

LAB 3 : Data Resources netCDF

(Network Common Data Form)

What is netCDF?

- NetCDF** (network Common Data Form) is an interface for array-oriented data access and a library that provides an implementation of the interface. The **NetCDF** library also defines a machine-independent format for representing scientific data. Together, the interface, library, and format support the creation, access, and sharing of scientific data.
- NetCDF** maintains a collection of **reanalysis datasets** for use in climate diagnostics and attribution.

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LAB 3 : Data Resources netCDF

- Reanalysis datasets** are created by assimilating ("inputting") climate **observations** using the same **climate model** throughout the entire **reanalysis period** in order to **reduce** the affects of modeling changes on climate statistics. **Observations** are from many different sources including ships, satellites, ground stations, **RAOBS**, and **radar**.
- Currently, **PSD** makes available these reanalysis datasets to the public in our standard **NetCDF format**.
- PSD** is **Physical Sciences Division** in **ESRL Earth System Research Laboratory** of **NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION**

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LAB 3 : NetCDF Data Model

- NetCDF (Network Common Data Form)**

Topics Covered:

1. The **ncdisp** command : Open NetCDF File
2. The **ncinfo** command : Get Information About NetCDF File
3. The **ncread** command : Read Data from NetCDF File

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LAB 3 : NetCDF Data Model

- A quick guide on how to use Matlab netCDF functions**

A **netCDF** file contains two parts:

- A "header" that describes the **names**, **dimensions**, etc., of the **variables** stored in the file.
- And the **main body** that contains the **real data**.

- To process a **netCDF** file, we need to **first** extract the **information** in the **header** and **determine** what **portion/segment** of the **data** we want to use.
 - ❖ This is usually done by using a **set of stand-alone tools**. we will discuss in **Part (A)**.
 - ❖ Once the content of a **netCDF** file is known, it is rather straight forward to **read** the **data** as will be discussed in **Part (B)**.

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LAB 3 : NetCDF Data Model

Part (A) Inspect the content of a netCDF file

We will use the **netCDF** data file, **PRESSURE_9.nc**, as an example to explain how the MATLAB functions work. This file, **extracted** and **downloaded** from the NOAA ESRL-PSD web portal (www.esrl.noaa.gov/psd), contains the Atmospheric model CMAP gridded data for the long-term **Mean sea level pressure** for the global domain on a **regular longitude latitude grid** for the climatological means for January, February, ..., December.

OR use this link for retrieve data from The European Centre for Medium-Range Weather Forecasts (ECMWF)

<http://apps.ecmwf.int/datasets/data/interim-full-daily>

<http://apps.ecmwf.int/datasets/data/macc-reanalysis/levtype=sfc/>

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Type of level

- Model levels
- Potential temperature
- Potential vorticity
- Pressure levels
- Surface

ERA Interim Fields

- Daily
- Invariant
- Synoptic Monthly Means
- Monthly Means of Daily Means
- Monthly Means of Daily Forecast Accumulations

About

- Conditions of use
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Navigation

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See also...

ERA Interim, Daily

Please note that the fields shown on this interface are a subset of the ERA Interim dataset. The complete dataset (including wave fields) is available via the batch access. The full list of fields can be found [here](#).

Select a month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1979												1980											
1981												1982											
1983												1984											
1985												1986											
1987												1988											
1989												1990											
1991												1992											
1993												1994											
1995												1996											
1997												1998											
1999												2000											
2001												2002											
2003												2004											
2005												2006											
2007												2008											
2009												2010											
2011												2012											
2013												2014											

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About Forecasts Computing Research Learning

Type of level

- Model levels
- Potential temperature
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- Surface**

ERA Interim Fields

- Daily
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ERA Interim, Monthly Means of Daily Means

Please note that the fields shown on this interface are a subset of the ERA Interim dataset. The complete dataset (including wave fields) is available via the batch access. The full list of fields can be found [here](#).

Select a year

1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989
 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
 2012 2013 2014 2015 2016 2017

Select parameter

<input type="checkbox"/> 2 metre dewpoint temperature	<input type="checkbox"/> 2 metre temperature
<input type="checkbox"/> 10 metre U wind component	<input type="checkbox"/> 10 metre V wind component
<input type="checkbox"/> 10 metre wind speed	<input type="checkbox"/> Albedo
<input type="checkbox"/> Boundary layer height	<input type="checkbox"/> Charnock
<input type="checkbox"/> Convective available potential energy	<input type="checkbox"/> Forecast albedo
<input type="checkbox"/> Forecast logarithm of surface roughness for heat	<input type="checkbox"/> Forecast surface roughness
<input type="checkbox"/> High cloud cover	<input type="checkbox"/> Ice temperature layer 1
<input type="checkbox"/> Ice temperature layer 2	<input type="checkbox"/> Ice temperature layer 3
<input type="checkbox"/> Ice temperature layer 4	<input type="checkbox"/> Instantaneous eastward turbulent surface stress
<input type="checkbox"/> Instantaneous moisture flux	<input type="checkbox"/> Instantaneous northward turbulent surface stress
<input type="checkbox"/> Instantaneous surface sensible heat flux	<input type="checkbox"/> Logarithm of surface roughness length for heat
<input type="checkbox"/> Low cloud cover	<input type="checkbox"/> Mean sea level pressure
<input type="checkbox"/> Medium cloud cover	<input type="checkbox"/> Sea surface temperature
<input type="checkbox"/> Sea-ice cover	<input type="checkbox"/> Skin reservoir content

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Select time

00:00:00 06:00:00 12:00:00 18:00:00
[Select All](#) or [Clear](#)

Select step

0 3 6 9 12
[Select All](#) or [Clear](#)

Select parameter

<input type="checkbox"/> 2 metre dewpoint temperature	<input type="checkbox"/> 2 metre temperature
<input type="checkbox"/> 10 metre U wind component	<input type="checkbox"/> 10 metre V wind component
<input type="checkbox"/> 10 metre wind gust since previous post-processing	<input type="checkbox"/> Albedo
<input type="checkbox"/> Boundary layer dissipation	<input type="checkbox"/> Boundary layer height
<input type="checkbox"/> Charnock	<input type="checkbox"/> Clear sky surface photosynthetically active radiation
<input type="checkbox"/> Convective available potential energy	<input type="checkbox"/> Convective precipitation
<input type="checkbox"/> Convective snowfall	<input type="checkbox"/> Downward UV radiation at the surface
<input type="checkbox"/> Eastward gravity wave surface stress	<input type="checkbox"/> Eastward turbulent surface stress
<input type="checkbox"/> Evaporation	<input type="checkbox"/> Forecast albedo
<input type="checkbox"/> Forecast logarithm of surface roughness for heat	<input type="checkbox"/> Forecast surface roughness
<input type="checkbox"/> Gravity wave dissipation	<input type="checkbox"/> High cloud cover
<input type="checkbox"/> Ice temperature layer 1	<input type="checkbox"/> Ice temperature layer 2
<input type="checkbox"/> Ice temperature layer 3	<input type="checkbox"/> Ice temperature layer 4
<input type="checkbox"/> Instantaneous eastward turbulent surface stress	<input type="checkbox"/> Instantaneous moisture flux
<input type="checkbox"/> Instantaneous northward turbulent surface stress	<input type="checkbox"/> Instantaneous surface sensible heat flux
<input type="checkbox"/> Large-scale precipitation	<input type="checkbox"/> Large-scale precipitation fraction
<input type="checkbox"/> Large-scale snowfall	<input type="checkbox"/> Logarithm of surface roughness length for heat
<input type="checkbox"/> Low cloud cover	<input type="checkbox"/> Maximum temperature at 2 metres since previous post-processing
<input checked="" type="checkbox"/> Mean sea level pressure	<input type="checkbox"/> Mean wave direction
<input type="checkbox"/> Mean wave period	<input type="checkbox"/> Medium cloud cover

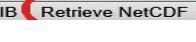
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apps.ecmwf.int/datasets/data/interim-full-daily/levtype=sfc  

<input type="checkbox"/> Total column ice water	<input type="checkbox"/> Total column liquid water
<input type="checkbox"/> Total column ozone	<input type="checkbox"/> Total column water
<input type="checkbox"/> Total column water vapour	<input type="checkbox"/> Total precipitation
<input type="checkbox"/> Vertical integral of cloud frozen water	<input type="checkbox"/> Vertical integral of cloud liquid water
<input type="checkbox"/> Vertical integral of divergence of cloud frozen water flux	<input type="checkbox"/> Vertical integral of divergence of cloud liquid water flux
<input type="checkbox"/> Vertical integral of divergence of geopotential flux	<input type="checkbox"/> Vertical integral of divergence of kinetic energy flux
<input type="checkbox"/> Vertical integral of divergence of mass flux	<input type="checkbox"/> Vertical integral of divergence of moisture flux
<input type="checkbox"/> Vertical integral of divergence of ozone flux	<input type="checkbox"/> Vertical integral of divergence of thermal energy flux
<input type="checkbox"/> Vertical integral of divergence of total energy flux	<input type="checkbox"/> Vertical integral of eastward cloud frozen water flux
<input type="checkbox"/> Vertical integral of eastward cloud liquid water flux	<input type="checkbox"/> Vertical integral of eastward geopotential flux
<input type="checkbox"/> Vertical integral of eastward heat flux	<input type="checkbox"/> Vertical integral of eastward kinetic energy flux
<input type="checkbox"/> Vertical integral of eastward mass flux	<input type="checkbox"/> Vertical integral of eastward ozone flux
<input type="checkbox"/> Vertical integral of eastward total energy flux	<input type="checkbox"/> Vertical integral of eastward water vapour flux
<input type="checkbox"/> Vertical integral of energy conversion	<input type="checkbox"/> Vertical integral of kinetic energy
<input type="checkbox"/> Vertical integral of mass of atmosphere	<input type="checkbox"/> Vertical integral of mass tendency
<input type="checkbox"/> Vertical integral of northward cloud frozen water flux	<input type="checkbox"/> Vertical integral of northward cloud liquid water flux
<input type="checkbox"/> Vertical integral of northward geopotential flux	<input type="checkbox"/> Vertical integral of northward heat flux
<input type="checkbox"/> Vertical integral of northward kinetic energy flux	<input type="checkbox"/> Vertical integral of northward mass flux
<input type="checkbox"/> Vertical integral of northward ozone flux	<input type="checkbox"/> Vertical integral of northward total energy flux
<input type="checkbox"/> Vertical integral of northward water vapour flux	<input type="checkbox"/> Vertical integral of ozone
<input type="checkbox"/> Vertical integral of potential+internal energy	<input type="checkbox"/> Vertical integral of potential+internal+latent energy
<input type="checkbox"/> Vertical integral of temperature	<input type="checkbox"/> Vertical integral of thermal energy
<input type="checkbox"/> Vertical integral of total energy	<input type="checkbox"/> Vertical integral of water vapour
<input type="checkbox"/> Volumetric soil water layer 1	<input type="checkbox"/> Volumetric soil water layer 2
<input type="checkbox"/> Volumetric soil water layer 3	<input type="checkbox"/> Volumetric soil water layer 4

[Select All](#) or [Clear](#)

[View the MARS request](#) | [Retrieve GRIB](#)  [Retrieve NetCDF](#)

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ecmwf.int/datasets/data/interim-full-daily/levtype=sfc/selectors/56191  

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Additional filtering

Stream: Atmospheric model
Parameter: Mean sea level pressure
Dataset: interim_daily
Type of level: Surface
Step: 0
Version: 1
Time: 00:00:00, 06:00:00, 12:00:00, 18:00:00
Date: 20150901 to 20150930
Type: Analysis
Class: ERA Interim

The request will be done using the following attributes:

Area: Default (as archived) 

Grid: 0.75x0.75 

[Retrieve now](#)

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Parameter: Mean sea level pressure
 Class: ERA Interim
 Step: 0
 Type: Analysis
 Time: 00:00:00, 06:00:00, 12:00:00, 18:00:00
 Step: 3 to 12 by 3
 Type: Forecast
 Time: 00:00:00, 12:00:00

The request will be done using the following attributes:

Area: Custom [\(change\)](#)

- Default (as archived)
- South Asia
- Inter-tropical band
- Northern Hemisphere
- Southern Hemisphere
- Tropical Pacific
- Europe
- North America
- Indonesia
- Custom: N W S E **IRAQ Coordinates**

Grid: 0.125x0.125 [\(change\)](#)

NetCDF Options [\(help\)](#): None selected [\(change\)](#)

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Area: Custom [\(change\)](#)

- Default (as archived)
- South Asia
- Inter-tropical band
- Northern Hemisphere
- Southern Hemisphere
- Tropical Pacific
- Europe
- North America
- Indonesia
- Custom: N W S E

Grid: 1x1 [\(change\)](#)

- 0.125x0.125
- 0.25x0.25
- 0.4x0.4
- 0.5x0.5
- 0.75x0.75
- 1x1
- 1.125x1.125
- 1.5x1.5
- 2x2
- 2.5x2.5
- 3x3

NetCDF Options [\(help\)](#): None selected [\(change\)](#)

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Area: Custom [\(change\)](#)

- Default (as archived)
- South Asia
- Inter-tropical band
- Northern Hemisphere
- Southern Hemisphere
- Tropical Pacific
- Europe
- North America
- Indonesia
- Custom: N **33.375** W **44.375** S **33.375** E **44.375**

BAGHDAD Coordinates

Grid: 0.125x0.125 [\(change\)](#)

- 0.125x0.125
- 0.25x0.25
- 0.4x0.4
- 0.5x0.5
- 0.75x0.75
- 1x1
- 1.125x1.125
- 1.5x1.5
- 2x2
- 2.5x2.5
- 3x3

NetCDF Options (help): None selected [\(change\)](#)

[Retrieve now!](#)

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netcdf [\(change\)](#)

Final request

Stream: Atmospheric model

Area: 28.0°N 38.5°E 38.0°N 48.5°E

Dataset: interim_daily

Version: 1

Type of level: Surface

Date: 20090901 to 20090930

[See full request](#)

The status of the request is: **active**

Request output:

```

STREAM = OPER,
= regrid,
REPRES = SH,
LEVTYPE = SFC,
PARAM = 151.136,
= 0000/1200,
STEP = 3/6/9/12,
DOMAIN = G,
RESOL = AUTO,
ARCFID = 38/38/28/49,
ARCFID = 38/38/28/49,
PADDING = 0,
EXPECT = ANY,
= 28090901/28090902/28090903/28090904/28090905/28090906/28090907/28090908/28090909/28090910/28090911/28090912/28090913/28090914/28090915/28090916/28090917/28090918/28090919/28090920/28090921/28090922/28090923/28090924/28090925/28090926/28090927/28090928/28090929/28090930
mars - INFO - 20371289, 095757 - Requesting any number of fields (request describes 240)
mars - INFO - 20371289, 095758 - Calling back to marser callback on 40156
mars - INFO - 20371289, 095758 - Server task is 988 [marser]
mars - INFO - 20371289, 095758 - Request cost: 240 fields, 40.8887 Mbytes online, nodes: mvr02 [marser]
  
```

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The screenshot shows the ECMWF website interface. On the left, there's a navigation sidebar with links like 'About', 'Forecasts', 'Computing', 'Research', 'Learning', 'Navigation' (which is currently selected), 'See also...', and 'GRIB decoder'. The main content area displays a 'Final request' for an 'Atmospheric model' stream at 28.0N 38.5E 38.0N 48.5E. The status is 'complete', and there's a red circle around the 'Download (0.1MB)' link. Below the download link is a 'Request output' section containing a large block of command-line log output related to the NetCDF processing.

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LAB 3 : Part(A) NetCDF Data Model(Header)

1. The ncdisp command

Display contents of NetCDF data source in Command Window

Syntax

1- ncdisp(source)

Displays as **text** in the Command Window ,**all the group** ,**dimensions**, **variable definitions**, and **all attributes** in the **NetCDF** data source

2- ncdisp(source,location)

Displays information about the **variable** or **group** specified by location in source.

3- ncdisp(source,location,modestr)

Displays the contents of the location in source according to the **value** of modestr.

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LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

It is strongly recommended that the **information** in the **header** be examined before one uses the **data** in a **netCDF** file.

1- **ncdisp(source)**

1- ncdisp(source) **source** — Name of NetCDF file

Displays all the **groups**, **dimensions**, **variable definitions**, and all **attributes** in the **NetCDF** data source, as **text** in the **Command Window**.

Example:

```
>>ncdisp('PRESSURE_9.nc')
```

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LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

1- **ncdisp(source)**

```
>>ncdisp('PRESSURE_9.nc')
```

Global Attributes:

history = '2017-12-09 09:58:01 GMT by grib_to_ncdf-2.5.0:

Dimensions:

longitude = 12

latitude = 11

time = 241 (UNLIMITED)

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LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

1- **ncdisp(source)**

```
>>ncdisp('PRESSURE_9.nc')
```

Variables:

longitude

Size: 12x1

Dimensions: longitude

Datatype: single

Attributes:

units = 'degrees_east'

long_name = 'longitude'

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LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

1- **ncdisp(source)**

```
>>ncdisp('PRESSURE_9.nc')
```

latitude

Size: 11x1

Dimensions: latitude

Datatype: single

Attributes:

units = 'degrees_north'

long_name = 'latitude'

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LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

1- **ncdisp(source)**

```
>>ncdisp('PRESSURE_9.nc')

time
Size: 241x1
Dimensions: time
Datatype: int32
Attributes:
    units = 'hours since 1900-01-01 00:00:0.0'
    long_name = 'time'
```

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LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

1- **ncdisp(source)**

```
>>ncdisp('PRESSURE_9.nc')

msl
Size: 12x11x241
Dimensions: longitude,latitude,time
Datatype: int16
Attributes:
    units = 'Pa'
    long_name = 'Mean sea level pressure'
    standard_name = 'air_pressure_at_sea_level'
```

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LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

2- **ncdisp(source,location)**

```
>>ncdisp('PRESSURE_9.nc','longitude')
```

Dimensions:

longitude = 12

Variables:

longitude

Size: 12x1

Dimensions: longitude

Datatype: single

Attributes:

units = 'degrees_east'

long_name = 'longitude'

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LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

2- **ncdisp(source,location)**

```
>>ncdisp('PRESSURE_9.nc','latitude')
```

Dimensions:

latitude = 11

Variables:

latitude

Size: 11x1

Dimensions: latitude

Datatype: single

Attributes:

units = 'degrees_north'

long_name = 'latitude'

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LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

2- ncdisp(source,location)

```
>>ncdisp('PRESSURE_9.nc','time')
```

Dimensions:

time = 241

Variables:

time

Size: 241x1

Dimensions: time

Datatype: int32

Attributes:

units = 'hours since 1900-01-01 00:00:0.0'

long_name = 'time'

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LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

2- ncdisp(source,location)

```
>>ncdisp('PRESSURE_9.nc','msl')
```

Dimensions:

longitude = 12

latitude = 11

time = 241 (UNLIMITED)

Variables:

msl

Size: 12x11x241

Dimensions: longitude,latitude,time

Datatype: int16

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LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

2- ncdisp(source,location)

```
>>ncdisp('PRESSURE_9.nc','msl')
```

Attributes:

```
units      = 'Pa'  
long_name  = 'Mean sea level pressure'  
standard_name = 'air_pressure_at_sea_level'
```

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LAB 3 : Part(A) NetCDF Data Model(Header)

Step 0: Display/check the header of the netCDF file

3- ncdisp(source,location,modestr)

source Text string specifying the name of the NetCDF file

location Text string specifying the location of the variable or group in the NetCDF file .

Set location to / (forward slash) to display the entire contents of the file.

Default: /

modestr specifies the type of display .

'min' Display group hierarchy and variables definitions.

'full' Display group hierarchy with dimensions, attributes, and variable definitions.

Default :full

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LAB 3 : Part(A) NetCDF Data Model(Header)

3- ncdisp(source,location,modestr)

>> ncdisp('PRESSURE_9.nc', '/', 'min')

Source: D:\MATLAB\PRESSURE_9.nc

Format: 64bit

Variables:

longitude

Size: 12x1

Dimensions: longitude

Datatype: single

latitude

Size: 11x1

Dimensions: latitude

Datatype: single

time

Size: 241x1

Dimensions: time

Datatype: int32

msl

Size: 12x11x241

Dimensions: longitude,latitude,time

Datatype: int16

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LAB 3 : Part(A) NetCDF Data Model(Header)

3- ncdisp(source,location,modestr)

>> ncdisp('PRESSURE_9.nc', '/', 'full')

Is the same command

>> ncdisp('PRESSURE_9.nc')

>> ncdisp('PRESSURE_9.nc', 'msl', 'min')

Source:

D:\MATLAB\PRESSURE_9.nc

Format: 64bit

Variables:

msl

Size: 12x11x241

Dimensions: longitude,latitude,time

Datatype: int16

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LAB 3 : Part(A) NetCDF Data Model(Header)

2.The **ncinfo** command Return information about NetCDF data source

Syntax

```
finfo = ncinfo(source)
vinfo = ncinfo(source,varname)
ginfo = ncinfo(source,groupname)

>> finfo=ncinfo('PRESSURE_9.nc')           Filename: 'D:\MATLAB\PRESSURE_9.nc'
>> finfo_msl=ncinfo('PRESSURE_9.nc','msl')   Name: '/'
                                         Dimensions: [1x3 struct]
                                         Variables: [1x4 struct]
                                         Attributes: [1x2 struct]
                                         Groups: []
                                         Format: '64bit'
```

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LAB 3 : Part(B) NetCDF Data Model(Contains)

1.The **ncread** command

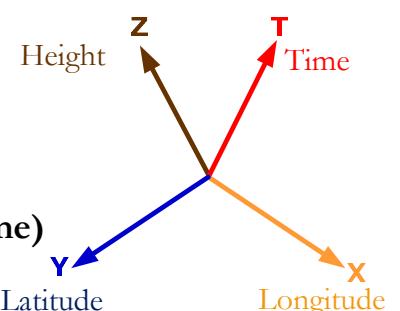
A NetCDF dataset contains :

- Dimensions
- Variables
- Attributes

- Dimensions
 - Longitude
 - Latitude
 - Time

Variables	
long	lat
10	11
12	13

- Variables(long , lat ,time)



For each location **one** value so for this ex.
we have **four** locations .

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LAB 3 : Part(B) NetCDF Data Model(Contains)

A NetCDF dataset contains :

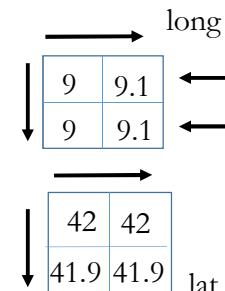
- Dimensions
- Variables
- Attributes

- Dimensions
 - Longitude
 - Latitude
 - Time

- Variables(long , lat ,time)

Variables
long

10	11
12	13



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LAB 3 : Part(B) NetCDF Data Model(Contains)

A NetCDF dataset contains :

- Dimensions
- Variables
- Attributes

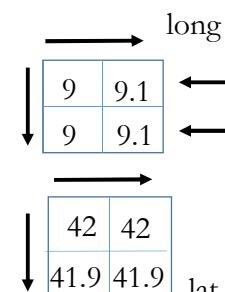
- Dimensions
 - Longitude
 - Latitude
 - Time

- Variables(long , lat ,time)

Variables
long

9	9.1
9	9.1

$$\begin{matrix} V_{(9,42)} & V_{(9.1,42)} \\ V_{(9,41.9)} & V_{(9.1,41.9)} \end{matrix}$$



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LAB 3 : Part(B) NetCDF Data Model(Contains)

A NetCDF dataset contains :

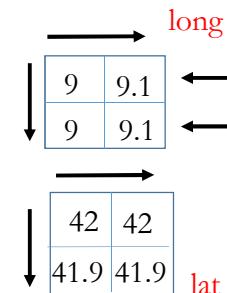
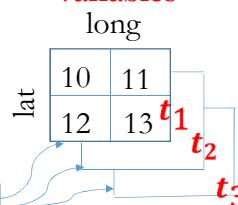
- Dimensions
- Variables
- Attributes

- Dimensions
 - Longitude
 - Latitude
 - Time

Time

- Variables(long , lat ,time)

Variables



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LAB 3 : Part(B) NetCDF Data Model(Contains)

A NetCDF dataset contains :

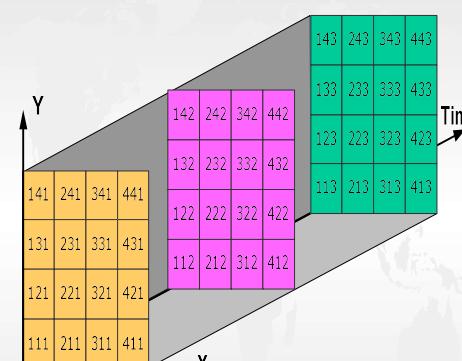
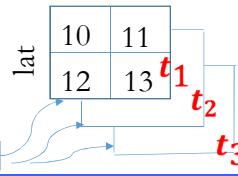
- Dimensions
- Variables
- Attributes

- Dimensions
 - Longitude
 - Latitude
 - Time

Time

Variables

long



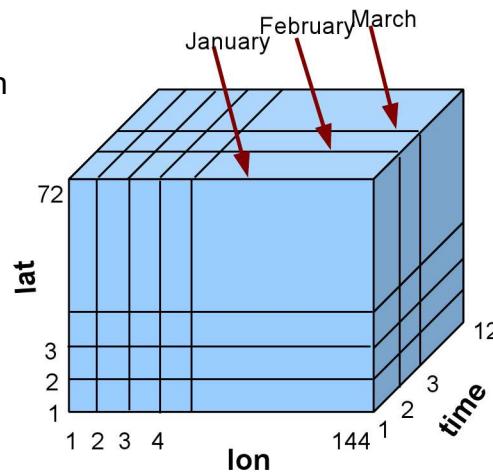
- Variables(long , lat ,time)

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LAB 3 : Part(B) NetCDF Data Model(Contains)

- Here, we use the "normal" convention with each of the **indices**, **i**, **j**, and **k**, starting from **1**.



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LAB 3 : NetCDF Data Model

1. Dimensions (for example, time, latitude, longitude, or height.)

A **dimension** may be used to represent a real physical dimension, for example, **time**, **latitude**, **longitude**, or **height**. A **dimension** might also be used to **index** other quantities, for example station or model-run-number.

A **netCDF dimension** has both a **name** and a **length**.

2. Variables (represents an array of values of the same type, which store the bulk data.)

Variables are used to store the bulk of the data in a **netCDF** dataset. A **variable** represents an array of values of the same type. A scalar value is treated as a 0-dimensional array. A **variable** has a **name**, a **data type**, and a shape described by its list of dimensions specified when the variable is created. A **variable** may also have associated **attributes**, which may be added, deleted or changed after the **variable** is created.

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LAB 3 : NetCDF Data Model

3. Attributes(are used to store data about the data ,ancillary data or metadata).

NetCDF attributes are used to store data about the data (ancillary data or metadata), similar in many ways to the information stored in data dictionaries and schema in conventional database systems. Most attributes provide information about a specific variable. These are identified by the name (or ID) of that variable, together with the name of the attribute.

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LAB 3 : Part(B) NetCDF Data Model(Contains)

3.The **ncread** command Read data from variable in NetCDF data source

Syntax

vardata = ncread(source,varname)

- ❖ **source** Text string specifying the name of the NetCDF file
- ❖ **Varname** Text string specifying the name of a variable in the NetCDF file
- ❖ **Vardata** The data in the variable, **ncread** uses the MATLAB datatype that is the closest type to the corresponding NetCDF datatype .

Example:

```
>> ncdisp('PRESSURE_9.nc', '/', 'min')
>> long=ncread('PRESSURE_9.nc', 'longitude')
```

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LAB 3 : Part(B) NetCDF Data Model(Contains)

3.The ncread command

Example: **vardata = ncread(source,varname)**

```
>> ncdisp( 'PRESSURE_9.nc', '/', 'min')
>>long=ncread( 'PRESSURE_9.nc' , 'longitude')
>>lat=ncread( 'PRESSURE_9.nc' , 'latitude')
>>time=ncread( 'PRESSURE_9.nc' , 'time')
>>msl=ncread( 'PRESSURE_9.nc' , 'msl')
```

Example(1) :-

Retrieve data from nc-file (PRESSURE_9.nc) to read again in excel sheet for Iraq region .

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LAB 3 : NetCDF Data Model

```
% Example 1: This is program to transfer data from
% netCDF source file to excel sheet
% Retrieve data for All grid
clc, clear all
format longE
% Step 1 : Display all variables in nc file using
% command: ncdisp
filename='PRESSURE_9.nc';
ncdisp( filename, '/', 'min')
%%%%%%%%%%%%%
```

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LAB 3 : NetCDF Data Model

```
% Step 2 : Read variables from nc file by command: ncread
variable=input('write your main variable=' , 's');
msl=ncread(filename,variable);
long=ncread(filename,'longitude');
lat=ncread(filename,'latitude');
time=ncread(filename,'time');
msl=0.01*msl;      % 1mb=0.01*Pa
```

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LAB 3 : NetCDF Data Model

```
% Step 3 : Read all longitude and latitude for all grid
% in 2-D (2 dimensional) of array
m=numel(long); % m:number of element of longitude
n=numel(lat); % n:number of element of latitude
h=0;g=0;
for i=1:n
    for j=1:m
        h=h+1;
        latt(h)=lat(i);
        longg(h)=long(j);
    end
end
latt1=[longg ; latt];
```

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LAB 3 : NetCDF Data Model

```
% Step 4 :Convert 3-D array to 2-D array for all
% stations
mm=length(time);
for i=1:n
    for j=1:m
        g=g+1;
        MSL(:,g)=msl(j,i,:);
    end
end
```

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LAB 3 : NetCDF Data Model

```
% Step 5 :Convert time from netCDF format to MATLAB
% format using its units and sort data in nc file
time=double(time);
A=time./24+datenum('1900-01-01 0:0:0');
[time,I] = sort(A);
MSL=MSL(I,:);
yy=year(time);mm=month(time);dd=day(time);hh=hour(time);
Date=[yy mm dd hh];
% Step 6:Display data in excel sheet or save data in .mat
% file
C={'LOCATION:IRAQ','FROM','TO','Longitude','DATE','1/9/200
9','30/9/2009','Latitude'};
DD={'Year','Month','Day','Hour'};
```

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LAB 3 : NetCDF Data Model

```

for i=1:n*m
    X(i)={'Pressure (mb)'};
end
fileName='PRESSURE_9.xlsx';
sheet =1 ;
xlswrite(fileName,C,sheet,'A1')
xlswrite(fileName,DD,sheet,'A3')
xlswrite(fileName,latt1,sheet,'E1')
xlswrite(fileName,X,sheet,'E3')
xlswrite(fileName,Date,sheet,'A4')
xlswrite(fileName,MSL,sheet,'E4')
save PRESSURE_9

```

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LAB 3 : NetCDF Data Model

>> NC_FILE

Variables:

- longitude**
Size: 12x1
Dimensions: longitude
- latitude**
Size: 11x1
Dimensions: latitude
- time**
Size: 241x1
Dimensions: time
- msl**
Size: 12x11x241
Dimensions: longitude,latitude,time

write your main variable=msl

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Example(1) :- Retrieve data from nc-file to read again in excel sheet for all location

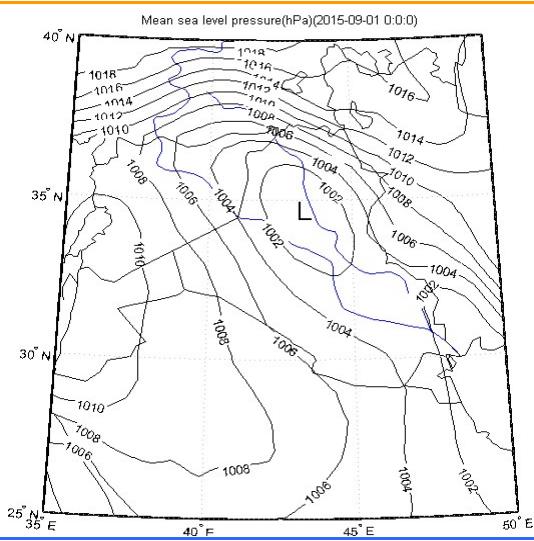
A	B	C	D	E	F	G	H	I	J	K	L	M
LOCATION	IRAQ	FROM	TO	Longitude	38	39	40	41	42	43	44	45
DATE		01/09/2009	30/09/2009	Latitude	38	38	38	38	38	38	38	38
Year	Month	Day	Hour	Pressure (mb)								
4	2009	9	1	0	1011.195727	1008.988508	1007.183011	1006.616669	1008.339856	1012.477471	1015.979128	1015.281745
5	2009	9	1	3	1011.818581	1009.884909	1008.081869	1007.519213	1009.23421	1013.423012	1016.821475	1016.478312
6	2009	9	1	6	1012.115061	1010.471727	1008.809146	1008.370159	1009.943468	1013.48239	1016.758412	1016.780934
7	2009	9	1	9	1010.300555	1008.717417	1007.358278	1007.112986	1008.529046	1011.495483	1014.368554	1014.117938
8	2009	9	1	12	1008.049109	1006.445906	1005.403312	1005.395941	1006.825925	1010.260833	1013.465191	1012.006543
9	2009	9	1	15	1006.832067	1005.13386	1004.3599	1004.587583	1006.344759	1010.086794	1013.407451	1012.503269
10	2009	9	1	18	1008.195711	1006.093324	1005.276367	1005.738648	1007.818559	1012.052407	1015.497143	1014.727278
11	2009	9	1	21	1009.122416	1008.768594	1005.614616	1006.031489	1008.267374	1012.425464	1015.893132	1015.822698
12	2009	9	2	0	1009.607287	1007.377934	1006.098238	1006.351721	1008.46844	1012.524973	1016.104436	1016.302226
13	2009	9	2	3	1010.47705	1008.224376	1006.731739	1006.801764	1008.641659	1012.33824	1015.770282	1015.989366
14	2009	9	2	6	1011.380413	1009.421352	1007.90865	1007.697346	1009.033144	1012.212113	1015.392311	1015.556931
15	2009	9	2	9	1009.871396	1008.159265	1006.741158	1006.431164	1007.649844	1010.090889	1012.598503	1012.136765
16	2009	9	2	12	1007.954923	1006.326741	1005.111747	1005.015513	1006.289067	1008.502838	1010.386141	1009.428314
17	2009	9	2	15	1007.767781	1006.144922	1004.939755	1004.849665	1006.330426	1008.648211	1010.173609	1008.368931
18	2009	9	2	18	1009.321434	1007.715364	1006.489723	1006.17072	1007.624455	1010.239539	1012.15683	1010.716609
19	2009	9	2	21	1009.882862	1008.278431	1006.970479	1006.523712	1007.80683	1010.446795	1012.676489	1012.136765
20	2009	9	3	0	1010.038882	1008.533551	1007.283749	1006.874655	1008.024948	1010.692039	1013.217852	1013.098686
21	2009	9	3	3	1010.595806	1009.03642	1007.893498	1007.750172	1009.074094	1011.984839	1014.638416	1014.393943
22	2009	9	3	6	1011.585164	1010.224797	1009.134701	1009.001612	1010.217835	1012.995492	1015.51639	1014.950457
23	2009	9	3	9	1010.115459	1008.895142	1007.887765	1007.630597	1008.699809	1011.010632	1013.140865	1012.525792
24	2009	9	3	12	1008.338218	1007.176049	1006.341073	1006.246478	1007.436493	1009.635522	1011.346424	1010.32103

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LAB 3 : NetCDF Data Model

```
>> load pressure_9
>> map_pressure(MSL,longg,latt,time)
input hour=9
input day=9
input month=9
input year=2009
```



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LAB 3 :**NetCDF Data Model**

>> NC_FILE

Variables:**longitude****Size: 12x1****Dimensions: longitude****latitude****Size: 11x1****Dimensions: latitude****time****Size: 241x1****Dimensions: time****msl****Size: 12x11x241****Dimensions: longitude,latitude,time****write your main variable=msl**

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**LAB 3 :****NetCDF Data Model**

A	B	C	D	E	F	G
1	LOCATION:IRAQ	FROM	TO	Longitude	44.375	
2	DATE	01/09/2009	30/09/2009	Latitude	33.375	
3	Year	Month	Day	Hour	Pressure (mb)	
4	2009	9	1	0	1002.919	
5	2009	9	1	3	1003.381	
6	2009	9	1	6	1004.433	
7	2009	9	1	9	1003.442	
8	2009	9	1	12	1001.978	
9	2009	9	1	15	1002.047	
10	2009	9	1	18	1003.093	
11	2009	9	1	21	1003.003	
12	2009	9	2	0	1002.876	
13	2009	9	2	3	1004.017	
14	2009	9	2	6	1005.26	
15	2009	9	2	9	1004.522	
16	2009	9	2	12	1002.861	
17	2009	9	2	15	1002.797	
18	2009	9	2	18	1003.614	
19	2009	9	2	21	1003.116	
20	2009	9	3	0	1002.611	
21	2009	9	3	3	1003.529	
22	2009	9	3	6	1005.149	
23	2009	9	3	9	1004.225	
24	2009	9	3	12	1002.602	

Example(2) :-

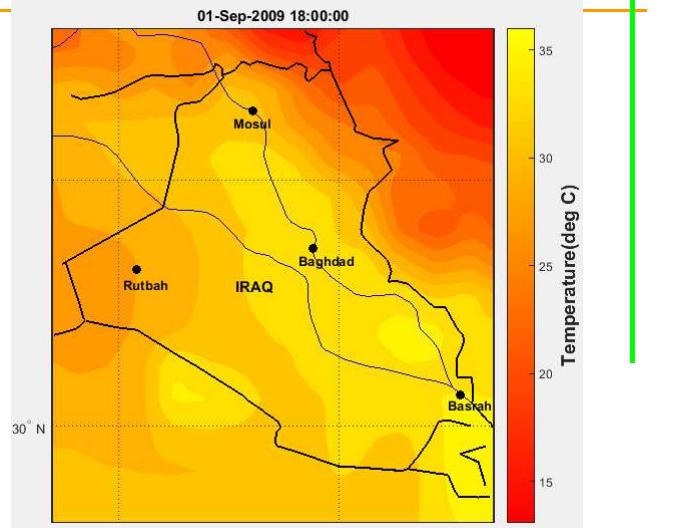
Retrieve data from nc-file to read again in excel sheet for Baghdad only .

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LAB 3 :**NetCDF Data Model**

```
>> load temp_9
>> map(MSL, longg, latt, time)
input hour=18
input day=1
input month=9
input year=2009
```



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Select parameter <http://apps.ecmwf.int/datasets/data/macc-reanalysis/levtype=sfc/>

- | | |
|---|--|
| <input type="checkbox"/> 2 metre dewpoint temperature
<input type="checkbox"/> 10 metre U wind component
<input type="checkbox"/> 10 metre wind gust since previous post-processing
<input type="checkbox"/> Angle of sub-gridscale orography
<input type="checkbox"/> Black Carbon Aerosol Optical Depth at 550nm
<input type="checkbox"/> Boundary layer height
<input type="checkbox"/> Convective available potential energy
<input type="checkbox"/> Downward UV radiation at the surface
<input type="checkbox"/> Dust emission potential
<input type="checkbox"/> Eastward turbulent surface stress
<input type="checkbox"/> Forecast albedo
<input type="checkbox"/> Forecast surface roughness
<input type="checkbox"/> Geopotential
<input type="checkbox"/> High cloud cover
<input type="checkbox"/> Ice temperature layer 1
<input type="checkbox"/> Ice temperature layer 3
<input type="checkbox"/> Land-sea mask
<input type="checkbox"/> Large-scale precipitation fraction | <input type="checkbox"/> 2 metre temperature
<input type="checkbox"/> 10 metre V wind component
<input type="checkbox"/> Albedo
<input type="checkbox"/> Anisotropy of sub-gridscale orography
<input type="checkbox"/> Boundary layer dissipation
<input type="checkbox"/> Budget values
<input type="checkbox"/> Convective precipitation
<input type="checkbox"/> Dust Aerosol Optical Depth at 550nm
<input type="checkbox"/> Eastward gravity wave surface stress
<input type="checkbox"/> Evaporation
<input type="checkbox"/> Forecast logarithm of surface roughness for heat
<input type="checkbox"/> GEMS Total column ozone
<input type="checkbox"/> Gravity wave dissipation
<input type="checkbox"/> High vegetation cover
<input type="checkbox"/> Ice temperature layer 2
<input type="checkbox"/> Ice temperature layer 4
<input type="checkbox"/> Large-scale precipitation
<input type="checkbox"/> Lifting threshold speed |
|---|--|

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apps.ecmwf.int/datasets/data/macc-reanalysis/levtype=sfc

- Logarithm of surface roughness length for heat
- Low vegetation cover
- Mean sea level pressure
- Minimum temperature at 2 metres since previous post-processing
- Near IR albedo for direct radiation
- Northward turbulent surface stress
- Photosynthetically active radiation at the surface
- Sea Salt Aerosol Optical Depth at 550nm
- Sea-ice cover
- Skin temperature
- Snow albedo
- Snow depth
- Snowfall
- Soil clay content
- Soil temperature level 2
- Soil temperature level 4
- Standard deviation of filtered subgrid orography
- Sulphate Aerosol Optical Depth at 550nm
- Surface latent heat flux
- Low cloud cover
- Maximum temperature at 2 metres since previous post-pro
- Medium cloud cover
- Near IR albedo for diffuse radiation
- Northward gravity wave surface stress
- Organic Matter Aerosol Optical Depth at 550nm
- Runoff
- Sea surface temperature
- Skin reservoir content
- Slope of sub-gridscale orography
- Snow density
- Snow evaporation
- Snowmelt
- Soil temperature level 1
- Soil temperature level 3
- Soil type
- Standard deviation of orography
- Sunshine duration
- Surface net solar radiation

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apps.ecmwf.int/datasets/data/macc-reanalysis/levtype=sfc

- Surface net solar radiation, clear sky
- Surface net thermal radiation, clear sky
- Surface sensible heat flux
- Surface thermal radiation downwards
- Top net solar radiation
- Top net thermal radiation
- Total Aerosol Optical Depth at 469nm
- Total Aerosol Optical Depth at 670nm
- Total Aerosol Optical Depth at 1240nm
- Total cloud cover
- Total column Formaldehyde
- Total column Sulphur dioxide
- Total column liquid water
- Total column water vapour
- Type of low vegetation
- UV visible albedo for direct radiation
- Volumetric soil water layer 2
- Volumetric soil water layer 4
- Surface net thermal radiation
- Surface roughness
- Surface solar radiation downwards
- Temperature of snow layer
- Top net solar radiation, clear sky
- Top net thermal radiation, clear sky
- Total Aerosol Optical Depth at 550nm
- Total Aerosol Optical Depth at 865nm
- Total Column Nitrogen Oxides
- Total column Carbon monoxide
- Total column Methane
- Total column ice water
- Total column water
- Type of high vegetation
- UV visible albedo for diffuse radiation
- Volumetric soil water layer 1
- volumetric soil water layer 3

Select All or Clear

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