

Towards ERA6 & C3S support to the energy community



Climate Change

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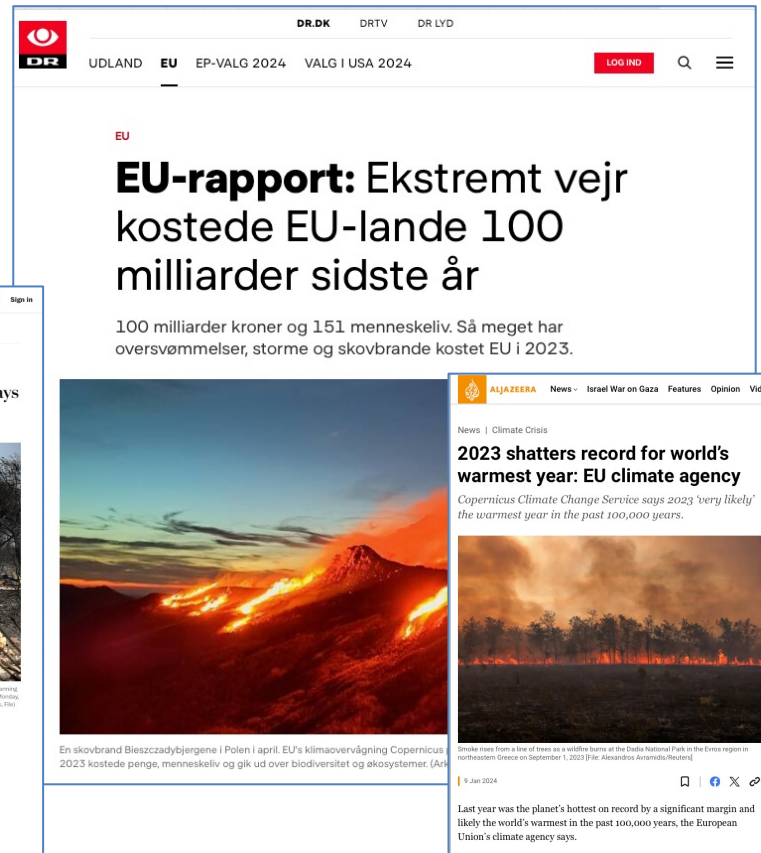




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Towards ERA6 – Outline

- Copernicus Climate Change Service
- ERA5 products
- Towards ERA6
- Quality aspects



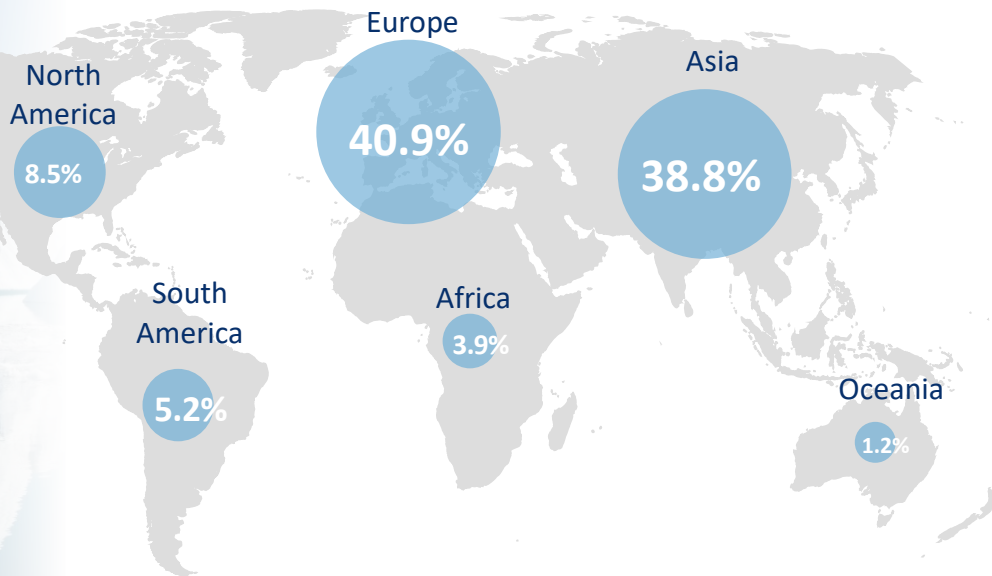


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Copernicus Climate Change Service: Some Numbers

Worldwide users

Open climate data has never been more important



Registered users
>285,000



Requests
800 million

Data downloaded
166 PB



Top datasets
ERA5, ERA5 land,
seasonal forecast,
CORDEX, CARRA,
CERRA, ORAS5 ...

Copernicus data = free and open



External users
Several millions



The European Vision

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2014
C3S launch

2015
Sentinel 2A,
Paris
agreement



Nations Unies
Conférence sur les Changements Climatiques 2015
COP21/CMP11
Paris, France

2016
Sentinel 1B
& 3A

2017
Sentinel 2B
& 5P

2018
CDS becomes operational,
Sentinel 3B

Climate Data Store (CDS)
Climate data at your fingertips

2020
European Green Deal,
Sentinel 6

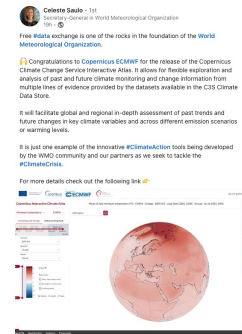


2023
Sentinel 4 – part 1

2023
Global Stocktake



2024
Climate Atlas



LIBRARY
LIBRARY
OF CONGRESS

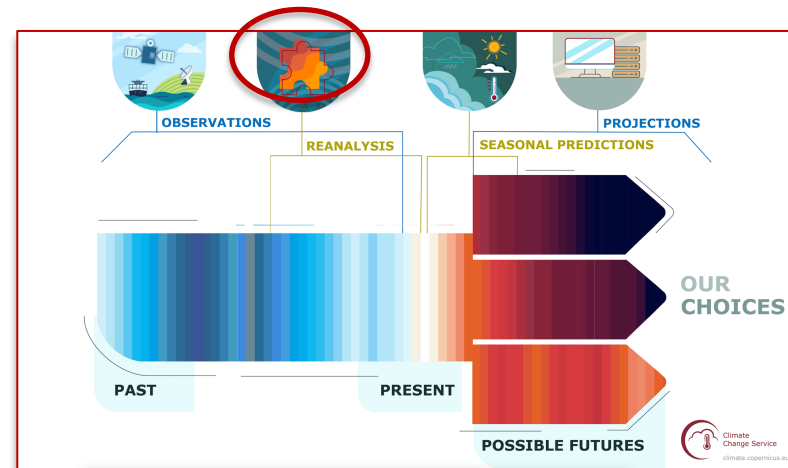


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The ERA5 global reanalysis

ERA5: *A full-observing-system global reanalysis for the atmosphere, land surface and ocean waves*

- >100 Tbyte of downloads per day
- Over 83 years of hourly data from 1940 till 5 days ago
- Uncertainty estimate at half resolution (from 10-member ensemble)
- ERA5-Land, providing a 9km dynamically down-scaled hourly product from 1950 till 5 days ago
- The ERA5T observing system is maintained in sync with that of ECMWF NWP, when feasible (new instruments, quality control checks, etc.)





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ERA5 CDS online catalogue entries

ERA5 hourly data on pressure levels from 1940 to present

[Overview](#) [Download data](#) [Quality assessment](#) [Documentation](#)

[Clear all](#)

Product type

☒ Reanalysis ☐ Ensemble members ☐ Ensemble mean ☐ Ensemble spread

[Select all](#) [Clear all](#)

Variable ?

At least one selection must be made

<input type="checkbox"/> Divergence	<input type="checkbox"/> Fraction of cloud cover
<input type="checkbox"/> Geopotential	<input type="checkbox"/> Ozone mass mixing ratio
<input type="checkbox"/> Potential vorticity	<input type="checkbox"/> Relative humidity
<input type="checkbox"/> Specific cloud ice water content	<input type="checkbox"/> Specific cloud liquid water content
<input type="checkbox"/> Specific humidity	<input type="checkbox"/> Specific rain water content
<input type="checkbox"/> Specific snow water content	<input type="checkbox"/> Temperature
<input type="checkbox"/> U-component of wind	<input type="checkbox"/> V-component of wind
<input type="checkbox"/> Vertical velocity	<input type="checkbox"/> Vorticity (relative)

[Select all](#)

Pressure level

At least one selection must be made

<input type="checkbox"/> 1 hPa	<input type="checkbox"/> 2 hPa	<input type="checkbox"/> 3 hPa	<input type="checkbox"/> 5 hPa
<input type="checkbox"/> 7 hPa	<input type="checkbox"/> 10 hPa	<input type="checkbox"/> 20 hPa	<input type="checkbox"/> 30 hPa
<input type="checkbox"/> 50 hPa	<input type="checkbox"/> 70 hPa	<input type="checkbox"/> 100 hPa	<input type="checkbox"/> 125 hPa
<input type="checkbox"/> 150 hPa	<input type="checkbox"/> 175 hPa	<input type="checkbox"/> 200 hPa	<input type="checkbox"/> 225 hPa
<input type="checkbox"/> 250 hPa	<input type="checkbox"/> 300 hPa	<input type="checkbox"/> 350 hPa	<input type="checkbox"/> 400 hPa
<input type="checkbox"/> 450 hPa	<input type="checkbox"/> 500 hPa	<input type="checkbox"/> 550 hPa	<input type="checkbox"/> 600 hPa
<input type="checkbox"/> 650 hPa	<input type="checkbox"/> 700 hPa	<input type="checkbox"/> 750 hPa	<input type="checkbox"/> 775 hPa
<input type="checkbox"/> 800 hPa	<input type="checkbox"/> 825 hPa	<input type="checkbox"/> 850 hPa	<input type="checkbox"/> 875 hPa
<input type="checkbox"/> 900 hPa	<input type="checkbox"/> 925 hPa	<input type="checkbox"/> 950 hPa	<input type="checkbox"/> 975 hPa
<input type="checkbox"/> 1000 hPa			

[Select all](#)

Year

At least one selection must be made

<input type="checkbox"/> 1940	<input type="checkbox"/> 1941	<input type="checkbox"/> 1942	<input type="checkbox"/> 1943	<input type="checkbox"/> 1944	<input type="checkbox"/> 1945
<input type="checkbox"/> 1946	<input type="checkbox"/> 1947	<input type="checkbox"/> 1948	<input type="checkbox"/> 1949	<input type="checkbox"/> 1950	<input type="checkbox"/> 1951
<input type="checkbox"/> 1952	<input type="checkbox"/> 1953	<input type="checkbox"/> 1954	<input type="checkbox"/> 1955	<input type="checkbox"/> 1956	<input type="checkbox"/> 1957
<input type="checkbox"/> 1958	<input type="checkbox"/> 1959	<input type="checkbox"/> 1960	<input type="checkbox"/> 1961	<input type="checkbox"/> 1962	<input type="checkbox"/> 1963

Help

[Get help](#)

Licence

[Licence to use Copernicus Products](#)

Publication date

2018-06-14

Resource updated

2023-08-22

References

[Citation](#)

[Acknowledgement](#)

DOI: [10.24381/cds.bd0915c6](#)

Related data

[Complete ERA5 global atmospheric reanalysis](#)

ERA5 hourly data on pressure levels from 1950 to 1978 (preliminary version)(deprecated 2023-08-15)

ERA5 hourly data on single levels from 1940 to present

ERA5 hourly data on single levels from 1950 to 1978 (preliminary version)(deprecated 2023-08-15)

ERA5 monthly averaged data on pressure levels from 1940 to present

ERA5 monthly averaged data on pressure levels from 1950 to 1978 (preliminary version)(deprecated 2023-08-15)

ERA5 monthly averaged data on single levels from 1940 to present

Target: non experts

- Regrided to 0.25 degrees
- Quick access: on disk
- Merge parameters from analysis and forecasts
- GRIB or NetCDF

Four catalogue entries

- Pressure, single levels
- Hourly, monthly
- Download forms
- Download API

Plus, derived CDS products:

- 30 datasets
 - 19 applications
- primarily based on (or using) ERA5 (e.g. ERA5-Land...)



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Also available from the CDS: ERA5-complete

Complete ERA5 global atmospheric reanalysis

Overview Download data Documentation

The access to this dataset can be **slow** and is intended for **expert** users to access the **complete** set of data produced by the ERA5 atmospheric reanalysis on its native grid. It includes data that is **not** provided through the other, more convenient ERA5 catalogue entries for **regridded** data.

- 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.

An overview of the range of products is provided [here](#).
A full list of available variables can be found [here](#).

Install the API

Access to ERA5 atmospheric reanalysis is provided through the Climate Data Store Application Program Interface (CDS API). This requires the installation of the CDS API application in the users' computer. More information on how to install can be found [here](#).

You also need to provide your user identity and public key, which can be found when you are logged in the Catalogue and click on your username at the top left.

Example of a request

Requests for these data using the CDS API have to use the MARS request syntax.

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.
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.
4. Tailor your request to
 1. re-grid to the desired regular lat-lon resolution
 2. convert to NetCDF (works for regular grids only, so you need to use the 'grid' keyword as well)
 3. select sub areas

Here is an example to download model level ERA5 analysis data (temperature) for a given area at a regular lat/lon grid in NetCDF format.

```
#!/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'
    '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.
    'leveltype': 'ml',
    'param' : '130', # Full information at https://apps.ecmwf.int/codes/grib/param-db/
    # The native representation for temperature is spherical harmonics
    # Denotes DRAS. Ensemble members are selected by 'enda'
    'stream' : 'oper', # You can drop :00:00 and use MARS short-hand notation, instead of :00/06/12/18'
    'time' : '00/10/23/by/6',
    'type' : 'an',
    'area' : '00/-90/-25/0', # North, West, South, East. Default: global
    'grid' : '1x0.1.0', # 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.
```

How to access ERA5

For ERA5 the same method can be used as above, however

Help

[Get help](#)

Licence

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Publication date

2023-05-25

References

[Citation](#)

[Acknowledgement](#)

DOI: [10.24381/cds.143582cf](https://doi.org/10.24381/cds.143582cf)

Related data

[ERA5 hourly data on pressure levels from 1940 to present](#)

[ERA5 hourly data on single levels from 1940 to present](#)

[Extreme precipitation risk indicators for Europe and European cities from 1950 to 2019](#)

[Flood risk indicators for European cities from 1989 to 2018](#)

[Mass-consistent atmospheric energy and moisture budget monthly data from 1979 to present derived from ERA5 reanalysis](#)

Related applications

[Daily statistics calculated from ERA5 data](#)

[ERA5 explorer](#)

[Heat wave days for Europe derived from ERA5 reanalysis](#)

[Heating and cooling degree days from 1979 to 2100](#)



Target: experts

- Full dataset
- Native resolution
- Slower access: on tape
- GRIB or NetCDF

One catalogue entry

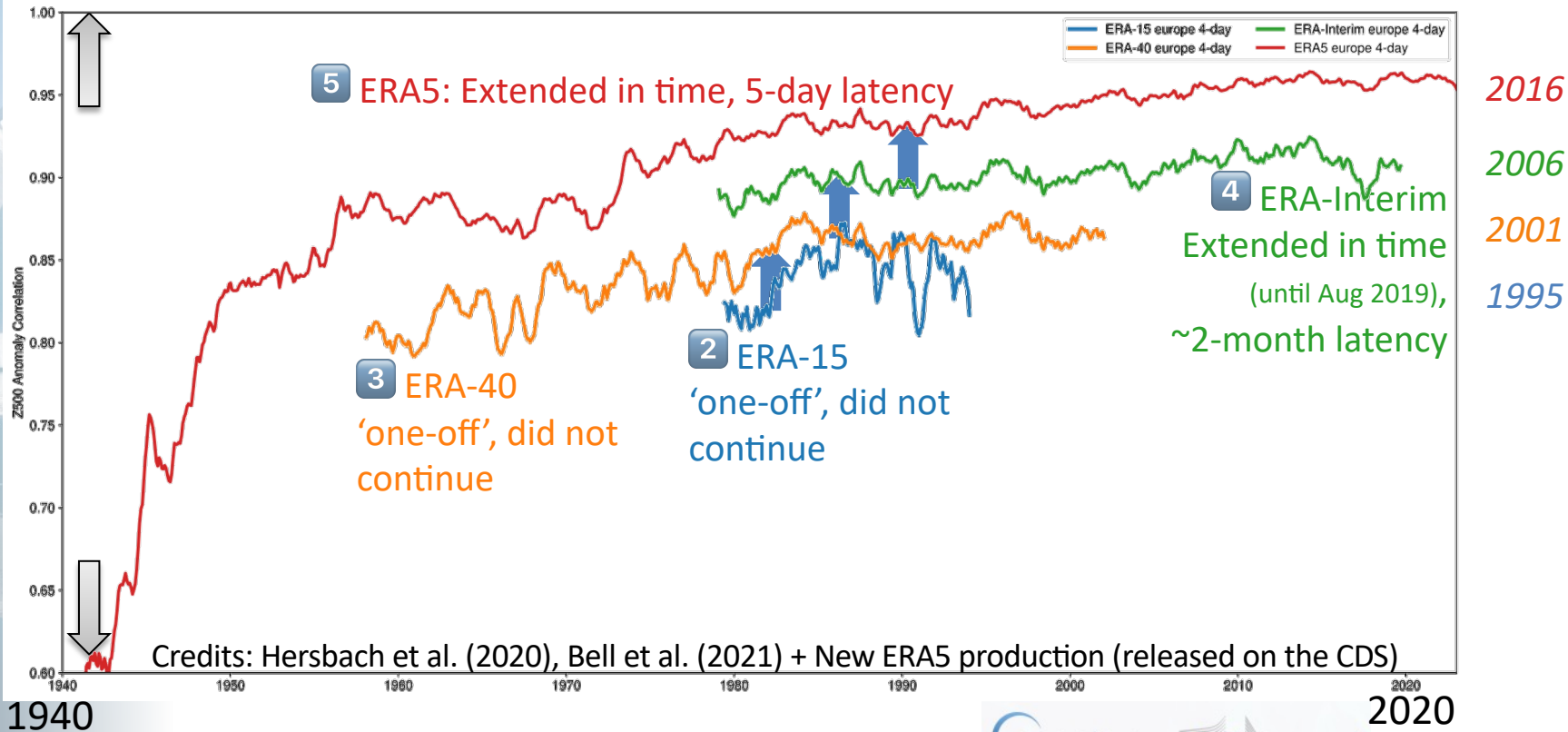
- No download forms
- API only



Why repeat global reanalyses?

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"Perfect forecast"





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Another reason to repeat: exploit improvements in the global observing system



**Observations assimilated in ERA5
January 1940 to December 1940**



PROGRAMME OF
THE EUROPEAN UNION



IMPLEMENTED BY



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climate.copernicus.eu



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Preparations for ERA6

Configuration:

- 17.5km (TCO639) horizontal resolution (31km for ERA5), including ocean waves
- Uncertainty estimate at 28km from 11-member ensemble (63km for ERA5)
- One way coupling with the ORAS6 ocean reanalysis (forcing for ERA5)

Products/output (*in development*):

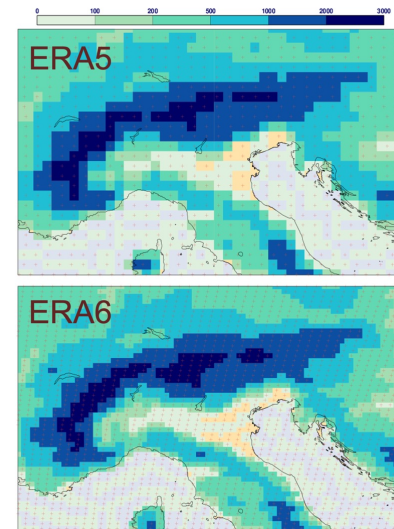
- Evolutions driven by user requirements
- New: Extended list of (new) parameters, e.g., Rh2m, clear-air turbulence
- New: Height levels for the lowest part of the atmosphere
- New: Additional pressure level
- New: Daily products

Enhanced observation input

- Reprocessed and rescued satellite and in-situ observations
- Enhanced use of observations, e.g. for timing and position, more use of all-sky radiances
- Enhanced quality control and handling of uncertainties

Full integration into ECMWF Integrated Forecasting System (IFS) lifecycles

- ERA5 diverged from a baseline: IFS CY41R2
- ERA6 developments are all included in the main IFS stream and part of a dedicated cycle: IFS CY49R2
- ERA6 capability will propagate onwards into later IFS cycles



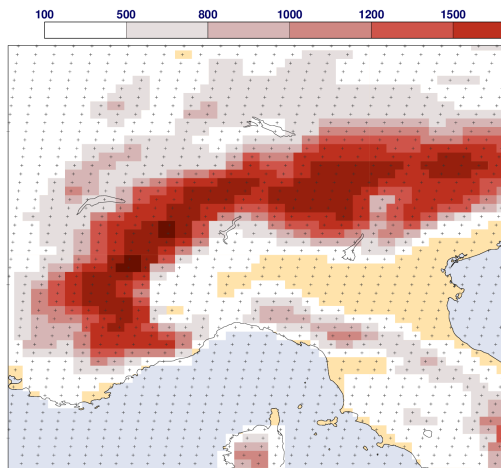


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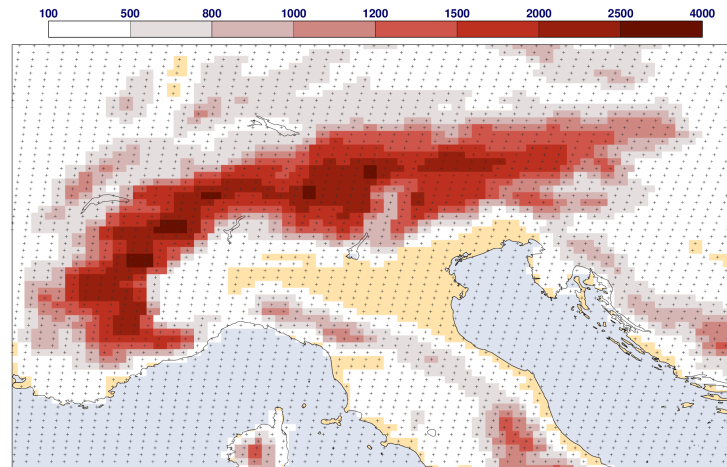
ERA6: Which resolution?

Octahedral reduced Gaussian grid

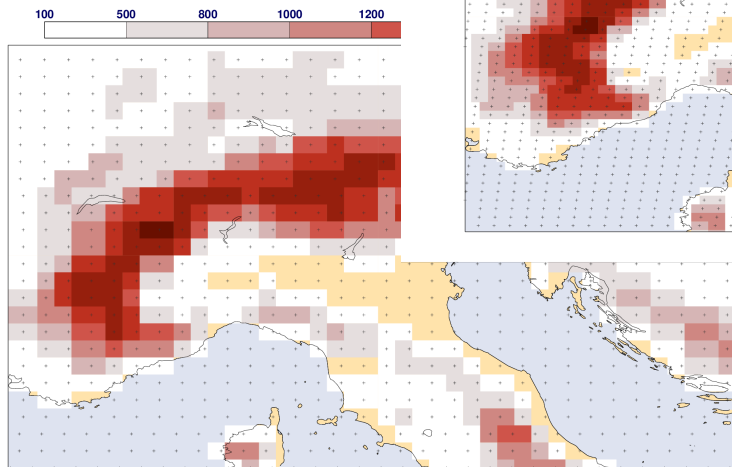
ERA6 candidate TCo639 ~ 17.5 km



ERA6 candidate TCo799 ~ 14 km



ERA5 TI 639 ~ 31 km



Note: production cost is not just a one-off. This cost is multiplied as data need to be served at correspondingly higher resolution. Under fixed resources, users end up paying the price: longer wait time, larger disc footprint,



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ERA6 science and innovations

Reanalysis-dedicated innovations:

- Establish level of coupling from the forthcoming ORAS6 ocean reanalysis
- Improved consistency of the mean state
- Improve evolution of the ERA5 uncertainty estimate (ensemble component)
- Resolve ERA5 'known issues' where possible

Make use of latest ECMWF mature R&D

(additional 8 years compared to ERA5):

Selection of recent developments:

- Reduce biases in snow and improve assimilation of snow observations
- Improved drag for extreme ocean waves
- New ozone model (HLO) and prognostic with radiation
- Revision of moist physics (clouds, precipitation, radiation)
- Vegetation cover and type, LAI, lake cover and properties, urban tile, some potentially time-evolving (from EU-H2020 CONFESS)
- New, and more species of aerosols and GHG's





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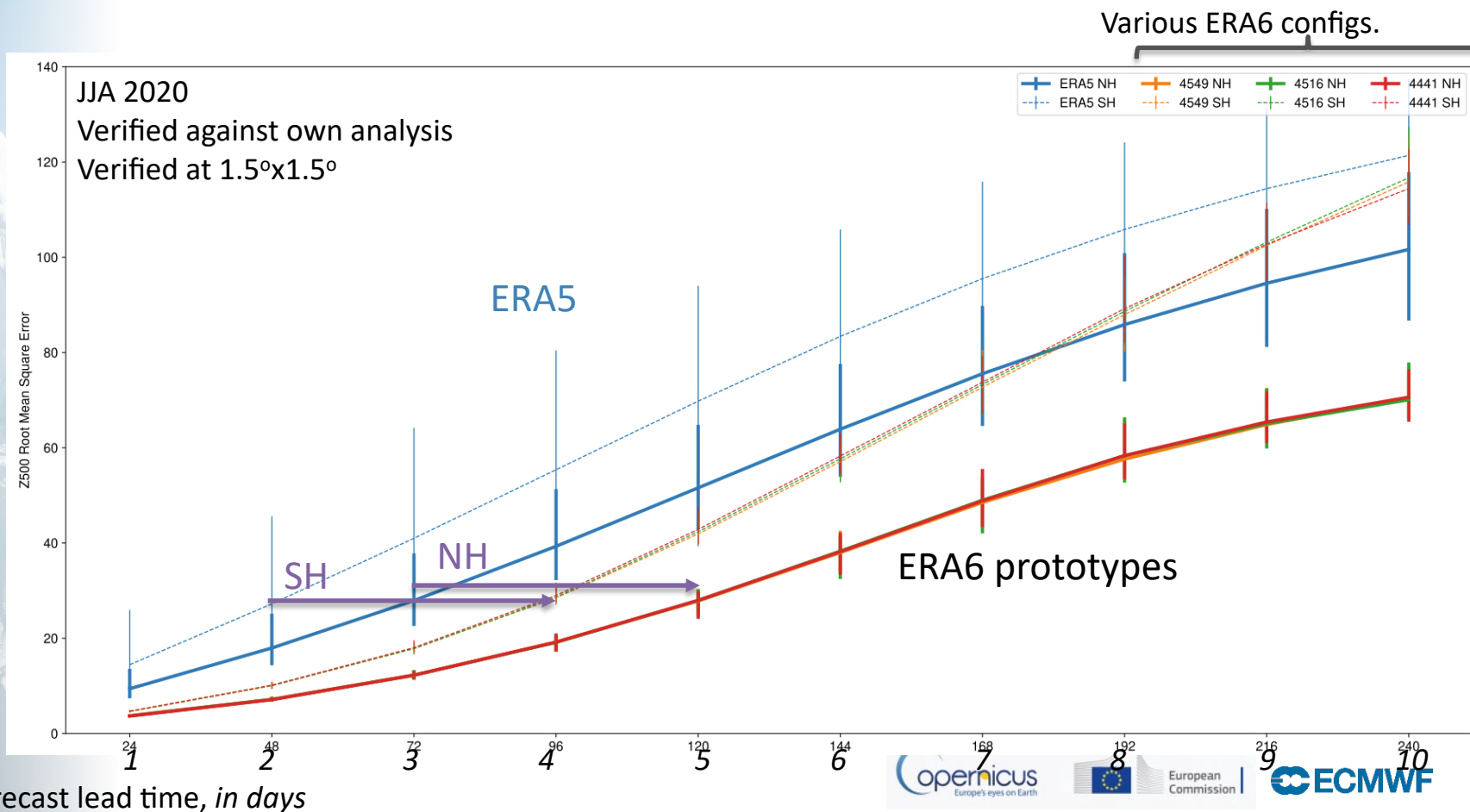
ERA systems specifications

	ERA-Interim	ERA5	ERA6
IFS version (year)	cy31R2 (2006)	cy41R2 (2016)	cy49R2 (2024)
Hor. Resol.	79 km	31 km	17.5 km
Vert. Resol.	60 model levels 37 press. levels 10-metre wind	137 model levels 37 press. levels 100,10-metre wind	137 model levels 38 press. levels 11 height levels
Temp. Resol.	3 or 6 h, Monthly	1 h, Monthly	1 h, Daily, Monthly
Ens. Hor. Resol.	-	63 km	28 km
Land-surface	TESSEL	HTESSEL	ECLand
Ocean waves	1 degree	0.36 degrees	17.5 km
Ocean	Daily SST forcing	Daily SST forcing	Hourly 1-way coupling
Latency	> 1 month	5 days	TBC



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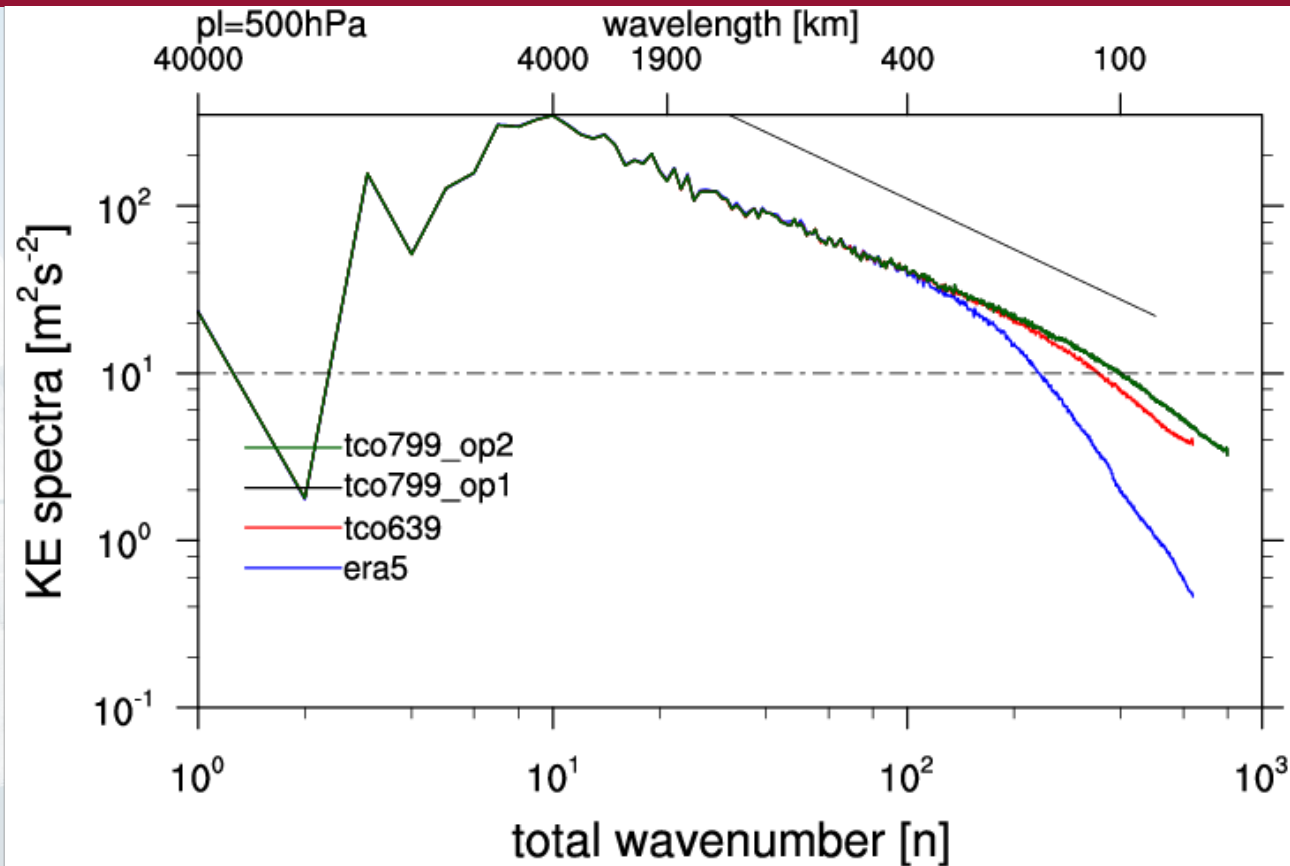
Preliminary trials: RMS Error of 500 hPa Geopotential Height Forecast





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Preliminary ERA6 trial: Energy spectra



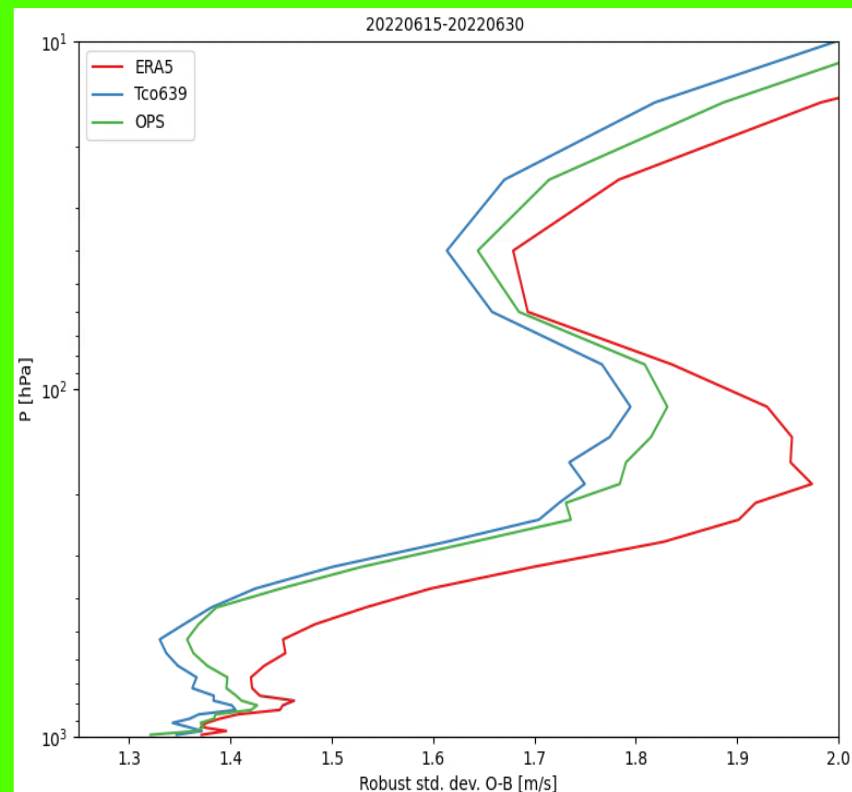
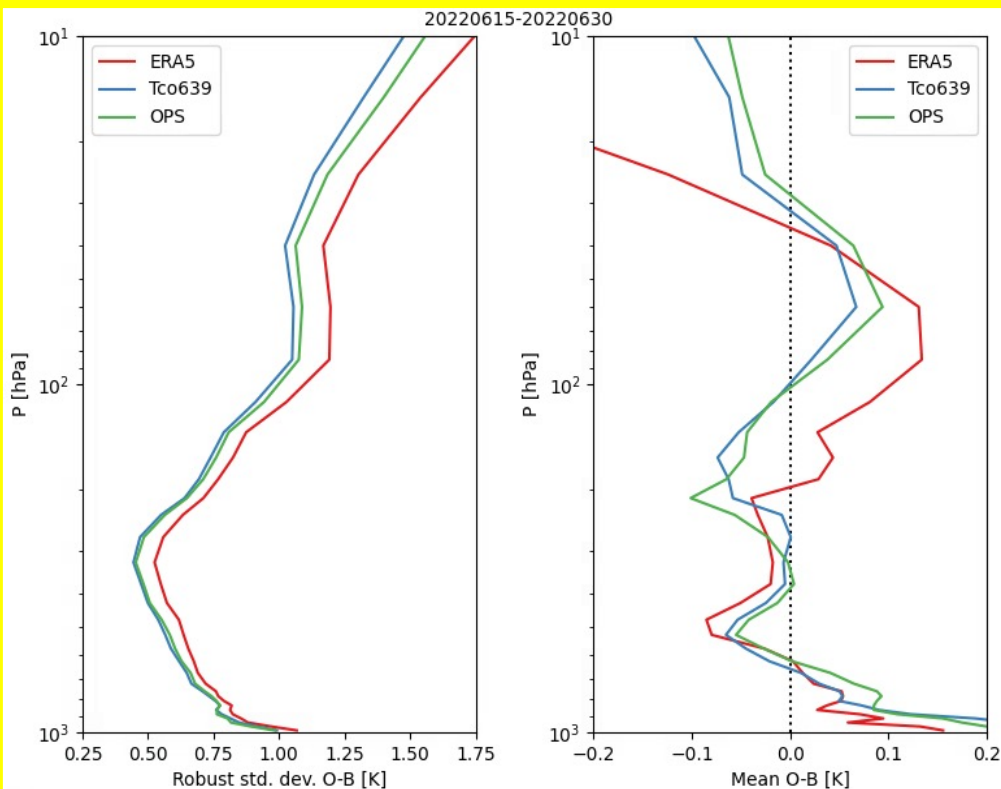


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Preliminary ERA6 trial: Differences with radiosonde observations

Temperature

Wind vector difference magnitude





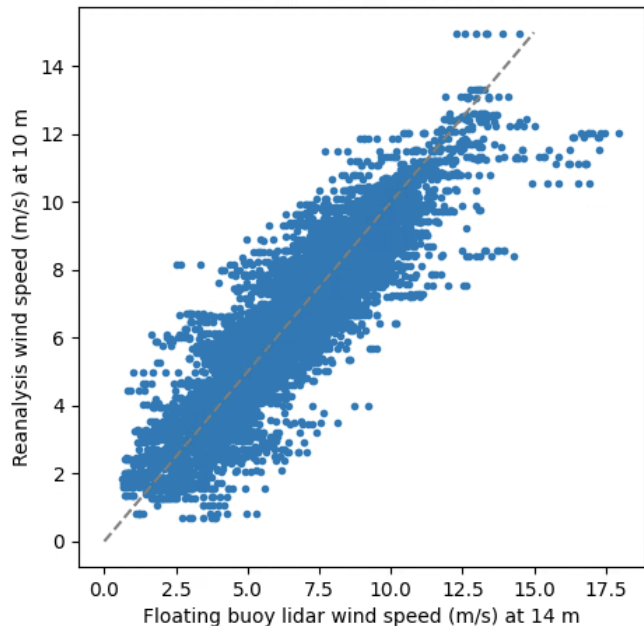
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Preliminary ERA6 trial: Independent check with buoy lidar

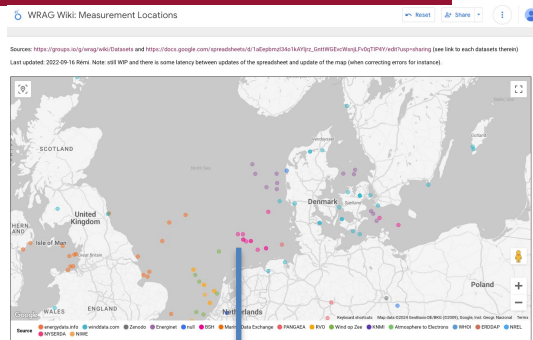
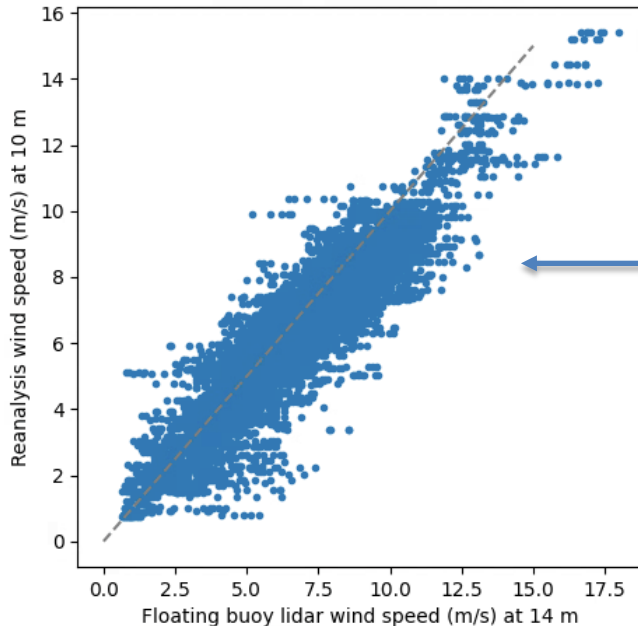
From WRAG datasets page <https://groups.io/g/wrag/wiki/13236>

ERA5 (left) ERA6 prototype (right), 01 June 2022 – 31 July 2022

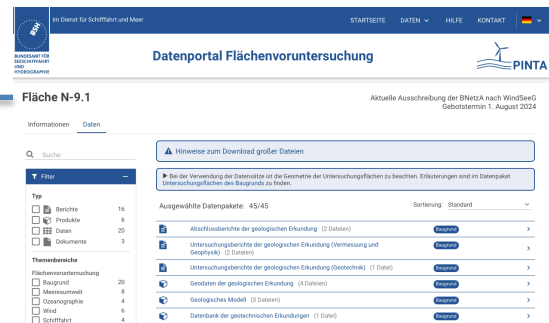
BSH ZX_LIDAR_WLBZ_6 vs ERA5AN
Robust diff. std.dev. 1.1 m/s



BSH ZX_LIDAR_WLBZ_6 vs ERA6ibpb
Robust diff. std.dev. 0.9 m/s



BSH N-9.1 buoy lidar site



Comparison done from reanalysis **hourly** fields of **10-meter wind speed** at **0.25°x0.25°**
Collocated to the variable "wind_speed" in the data group "ZX_LIDAR_WLBZ_6"



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'In the pursuit of excellence' ... Quality aspects

- Motivations: **quality-related**
 - Primary: *ensure* quality (→ **quality assurance**)
 - Secondary: *document* quality (→ **quality assessment**)
- Scope: **preparation, production, consolidation, continuation**
 - System *and its various components*
 - Inputs
 - Outputs
 - User feedback
- For whom: **Stakeholders**
 - Resource providers (HPC, storage, network, funder, ...)
 - Users (energy sector, ...)
 - Science peers (other reanalysis providers, ...)
 - Providers of information/science used in the system and its input (feedback loop)





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ERA6 Diagnostics Menu

ERA6 Pre-production Diagnostics verified once

Climate forcing fields (orography, ...)
Full configuration forecast verification
Forecast score cards
Energy spectra
Solar atmospheric tides

“Quality Assurance”

ERA6 Production Onset Diagnostics verified once per production stream

Forecast scores compared to OPS and ERA5
Background errors (Jb stdev. and horz. error correl. len.)
Observation errors (sigma_o) 
Archive integrity & contents 

ERA6 Production Diagnostics monitored as the production advances

“Vital signs” (+)
Observations available, rejected, assimilated
Observation departures and other statistics
Model error bias correction
Observation bias correction
Ensemble spread vs. skill closure diagnostics
Analysis increments and anomalies

ERA6 Post-Production Diagnostics before products publication

Global mean budgets: water cycle, energy, mass
General circulation and climate indices
Peer-product comparison: ECV thematic assessments
Synoptic timescales: 10-day forecast skill
Daily timescales: historic cases of European storms
Tropical cyclones
Diurnal cycle

“Quality Assessment”



to be monitored for the whole duration of the production

(+) production speed, 4D-Var metrics, Nb.obs in all DA components (4D-Var, land, ocean waves)



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ERA6 prototype sample data



Description

These are TEST data, with all the limitations that this implies. These data are for feeding back issues & findings to ECMWF. These data are unsuitable for any other application such studies, publications, ... The configuration used to produce these data is not the final ERA6 configuration. Many of the ERA6-intended output parameters are still missing in these data.

How to access

Go to <https://apps.ecmwf.int/ifs-experiments/rd/ibpb/>

- Data access is yet to be open with DOI publication: [DOI:10.21957/gmf0-rw02](https://doi.org/10.21957/gmf0-rw02)
- Technical questions about data access? See the page <https://www.ecmwf.int/en/computing/software/ecmwf-web-api>

How to feed back findings

- Email today's presenters: paul.poli 'at' ecmwf.int , delphine.deryng 'at' ecmwf.int
- Quality issues: documented example, reproducible
 - Good practice (ideal?) Jupyter notebook which includes importing all data needed to reproduce the results. Then one can replay the example with new test data as they become available.

The screenshot shows the ECMWF website interface for the ERA6 prototype 1 sample data. The page title is "ERA6 prototype 1 sample data for testing only June to August 2022". Below the title, there is a note: "To retrieve the data described in this experiment, you will need to use the ECMWF Web API with the example(s) given on this page. Please note that when accessing the data you are bound by the ECMWF terms of use." The page contains a table with the following information:

Field	Value
Title	ERA6 prototype 1 sample data for testing only June to August 2022
Description	This experiment is a prototype. It has several important limitations. It is not an ERA6 production. It has known missing components. It should not be used for any application or publication. It should be used to provide feedback to ECMWF.
DOI	10.21957/gmf0-rw02
Experiment ID	ibpb Q
Experiment class	ECMWF Research Department
Examples	This example extracts 10-meter wind components 3-hour forecast data issued from the first day/hour of the experiment as a GRIB file. <pre>#!/usr/bin/env python from ecmwfapi import ECMWFDataServer server = ECMWFDataServer() server.retrieve({ "class": "rd", "dataset": "research", "date": "2022-06-01", "expver": "ibpb", "levtype": "sfc", "param": "10u/10v", "step": "3", "stream": "lwnda", "target": "output1.grib", "time": "00:00:00", "type": "fc" })</pre>

Below the code block, there is a "Copy to clipboard" button and a note: "This example extracts hourly (00:00:00, 01:00:00, ... 23:00:00) two-meter temperature analysis data issued for all 24 hours on".



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Summary

- Strong support from the European Union for European-based reanalyses (transboundary, global, impactful) for climate services
 - ERA5 is only one part of this offer, but a foundation one
- Global reanalysis at ECMWF: methodologically-sound & iterative framework delivering uncertainty-quantified products
 - ERA6 expected improvements (from ERA5): over land (higher resolution), over ocean, (one-way coupling), and upper-air (improved radiation, aerosols, GHGs)
 - ERA6 prototype data: [DOI:10.21957/gmf0-rw02](https://doi.org/10.21957/gmf0-rw02)
- Essential sources of information for continuous improvement:
 - User communities' specialized observations
 - User feedback
- Resolution isn't everything, completeness of a product portfolio meeting user requirements is another essential aspect → Next presentation



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C3S Support to the Energy Community

Delphine Deryng

Partnership & User Engagement Specialist

delphine.deryng@ecmwf.int

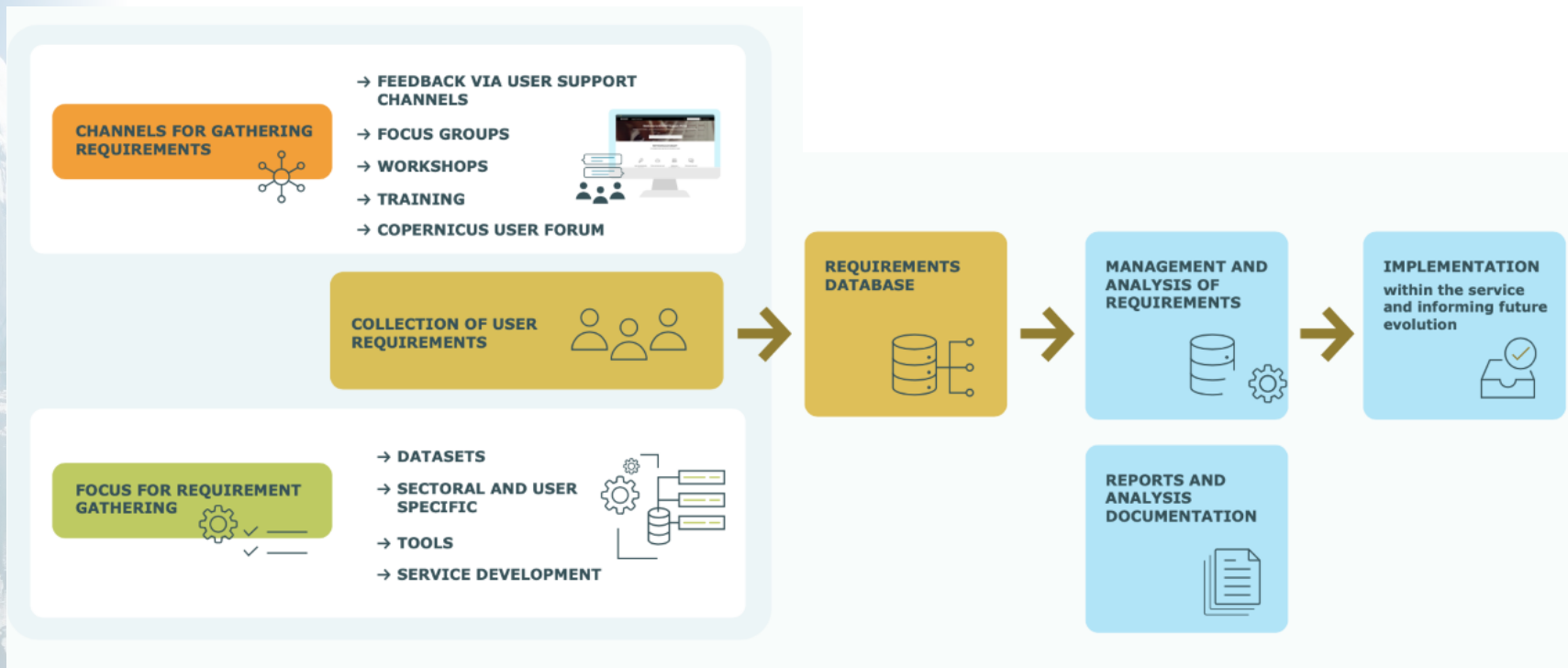




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C3S User-Driven Services

- User requirements process





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C3S User-Driven Services



Position Paper - ERA6 User Community Needs

- ERA6 User needs workshop

<https://climate.copernicus.eu/sites/default/files/2024-04/ERA6%20Users%20Workshop%20Position%20Paper%20ECMWF%20v2%20240410.pdf>

Essential features	Other high priority needs
<ul style="list-style-type: none">- Higher spatial resolution- Diagnostics by ECMWF for smaller regions- Early release of ERA6 data for machine learning applications- Validations against specific conditions- Storm catalogue	<ul style="list-style-type: none">- Downscaled ERA6 products- Open-source machine learning-based downscaling methods- Bias-corrected datasets and methods- Detailed observation coverage- Use of analysis increments- Uncertainty products (e.g., ensemble mean and spread)- Tools for comparing and merging with national datasets- User-friendly post-processing workflows



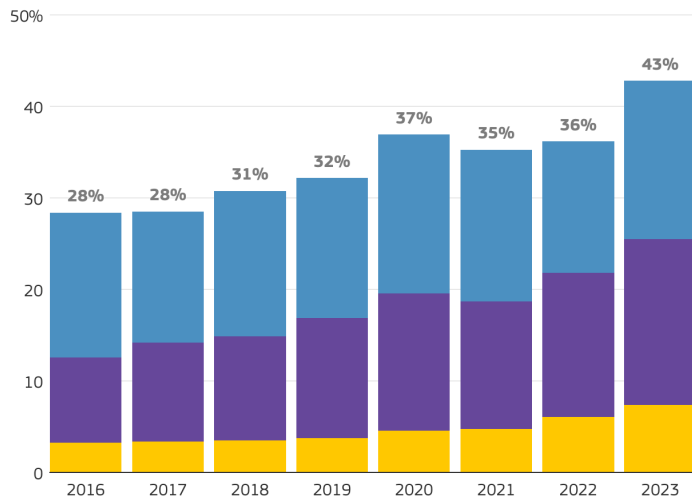
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C3S Data & Apps for Renewable Energy

Percentage of the total annual actual electricity generation for Europe from different sources



Solar power Wind power Hydro power



Data: ENTSO-E and Elexon • Credit: C3S/ECMWF

Copernicus Climate Change Service
European State of the Climate | 2023

PROGRAMME OF
THE EUROPEAN UNION

Copernicus

ECMWF



climate.copernicus.eu/esotc/2023

- The increasing share of renewable generation (wind, solar, and hydropower) makes this sector vulnerable to climate variability and climate change
- C3S Applications work on connecting climate information to user needs:
- Providing tools, data, post-processing workflow
- Providing examples and recipes
- Collecting requirements and feedback to products
- Connecting new research top operational activities

Copernicus
Europe's eyes on Earth

European
Commission

ECMWF



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European State of Climate 2023



Renewable energy resources

A record proportion of electricity generation by renewables

In 2023, a record proportion of actual electricity generation in Europe was from renewable sources, at 43%, compared to 36% in 2022.

Climate-driven electricity demand was above average in southern Europe, due to cooling required during exceptional summer temperatures, and in Scandinavia, where cooler-than-average temperatures in several months led to increased demand for heating.

For the year as a whole, potential for solar photovoltaic power generation was below average in northwestern and central Europe, and above average in southwestern and southern Europe, and Fennoscandia. Potential for run-of-river hydropower generation was above average across much of Europe, linked to above-average precipitation and river flow.

Increased storm activity from October to December resulted in above-average potential for wind power production.



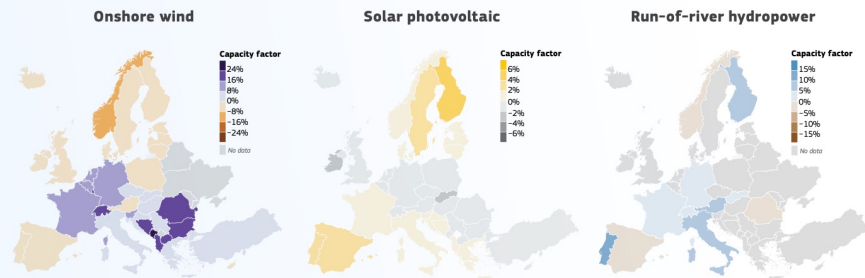
Reference period
1991-2020



Climate
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EUROPEAN STATE OF THE CLIMATE - SUMMARY 2023

13



Anomalies (%) in potential electricity generation (capacity factor) in 2023 from: onshore wind (left), solar PV (centre), run-of-river hydropower (right)

Data source: C3S Climate and Energy Indicators for Europe • Credit: C3S/ECMWF

climate.copernicus.eu/esotc/2023





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Copernicus Thematic Hub: New Approach to the Users

- **Single entry point** for the ensemble of data, products and information generated by the Copernicus services and components (e.g. ESA and EUMETSAT) for specific thematic areas
- **Traceable** back to specific EU policy needs
- **Simplified access** (simple, user friendly, subject oriented) to key existing Copernicus products relevant for a specific user communities (stakeholders, policy makers and users)

The main goals are:

- Improve the coordination and information flow between different related projects and initiatives
- Facilitate thematic studies (e.g., renewable energy)
- Provide knowledge and expertise on data/products
- Showcase how the data can be integrated with other data/information (user's stories)
- Leverage the collaboration/interactions with other organizations and Copernicus member states





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Copernicus Energy Hub

EASY ACCESS TO DATA

Access to free-of-charge
energy-related
Copernicus information
and datasets

DATASETS FOR ENERGY

Find below some data sets that can be
used by and for the energy sector.

Home > Products and Data > Datasets for energy

Search datasets | Sector | Global | Data provider | Reset

Global atmospheric composition for energy

CAMS produces global forecasts for atmospheric composition. The forecast is available for the following sectors:

- ✓ Sector
- Renewable energy
- Solar
- Wind
- Hydro
- Waves and Tidal
- Oil, gas and coal
- Energy infrastructure
- Energy demand
- Energy security
- Energy system integrations

Data provider: CAMS

Global Horizontal Irradiation

Global values (2004 to 2020) (DHI) solar radiation (W/m²)

— clear sky
— all sky

To access the Copernicus
Security Service (CSS)
products please contact
copernicus@satcen.europa.eu

Data providers

- Copernicus Climate Change Service (C3S)
- Copernicus Atmosphere Monitoring Service (CAMS)
- Copernicus Emergency Management Service (CEMS)
- Copernicus Land Monitoring Service (CLMS)

energy.hub.copernicus.eu



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Energy Hub: Examples of Datasets from C3S

OCTOBER 2023

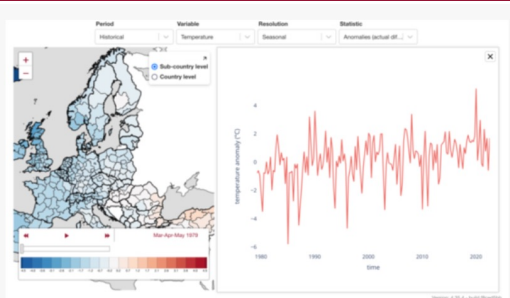
European energy and climate data explorer

This application explores climate data over Europe and the effect of climate change on energy supply and demand. Data is provided for the European domain, in a multi-variable, multi-timescale view of the climate and energy systems

Sector: [Renewable energy](#) , [Solar](#) , [Wind](#) , [Hydro](#) ,
[Energy demand](#)

Region:
[Europe](#)

Data provider:
[C3S](#)



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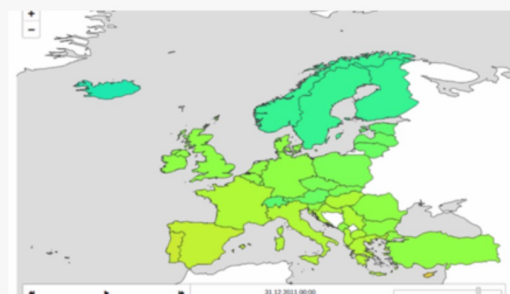
Climate and energy indicators for Europe from 1979 to present derived from reanalysis

The Copernicus climate change service (C3S) operational energy dataset provides climate and energy indicators for the European energy sector

Sector: [Renewable energy](#) , [Solar](#) , [Wind](#) , [Hydro](#) ,
[Energy demand](#)

Region:
[Europe](#)

Data provider:
[C3S](#)



OCTOBER 2023

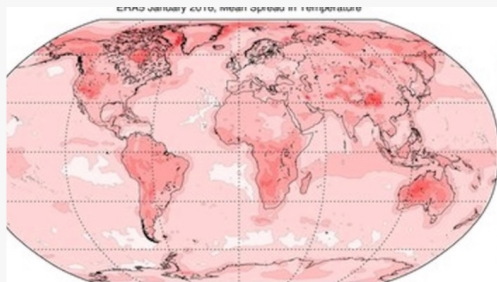
ERA5 hourly data on single levels from 1940 to present

ERA5 is the fifth generation ECMWF reanalysis for the global climate and weather for the past 8 decades. Data is available from 1940 onwards. ERA5 replaces the ERA-Interim reanalysis.

Sector: [Renewable energy](#) , [Solar](#) , [Wind](#) , [Hydro](#) , [Waves](#)
and Tidal , [Oil, gas and coal](#) , [Energy infrastructure](#) , [Energy demand](#)

Region:
[Global](#)

Data provider:
[C3S](#)





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Energy Hub: More Datasets to Come...



Atmosphere
Monitoring

Total/clear-sky solar radiation
CH4 anomalies detection
Aerosol optical depth (e.g. dust)



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Reanalysis & climate projections
• Meteorological variables (wind speed, precipitation,
solar radiation, air temperature, sea level pressure)
• Energy derived variables (electricity demand, hydro,
solar and wind power generation)
Next: Information at seasonal forecast timescale



Land
Monitoring

Urban atlas
High resolution Vegetation Phenology and Productivity
Corine Land Cover (CLC) and CLC+,
European Ground Motion Service (EGMS), HR VPP (for
biofuels)
Surface Albedo, Land Surface Temperature
Leaf Area Index & Soil Water Index (biomass
estimation)
Land Cover Map



Marine
Monitoring

Reanalysis and forecasts of river discharge
to assess hydropower potential
Drought impacts on energy production
Information on population, buildings and
settlements



Security

Global ocean waves Reanalysis
Global ocean waves Analysis and Forecast
Global ocean physics Reanalysis
Mediterranean Sea Biogeochemistry
Analysis and Forecast
Global Ocean Along Track L3 Sea Surface
Heights



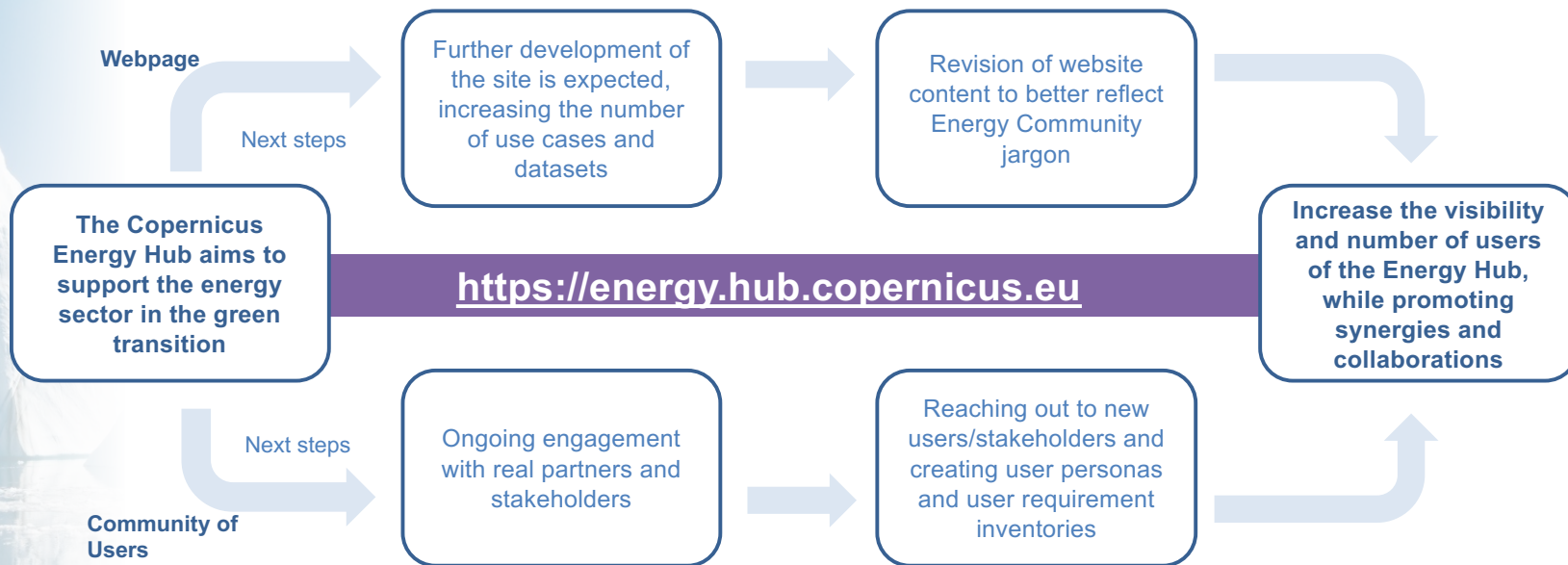
Emergency
Management

Geospatial Analysis
Mapping for Situational Awareness
Support to Planning



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Energy Hub: Final Remarks and Next Steps



Collecting your needs is of paramount importance for us

Which environmental datasets do you need? What do you want to see on the Energy Hub?



Climate Change

Thank You for your Attention!

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Delphine Deryng delphine.deryng@ecmwf.int





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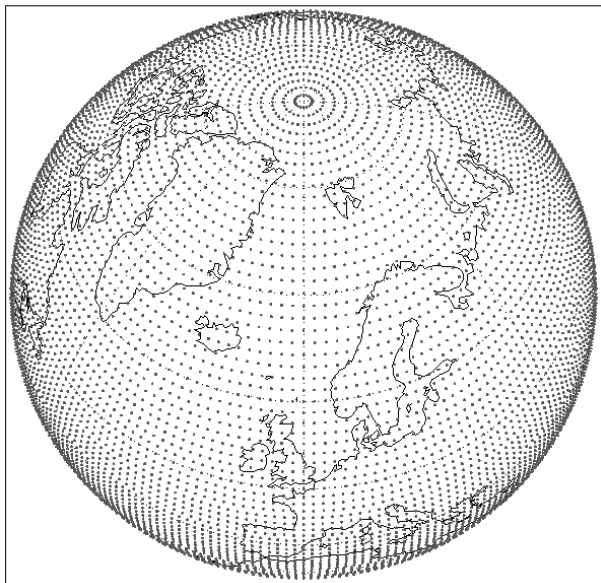
Additional slides



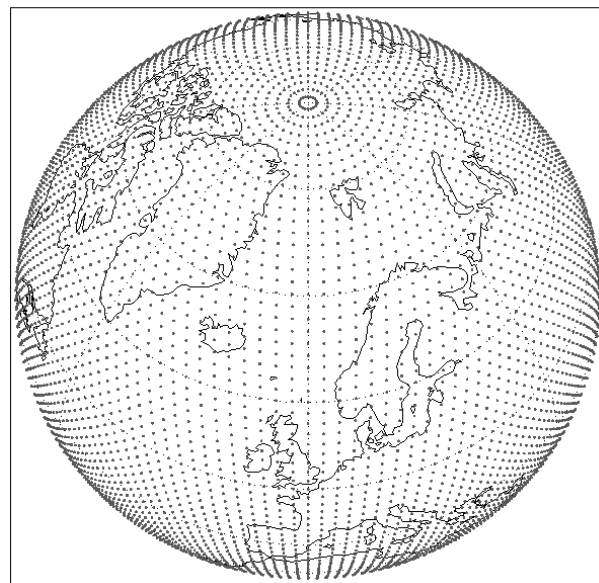
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About Gaussian Grids

N80 original reduced Gaussian grid



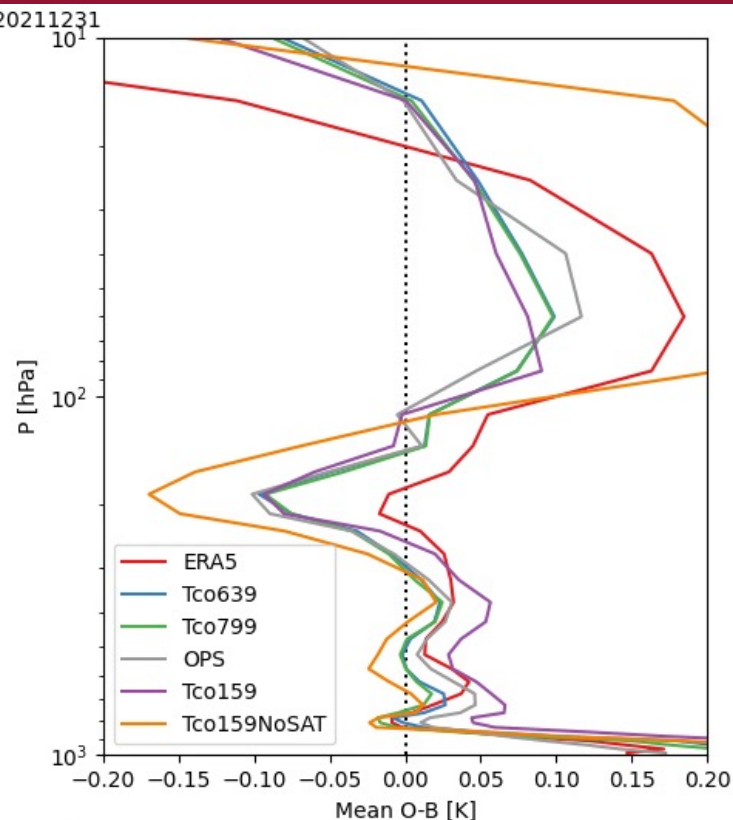
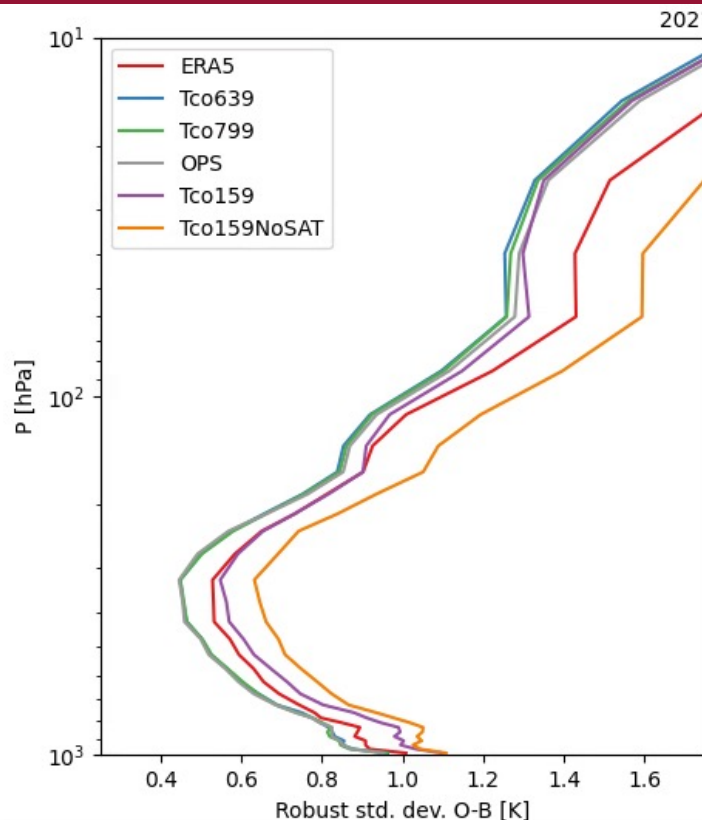
O80 octahedral reduced Gaussian grid





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Preliminary ERA6 trials: Differences with respect to radiosonde temperature (December)



Tco639, Tco799 = Various **ERA6** configurations

OPS = **ECMWF Operations**

Tco159 = Lower-resolution run ~ **ERA-Interim**-like (NoSAT = No satellite data assimilated)



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Preliminary ERA6 trials: Wind vector difference magnitude

