper/20240301000000-24h-oper-fc.index
```

Inspect the index file and look for the entry for 2m temperature ('param' : '2t')

```
...
{"domain": "g", "date": "20240301", "time": "0000", "expver": "0001",
"class": "od", "type": "fc", "stream": "oper", "step": "24", "levtype":
"sfc", "param": "2t", "_offset": 17459800, "_length": 609046}
...
```

Use the values of `_offset` and `_length` keys for this record to construct the `start_bytes` and `end_bytes`:

```
start_bytes = _offset = 17459800
end_bytes = _offset + _length - 1 = 17459800 + 609046 - 1 = 18068845
```



The "`_offset`" and "`_length`" values of a specific field will change from forecast run to forecast run. It is necessary to redo this computation for each download.

Use the `start_bytes` and `end_bytes` values calculated to pass the range of bytes to be downloaded to `wget`, this time for the .grib2 file:

```
wget [ROOT]/20240301/00z/ifs/0p25/oper/20240301000000-24h-oper-fc.grib2
--header="Range: bytes=17459800-18068845"
```

Alternatively, `curl` can be used:

```
curl --range 17459800-18068845 [ROOT]/20240301/00z/0p25/oper
/20240301000000-24h-oper-fc.grib2 --output 2t.grib2
```



Multipart byte ranges of the form:

```
wget ... --header="Range: bytes=17459800-18068845, 18168021-
1819654"
```

are **not** supported by all servers.

## Index files

Each GRIB file is associated with a corresponding index file, accessible by substituting the '.grib2' extension with '.index' in the URL. Index files are text files where each line is a JSON record (JSON details [here](#)). Each record represents a GRIB field in the corresponding GRIB file, described using the MARS query language, for example:

```
{ "domain": "g", "date": "20240301", "time": "1200", "expver": "0001",  
  "class": "od", "type": "fc", "stream": "oper", "step": "6", "levelist":  
  "1000", "levtype": "pl", "param": "q", "_offset": 3857250, "_length":  
  609046 }
```

In addition, the keys `_offset` and `_length` represent the byte offset and length of the corresponding field. This allows the download of a single field using the HTTP [Byte-Range request](#). An example is provided in [Download a single field with wget](#) above.

## Differences between MARS language and file naming convention

There are some minor differences between the normal [MARS request language](#) and the open data file naming.

These are summarised in the table for information.

MARS			File names		
Stream	Type	Step	Stream	Type	Step
oper /wave	fc	nnn	oper /wave	fc	nnn
enfo/waef	cf	nnn	enfo/waef	ef	nnn
enfo/waef	pf	nnn	enfo/waef	ef	nnn
enfo/waef	em	nnn	enfo/waef	ep	240 if nnn <= 240 else 360
enfo/waef	es	nnn	enfo/waef	ep	240 if nnn <= 240 else 360
enfo/waef	ep	nnn	enfo/waef	ep	240 if nnn <= 240 else 360
mshm /em	fcmean /em	nnn	mmsf	fc	nnn