Introduction to CDO

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Contents

1. Introduction to CDO

CDO – stands for Climate Data Operators

- is a free open source tool used at the Linux command line

- CDO is a collection of operators to manipulate and analyze climate and forecast model data.

- developed at Max-Planck-Institute for Meteorology

https://code.zmaw.de/projects/cdo

- Supported file formates:GRIB1/2,netCDF3/4

- supported grid types:rectangular,curvilinear and unstructured

Usage and output format

Usage

Bash$ cdo <option> <operator>input.nc <out.nc>

- Global option for all operators:

- h Help information for the operators

e.g : $cdo -h<operator>

- f <format>

Format of the output file (grb, nc, srv, ext, ieg)

e.g: $cdo -f nc copy input.grb out.nc

-m<missval>

set the default missing value(default:-9e+33)

-r Converts from absolute to relative time axis

e.g: $cdo -r -f nc copy input.grb out.nc

1.1 Operations

Categories	Description	Example
File information	Print information about the datasets	cdo sinfo file.nc
File operations	Copy,split,merge datasets	cdo cat fil1.nc file2.nc file12.nc
Selection	Select part of the dataset	cdo selmon,06/08 file.nc out_jja.nc
Comparison	Compare datasets	cdo eq
Modification		
Arithmetic	Perform arithmetic operation to dataset	cdo add conv.nc lsp.nc totpr.nc
Statistic	Ensemble, field, vertical, time statistics	cdo timmean input.nc out.nc
interpolation	Perform horizontal,vertical, time interpolation	cdo remapcon,grid.txt inp.nc out.nc
Adv.statistics	Trend,correlation, eof, filtering	cdo timcor sst.nc wnd.nc out.nc

1.2 Information about the structure and content of netCDF file

Infov writes information about the structure and content of the netCDF file to screen.

```
$ cdo infov inputfile.nc
```

or

```
$ cdo sinfov inputfile.nc
```

- Compare this with ncdump i.e.

```
$ ncdump -h inputfile.nc
```

For simple visualization of a netcdf file

```
$ ncview inputfile.nc
```

2. Climatological seasonal mean calculation

e.g. calculate the 1970-1990 seasonal (MAM) mean values.

timmean calculate the mean over all time steps in a file. We have combined timmean with selmon and selyear to be selective about the time period (e.g . selecting only MAM-the 3rd,4th and the 5th months)

Step by step:

bash$cdo selmon,3,4,5 inputfile.nc out_mam.nc

bash$cdo selyear,1970/1990 out_mam.nc out_mam_70_90.nc

bash$cdo timmean out_mam_70_90.nc output.mam_mean.nc

Piping

Reduce unnecessary disk I/O

- **Note** *sometimes commands are too long to fit on one line,if a line does not start with $,the command is continued on the next line and you should not press enter until it is complete.*

bash$ cdo timmean -selmon,3,4,5 -selyear,1970/1990 inputfile.nc output.mam_mean.nc

bash$ ncview output.mam_mean.nc

3. Mean annual cycle calculation

1.a) Extract the area around the Great Plains from the monthly precipitation data by specifying long and lat co-ordinates.

sellonlatbox allows you to extract an area from fields by choosing lon1,lon2,lat1,lat2.

bash$ cdo sellonlatbox,-110,-90,35,50 inputfile.nc outputfile_grtplns.nc

1.b) calculate monthly mean fields for all the time steps 1970-1990 for each of the twelve months for the Great Plains.

ymonmean computes the mean of all the time steps of multiple years in each month.

bash$cdo ymonmean -selyear,1970/1990 outputfile_grtplns.nc grtplns_monmean.out.nc

bash$ ncview grtplns_monmean.out.nc

4. Annual Cycle averaged over the Great Plains

step by step

bash$ cdo sellonlatbox ,-110,-90,35,50, input.nc out-box.nc

bash$ cdo fldmean out-box.nc out-box-fldmean.nc

bash$ cdo ymonmean out-box-fldmean.nc out-box-ymonmean.nc

piping:

bash$ cdo ymonmean -fldmean-sellonlatbox,-110,-90,35,50 input.
nc out-box-ymonmean.nc

bash$ ncview out-box-ymonmean.nc

5. More on piping

Eg: standard deviation of JJAS precipitation anomalies

<u>Step by step:</u>

bash$ cdo selmon,6,7,8,9 input.nc out-jjas.nc

bash$ cdo timmean out-jjas.nc out-jjas-mean.nc

bash$ cdo sub out-jjas.nc out-jjas-mean.nc out-jjas-anom.nc

bash$ cdo timstd out–jjas-anom.nc out-jjas-std.nc

<u>Piping</u>

bash$ cdo timstd -sub -selmon,6,7,8,9 input.nc -timmean -selmon, 6,7,8,9 input.nc out-jjas-std.nc

bash$ncview out-jjas-std.nc

Correlation

1.a) Compute the temporal correlation between two variables. Is there a linear relationship between spring surface temperature and the following summer precipitation

Cdo –selmon,3/5 cru_1990_2009_tmp.nc cru_mam_tmp.nc
Cdo –selmon,6/8 cru_1990_2009_pre.nc cru_jja_pr.nc

Cdo timcor cru_mam_tmp.nc cru_jja_pr.nc timcor.nc

6. More on operation: Artimetic example: sqr, sqrt

Wind speed=sqrt(u**2 + v**2)

step by step

bash$ cdo sqr uwind.nc uwind-sqr.nc

bash$ cdo sqr vwind.nc vwind-sqr.nc

bash$ cdo add uwind-sqr.nc vwind-sqr.nc wind-add.nc

bash$ cdo sqrt wind-add.nc wind-spd.nc

Piping

Bash$ cdo sqrt -add -sqr uwnd.nc-sqr vwind.nc wind-spd.nc

bash$ncview wind-spd.nc

Attributes of a netCDF Data

Netcdf file.nc{dimensions:

lon = 192;

lon =96

double lon (lon)

lon:long-name =“longitude”

lon:units= “degrees-east”

double lat (lat)

Lat :long- name = “latitude”

lat: units = “degrees-north”

float q(lat,lon)

q:long-name= "specific humidity"

Q:units="kg/kg"

q:code=133

q:table=128

q:grid- type="gaussian"

//global attributes:

:CDO="climate Data Operators version 0.9.5"