

A Short Introduction to Climate Data Operators

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Lunch Meeting on November 6, 2013

Climate Data Operators (CDO)¹

"Collection of many operators for standard processing of climate and NWP model output"

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

- Developed at Max Planck Institute for Meteorology
- More than 600 operators available
- Very simple UNIX command line interface
- Fast processing of large datasets

¹Schulzweida, U. *CDO User's Guide: Climate Data Operators Version 1.6.1*, MPI for Meteorology, 2013

Syntax

```
cdo [options] operator1 [-operator2 [-operatorN]]
```

Selected options:

- -b: output precision, e.g. -b F64
- -f: output file format, e.g. -f nc
- -s: silent mode

Syntax

```
cdo [options] operator1 [-operator2 [-operatorN]]
```

Selected options:

- -b: output precision, e.g. -b F64
- -f: output file format, e.g. -f nc
- -s: silent mode

```
INDIR=/home/matternp/otn_simulations/021_LB_out/  
INFILE=${INDIR}avg_021a_lb_AllFlux_0001.nc
```

General file information

```
/home/renkl@nodeXX> cdo info $INFILE
```

General file information

```
/home/renkl@nodeXX> cdo info $INFILE
-1 : Date Time Level Gridsize Miss : Minimum Mean Maximum : Parameter ID
1 : 1999-01-06 00:00:00 0 2 0 : 50.000 50.000 50.000 : -1
2 : 1999-01-06 00:00:00 0 2 0 : 5.0000e-06 5.0000e-06 5.0000e-06 : -2
3 : 1999-01-06 00:00:00 0 2 0 : 0.033333 0.033333 0.033333 : -3
4 : 1999-01-06 00:00:00 0 4 0 : 0.0000 0.0000 0.0000 : -4
5 : 1999-01-06 00:00:00 0 4 0 : 0.0000 0.0000 0.0000 : -5
6 : 1999-01-06 00:00:00 0 4 0 : 0.0000 0.0000 0.0000 : -6
7 : 1999-01-06 00:00:00 0 4 0 : 0.0000 0.0000 0.0000 : -7
8 : 1999-01-06 00:00:00 0 8 0 : 0.00046296 0.00046296 0.00046296 : -8
9 : 1999-01-06 00:00:00 0 8 0 : 2.3148e-05 2.3148e-05 2.3148e-05 : -9
10 : 1999-01-06 00:00:00 0 4 0 : 0.00043981 0.00045139 0.00046296 : -10
11 : 1999-01-06 00:00:00 0 4 0 : 2.1991e-05 2.2569e-05 2.3148e-05 : -11
:
:
cdo info: Processed 26773969 values from 28 variables over 6 timesteps ( 1.41s )
```

General file information

```
/home/renkl@nodeXX> cdo showname $INFILE
```

General file information

```
/home/renkl@nodeXX> cdo showname $INFILE
nl_tnu2 Akt_bak Tnudg FSobc_in FSobc_out M2obc_in M2obc_out Tobc_in Tobc_out M3obc_in
M3obc_out LtracerSrc h f pm pn mask_rho mask_u mask_v mask_psi zeta ubar vbar u v w
temp salt
cdo showname:  Processed 28 variables ( 0.02s )
```


General file information

```
/home/renkl@nodeXX> cdo showname $INFILE
nl_tnu2 Akt_bak Tnudg FSobc_in FSobc_out M2obc_in M2obc_out Tobc_in Tobc_out M3obc_in
M3obc_out LtracerSrc h f pm pn mask_rho mask_u mask_v mask_psi zeta ubar vbar u v w
temp salt
cdo showname:  Processed 28 variables ( 0.02s )

/home/renkl@nodeXX> cdo ntime $INFILE
```

General file information

```
/home/renkl@nodeXX> cdo showname $INFILE
nl_tnu2 Akt_bak Tnudg FSobc_in FSobc_out M2obc_in M2obc_out Tobc_in Tobc_out M3obc_in
M3obc_out LtracerSrc h f pm pn mask_rho mask_u mask_v mask_psi zeta ubar vbar u v w
temp salt
cdo showname: Processed 28 variables ( 0.02s )

/home/renkl@nodeXX> cdo ntime $INFILE
6
cdo ntime: Processed 28 variables over 6 timesteps ( 0.00s )
```

General file information

```
/home/renkl@nodeXX> cdo showname $INFILE
nl_tnu2 Akt_bak Tnudg FSobc_in FSobc_out M2obc_in M2obc_out Tobc_in Tobc_out M3obc_in
M3obc_out LtracerSrc h f pm pn mask_rho mask_u mask_v mask_psi zeta ubar vbar u v w
temp salt
cdo showname: Processed 28 variables ( 0.02s )

/home/renkl@nodeXX> cdo ntime $INFILE
6
cdo ntime: Processed 28 variables over 6 timesteps ( 0.00s )

/home/renkl@nodeXX> cdo showdate $INFILE
```

General file information

```
/home/renkl@nodeXX> cdo showname $INFILE
nl_tnu2 Akt_bak Tnudg FSobc_in FSobc_out M2obc_in M2obc_out Tobc_in Tobc_out M3obc_in
M3obc_out LtracerSrc h f pm pn mask_rho mask_u mask_v mask_psi zeta ubar vbar u v w
temp salt
cdo showname: Processed 28 variables ( 0.02s )
```

```
/home/renkl@nodeXX> cdo ntime $INFILE
6
cdo ntime: Processed 28 variables over 6 timesteps ( 0.00s )
```

```
/home/renkl@nodeXX> cdo showdate $INFILE
1999-01-06 1999-01-11 1999-01-16 1999-01-21 1999-01-26 1999-01-31
cdo showdate: Processed 28 variables over 6 timesteps ( 0.01s )
```

General file information

```
/home/renkl@nodeXX> cdo nlevel $INFILE
```

General file information

```
/home/renkl@nodeXX> cdo nlevel $INFILE
1
1
1
1
1
1
1
:
:
1
1
1
1
1
1
30
30
30
31
30
30
cdo nlevel:  Processed 28 variables ( 0.00s )
```

General file information

```
/home/renkl@nodeXX> cdo griddes $INFILE
```

General file information

```
/home/renkl@nodeXX> cdo griddes $INFILE
#
# gridID 2
#
gridtype = generic
gridsize = 2
xsize = 2
:
#
# gridID 5
#
gridtype = curvilinear
gridsize = 28800
xname = lon_rho
xlongname = longitude of RHO-points
xunits = degree_east
yname = lat_rho
ylongname = latitude of RHO-points
yunits = degree_north
xsize = 240
ysize = 120
xvals = -68.1035417 -68.0071909 -67.9108401 -67.8144893 -67.7181384 -67.6217876
        -67.5254368 -67.429086 -67.3327352 -67.2363844 -67.1400335 -67.0436827 ...
cdo griddes: Processed 28 variables ( 0.37s )
```


Data selection

```
/home/renkl@nodeXX> cdo selname,temp $INFILE tmp_temp
```

Data selection

```
/home/renkl@nodeXX> cdo selname,temp $INFILE tmp.temp  
cdo selname: Processed 5184000 values from 28 variables over 6 timesteps ( 0.24s  
)
```

Data selection

```
/home/renkl@nodeXX> cdo selname,temp $INFILE tmp_temp  
cdo selname: Processed 5184000 values from 28 variables over 6 timesteps ( 0.24s  
)
```

```
/home/renkl@nodeXX> cdo sellevidx,30 tmp_temp tmp_temp30
```

Data selection

```
/home/renkl@nodeXX> cdo selname,temp $INFILE tmp_temp  
cdo selname: Processed 5184000 values from 28 variables over 6 timesteps ( 0.24s  
)
```

```
/home/renkl@nodeXX> cdo sellevidx,30 tmp_temp tmp_temp30  
cdo sellevidx: Processed 172800 values from 1 variable over 6 timesteps ( 0.02s )
```

Data selection

```
/home/renkl@nodeXX> cdo selname,temp $INFILE tmp_temp
cdo selname: Processed 5184000 values from 28 variables over 6 timesteps ( 0.24s
)

/home/renkl@nodeXX> cdo sellevidx,30 tmp_temp tmp_temp30
cdo sellevidx: Processed 172800 values from 1 variable over 6 timesteps ( 0.02s )

/home/renkl@nodeXX> cdo -f grb timmean tmp_temp30 run21a_surf_temp_timmean.grb
```

Data selection

```
/home/renkl@nodeXX> cdo selname,temp $INFILE tmp_temp  
cdo selname: Processed 5184000 values from 28 variables over 6 timesteps ( 0.24s  
)
```

```
/home/renkl@nodeXX> cdo sellevidx,30 tmp_temp tmp_temp30  
cdo sellevidx: Processed 172800 values from 1 variable over 6 timesteps ( 0.02s )
```

```
/home/renkl@nodeXX> cdo -f grb timmean tmp_temp30 run21a_surf_temp_timmean.grb  
cgribexDefLevel : Changed zaxis type from generic to pressure  
cdo timmean: Processed 172800 values from 1 variable over 6 timesteps ( 0.01s )
```

Data selection

```
/home/renkl@nodeXX> cdo selname,temp $INFILE tmp_temp  
cdo selname: Processed 5184000 values from 28 variables over 6 timesteps ( 0.24s  
)
```

```
/home/renkl@nodeXX> cdo sellevidx,30 tmp_temp tmp_temp30  
cdo sellevidx: Processed 172800 values from 1 variable over 6 timesteps ( 0.02s )
```

```
/home/renkl@nodeXX> cdo -f grb timmean tmp_temp30 run21a_surf_temp_timmean.grb  
cgribexDefLevel : Changed zaxis type from generic to pressure  
cdo timmean: Processed 172800 values from 1 variable over 6 timesteps ( 0.01s )
```

```
/home/renkl@nodeXX> cdo infov run21a_surf_temp_timmean.grb
```

Data selection

```
/home/renkl@nodeXX> cdo selname,temp $INFILE tmp.temp
cdo selname: Processed 5184000 values from 28 variables over 6 timesteps ( 0.24s
)
```

```
/home/renkl@nodeXX> cdo sellevidx,30 tmp.temp tmp.temp30
cdo sellevidx: Processed 172800 values from 1 variable over 6 timesteps ( 0.02s )
```

```
/home/renkl@nodeXX> cdo -f grb timmean tmp.temp30 run21a_surf_temp_timmean.grb
cgribexDefLevel : Changed zaxis type from generic to pressure
cdo timmean: Processed 172800 values from 1 variable over 6 timesteps ( 0.01s )
```

```
/home/renkl@nodeXX> cdo infov run21a_surf_temp_timmean.grb
-1 : Date Time Level Gridsize Miss : Minimum Mean Maximum : Parameter name
 1 : 1999-01-31 00:00:00 0 28800 7639 : -4.7383 5.6597 21.980 : var1
cdo infon: Processed 28800 values from 1 variable over 1 timestep ( 0.00s )
```


Data selection

```
/home/renkl@nodeXX> cdo -s -f grb timmean -sellevidx,30 -selname,temp $INFILE  
run21a_surf_temp_timmean.grb
```

Data selection

```
/home/renkl@nodeXX> cdo -s -f grb timmean -sellevidx,30 -selname,temp $INFILE  
run21a_surf_temp_timmean.grb  
cgribexDefLevel : Changed zaxis type from generic to pressure
```

Data selection

```
/home/renkl@nodeXX> cdo -s -f grb timmean -sellevidx,30 -selname,temp $INFILE  
run21a_surf_temp_timmean.grb  
cgribexDefLevel : Changed zaxis type from generic to pressure
```

```
/home/renkl@nodeXX> cdo infov run21a_surf_temp_timmean.grb
```

Data selection

```
/home/renkl@nodeXX> cdo -s -f grb timmean -sellevidx,30 -selname,temp $INFILE  
run21a_surf_temp_timmean.grb  
cgribexDefLevel : Changed zaxis type from generic to pressure
```

```
/home/renkl@nodeXX> cdo infov run21a_surf_temp_timmean.grb  
-1 : Date Time Level Gridsize Miss : Minimum Mean Maximum : Parameter name  
1 : 1999-01-31 00:00:00 0 28800 7639 : -4.7383 5.6597 21.980 : var27  
cdo infon: Processed 28800 values from 1 variable over 1 timestep ( 0.00s )
```

Summary

- shown:
 - introduction to CDOs
 - examples of application
- not shown:
 - installation
 - usage in shell scripts

Further information:

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

Documentation:

<https://code.zmaw.de/embedded/cdo/1.6.1/cdo.html>

Reference card:

https://code.zmaw.de/files/cdo/html/1.6.1/cdo_refcard.pdf