Dealing with NetCDF files

Training module 0. . .

F. Viola[1]

[1] CMCC – Centro EuroMediterraneo sui Cambiamenti Climatici
OPA Division – Ocean Predictions and Applications

2021/05/03

Where to find data

NetCDF (Network Common Data Form) is a self-describing, machine-independent data format that support the creation, access, and sharing of array-oriented scientific data. It is commonly used in climatology, meteorology and oceanography applications.

Self-describing means that there is a header which describes the layout of the rest of the file.

Where to find data

NetCDF (Network Common Data Form) is a self-describing, machine-independent data format that support the creation, access, and sharing of array-oriented scientific data. It is commonly used in climatology, meteorology and oceanography applications.

Self-describing means that there is a header which describes the layout of the rest of the file.

Example of NetCDF files are those used as input for Medslik and containing all the data about winds, currents and sea temperature for a given region.

Where to find data

First of all, we need to retrieve at least one NetCDF file in order to try the commands presented in the following frames.

Where to find data

First of all, we need to retrieve at least one NetCDF file in order to try the commands presented in the following frames.

We can find this kind of files on Zeus (our models run on it and produce NetCDF files, e.g. currents for the Mediterranean sea) or download them from CMEMS portal:

Copernicus Marine Service – Ocean Products ↗

Inspecting data

Our best friend will be from now on **ncdump**. It allows us to see the structure of a NetCDF file by reading its headers with:

```
$ ncdump -h file.nc
```

Inspecting data

Our best friend will be from now on **ncdump**. It allows us to see the structure of a NetCDF file by reading its headers with:

```
$ ncdump -h file.nc
```

We can check the version of a NetCDF file with:

```
$ ncdump -k file.nc
```

Inspecting data

Our best friend will be from now on **ncdump**. It allows us to see the structure of a NetCDF file by reading its headers with:

```
$ ncdump -h file.nc
```

We can check the version of a NetCDF file with:

```
$ ncdump -k file.nc
```

. . . View the content of a variable with:

```
$ ncdump -v varName file.nc | less
```

Inspecting data

Our best friend will be from now on **ncdump**. It allows us to see the structure of a NetCDF file by reading its headers with:

```
$ ncdump -h file.nc
```

We can check the version of a NetCDF file with:

```
$ ncdump -k file.nc
```

. . . View the content of a variable with:

```
$ ncdump -v varName file.nc | less
```

. . . Or reading the whole content of the file with:

```
$ ncdump file.nc | less
```

Visualising data

Reading an endless matrix of data is not as easy and helpful as a graphical visualisation. Here, another tool comes in help: **ncview**

```
$ ncview file.nc
```

Note: please beware that ncview is extremely fragile!

Another CLI tool...

Sometimes, **cdo** is more useful than ncdump to check the content of a NetCDF file. For example, if a NetCDF file contains timestamps expressed in number of milliseconds since midnight, January 1, 1970 UTC, cdo automatically performs a conversion to show the dates in human readable format...

```
$ cdo sinfo file.nc
```

Another CLI tool. . .

Sometimes, **cdo** is more useful than ncdump to check the content of a NetCDF file. For example, if a NetCDF file contains timestamps expressed in number of milliseconds since midnight, January 1, 1970 UTC, cdo automatically performs a conversion to show the dates in human readable format. . .

```
$ cdo sinfo file.nc
```

Another example is to have info about the underlying grid:

```
$ cdo -griddes file.nc
```

Manipulating NetCDF files

Now it's time to perform a bit of surgery on our files. . . What tools should we use?

Manipulating NetCDF files

Now it's time to perform a bit of surgery on our files... What tools should we use?

- those in nco suite

Manipulating NetCDF files

Now it's time to perform a bit of surgery on our files. . . What tools should we use?

- those in nco suite
- cdo

Manipulating NetCDF files

Now it's time to perform a bit of surgery on our files... What tools should we use?

- those in nco suite
- cdo
- self-made tools

Some example

- Convert from NetCDF4 to NetCDF3

```
$ ncks -3 file4.nc file3.nc
```

- Convert from NetCDF3 to NetCDF4

```
$ ncks -4 file3.nc file4.nc
```

- Merge files

```
$ cdo merge input1.nc ... inputN.nc output.nc
```

- Rename dimensions/variables

```
ncrename -O -d longitude,lon -d  -v time,time_counter file.nc
```

- Remove variables

```
$ ncks -x -v uselessVar input.nc output.nc
```

- Select depth levels

```
$ ncks -d depth,1.50 -d depth,5.20 input.nc -o output.nc
```

Some examples

- Extract data

```
$ ncks -v varOfInterest -d lon,0,5 -d lat,0,5 input.nc
```

- Convert to grib

```
$ cdo -f grb -copy input.nc output.grb
```

- Rearrange data from lon $[0, 360]$ to $[-180, 180]$ degrees:

```
$ cdo -sellonlatbox,-180,180,-90,90 input.nc output.nc
```

- Add attribute to variable:

```
$ cdo -setattribute,pressure@units=pascal input.nc output.nc
```

- Interpolate 6-hourly data to 1-hourly data:

```
$ cdo -inttime,6 input.nc output.nc
```

- Interpolate time by number of timesteps from one timestep to the next:

```
$ cdo -intntime,12 input.nc output.nc
```

Exercise 0 - Inspection

Try to perform the following steps:

1. Download **this** ↗ file containing ECMWF 0125 wind data for 2021/05/01
2. Try to understand which variables it contains
3. Which is the bounding box (lat,lon)?
4. Print the values of the wind variables for the first timestep at a lat 43.2 and lon 35.7
5. Plot data

Exercise 1 - Manipulation

Try to perform the following steps:

1. Download a file for the Black Sea containing hourly data about waves forecast for the time interval 2021/05/01 – 2021/05/03. Just select VHM0 and VMDR variables (should be approx. 30 MB)
2. Preserve only variable VHM0
3. Rename variable to WaveHeight
4. Split the file in n files, one per day
5. Plot the resulting data