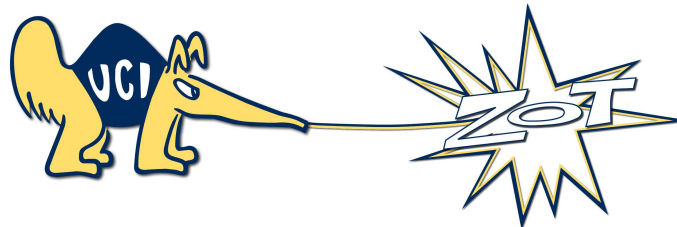
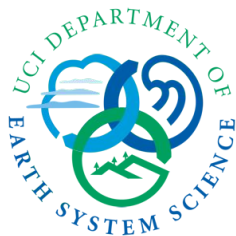




NCO Introduction

Week 1 How can NCO help you?



Wenshan Wang
Half-baked seminar
Oct. 23, 2015

Answer questions:

- What is NCO?
- Should I learn it if I already know MATLAB, NCL, IDL, python or CDO ?
- How to use it?
- How to learn it fast?
- How to find help?

What is NCO?



A word cloud featuring various terms associated with NCO, including file formats, operations, and data characteristics. The words are arranged in a dense, overlapping cluster with varying font sizes and colors (teal, brown, yellow, and orange).

Helpful HDF4 Annual
OPeNDAP Concatenate Seasonal
HDF5 Batch-Mode HyperSlabs Efficient
Average Regridding Group-Features
Standard-Deviation Unpack Monthly
Rename Time-Saving
Large-Number-of-Files Attributions
Large-File Friendly NetCDF Variables
Append Subset Selection
CMIP5

The NetCDF Operators are a suite of programs known as operators, that facilitate manipulation and analysis of data stored in the self-describing netCDF format

12 operators used like `ls` or `cp`

```
$ operator [options] input [output]
```


	<code>ncks</code>	netCDF Kitchen Sink
Concatenator	<code>ncrcat</code>	netCDF Record conCATenator
	<code>ncecat</code>	netCDF Ensemble conCATenator
Averager	<code>ncra</code>	netCDF Record Averager
	<code>nces</code>	netCDF Ensemble Statistics
	<code>ncwa</code>	netCDF Weighted Averager
	<code>ncbo</code>	netCDF Binary Operator
	<code>ncap2</code>	netCDF Arithmetic Processor
	<code>ncrename</code>	netCDF RENAMEer
	<code>ncatted</code>	netCDF ATtribute EDitor
	<code>ncpdq</code>	netCDF Permute Dimensions Quickly netCDF Pack Data Quietly
	<code>ncflint</code>	netCDF FiLe INTerpolator

12 operators used like `ls` or `cp`


```
$ operator input output
```

```
$ ncbo in1.nc in2.nc out.nc  
vars_out = vars_in1 - vars_in2
```

```
$ ncra in.nc out.nc
```



```
netcdf in.nc {  
dimensions:  
    dimension1 = 3;  
    dimension2 = unlimited; // (12 currently)  
variables:  
    type var1(dimension2, dimension1)  
    type var2(dimension2, dimension1)
```



```
netcdf out.nc {  
dimensions:  
    dimension1 = 3;  
    dimension2 = unlimited; // (1 currently)  
variables:  
    type var1(dimension2, dimension1)  
    type var2(dimension2, dimension1)
```

Operators × Options

```
$ operator options input [output]
```

```
$ ncbo --op_typ='+' in1.nc in2.nc out.nc  
vars_out = vars_in1 + vars_in2
```

```
$ ncra --mro -d dimension2,,,3,3 in.nc out.nc
```

```
netcdf in.nc {  
  dimensions:  
    dimension1 = 3;  
    dimension2 = unlimited; // (12 currently)  
  variables:  
    type var1(dimension2, dimension1)  
    type var2(dimension2, dimension1)
```

```
netcdf out.nc {  
  dimensions:  
    dimension1 = 3;  
    dimension2 = unlimited; // (4 currently)  
  variables:  
    type var1(dimension2, dimension1)  
    type var2(dimension2, dimension1)
```

Operators × Options × Shell Script

```
$ operator [options] input [output]
```

```
$ nccat -u year 198?.nc 20??.nc out.nc
```

```
netcdf out.nc {
```

```
dimensions:
```

```
    year = 110 → 1980, 1981, 1982, ..., 1989, 2000, 2001, ... 2098, 2099
```

```
variables:
```

```
    float var1(year)
```

```
    float var2(year)
```

```
$ cat avg_mth.sh
```

```
#!/bin/bash
```

```
for mm in {01..12}; do
```

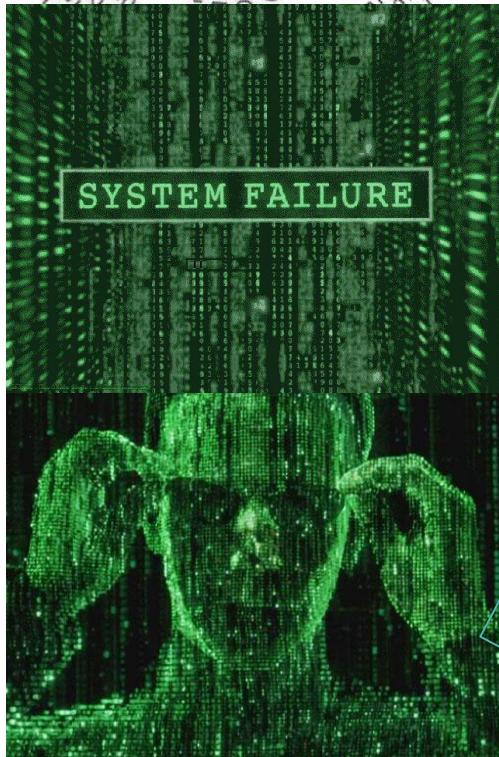
```
    ncra -d time, "2000-{$mm}-01","2000-{$mm}-31" in.nc out_{$mm}.nc
```

```
done
```

```
ncrcat out_??.nc out_mthly-avg.nc
```

```
$ bash avg_mth.sh
```


Take only the pieces you need efficiently



SYSTEM FAILURE

01011

01011

01011

01011

01011

01011

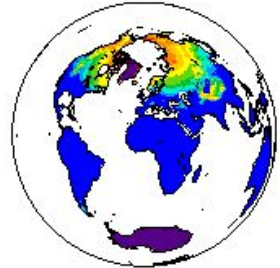
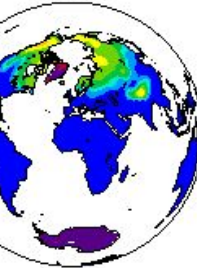
NCOctopus

01011
01110
11010

Global Annual Average Snow Cover Fraction (%)

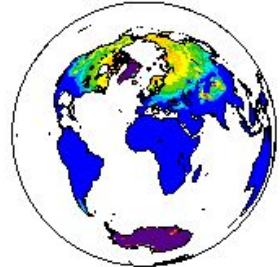
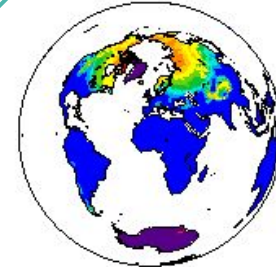
bcc-csm1-1

CCSM4



CESM1-CAM5

GISS-E2-R-CC



Outlines

Week 1: Real-world examples

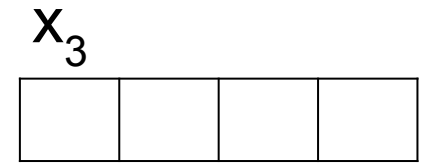
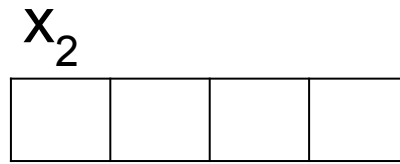
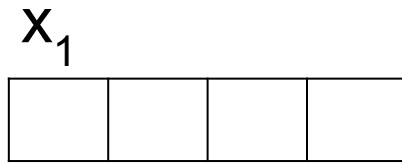
Week 2: Basic Linux using and shell scripting on HPC

Week 3-4: Hands-on tutorial of NCO

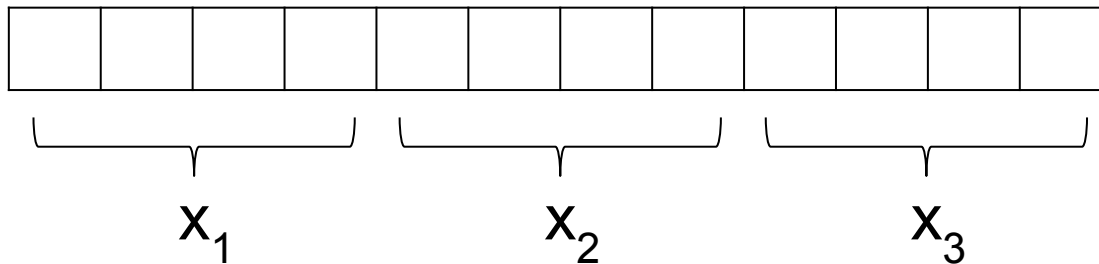
Example 1: CESM monthly output

```
woodlan — wenshanw@grele: /data/wenshanw/shp/model/edison_backup/ctrl_rcp85_cam5_deg1/lnd/hist — ssh — Solid Colors — 88x20
wenshanw@grele: /data/wenshanw/shp/model/edison_backup/ctrl_rcp85_cam5_deg1/lnd/hist
wenshanw@grele$ ll
total 1.1G
drwxr-x--- 2 wenshanw nco 4.0K Oct 19 14:52 ./
drwxr-x--- 4 wenshanw nco 28 Oct 19 14:52 ../
-rw-r----- 1 wenshanw nco 103M Oct 19 14:52 ctrl_rcp85_cam5_deg1.clm2.h0.2005-01.nc
-rw-r----- 1 wenshanw nco 84M Oct 19 14:51 ctrl_rcp85_cam5_deg1.clm2.h0.2005-02.nc
-rw-r----- 1 wenshanw nco 103M Oct 19 14:52 ctrl_rcp85_cam5_deg1.clm2.h0.2005-03.nc
-rw-r----- 1 wenshanw nco 84M Oct 19 14:51 ctrl_rcp85_cam5_deg1.clm2.h0.2005-04.nc
-rw-r----- 1 wenshanw nco 103M Oct 19 14:52 ctrl_rcp85_cam5_deg1.clm2.h0.2005-05.nc
-rw-r----- 1 wenshanw nco 84M Oct 19 14:51 ctrl_rcp85_cam5_deg1.clm2.h0.2005-06.nc
-rw-r----- 1 wenshanw nco 84M Oct 19 14:50 ctrl_rcp85_cam5_deg1.clm2.h0.2005-07.nc
-rw-r----- 1 wenshanw nco 84M Oct 19 14:51 ctrl_rcp85_cam5_deg1.clm2.h0.2005-08.nc
-rw-r----- 1 wenshanw nco 103M Oct 19 14:52 ctrl_rcp85_cam5_deg1.clm2.h0.2005-09.nc
-rw-r----- 1 wenshanw nco 84M Oct 19 14:50 ctrl_rcp85_cam5_deg1.clm2.h0.2005-10.nc
-rw-r----- 1 wenshanw nco 84M Oct 19 14:51 ctrl_rcp85_cam5_deg1.clm2.h0.2005-11.nc
-rw-r----- 1 wenshanw nco 84M Oct 19 14:51 ctrl_rcp85_cam5_deg1.clm2.h0.2005-12.nc
wenshanw@grele$
```

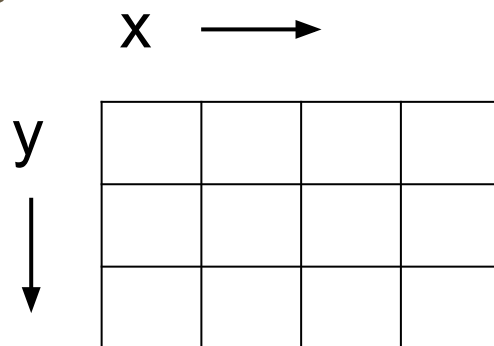
Concatenate Files: `ncrcat`, `ncecat`



`ncrcat`



`ncecat`



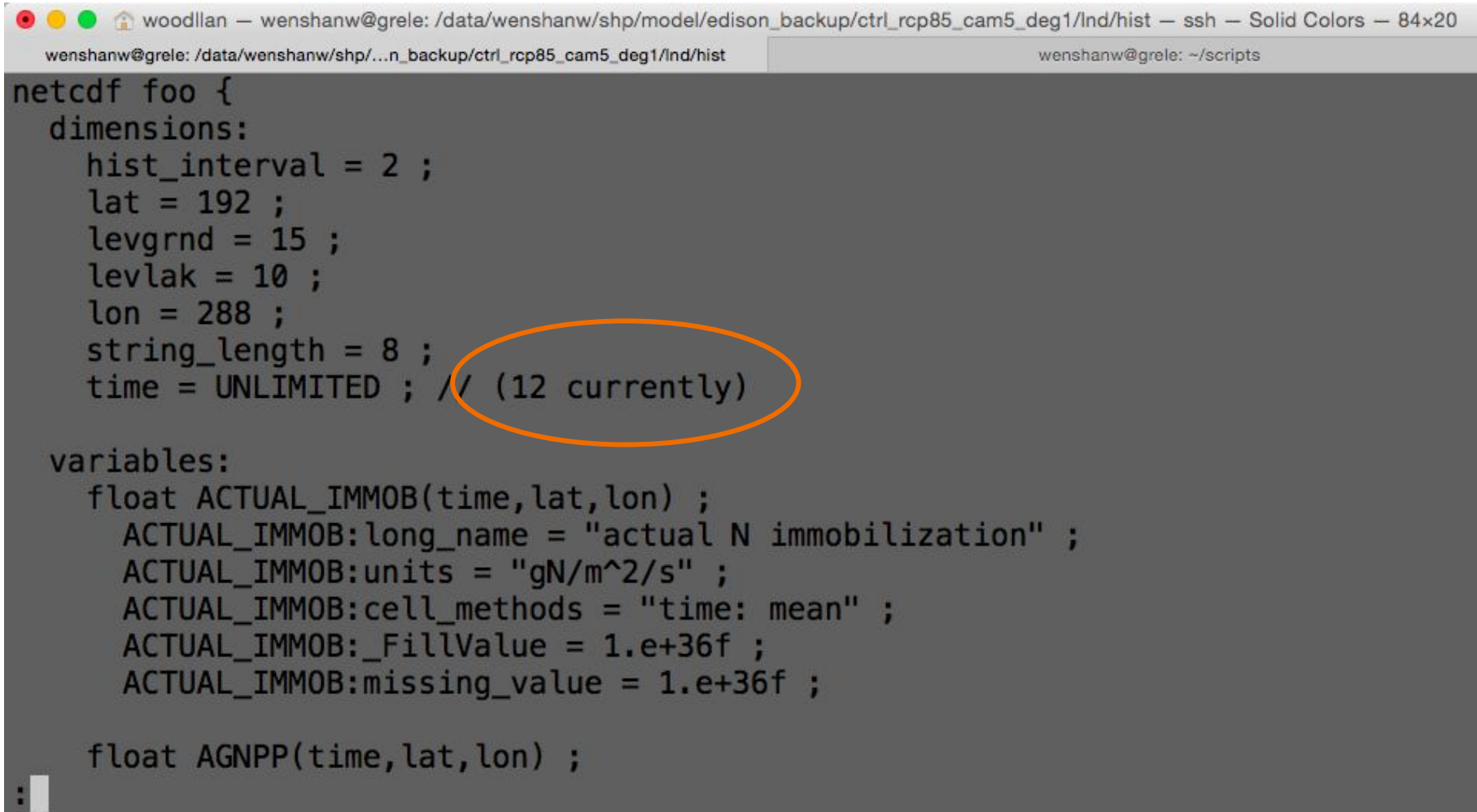
Same difference between:
`ncra` and `nces`

Example 1: CESM monthly output

```
woodllan — wenshanw@grele: /data/wenshanw/shp/model/edison_backup/ctrl_rcp85_cam5_deg1/lnd/hist — ssh — Solid Colors — 88x20
wenshanw@grele: /data/wenshanw/shp/model/edison_backup/ctrl_rcp85_cam5_deg1/lnd/hist
wenshanw@grele$ ll
total 12
drwxr-xr-x 2 wenshanw wenshanw 4096 Jan 1 12:00 .
drwxr-xr-x 2 wenshanw wenshanw 4096 Jan 1 12:00 ..
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 netcdf ctrl_rcp85_cam5_deg1.clm2.h0.2005-01 {
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 dimensions:
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 hist_interval = 2 ;
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 lat = 192 ;
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 levgrnd = 15 ;
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 levlak = 10 ;
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 lon = 288 ;
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 string_length = 8 ;
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 time = UNLIMITED ; // (1 currently)
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 variables:
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 float ACTUAL_IMMOB(time,lat,lon) ;
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 ACTUAL_IMMOB:long_name = "actual N immobilization" ;
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 ACTUAL_IMMOB:units = "gN/m^2/s" ;
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 ACTUAL_IMMOB:cell_methods = "time: mean" ;
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 ACTUAL_IMMOB:FillValue = 1.e+36f ;
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 ACTUAL_IMMOB:missing_value = 1.e+36f ;
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 float AGNPP(time,lat,lon) ;
-rw-r--r-- 1 wenshanw wenshanw 1000000000 Jan 1 12:00 :
```

Example 1.1 Concat Files nccrcat

```
$ nccrcat ctrl_rcp85_cam5_deg1.clm2.h0.2005-???.nc out.nc
```

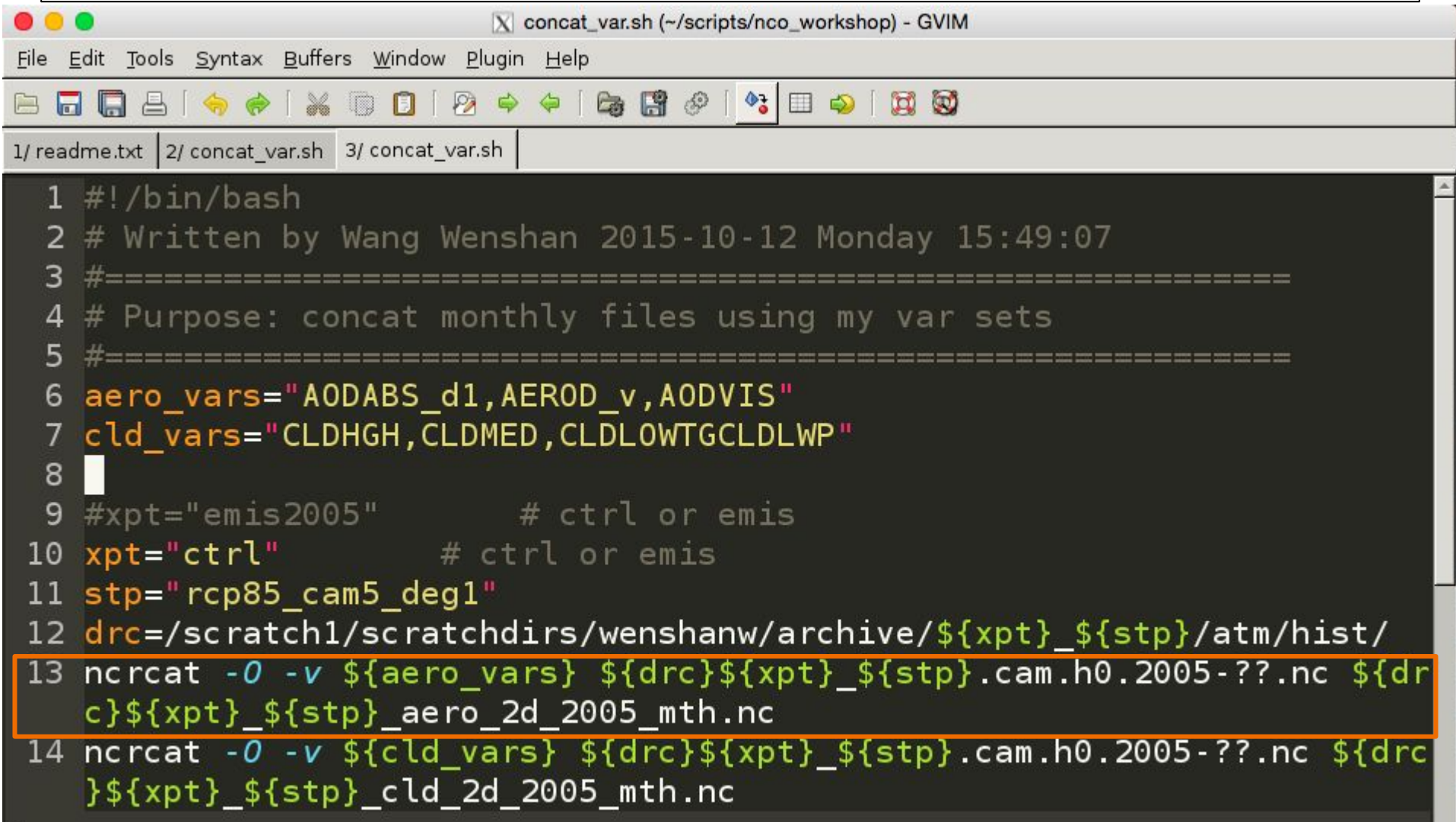


A terminal window titled "woodlan — wenshanw@grele: /data/wenshanw/shp/model/edison_backup/ctrl_rcp85_cam5_deg1/Ind/hist — ssh — Solid Colors — 84x20". The terminal shows the execution of the `nccrcat` command to concatenate files. Below the command, the netCDF file structure is displayed. The `time = UNLIMITED ; // (12 currently)` line is circled in orange. The file structure includes dimensions, variables, and a global attribute.

```
netcdf foo {  
  dimensions:  
    hist_interval = 2 ;  
    lat = 192 ;  
    levgrnd = 15 ;  
    levlak = 10 ;  
    lon = 288 ;  
    string_length = 8 ;  
    time = UNLIMITED ; // (12 currently)  
  
  variables:  
    float ACTUAL_IMMOB(time,lat,lon) ;  
      ACTUAL_IMMOB:long_name = "actual N immobilization" ;  
      ACTUAL_IMMOB:units = "gN/m^2/s" ;  
      ACTUAL_IMMOB:cell_methods = "time: mean" ;  
      ACTUAL_IMMOB:_FillValue = 1.e+36f ;  
      ACTUAL_IMMOB:missing_value = 1.e+36f ;  
  
    float AGNPP(time,lat,lon) ;  
:  
}
```


Example 1.1 Concat Files nccrcat

```
$ nccrcat -v var1,var2,var3 ctrl...h0.2005-???.nc out.nc
```



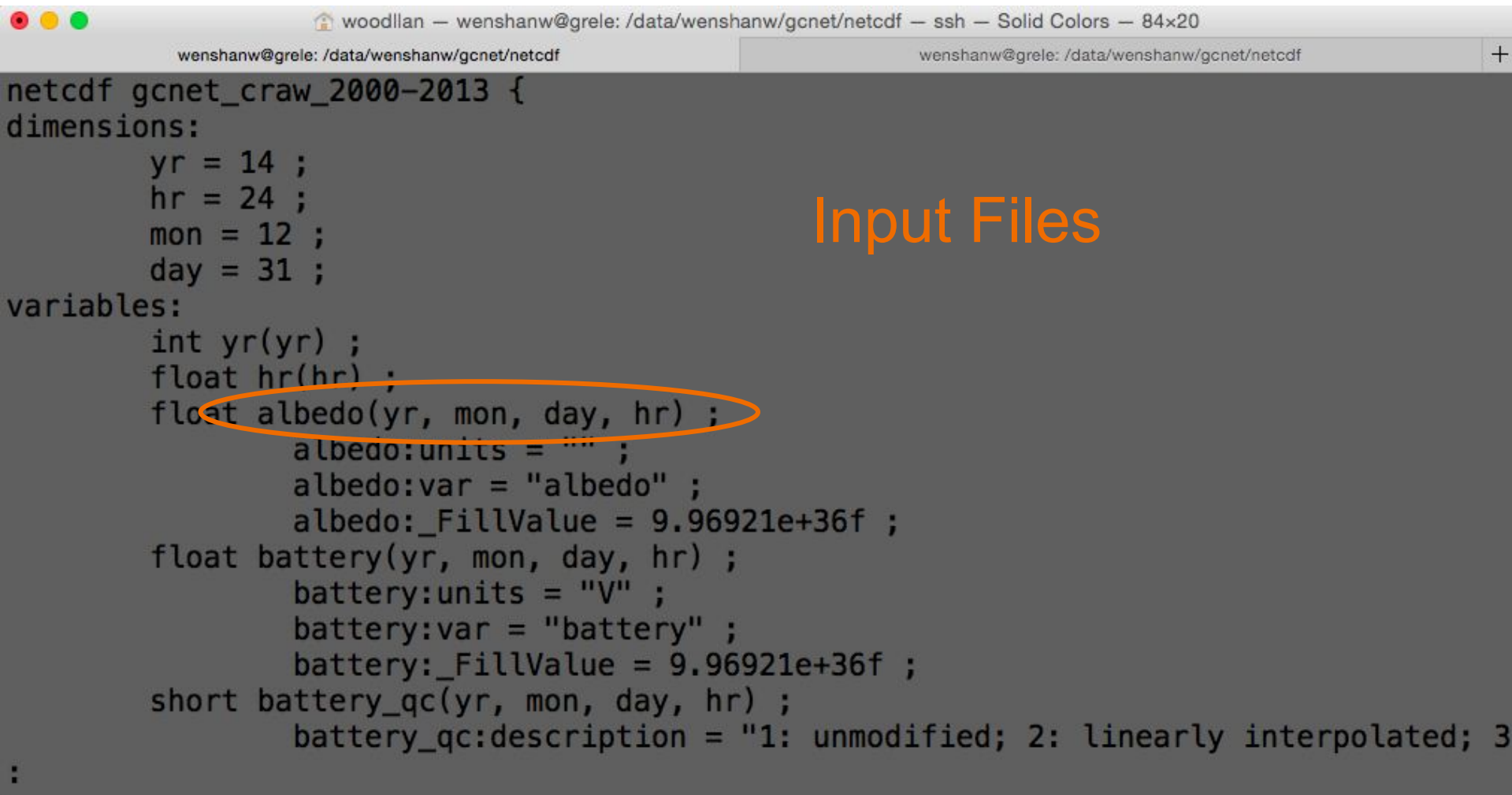
```
concat_var.sh (~/.scripts/nco_workshop) - GVIM
File Edit Tools Syntax Buffers Window Plugin Help
1/ readme.txt 2/ concat_var.sh 3/ concat_var.sh
1 #!/bin/bash
2 # Written by Wang Wenshan 2015-10-12 Monday 15:49:07
3 #=====
4 # Purpose: concat monthly files using my var sets
5 #=====
6 aero_vars="AODABS_d1,AEROD_v,AODVIS"
7 cld_vars="CLDHGH,CLDMED,CLDLOWTGCLDLWP"
8
9 #xpt="emis2005"          # ctrl or emis
10 xpt="ctrl"              # ctrl or emis
11 stp="rcp85_cam5_deg1"
12 drc=/scratch1/scratchdirs/wenshanw/archive/${xpt}_${stp}/atm/hist/
13 nccrcat -O -v ${aero_vars} ${drc}${xpt}_${stp}.cam.h0.2005-???.nc ${drc}
   ${xpt}_${stp}_aero_2d_2005_mth.nc
14 nccrcat -O -v ${cld_vars} ${drc}${xpt}_${stp}.cam.h0.2005-???.nc ${drc}
   ${xpt}_${stp}_cld_2d_2005_mth.nc
```

Example 1.2 Concat Files ncccat

```
woodllan — wenshanw@grele: /data/wenshanw/gcnet/netcdf — ssh — Solid Colors — 84x20
wenshanw@grele: /data/wenshanw/gcnet/netcdf
wenshanw@grele$ ll gcnet_*
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_craw_2000-2013.nc
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_dye_2000-2013.nc
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_gits_2000-2013.nc
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_humb_2000-2013.nc
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_jar1_2000-2013.nc
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_jar2_2000-2013.nc
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_neem_2000-2013.nc
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_nse_2000-2013.nc
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_nsse_2000-2013.nc
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_nsu_2000-2013.nc
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_ptre_2000-2013.nc
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_ptrg_2000-2013.nc
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_saddle_2000-2013.nc
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_sdome_2000-2013.nc
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_smt_2000-2013.nc
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_swiss_2000-2013.nc
-rw-r--r-- 1 wenshanw nco 28M Sep 13 22:29 gcnet_tunu_2000-2013.nc
wenshanw@grele$
```


Example 1.2 Concat Files nccrcat

```
$ nccrcat -O -u stn gcnet_*.nc gcnet_stn_2000-2013.nc
```

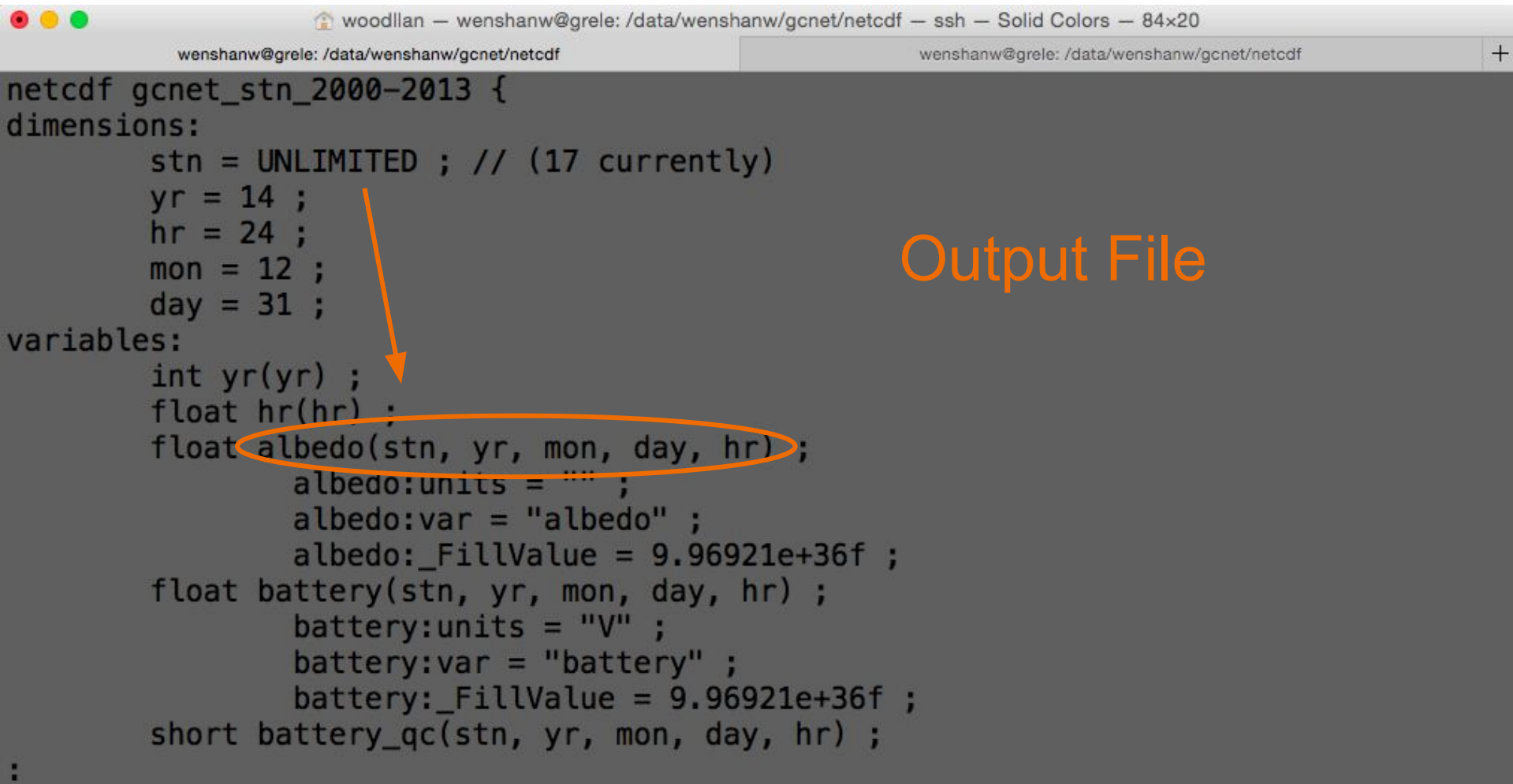


```
woodllan — wenshanw@grele: /data/wenshanw/gcnet/netcdf — ssh — Solid Colors — 84x20
wenshanw@grele: /data/wenshanw/gcnet/netcdf
netcdf gcnet_craw_2000-2013 {
dimensions:
    yr = 14 ;
    hr = 24 ;
    mon = 12 ;
    day = 31 ;
variables:
    int yr(yr) ;
    float hr(hr) ;
    float albedo(yr, mon, day, hr) ;
        albedo:units = "" ;
        albedo:var = "albedo" ;
        albedo:_FillValue = 9.96921e+36f ;
    float battery(yr, mon, day, hr) ;
        battery:units = "V" ;
        battery:var = "battery" ;
        battery:_FillValue = 9.96921e+36f ;
    short battery_qc(yr, mon, day, hr) ;
        battery_qc:description = "1: unmodified; 2: linearly interpolated; 3
:
```

Input Files

Example 1.2 Concat Files nccrcat

```
$ nccrcat -O -u stn gcnet_*.nc gcnet_stn_2000-2013.nc
```



```
woodlan — wenshanw@grele: /data/wenshanw/gcnet/netcdf — ssh — Solid Colors — 84x20
wenshanw@grele: /data/wenshanw/gcnet/netcdf
netcdf gcnet_stn_2000-2013 {
dimensions:
    stn = UNLIMITED ; // (17 currently)
    yr = 14 ;
    hr = 24 ;
    mon = 12 ;
    day = 31 ;
variables:
    int yr(yr) ;
    float hr(hr) ;
    float albedo(stn, yr, mon, day, hr) ;
        albedo:units = "" ;
        albedo:var = "albedo" ;
        albedo:_FillValue = 9.96921e+36f ;
    float battery(stn, yr, mon, day, hr) ;
        battery:units = "V" ;
        battery:var = "battery" ;
        battery:_FillValue = 9.96921e+36f ;
    short battery_qc(stn, yr, mon, day, hr) ;
}
```

Output File

Example 1.3: Average

eg, time = unlimited // (600 currently)

- Annual Mean

```
$ ncra --mro -d time,0,599,12,12 in.nc ann.nc  
$ ncra --mro -d time,,,12,12 in.nc ann.nc
```

time = 50

- Seasonal Mean

```
$ ncra --mro -d time,,,3,3 in.nc ssn.nc
```

time = 200

```
$ ncra --mro -F -d time,6,,,12,3 in.nc JJA.nc
```

time = 50

```
$ ncra -F -d time,6,,,12,3 in.nc JJA.nc
```

time = 1

Example 1.3: Average

eg, time = unlimited // (600 currently)

- Annual Mean

```
$ ncra --mro -d time,0,599,12,12 in.nc ann.nc
```

```
$ ncra --mro -d time,,,12,12 in.nc ann.nc
```

```
# time = 50
```

- Seasonal Mean

```
$ ncra --mro -d time,,,3,3 in.nc ssn.nc
```

```
# time = 200
```

```
$ ncra --mro -F -d time,6,,,12,3 in.nc JJA.nc
```

```
# time = 50
```

```
$ ncra -F -d time,6,,,12,3 in.nc JJA.nc
```

```
# time = 1
```

Example 1.3: Average

eg, time = unlimited // (600 currently)

- Annual Mean

```
$ ncra --mro -d time,0,599,12,12 in.nc ann.nc
```

```
$ ncra --mro -d time,,,12,12 in.nc ann.nc
```

```
# time = 50
```

- Seasonal Mean

```
$ ncra --mro -d time,,,3,3 in.nc ssn.nc
```

```
# time = 200
```

```
$ ncra --mro -d time,5,,,12,3 in.nc JJA.nc
```

```
$ ncra --mro -F -d time,6,,,12,3 in.nc JJA.nc
```

```
# time = 50
```

```
$ ncra -F -d time,6,,,12,3 in.nc JJA.nc
```

```
# time = 1
```

Example 1.3: Average

eg, time = unlimited // (600 currently)

- Annual Mean

```
$ ncra --mro -d time,0,599,12,12 in.nc ann.nc
```

```
$ ncra --mro -d time,,,12,12 in.nc ann.nc
```

```
# time = 50
```

- Seasonal Mean

```
$ ncra --mro -d time,,,3,3 in.nc ssn.nc
```

```
# time = 200
```

```
$ ncra --mro -d time,5,,,12,3 in.nc JJA.nc
```

```
$ ncra --mro -F -d time,6,,,12,3 in.nc JJA.nc
```

```
# time = 50
```

```
$ ncra -F -d time,6,,,12,3 in.nc JJA.nc
```

```
# time = 1
```

Example 1.3: Average

eg, time = unlimited // (600 currently)

- Annual Mean

```
$ ncra --mro -d time,,,12,12 in.nc out.nc  
# time = 50
```

- Seasonal Mean

```
$ ncra --mro -d time,,,3,3 in.nc out.nc  
# time = 200
```

```
$ ncra -F --mro -d time,3,,3,3 in.nc out.nc  
# time = 199
```

```
$ ncra --mro \  
-d time,"2000-03-01","2049-11-30",3,3 \  
in.nc out.nc # time = 199  
$ ncra ... -d lat,65.0,80.0 -d lon,-70.0,-10.0 ...
```


Example 1.3: Average

eg, time = unlimited // (600 currently)

- Annual Mean

```
$ ncra --mro -d time,,,12,12 in.nc out.nc  
# time = 50
```

- Seasonal Mean

```
$ ncra --mro -d time,,,3,3 in.nc out.nc  
# time = 200
```

```
$ ncra -F --mro -d time,3,,,3,3 in.nc out.nc  
# time = 199
```

```
$ ncra --mro \  
-d time,"2000-03-01","2049-11-30",3,3 \  
in.nc out.nc # time = 199
```

```
$ ncra ... -d lat,65.0,80.0 -d lon,-70.0,-10.0 ...
```

Example 1.3: Average

eg, time = unlimited // (600 currently)

- Annual Mean

```
$ ncra --mro -d time,,,12,12 in.nc out.nc  
# time = 50
```

- Seasonal Mean

```
$ ncra --mro -d time,,,3,3 in.nc out.nc  
# time = 200
```

```
$ ncra -F --mro -d time,3,,3,3 in.nc out.nc  
# time = 199
```

```
$ ncra --mro \  
-d time,"2000-03-01","2049-11-30",3,3 \  
in.nc out.nc # time = 199
```

```
$ ncra ... -d lat,65.0,80.0 -d lon,-70.0,-10.0 ...
```

Example 1.3: Average

```
$ ncra ... -d lat,65.0,80.0 -d lon,-70.0,-10.0 ...
```

```
$ ncra ... -v var1,var2 ...
```

```
$ ncks ...
```

- Spatial Average

```
$ ncwa -w gw -a lat,lon in.nc out.nc
```

```
$ ncwa ... -d lat ... -d lon ... -d time ... -v var ...
```

Example 1.3: Average

```
$ ncra ... -d lat,65.0,80.0 -d lon,-70.0,-10.0 ...
```

```
$ ncra ... -v var1,var2 ...
```

```
$ ncks ...
```

- Spatial Average

```
$ ncwa -w gw -a lat,lon in.nc out.nc
```

```
$ ncwa ... -d lat ... -d lon ... -d time ... -v var ...
```

Example 1.3: Average

```
$ ncra ... -d lat,65.0,80.0 -d lon,-70.0,-10.0 ...  
$ ncra ... -v var1,var2 ...  
$ ncks ...
```

- Spatial Average

```
$ ncwa -w gw -a lat,lon in.nc out.nc  
$ ncwa ... -d lat ... -d lon ... -d time ... -v var ...
```

How to find help?

- NCO Reference Card
- NCO User Guide
- Hands-on Tutorial
- NCO open discussion

NetCDF Operator (NCO) Reference Card version 4.5.2

Syntax: Operator Options Input_File(s) Output_File	Anomaly: # Step 1: annual average ncra -d time,,11 in.nc annual_avg.nc # Step 2: subtraction ncbo -d time,,11 in.nc annual_avg.nc out.nc
Hyperslab: ncks -d dim_name,min,max[,stride] in out ncks -d lon,0,2 # First through third longitudes ncks -F -d lon,1,3 # First through third longitudes ncks -d lon,,2 # First through third longitudes ncks -d lon,2, # Third to last longitudes ncks -d lon,,2 # First to last every other longitudes ncks -d lon,-70.0,-10.0 # Lon values btw -70° and -10° ncks -d time,'1939-09-09 12:00:0.0',\ '1945-05-08 00:00:0.0' ncks -d time,'1918-11-11','1939-9-9' ncks -d time,'1979-1',,12 # Every January	Standard Deviation (std): # Method 1: for big data file # Temporal std of all data in one file # Step 1: average ncwa -a time in.nc avg.nc # Step 2: anomaly ncbo in.nc avg.nc anm.nc # Step 3: root-mean square ncra -y rmssdn anm.nc std.nc # Spatial std of all data in one file using weights # Step 1: average ld.nc ssdn(\$time)' \ nc var1 and var2 bles but var1
Concatenate Files: ncecat or ncrcat # Monthly files into annual with new dimension: month ncecat -u month file_{1..12}.nc file_annual.nc # Station files into one with new dimension: sta	

NCO 4.5.3 User Guide

This file documents NCO, a collection of utilities to manipulate and analyze netCDF files.

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This is the first edition of the *NCO User Guide*,
and is consistent with version 2 of `texinfo.tex`.

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The original author of this software, Charlie Zender, wants to improve it with the help of your suggestions, improvements, bug-reports, and patches.
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Table of Contents

[Foreword](#)

[Summary](#)

[1 Introduction](#)

[1.1 Availability](#)

[1.2 How to Use This Guide](#)

What else can NCO do?

- Anomaly: `$ ncbo file1.nc file2.nc out.nc`

- Standard Deviation:

```
$ ncwa -a time in.nc avg.nc
```

```
$ ncbo in.nc avg.nc anm.nc
```

```
$ ncra -y rmssdn anm.nc std.nc
```

Large Files

OR

Small Files

```
$ ncap2 -s `var_std=(var-var.avg($time)).rmssdn  
($time)`\  
in.nc std.nc
```

- Rename var, dimension, group, attribute

```
$ ncrename -v varOld,varNew -d dimOld,dimNew ...
```

- Edit Attributes

```
$ ncatted -a long_name,T,o,c,"Temperature" in.nc
```

- Permute dimensions, Interpolate, Regrid ...

...

Group Feature

```
$ ls
```

```
snc_LImon_CCSM4_historical_r1i1p1_[time].nc
```

```
snc_LImon_CESM1-CAM5_historical_r1i1p1_[time].nc
```

```
snc_LImon_CESM1-BGC_historical_r1i1p1_[time].nc
```

```
snc_LImon_CESM1-BGC_historical_r2i1p1_[time].nc
```

```
snc_LImon_CESM1-BGC_historical_r3i1p1_[time].nc
```

```
snc_LImon_CESM1-BGC_esmhistorical_r1i1p1_[time].nc
```

```
snd_LImon_CESM1-BGC_esmhistorical_r1i1p1_[time].nc
```

```
...
```

Groups in one file


```
#-----  
# Output file structure  
#-----  
# esmHistorical  
# {  
#   CESM1-BGC  
#   {  
#     CESM1-BGC_00  
#     {  
#       snc(time, lat, lon)  
#       snd(time, lat, lon)  
#     }  
#   }  
# }  
# historical  
# {  
#   CCSM4  
#   {  
#     CCSM4_00  
#     {  
#       snc(time, lat, lon)  
#       snd(time, lat, lon)  
#     }  
#     CCSM4_01  
#     {  
#       snc(time, lat, lon)  
#       snd(time, lat, lon)  
#     }  
#     CCSM4_02 { ... }  
#     CCSM4_03 { ... }  
#     CCSM4_04 { ... }  
#   }  
#   CESM1-BGC  
#   {  
#     CESM1-BGC_00 { ... }  
#   }  
# }
```

Group Feature

- Ensemble Average:

```
$ nces --nsm_grp --nsm_sfx='_avg' in.nc out.nc
```

```
# historical
# {
#   CCSM4
#   {
#     CCSM4_00
#     {
#       snc(time, lat, lon)
#       snd(time, lat, lon)
#     }
#     CCSM4_01
#     {
#       snc(time, lat, lon)
#       snd(time, lat, lon)
#     }
#     CCSM4_02 { ... }
#     CCSM4_03 { ... }
#     CCSM4_04 { ... }
#   }
# }
```

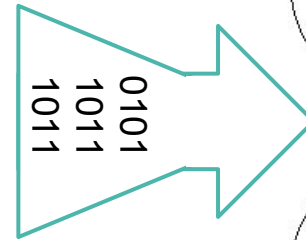
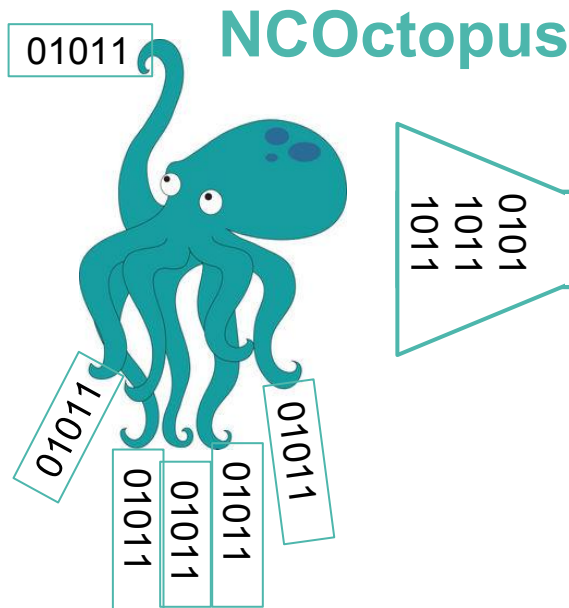


```
CCSM4_avg
{
  snc(time, lat, lon)
  snd(time, lat, lon)
}
```

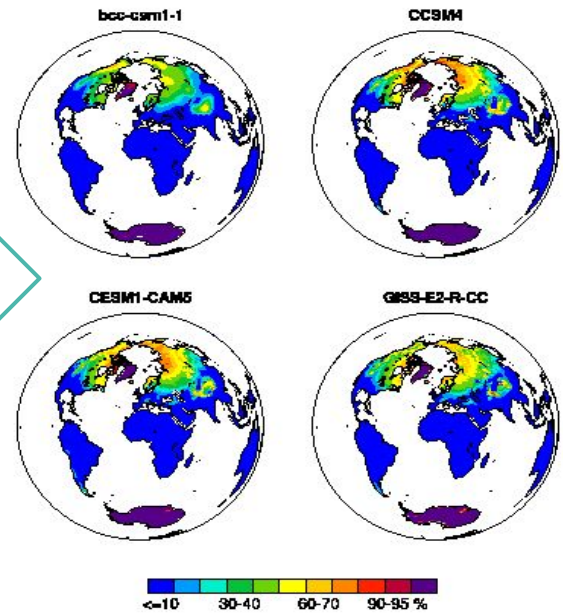
Reference

- Charlie Zender (2015), NCO 4.5.3 User Guide, <http://nco.sourceforge.net/nco.html>
- Neil Berg (2013), The wonderful world of NCO, http://research.atmos.ucla.edu/csi/GROUP/tips/NCO_basics_N.Berg2013.pdf

NCO Take only what you need efficiently



Global Annual Average Snow Cover Fraction (%)



NCO Introduction Workshop Series

Week 1: What Can NCO do?

Time: 4:00 PM Friday (Oct. 23)

Place: Round Room

LINUX



NCO Introduction Workshop Series

Week 2: The Beauty of Linux

Time: 4:00 PM Friday (Nov. 13)

Place: Round Room