ECMWF COPERNICUS REPORT

Copernicus Climate Change Service

Daily statistics calculated from ERA5 data

User Guide

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1. Introduction

The application allows users to calculate, on demand, daily statistics for a number of variables published from ERA5 and to download the resulting data in a file. By using this application, users who only need the data sampled at daily frequency can reduce the amount of data downloaded. The options on offer include a number of commonly used statistics, as well as flexibility in the definition of the "day" (as a function of time zone) and of the sampling interval within such period.

1.1 Executive Summary

This application allows users to compute and download selected daily statistics from a number of ERA5 datasets published on the C3S CDS. It provides a simple tool for extracting a month of ERA5 data and aggregating at daily frequency without having to download the original sub-daily resolution data.

1.2 Scope of Documentation

This document describes the application "ERA5 daily statistics". It includes a description of the application, its functionalities and the methodology used.

1.3 Version History

The version history of this application is summarized in Table 1.

Table 1 - Application versions history

Version	Changes from previous version
1.0	-
2.0	• Add "ERA5 hourly data on pressure levels" and "ERA5-Land" datasets • Add backward extension data (1950-1978) for "ERA5 hourly data on single levels" and "ERA5 hourly data on pressure levels" datasets

2. Product Description

2.1 Application Interface

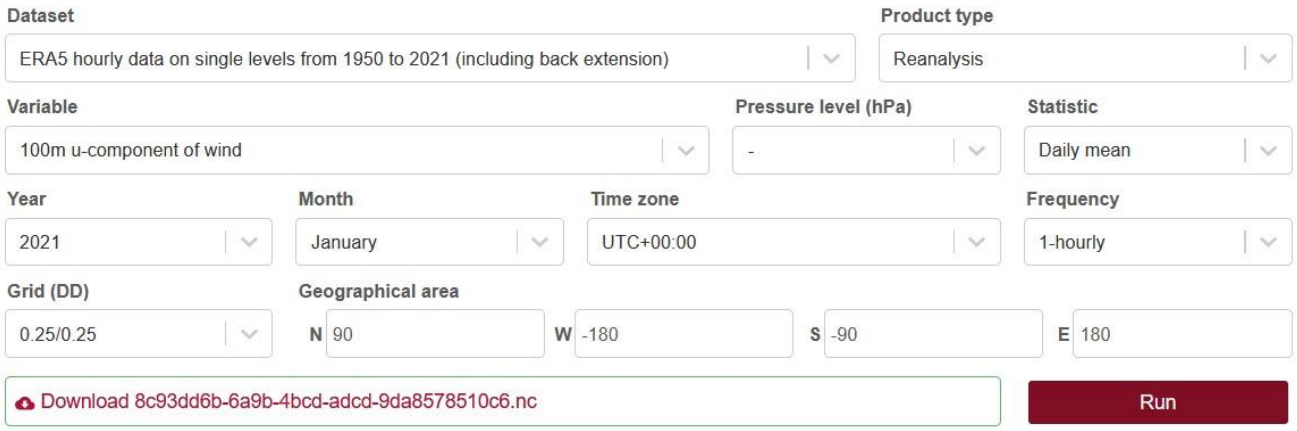

Figure 1 - Application interface

The application interface consists of a series of input widgets which let users specify which variable they want to aggregate, the particular statistics to apply and various temporal and spatial constraints:

- Variable selection is achieved using the dropdown menus *Dataset, Product type*, *Variable* and *Pressure level*. This set of widgets is based upon the structure of the CDS catalogue entry of the used input dataset; further details can be found at the resources cited in section 2.2.
- The choice of the aggregation function is performed using the *Statistic* menu; for implementation details of the different functions, see section 2.4.2.
- Temporal constraints are selected through the *Year*, *Month*, *Time zone* and *Frequency* menus. More specifically, ○ *Year* and *Month* let users specify the year and month of data to retrieve and aggregate; ○ *Time zone* choice changes the definition of "day", which always start from 00:00:00 in the selected time zone;
  - ○ *Frequency* let users request a time subsampling before aggregation, with each subsampling always starting from 00:00:00 in the selected time zone;
- Spatial constraints are specified through the *Grid* and *Geographical area* widgets, which let the users define respectively the spatial resolution of the input data and the bounding coordinates of the geographical area over which the daily aggregation has to be performed.

Finally, the *Run* button initiates the computation with the selected options.

2.2 Input data

Input data vary depending on the selection made in the *Dataset*, *Variable* and (if applicable) *Pressure level* dropdown menus. In the following paragraphs, a brief description of the available input data is provided for each option in the *Dataset* menu.

2.2.1 ERA5 hourly data on pressure levels from 1950 to present (including back extension)

All time-varying variables from the datasets "ERA5 hourly data on pressure levels from 1979 to present" [3] and "ERA5 hourly data on pressure levels from 1950 to 1978 (preliminary version)" [4] can be used as input when this option is selected from the *Dataset* menu. In particular, the two datasets are used when a *Year* included in the ranges 1979 to present and 1950 to 1978 is selected, respectively.
Due to the time shift applied to the data when selecting a *Time zone* different from UTC+00:00, as described in section 2.3, data from the two datasets may be combined when selecting December 1978 and January 1979 from the *Month* and *Year* menus.

2.2.2 ERA5 hourly data on single levels from 1950 to present (including back extension)

All time-varying variables from the datasets "ERA5 hourly data on single levels from 1979 to present" [1] and "ERA5 hourly data on single levels from 1950 to 1978 (preliminary version)" [2] can be used as input when this option is selected from the *Dataset* menu. In particular, the two datasets are used when a *Year* included in the ranges 1979 to present and 1950 to 1978 is selected, respectively. Due to the time shift applied to the data when selecting a *Time zone* different from UTC+00:00, as described in section 2.3, data from the two datasets may be combined when selecting December 1978 and January 1979 from the *Month* and *Year* menus.

2.2.3 ERA5-Land hourly data from 1981 to presents

All time-varying variables from the datasets "ERA5-Land hourly data from 1981 to present" [5] can be used as input when this option is selected from the *Dataset* menu.

2.3 Workflow

The workflow consists of the following steps, with details depending on the particular option chosen in the different widgets:

1. Input data is retrieved, according to the options specified in the *Dataset, Product type, Variable, Pressure level* (if applicable)*, Year, Month* and *Grid* widgets;
2. The geographical region specified by the *Geographical area* widget is selected from the data;
3. The time coordinate is shifted according to the option selected in the *Time zone* widget; 4. A temporal subsampling defined by the option selected in the *Frequency* widget is performed;
5. The daily aggregation selected in the *Statistic* widget is performed.

Preprocessing

Step 1 includes the following preprocessing steps:

1. To ensure that the necessary time shifts do not leave missing values at the edge of the selected time-range, a day worth of additional data (either preceding or following the selected month, depending on the sign of the shift) is retrieved and concatenated to the main data. This happens after the main retrieve and before any other processing.

2. In case an accumulated or mean rate variable is chosen, a default backward time shift of one hour is applied to the data. For these variables, recorded values are valid for the hour ending at each time coordinate: so, for example, the value recorded for time 00:00 of day *d* actually belongs to day *d-1*. The applied time shift ensure that daily aggregations are performed correctly.

2.4 Functionalities

A description of the different input widgets follows.

2.4.1 *Dataset, Product type, Variable, Pressure level*

These widgets are responsible for the choice of the product and variable to be processed. They are based upon the structure of the C3S CDS catalogue entries of the input datasets described in section 2.2. A list of all the available input variables can be found in Appendix A - Input variables.

2.4.2 *Statistic*

This widget allows users to select the aggregation function to be applied to the data. As described in section 2.2.2, aggregations are performed at the end of the workflows, after all other processing steps have been carried out. A list of the available functions follows:

- *Daily mean*, computed as the arithmetic mean of the values belonging to the same day;
- *Daily minimum*, computed as the minimum among the values belonging to the same day;
- *Daily maximum*, computed as the maximum among the values belonging to the same day;
- *Daily mid-range*, computed as the arithmetic mean between daily minimum and daily maximum, as defined above.

2.4.3 *Year* and *Month*

These widgets allow users to select the time-range of data they want to be processed. For efficiency reasons, the application is limited to process one-month worth of data at a time. One possibility to process multiple months in an automated fashion is to run the application via the CDS API. For details on how to perform such operation, see section 3.

2.4.4 *Time zone*

This widget allows users to select the time zone of reference for the definition of “day”. In this regard, times starting from 00:00 of day *d* and ending at 00:00 of day *d+1* (excluded) in the selected time zone are considered belonging to day *d*.

2.4.5 *Frequency*

This widget allows users to select the actual frequency they want sample input data before performing the daily aggregation. Times are always sampled starting from 00:00 in the selected time zone.

2.4.6 *Grid*

This widget allows users to select the grid resolution of the input data. This selection is passed directly to the data retrieve function.

2.4.7 *Geographical area*

This widget allows users to select a rectangular geographical area from the input data to be processed.

2.5 Output Data

The output of the application is a link to the netCDF file containing the daily aggregated data, which appears next to the *Run* button. Clicking on the link, the download of the file begins.

3. Batch processing via the CDS API

Even though the present application limits users to select one option per widget for each run, functionalities provided by the python CDS API allow for the launch of multiple instances of the application with different sets of options in an automated fashion. A typical use for this feature would be to easily process multiple years and/or months of a given variable.
In the following paragraphs, details are given on how to set up and use the CDS API with the present application.

3.1 Installing the CDS API key and client

Detailed instructions on how to install the CDS API key and client are given at [6].

3.2 Setting up and running the Python script

The python script to be run should have the following base structure:

```
import cdsapi

c = cdsapi.Client()
 result =
c.service(
    "tool.toolbox.orchestrator.workflow",
params={
        "realm": "user-apps",
        "project": "app-c3s-daily-era5-statistics",
        "version": "master",
        "kwargs": <kwargs_dict>,
"workflow_name": "application"
})

c.download(result)
```

where `<kwargs_dict>` is a python dictionary containing the application input parameters as parameter/value pairs. The complete list of available CDS API `kwargs` parameters and values, alongside the labels and values of the corresponding input widgets in the application graphical user interface (GUI), can be found in Table 2.

Table 2 - CDS API `kwargs` parameter/value pairs

label/parameter		**values**	
GUI	**CDS API**	**GUI**	**CDS API**

Dataset	`dataset`	ERA5 hourly data on single levels […]
		ERA5 hourly data on pressure levels […]
		ERA5-Land […]
			`reanalysis-era5-single-levels`
			`reanalysis-era5-pressure-levels`
			`reanalysis-era5-land`

Product type	`product_type`	Reanalysis
		Ensemble members
		Ensemble mean
			`reanalysis`
			`ensemble_members`
			`ensemble_mean`

Variable	`variable`	See Appendix A, Table 3	See Appendix A, Table 3
Pressure level	`pressure_level`	-, 1 hPa, 2 hPa, …	`-, 1, 2, …`

Statistic	`statistic`	Daily mean
		Daily minimum
		Daily maximum
		Daily mid-range
			`daily_mean`
			`daily__minimum`
			`daily_maximum`
			`daily_mid_range`

Year	`year`	1950, 1951, …, 2021	`1950, 1951, …, 2021`
Month	`month`	January, February, …, December	`01, 02, …, 12`
Time zone	`time_zone`	UTC-12:00, UTC+00:00, …, UTC+14:00	`UTC-12:00, UTC+00:00, …, UTC+14:00`

Frequency	`frequency`	1-hourly
		3-hourly
		6-hourly
			`1-hourly`
			`3-hourly`
			`6-hourly`

Grid	`grid`	0.1/0.1, 0.25/0.25, …, 3.0/3.0	`0.1/0.1, 0.25/0.25, …, 3.0/3.0`
Geographical area	`area`	90, -180, -90, 180	`{'lat': [-90, 90], 'lon': [-180, 180]}`

One way to launch multiple instances of the application with different values for a particular input parameter is using python's for loops. As an example, the script below launches the application for all the months of a particular year and download processed data at the end of each iteration.

```
import cdsapi

c = cdsapi.Client()

MONTHS = [
    "01", "02", "03", "04", "05", "06",
    "07", "08", "09", "10", "11", "12"
]  for month in
MONTHS:
     result =
c.service(
        "tool.toolbox.orchestrator.workflow",
params={
            "realm": "user-apps",
            "project": "app-c3s-daily-era5-statistics",
            "version": "master",
            "kwargs": {
                "dataset": "reanalysis-era5-single-levels",
                "product_type": "reanalysis",
                "variable": "2m_temperature",
                "statistic": "daily_mean",
                "year": "2020",
                "month": month,
                "time_zone": "UTC+00:00",
                "frequency": "1-hourly",
                "grid": "0.25/0.25",
                "area": {"lat": [-90, 90], "lon": [-180, 180]}
            },
            "workflow_name": "application"
    })

    c.download(result)
```

Once the python script, which we assumed to be named `script.py`, is ready, the processing (and the consequent download of the results) can be launched running it in the terminal via

```
python script.py
```

4. Concluding Remarks

The application provides users with a simple tool to obtain ERA5 data aggregated at daily frequency, without having to download the data at the original resolution. The application will also be used to gauge the user interest in the provided diagnostics and the degree of flexibility required in the

definition of the aggregation periods and methods. If a certain combination of options proves dominant, a new dataset reflecting these options could be later created and published for direct download from the CDS.

5. References

[1] H. Hersbach, B. Bell, P. Berrisford, G. Biavati, A. Horányi, J. Muñoz Sabater, J. Nicolas, C. Peubey, R. Radu, I. Rozum, D. Schepers, A. Simmons, C. Soci, D. Dee and J.-N. Thépaut, "ERA5 hourly data on single levels from 1979 to present," Copernicus Climate Change Service (C3S) Climate Data Store (CDS), 2018. [Online]. Available: 10.24381/cds.adbb2d47. [Accessed 13 4 2021].

[2] B. Bell, H. Hersbach, P. Berrisford, P. Dahlgren, A. Horányi, J. Muñoz Sabater, J. Nicolas, R. Radu, D. Schepers, A. Simmons, C. Soci and J.-N. Thépaut, "ERA5 hourly data on single levels from 1950 to 1978 (preliminary version)," Copernicus Climate Change Service (C3S) Climate Data Store (CDS), 2020. [Online]. Available: https://cds.climate.copernicus-climate.eu/cdsapp#!/dataset/reanalysis-era5-single-levels-preliminary-backextension?tab=overview. [Accessed 13 4 2021].

[3] H. Hersbach, B. Bell, P. Berrisford, G. Biavati, A. Horányi, J. Muñoz Sabater, J. Nicolas, C. Peubey, R. Radu, I. Rozum, D. Schepers, A. Simmons, C. Soci, D. Dee and J.-N. Thépaut, "ERA5 hourly data on pressure levels from 1979 to present," Copernicus Climate Change Service (C3S) Climate Data Store (CDS), 2018. [Online]. Available: 10.24381/cds.bd0915c6. [Accessed 13 4 2021].

[4] B. Bell, H. Hersbach, P. Berrisford, P. Dahlgren, A. Horányi, J. Muñoz Sabater, J. Nicolas, R. Radu, D. Schepers, A. Simmons, C. Soci and J.-N. Thépaut, "ERA5 hourly data on pressure levels from 1950 to 1978 (preliminary version)," Copernicus Climate Change Service (C3S) Climate Data Store (CDS), 2020. [Online]. Available: https://cds.climate.copernicus-climate.eu/cdsapp#!/dataset/reanalysis-era5-pressure-levels-preliminary-backextension?tab=overview. [Accessed 13 4 2021].

[5] J. Muñoz Sabater, "ERA5-Land hourly data from 1981 to present," Copernicus Climate Change Service (C3S) Climate Data Store (CDS), 2019. [Online]. Available: 10.24381/cds.e2161bac. [Accessed 13 4 2021].

[6] "How to use the CDS API," Copernicus Climate Change Service (C3S) Climate Data Store (CDS), [Online]. Available: https://cds.climate.copernicus.eu/api-how-to. [Accessed 13 4 2021].

Glossary

Acronym	Description
C3S	Copernicus Climate Change Service
CDS	Climate Data Store

Appendix A - Input variables

The following tables contain the complete lists of all the available input variables with corresponding values of the `variable` CDS API parameter.

Table 3 - List of user-selectable variables

Variable (GUI)	`variable` parameter (CDS API)
100m u-component of wind	`100m_u_component_of_wind`
100m v-component of wind	`100m_v_component_of_wind`
10m u-component of neutral wind	`10m_u_component_of_neutral_wind`
10m u-component of wind	`10m_u_component_of_wind`
10m u-component of wind	`10m_u_component_of_wind`
10m u-component of wind	`10m_u_component_of_wind`
10m v-component of neutral wind	`10m_v_component_of_neutral_wind`
10m v-component of wind	`10m_v_component_of_wind`
10m v-component of wind	`10m_v_component_of_wind`
10m v-component of wind	`10m_v_component_of_wind`
10m wind gust since previous postprocessing	`10m_wind_gust_since_previous_post_processing`
2m dewpoint temperature	`2m_dewpoint_temperature`
2m dewpoint temperature	`2m_dewpoint_temperature`
2m dewpoint temperature	`2m_dewpoint_temperature`
2m temperature	`2m_temperature`
2m temperature	`2m_temperature`
2m temperature	`2m_temperature`
Air density over the oceans	`air_density_over_the_oceans`
Altimeter corrected wave height	`altimeter_corrected_wave_height`
Altimeter range relative correction	`altimeter_range_relative_correction`
Altimeter wave height	`altimeter_wave_height`
Benjamin-feir index	`benjamin_feir_index`
Boundary layer dissipation	`boundary_layer_dissipation`
Boundary layer height	`boundary_layer_height`
Charnock	`charnock`
Clear-sky direct solar radiation at surface	`clear_sky_direct_solar_radiation_at_surface`
Cloud base height	`cloud_base_height`
Coefficient of drag with waves	`coefficient_of_drag_with_waves`
Convective available potential energy	`convective_available_potential_energy`
Convective inhibition	`convective_inhibition`
Convective precipitation	`convective_precipitation`
Convective rain rate	`convective_rain_rate`
Convective snowfall	`convective_snowfall`
Convective snowfall rate water equivalent	`convective_snowfall_rate_water_equivalent`
Divergence	`divergence`

Downward UV radiation at the surface	downward_uv_radiation_at_the_surface
Duct base height	duct_base_height
Eastward gravity wave surface stress	eastward_gravity_wave_surface_stress
Eastward turbulent surface stress	eastward_turbulent_surface_stress
Evaporation	evaporation
Evaporation from bare soil	evaporation_from_bare_soil

Evaporation from open water surfaces excluding oceans	evaporation_from_open_water_surfaces_excluding_oceans
Evaporation from the top of canopy	evaporation_from_the_top_of_canopy
Evaporation from vegetation transpiration	evaporation_from_vegetation_transpiration
Forecast albedo	forecast_albedo
Forecast albedo	forecast_albedo
Forecast logarithm of surface roughness for heat	forecast_logarithm_of_surface_roughness_for_heat
Forecast surface roughness	forecast_surface_roughness
Fraction of cloud cover	fraction_of_cloud_cover
Free convective velocity over the oceans	free_convective_velocity_over_the_oceans
Friction velocity	friction_velocity
Geopotential	geopotential
Gravity wave dissipation	gravity_wave_dissipation
High cloud cover	high_cloud_cover
Ice temperature layer 1	ice_temperature_layer_1
Ice temperature layer 2	ice_temperature_layer_2
Ice temperature layer 3	ice_temperature_layer_3
Ice temperature layer 4	ice_temperature_layer_4
Instantaneous 10m wind gust	instantaneous_10m_wind_gust
Instantaneous eastward turbulent surface stress	instantaneous_eastward_turbulent_surface_stress
Instantaneous large-scale surface precipitation fraction	instantaneous_large_scale_surface_precipitation_fraction
Instantaneous moisture flux	instantaneous_moisture_flux
Instantaneous northward turbulent surface stress	instantaneous_northward_turbulent_surface_stress
Instantaneous surface sensible heat flux	instantaneous_surface_sensible_heat_flux
K index	k_index
Lake bottom temperature	lake_bottom_temperature
Lake bottom temperature	lake_bottom_temperature
Lake ice depth	lake_ice_depth
Lake ice depth	lake_ice_depth
Lake ice temperature	lake_ice_temperature

Lake ice temperature	lake_ice_temperature
Lake mix-layer depth	lake_mix_layer_depth
Lake mix-layer depth	lake_mix_layer_depth
Lake mix-layer temperature	lake_mix_layer_temperature
Lake mix-layer temperature	lake_mix_layer_temperature
Lake shape factor	lake_shape_factor
Lake shape factor	lake_shape_factor
Lake total layer temperature	lake_total_layer_temperature
Lake total layer temperature	lake_total_layer_temperature
Large scale rain rate	large_scale_rain_rate
Large scale snowfall rate water equivalent	large_scale_snowfall_rate_water_equivalent
Large-scale precipitation	large_scale_precipitation
Large-scale precipitation fraction	large_scale_precipitation_fraction
Large-scale snowfall	large_scale_snowfall
Leaf area index, high vegetation	leaf_area_index_high_vegetation
Leaf area index, high vegetation	leaf_area_index_high_vegetation
Leaf area index, low vegetation	leaf_area_index_low_vegetation
Leaf area index, low vegetation	leaf_area_index_low_vegetation
Low cloud cover	low_cloud_cover

Maximum 2m temperature since previous post-processing	maximum_2m_temperature_since_previous_post_processing
Maximum individual wave height	maximum_individual_wave_height
Maximum total precipitation rate since previous post-processing	maximum_total_precipitation_rate_since_previous_post_processing
Mean boundary layer dissipation	mean_boundary_layer_dissipation
Mean convective precipitation rate	mean_convective_precipitation_rate
Mean convective snowfall rate	mean_convective_snowfall_rate
Mean direction of total swell	mean_direction_of_total_swell
Mean direction of wind waves	mean_direction_of_wind_waves
Mean eastward gravity wave surface stress	mean_eastward_gravity_wave_surface_stress
Mean eastward turbulent surface stress	mean_eastward_turbulent_surface_stress
Mean evaporation rate	mean_evaporation_rate
Mean gravity wave dissipation	mean_gravity_wave_dissipation
Mean large-scale precipitation fraction	mean_large_scale_precipitation_fraction
Mean large-scale precipitation rate	mean_large_scale_precipitation_rate
Mean large-scale snowfall rate	mean_large_scale_snowfall_rate
Mean northward gravity wave surface stress	mean_northward_gravity_wave_surface_stress
Mean northward turbulent surface stress	mean_northward_turbulent_surface_stress

Mean period of total swell	mean_period_of_total_swell
Mean period of wind waves	mean_period_of_wind_waves
Mean potential evaporation rate	mean_potential_evaporation_rate
Mean runoff rate	mean_runoff_rate
Mean sea level pressure	mean_sea_level_pressure
Mean sea level pressure	mean_sea_level_pressure
Mean snow evaporation rate	mean_snow_evaporation_rate
Mean snowfall rate	mean_snowfall_rate
Mean snowmelt rate	mean_snowmelt_rate
Mean square slope of waves	mean_square_slope_of_waves
Mean sub-surface runoff rate	mean_sub_surface_runoff_rate
Mean surface direct short-wave radiation flux	mean_surface_direct_short_wave_radiation_flux
Mean surface direct short-wave radiation flux, clear sky	mean_surface_direct_short_wave_radiation_flux_clear_sky
Mean surface downward UV radiation flux	mean_surface_downward_uv_radiation_flux
Mean surface downward long-wave radiation flux	mean_surface_downward_long_wave_radiation_flux
Mean surface downward long-wave radiation flux, clear sky	mean_surface_downward_long_wave_radiation_flux_clear_sky
Mean surface downward shortwave radiation flux	mean_surface_downward_short_wave_radiation_flux
Mean surface downward short-wave radiation flux, clear sky	mean_surface_downward_short_wave_radiation_flux_clear_sky
Mean surface latent heat flux	mean_surface_latent_heat_flux
Mean surface net long-wave radiation flux	mean_surface_net_long_wave_radiation_flux
Mean surface net long-wave radiation flux, clear sky	mean_surface_net_long_wave_radiation_flux_clear_sky
Mean surface net short-wave radiation flux	mean_surface_net_short_wave_radiation_flux

Mean surface net short-wave radiation flux, clear sky	mean_surface_net_short_wave_radiation_flux_clear_sky
Mean surface runoff rate	mean_surface_runoff_rate
Mean surface sensible heat flux	mean_surface_sensible_heat_flux
Mean top downward short-wave radiation flux	mean_top_downward_short_wave_radiation_flux
Mean top net long-wave radiation flux	mean_top_net_long_wave_radiation_flux
Mean top net long-wave radiation flux, clear sky	mean_top_net_long_wave_radiation_flux_clear_sky
Mean top net short-wave radiation flux	mean_top_net_short_wave_radiation_flux
Mean top net short-wave radiation flux, clear sky	mean_top_net_short_wave_radiation_flux_clear_sky
Mean total precipitation rate	mean_total_precipitation_rate

Mean vertical gradient of refractivity inside trapping layer	mean_vertical_gradient_of_refractivity_inside_trapping_layer
Mean vertically integrated moisture divergence	mean_vertically_integrated_moisture_divergence
Mean wave direction	mean_wave_direction
Mean wave direction	mean_wave_direction
Mean wave direction of first swell partition	mean_wave_direction_of_first_swell_partition
Mean wave direction of second swell partition	mean_wave_direction_of_second_swell_partition
Mean wave direction of third swell partition	mean_wave_direction_of_third_swell_partition
Mean wave period	mean_wave_period
Mean wave period	mean_wave_period
Mean wave period based on first moment	mean_wave_period_based_on_first_moment
Mean wave period based on first moment for swell	mean_wave_period_based_on_first_moment_for_swell
Mean wave period based on first moment for wind waves	mean_wave_period_based_on_first_moment_for_wind_waves
Mean wave period based on second moment for swell	mean_wave_period_based_on_second_moment_for_swell
Mean wave period based on second moment for wind waves	mean_wave_period_based_on_second_moment_for_wind_waves
Mean wave period of first swell partition	mean_wave_period_of_first_swell_partition
Mean wave period of second swell partition	mean_wave_period_of_second_swell_partition
Mean wave period of third swell partition	mean_wave_period_of_third_swell_partition
Mean zero-crossing wave period	mean_zero_crossing_wave_period
Medium cloud cover	medium_cloud_cover
Minimum 2m temperature since previous post-processing	minimum_2m_temperature_since_previous_post_processing
Minimum total precipitation rate since previous post-processing	minimum_total_precipitation_rate_since_previous_post_processing
Minimum vertical gradient of refractivity inside trapping layer	minimum_vertical_gradient_of_refractivity_inside_trapping_layer
Model bathymetry	model_bathymetry
Near IR albedo for diffuse radiation	near_ir_albedo_for_diffuse_radiation
Near IR albedo for direct radiation	near_ir_albedo_for_direct_radiation
Normalized energy flux into ocean	normalized_energy_flux_into_ocean
Normalized energy flux into waves	normalized_energy_flux_into_waves
Normalized stress into ocean	normalized_stress_into_ocean
Northward gravity wave surface stress	northward_gravity_wave_surface_stress
Northward turbulent surface stress	northward_turbulent_surface_stress

Ocean surface stress equivalent 10m neutral wind direction	ocean_surface_stress_equivalent_10m_neutral_wind_direction
Ocean surface stress equivalent 10m neutral wind speed	ocean_surface_stress_equivalent_10m_neutral_wind_speed
Ozone mass mixing ratio	ozone_mass_mixing_ratio
Peak wave period	peak_wave_period
Period corresponding to maximum individual wave height	period_corresponding_to_maximum_individual_wave_height
Potential evaporation	potential_evaporation
Potential evaporation	potential_evaporation
Potential vorticity	potential_vorticity
Precipitation type	precipitation_type
Relative humidity	relative_humidity
Runoff	runoff
Runoff	runoff
Sea surface temperature	sea_surface_temperature
Sea surface temperature	sea_surface_temperature
Sea-ice cover	sea_ice_cover
Significant height of combined wind waves and swell	significant_height_of_combined_wind_waves_and_swell
Significant height of combined wind waves and swell	significant_height_of_combined_wind_waves_and_swell
Significant height of total swell	significant_height_of_total_swell
Significant height of wind waves	significant_height_of_wind_waves
Significant wave height of first swell partition	significant_wave_height_of_first_swell_partition
Significant wave height of second swell partition	significant_wave_height_of_second_swell_partition
Significant wave height of third swell partition	significant_wave_height_of_third_swell_partition
Skin reservoir content	skin_reservoir_content
Skin reservoir content	skin_reservoir_content
Skin temperature	skin_temperature
Skin temperature	skin_temperature
Snow albedo	snow_albedo
Snow albedo	snow_albedo
Snow cover	snow_cover
Snow density	snow_density
Snow density	snow_density
Snow depth	snow_depth
Snow depth	snow_depth
Snow evaporation	snow_evaporation
Snow evaporation	snow_evaporation
Snowd depth water equivalent	snowd_depth_water_equivalent
Snowfall	snowfall
Snowfall	snowfall
Snowmelt	snowmelt

Snowmelt	snowmelt
Soil temperature level 1	soil_temperature_level_1
Soil temperature level 1	soil_temperature_level_1
Soil temperature level 2	soil_temperature_level_2
Soil temperature level 2	soil_temperature_level_2
Soil temperature level 3	soil_temperature_level_3

Soil temperature level 3	soil_temperature_level_3
Soil temperature level 4	soil_temperature_level_4
Soil temperature level 4	soil_temperature_level_4
Specific cloud ice water content	specific_cloud_ice_water_content
Specific cloud liquid water content	specific_cloud_liquid_water_content
Specific humidity	specific_humidity
Specific rain water content	specific_rain_water_content
Specific snow water content	specific_snow_water_content
Sub-surface runoff	sub_surface_runoff
Sub-surface runoff	sub_surface_runoff
Surface latent heat flux	surface_latent_heat_flux
Surface latent heat flux	surface_latent_heat_flux
Surface net solar radiation	surface_net_solar_radiation
Surface net solar radiation	surface_net_solar_radiation
Surface net solar radiation, clear sky	surface_net_solar_radiation_clear_sky
Surface net thermal radiation	surface_net_thermal_radiation
Surface net thermal radiation	surface_net_thermal_radiation
Surface net thermal radiation, clear sky	surface_net_thermal_radiation_clear_sky
Surface pressure	surface_pressure
Surface pressure	surface_pressure
Surface pressure	surface_pressure
Surface runoff	surface_runoff
Surface runoff	surface_runoff
Surface sensible heat flux	surface_sensible_heat_flux
Surface sensible heat flux	surface_sensible_heat_flux
Surface solar radiation downward, clear sky	surface_solar_radiation_downward_clear_sky
Surface solar radiation downwards	surface_solar_radiation_downwards
Surface solar radiation downwards	surface_solar_radiation_downwards
Surface thermal radiation downward, clear sky	surface_thermal_radiation_downward_clear_sky
Surface thermal radiation downwards	surface_thermal_radiation_downwards
Surface thermal radiation downwards	surface_thermal_radiation_downwards
TOA incident solar radiation	toa_incident_solar_radiation
Temperature	temperature
Temperature of snow layer	temperature_of_snow_layer

Temperature of snow layer	temperature_of_snow_layer
Top net solar radiation	top_net_solar_radiation
Top net solar radiation, clear sky	top_net_solar_radiation_clear_sky
Top net thermal radiation	top_net_thermal_radiation
Top net thermal radiation, clear sky	top_net_thermal_radiation_clear_sky
Total cloud cover	total_cloud_cover
Total column cloud ice water	total_column_cloud_ice_water
Total column cloud liquid water	total_column_cloud_liquid_water
Total column ozone	total_column_ozone
Total column rain water	total_column_rain_water
Total column snow water	total_column_snow_water
Total column supercooled liquid water	total_column_supercooled_liquid_water
Total column water	total_column_water
Total column water vapour	total_column_water_vapour
Total evaporation	total_evaporation
Total precipitation	total_precipitation

Total precipitation	total_precipitation
Total precipitation	total_precipitation
Total sky direct solar radiation at surface	total_sky_direct_solar_radiation_at_surface
Total totals index	total_totals_index
Trapping layer base height	trapping_layer_base_height
Trapping layer top height	trapping_layer_top_height
U-component of wind	u_component_of_wind
U-component stokes drift	u_component_stokes_drift
UV visible albedo for diffuse radiation	uv_visible_albedo_for_diffuse_radiation
UV visible albedo for direct radiation	uv_visible_albedo_for_direct_radiation
V-component of wind	v_component_of_wind
V-component stokes drift	v_component_stokes_drift
Vertical integral of divergence of cloud frozen water flux	vertical_integral_of_divergence_of_cloud_frozen_water_flux
Vertical integral of divergence of cloud frozen water flux	vertical_integral_of_divergence_of_cloud_frozen_water_flux
Vertical integral of divergence of cloud liquid water flux	vertical_integral_of_divergence_of_cloud_liquid_water_flux
Vertical integral of divergence of cloud liquid water flux	vertical_integral_of_divergence_of_cloud_liquid_water_flux
Vertical integral of divergence of geopotential flux	vertical_integral_of_divergence_of_geopotential_flux
Vertical integral of divergence of kinetic energy flux	vertical_integral_of_divergence_of_kinetic_energy_flux
Vertical integral of divergence of mass flux	vertical_integral_of_divergence_of_mass_flux

Vertical integral of divergence of moisture flux	vertical_integral_of_divergence_of_moisture_flux
Vertical integral of divergence of ozone flux	vertical_integral_of_divergence_of_ozone_flux
Vertical integral of divergence of thermal energy flux	vertical_integral_of_divergence_of_thermal_energy_flux
Vertical integral of divergence of total energy flux	vertical_integral_of_divergence_of_total_energy_flux
Vertical integral of eastward cloud frozen water flux	vertical_integral_of_eastward_cloud_frozen_water_flux
Vertical integral of eastward cloud frozen water flux	vertical_integral_of_eastward_cloud_frozen_water_flux
Vertical integral of eastward cloud liquid water flux	vertical_integral_of_eastward_cloud_liquid_water_flux
Vertical integral of eastward cloud liquid water flux	vertical_integral_of_eastward_cloud_liquid_water_flux
Vertical integral of eastward geopotential flux	vertical_integral_of_eastward_geopotential_flux
Vertical integral of eastward heat flux	vertical_integral_of_eastward_heat_flux
Vertical integral of eastward kinetic energy flux	vertical_integral_of_eastward_kinetic_energy_flux
Vertical integral of eastward mass flux	vertical_integral_of_eastward_mass_flux
Vertical integral of eastward ozone flux	vertical_integral_of_eastward_ozone_flux
Vertical integral of eastward total energy flux	vertical_integral_of_eastward_total_energy_flux

Vertical integral of eastward water vapour flux	vertical_integral_of_eastward_water_vapour_flux
Vertical integral of energy conversion	vertical_integral_of_energy_conversion
Vertical integral of kinetic energy	vertical_integral_of_kinetic_energy
Vertical integral of mass of atmosphere	vertical_integral_of_mass_of_atmosphere
Vertical integral of mass tendency	vertical_integral_of_mass_tendency
Vertical integral of northward cloud frozen water flux	vertical_integral_of_northward_cloud_frozen_water_flux
Vertical integral of northward cloud frozen water flux	vertical_integral_of_northward_cloud_frozen_water_flux
Vertical integral of northward cloud liquid water flux	vertical_integral_of_northward_cloud_liquid_water_flux
Vertical integral of northward cloud liquid water flux	vertical_integral_of_northward_cloud_liquid_water_flux
Vertical integral of northward geopotential flux	vertical_integral_of_northward_geopotential_flux
Vertical integral of northward heat flux	vertical_integral_of_northward_heat_flux

Vertical integral of northward kinetic energy flux	vertical_integral_of_northward_kinetic_energy_flux
Vertical integral of northward mass flux	vertical_integral_of_northward_mass_flux
Vertical integral of northward ozone flux	vertical_integral_of_northward_ozone_flux
Vertical integral of northward total energy flux	vertical_integral_of_northward_total_energy_flux
Vertical integral of northward water vapour flux	vertical_integral_of_northward_water_vapour_flux
Vertical integral of potential and internal energy	vertical_integral_of_potential_and_internal_energy
Vertical integral of potential, internal and latent energy	vertical_integral_of_potential_internal_and_latent_energy
Vertical integral of temperature	vertical_integral_of_temperature
Vertical integral of thermal energy	vertical_integral_of_thermal_energy
Vertical integral of total energy	vertical_integral_of_total_energy
Vertical velocity	vertical_velocity
Vertically integrated moisture divergence	vertically_integrated_moisture_divergence
Volumetric soil water layer 1	volumetric_soil_water_layer_1
Volumetric soil water layer 1	volumetric_soil_water_layer_1
Volumetric soil water layer 2	volumetric_soil_water_layer_2
Volumetric soil water layer 2	volumetric_soil_water_layer_2
Volumetric soil water layer 3	volumetric_soil_water_layer_3
Volumetric soil water layer 3	volumetric_soil_water_layer_3
Volumetric soil water layer 4	volumetric_soil_water_layer_4
Volumetric soil water layer 4	volumetric_soil_water_layer_4
Vorticity (relative)	vorticity
Wave spectral directional width	wave_spectral_directional_width
Wave spectral directional width for swell	wave_spectral_directional_width_for_swell
Wave spectral directional width for wind waves	wave_spectral_directional_width_for_wind_waves
Wave spectral kurtosis	wave_spectral_kurtosis
Wave spectral peakedness	wave_spectral_peakedness
Wave spectral skewness	wave_spectral_skewness
Zero degree level	zero_degree_level

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