CDO Introduction

Climate Data Operators

Uwe Schulzweida

Max-Planck-Institute for Meteorology

Overview

CDO is a collection of Operators to manipulate and analyse Climate and forecast model Data.

- Supported file formats are GRIB, netCDF, SERVICE, EXTRA, and IEG
- Supported grid types are rectangular, curvilinear and unstructured grid cells
- Hardware independent with a fast and efficient I/O
- Modular design and easily extendable with new operators
- Using the SCRIP regridder to interpolate between any lon/lat grids (http://climate.lanl.gov/Software/SCRIP)

Documentation

Documentation in PDF can be found on the CDO homepage: http://www.mpimet.mpg.de/cdo

- User's Guide
- Reference Card

Online reference manuals

- `cdo -h <operator>`

Availability

- The `cdo` executable is installed in:

Site	Systems	Directory
ZMAW	Linux/Sun	/client/bin
DKRZ	IBM HLRE2	/client/bin

- Installation from source code (with netCDF support):
  - Get the latest CDO archive from the homepage
  - `gzip -cd cdo.tar.gz | tar xf - ; cd cdo`
  - `./configure --prefix=$HOME/bin`
    `--with-netcdf=/client`
  - `make install`

Program options

Global options for all operators:

-a	Converts from relative to absolute time axis
-b <nbits>	Sets the number of bits for the output precision
	(32/64 for nc/nc2/nc4/srv/ext/ieg; 1-32 for grb)
-f <format>	Output file format(grb/nc/nc2/nc4/srv/ext/ieg)
-g <grid>	Grid name or file
-h	Help information for the operators
-m <missval>	Sets the default missing value (default:-9e+33)
-R	Converts from reduced to regular grid
-r	Converts from absolute to relative time axis
-t <partab>	Parameter table name or file
	Predefined tables: echam4 echam5 mpiom1

Operators

There are more than 400 operators available.

Main categories	Description
File information	Print information about datasets
File operations	Copy, split and merge datasets
Selection	Select parts of a dataset
Comparision	Compare datasets
Modification	Modify datasets
Arithmetic	Arithmeticly process datasets
Statistical values	Ensemble, field, vertical and time statistic
Regression	Detrend of time series
Interpolation	Field, vertical and time interpolation
Transformation	Spectral transformation

Operator parameter

- STRING
  Unquoted characters without blanks and tabs.

```
cdo selvar,pressure,tsurf ifile ofile
```

- FLOAT
  Floating point number in any representation.

```
cdo setrtomiss,0,273.15 ifile ofile
```

- INTEGER
  A list of integers can be specified by first/last[/inc].

```
cdo selday,5/9 ifile ofile
```

  is the same as

```
cdo selday,5,6,7,8,9 ifile ofile
```

Operator piping

All operators with one output stream can pipe the result directly to an other operator. The operator must begin with "-", in order to combine it with others. This can improve the performance by:

- reducing unnecessary disk I/O
- parallel processing

Use

```
cdo sub -dayavg ifile2 -timavg ifile1 ofile
```

instead of

```
cdo timavg ifile1 tmp1
cdo dayavg ifile2 tmp2
cdo sub tmp2 tmp1 ofile
rm tmp1 tmp2
```

File formats

- The output format is the same as the input format.
- You can change the output file format of all operators with the option "`-f <format>`".
- The precision of the output data is the same as the input precision.
- You can change the output data precision with the option "`-b <nbits>`".

Filetype	`<format>`	`<nbits>`
GRIB	grb	1-32 bits
netCDF	nc, nc2, nc4	32/64 bits
binary	srv, ext, ieg	32/64 bits

Convert the file format

- GRIB to netCDF

  ```
  cdo -f nc copy file.grb file.nc
  ```

  with relative time axis (for usage with GrADS)

  ```
  cdo -r -f nc copy file.grb file.nc
  ```

  ECMWF reanalysis on reduced grid

  ```
  cdo -R -f nc copy file.grb file.nc
  ```

- netCDF to GRIB

  ```
  cdo -f grb copy file.nc file.grb
  ```

Interpolation

- Field interpolation
  ECMWF reanalysis on T106 grid to T63 grid:

```
cdo -R remapbil,t63grid ifile ofile
```

- Vertical interpolation
  ECHAM model levels to pressure levels:

```
cdo ml2pl,92500,85000,50000 ifile ofile
```

- Time interpolation
  Daily mean data to 6 hourly data:

```
cdo inttime,19780102,1200,6h ifile ofile
```