

# How to download ERA5

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## 1 - Introduction

This article describes how users can access [the family of ERA5 datasets](#) via the Climate Data Store (CDS) infrastructure.

ERA5 data can be downloaded through the CDS either via the CDS web interface or programmatically using the CDS API service.

Any data in the CDS catalogue can be accessed in these two ways. And since such data is kept online, access is usually fast. Some parts of the ERA5 dataset are only accessible through the CDS API service. An example is ERA5 model level data that resides in the ECMWF's MARS tape archive. The extraction of such data from tape can lead to significantly longer retrieval times than data that is available online.



Users are now able to check the **status of the CDS queue**. You will be able to view status of requests submitted by yourself (you need to log into the CDS) and other users: <https://cds.climate.copernicus.eu/live/queue>

## 2 - Prerequisites

- Learn more about [the family of ERA5 datasets](#), and browse through the [ERA5 data documentation](#) and [ERA5-Land data documentation](#).
- CDS account - If you do not yet have a CDS account, please create one [HERE](#).
- Accept the Copernicus licence by creating a test download using the CDS Download web form interface (see below).

## 3 - Downloading online ERA5 family data through the CDS web interface

1. Go to the [C3S climate data store \(CDS\)](#).
2. Type 'ERA5' in the search box.
3. Follow the ERA5 dataset title link of interest (there will be many more hits).
4. Currently there are eight online ERA5 and two ERA5-Land catalogue entries
  - [ERA5 hourly data on single levels from 1940 to present](#)
  - [ERA5 monthly averaged data on single levels from 1940 to present](#)
  - [ERA5 hourly data on pressure levels from 1940 to present](#)
  - [ERA5 monthly averaged data on pressure levels from 1940 to present](#)
  - [ERA5-Land hourly data from 1950 to present](#)
  - [ERA5-Land monthly averaged data from 1950 to present](#)
5. Each of these dataset catalogue entries includes the following tabs:
  - **Overview** . This gives a description of the selected dataset and metadata information (e.g. spatial details, file format, variables, etc).
  - **Documentation** . This provides links to detailed documentation about the dataset.
  - **Download data** . This is a download web form.
6. Go to the Download data tab to make your selection for ERA5 data retrieval. Using this web interface, you can:
  - make selections as per your requirements. For your convenience only valid combinations will show; invalid combinations are greyed out interactively.
  - accept the data licence in the **Terms of use** section (in case you had not yet accepted it). You will only see this section after you have logged in.



You will need to do this regardless whether you are accessing data through the web interface or through the CDS API (see below).

7. Click on the button **Submit Form** at the bottom right to submit your data request (you must be logged in and have accepted the terms and conditions before submitting your request).
8. You will now be redirected to the **Your requests** page.

Once your request has been processed you can download the data by clicking the green **Download button**. You can check the [Live status of your request](#).

## 4 - Download ERA5 family data through the CDS API

### First: Install CDS API on your machine

1. This is Python based.
  - This may require some basic knowledge of Python. However, in most cases common-sense adaptations of example requests obtained from the web interface should be sufficient.
2. Install the CDS API:
  - this may require some basic knowledge of pip, in particular know how to install packages on your local machine using pip.
  - On linux or on cygwin, please follow the instructions [HERE](#).
  - Windows users may follow the instructions [HERE](#) instead.
  - Mac users may follow the instructions [HERE](#).
3. You are recommended to use the latest release of package [CDS API](#).
4. Run CDS API requests, either interactively or in batch mode.



In a small number of cases, users may experience some issues when requesting data from the CDS API. The most common issues are documented [here](#).

### Option A: Download ERA5 family data stored on CDS disks - FAST ACCESS

1. Build a basic CDS API request.
  - You can use the CDS web interface to help you build your CDS API download script.
  - In the **Download data** tab, make some selections, then click the button **Show API request** at the bottom left and you will be presented with the script.
  - Copy and paste this to your preferred text editor.

```
#!/usr/bin/env python

import cdsapi

c = cdsapi.Client()

c.retrieve(
    'reanalysis-era5-pressure-levels',
    {
        'product_type': 'reanalysis',
        'variable': 'temperature',
        'pressure_level': '1000',
        'year': '2008',
        'month': '01',
        'day': '01',
        'time': '12:00',
        'format': 'netcdf',          # Supported format: grib and netcdf. Default: grib
    },
    'download.nc')                 # Output file. Adapt as you wish.
```

2. Refine your CDS API script for ERA5 data listed in CDS for optional post-processing.
  - For a different grid resolution, use the key **'grid'**.
  - Please note that the ERA5 native grid of online CDS is 0.25°x0.25° (atmosphere), 0.5°x0.5° (ocean waves), mean, spread and members: 0.5°x0.5° (atmosphere), 1°x1° (ocean waves). ERA5-Land: 0.1°x0.1°. So this will be returned by default.

```

• #!/usr/bin/env python
import cdsapi

c = cdsapi.Client()

c.retrieve(
    'reanalysis-era5-pressure-levels',
    {
        'product_type': 'reanalysis',
        'variable': 'temperature',
        'pressure_level': '1000',
        'year': '2008',
        'month': '01',
        'day': '01',
        'time': '12:00',
        'format': 'netcdf', # Supported format: grib and netcdf. Default: grib
        'area': [60, -10, 50, 2], # North, West, South, East. Default: global
        'grid': [1.0, 1.0], # Latitude/longitude grid. Default: 0.25 x
    },
    'era5_temperature_sub_area.nc') # Output file. Adapt as you wish.

```

To retrieve data efficiently using the CDS API please have a look at the [efficiency tips section on CDS documentation](#).



#### Requests for ERA5 data in NetCDF

When requesting ERA5 data from the CDS in NetCDF (web or CDS API), users should not request ERA5 reanalysis atmospheric data, wave data, and ensemble data in one request. This is because the data has different spatial grids, which can cause issues for the current grib to NetCDF converter and produce incorrect results.

## Option B: Download ERA5 family data stored on MARS tape archive (no data selection can be made from the CDS download form) - SLOW ACCESS

Although some flavours of the ERA5 family data is not online in the CDS (i.e. not available through the interactive web download form), it is accessible through CDS API. This embraces ERA5-complete and ERA5.1-complete, which provide data in the 'raw' format as they were produced:

- native grid rather than regridded into regular lat-lon,
- model and potential temperature/vorticity levels, in addition to pressure levels and surface fields,
- full two-dimensional ocean-wave spectra in addition to integrated wave parameters,
- explicit distinction between analysis, short-forecast and other, more technical, products.

The ERA5-Land dataset at the native 9km octahedral grid is an exception and is not available via the CDS API protocol. However, all information is available online at the slightly reduced 0.1°x0.1° regular lat-lon grid (access via Option A, above).

Due to the vast volume of these datasets (currently about 10petabyte) these are not stored on spinning disk, but reside in the ECMWF's MARS tape archive, instead. Access to this data is in general much slower, except for the latest couple of months of ERA5-complete, which are also kept online.



Please be aware that there is an additional queueing system for downloading data from the ECMWF's MARS archive - **expect several hours to several days for submitted requests to complete** at this time. You can check the [Live status of your request](#)

**You can discover the ERA5-complete structure (1940-present) and learn how to build a CDS API request by following these steps:**

1. Open the [MARS ERA5 catalogue](#)
2. browse for discovery, and browse your way to the parameter level to build a request.



- More information on the available streams, product types and levels is available in the [ERA5 data documentation](#).
- On the parameter level, use the left-mouse button and the shift key to select more than one field in one retrieval.
- The MARS catalogue only shows data for the final quality controlled data that is made available 2-3 months in arrears. However, data is also available from preliminary timely updates up to 5 days behind real time, using the same retrieval structure.



To retrieve MARS data efficiently (and get your data quicker!) **you should retrieve all the data you need from one tape, then from the next tape, and so on.**

As a rule of thumb everything shown on one page at parameter level in the [MARS ERA5 catalogue](#) is grouped together on one tape

- For analysis fields this is one month of data with respect to one particular level type (e.g. surface).
- For forecast fields on model levels this is limited to one single day.

3. Use the "[View MARS request](#)" feature - this will help you build your own CDS API Python script to retrieve the data through the CDS API.

```
#!/usr/bin/env python
import cdsapi
c = cdsapi.Client()
c.retrieve('reanalysis-era5-complete', { # Requests follow MARS syntax
                                         # Keywords 'expver' and 'class' can be dropped. They are
obsolete                                # since their values are imposed by 'reanalysis-era5-complete'
                                         # The hyphens can be omitted
    'date'      : '2013-01-01',          # 1 is top level, 137 the lowest model level in ERA5. Use '/'
    'levelist'  : '1/10/100/137',        to separate values.
    'levtype'   : 'ml',
    'param'     : '130',                 # Full information at https://apps.ecmwf.int/codes/grib/param-
db/                                     db/
                                         # The native representation for temperature is spherical
harmonics
    'stream'    : 'oper',                # Denotes ERA5. Ensemble members are selected by 'enda'
    'time'      : '00/to/23/by/6',        # You can drop :00:00 and use MARS short-hand notation, instead
of '00/06/12/18'
    'type'      : 'an',
}, 'output')                             # Output file; in this example containing fields in grib
format. Adapt as you wish.
```

4. Tailor your request to

- re-grid to the desired regular lat-lon resolution
- convert to NetCDF (works for regular grids only, i.e., so you need to use the 'grid' keyword as well)
- select sub areas

```
#!/usr/bin/env python
import cdsapi
c = cdsapi.Client()
c.retrieve('reanalysis-era5-complete', { # Requests follow MARS syntax
                                         # Keywords 'expver' and 'class' can be dropped. They are
obsolete                                # since their values are imposed by 'reanalysis-era5-
complete'                                complete'
    'date'      : '2013-01-01',          # The hyphens can be omitted
    'levelist'  : '1/10/100/137',        # 1 is top level, 137 the lowest model level in ERA5. Use
    '/'         : 'to separate values.
    'levtype'   : 'ml',
    'param'     : '130',                 # Full information at https://apps.ecmwf.int/codes/grib
    '/param-db/'                          /param-db/
                                         # The native representation for temperature is spherical
harmonics
    'stream'    : 'oper',                # Denotes ERA5. Ensemble members are selected by 'enda'
    'time'      : '00/to/23/by/6',        # You can drop :00:00 and use MARS short-hand notation,
instead of '00/06/12/18'
    'type'      : 'an',
    'area'      : '80/-50/-25/0',        # North, West, South, East. Default: global
    'grid'      : '1.0/1.0',             # Latitude/longitude. Default: spherical harmonics or
reduced Gaussian grid
    'format'    : 'netcdf',               # Output needs to be regular lat-lon, so only works in
combination with 'grid'!
}, 'ERA5-ml-temperature-subarea.nc')     # Output file. Adapt as you wish.
```

For ERA5.1-complete follow the same procedure as for era5-complete explained above, however:



Please read: [Technical issue fixed on ERA5.1 CDS API](#)

1. edit the script to change:

```
'reanalysis-era5-complete' to 'reanalysis-era5.1-complete'
```

data is only available for the years **2000-2006 inclusive** - so make sure that your request dates are within this time period.

```
#!/usr/bin/env python
import cdsapi
c = cdsapi.Client()
c.retrieve('reanalysis-era5.1-complete', { # Please note the addition '.1' for ERA5.1!
    # Keywords 'expver' and 'class' can be dropped. They are obsolete
    # since their values are imposed by 'reanalysis-era5.1-complete'
    # Valid range: 2000-01-01 to 2006-12-31. Always first of the month

    'date': '2005-01-01',
    for monthly means
    'levelist': '50',
    'levtype': 'pl',
    'param': '130.128',
    'stream': 'moda',
    'type': 'an',
    'grid' : '1.0/1.0',
    'format' : 'netcdf',
    with 'grid'!
}, 'era5.1-temperature-monthly-mean.nc')
# Pressure level at 50 hPa
# Full information at https://apps.ecmwf.int/codes/grib/param-db/
# Monthly means (of Daily means).
# Latitude/longitude grid resolution.
# Output needs to be regular lat-lon, so only works in combination
```

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## Related articles

- [Please read: CDS and ADS migrating to new infrastructure: Common Data Store \(CDS\) Engine](#)
- [ERA5: data documentation](#)
- [ERA5: large 10m winds](#)
- [Climate Data Store \(CDS\) documentation](#)
- [Common Error Messages for CDS Requests](#)