

# Interactive 3-D visual analysis of ERA5 reanalysis data

The visualization software *Met.3D* can be used for interactive visual exploration of meteorological phenomena in ERA5. This page provides a short guide towards using *Met.3D* for interactive 3D visual analysis of ERA5 data.

## Introduction

The ERA5 reanalysis dataset (ECMWF Reanalysis 5th Generation) is the most recent global reanalysis data covering the time-period from 1950 until today. The data is obtained by combining a numerical weather prediction model with empirical observations (4DVar data assimilation in CY41R2 of ECMWFs IFS). It contains estimates of atmospheric variables, such as air temperature, pressure, and wind, as well as surface variables such as rainfall and soil moisture. The meteorological variables are available with hourly temporal resolution on a global data grid with approximate horizontal resolution of 31km and 137 vertical model levels.

- For more information about ERA5, please see the ECMWFs documentation: <https://confluence.ecmwf.int/display/CKB/ERA5%3A+data+documentation>

*Met.3D* can be used for interactive visual exploration of meteorological phenomena in ERA5. Examples of available visualization methods include:

- sliding of horizontal and vertical cross-sections through 3D data-cubes
- computation of 3-D isosurfaces with interactive variation of isovalues
- direct volume rendering of clouds using raycasting
- flow visualization via wind barbs and trajectories.

In contrast to the widely-used visualization software packages, *Met.3D* allows visual data exploration at interactive frame-rates, enabling you to quickly discover interesting features and explore system dependencies.

## Step by step procedure

The following steps are necessary for analysing ERA5 data with *Met.3D*.

1. ERA5 data acquisition
2. Pre-processing of ERA5 data to a regular grid (*Met.3D* currently requires data on regular grids)
3. Visual exploration of ERA5 using the graphical user interface of *Met.3D*

### 1 ERA5 data acquisition

ERA5 data is freely available for download.

- For a detailed description on how to download ERA5 data, please see: <https://confluence.ecmwf.int/display/CKB/How+to+download+ERA5>.
- Alternatively, the ERA5 data is also available at the German Climate Computing Center (DKRZ). For details, please see: <https://www.dkrz.de/up/services/data-management/projects-and-cooperations/era>

### 2 Pre-processing of ERA5 to a regular grid

*Met.3D* requires gridded meteorological (simulation) data on a regularly spaced grid.

- The [data handling](#) section of this documentation provides an overview about the supported data and file types.
  - If you download ERA5 data on a regular grid, as provided by the ECMWFs download options, you should be able to directly load the data into *Met.3D* without any other processing, and start your interactive visual data exploration.
  - If the data is on a Gaussian or Spectral grid, you need to interpolate the data to a regular grid before you can analyse it using *Met.3D*.

The Climate Data Operators (CDO) provide a convenient way to interpolate ERA5 data onto a regular grid.

- For a detailed documentation of CDO, please see: <https://code.mpimet.mpg.de/projects/cdo/>.

The [remapping section](#) of this documentation outlines the procedure for the conversion of spectral or gaussian grids to regular lat lon grids.

The [stereographic conversion](#) section of this documentation outlines the procedure for the conversion of a regular grid to a stereographic grid.

### 3 Visual exploration of ERA5 using the features of *Met.3D*

Start your 3D interactive visual data analysis. The [getting started section](#) summarizes first steps.