

# **An Introduction to Advanced UNIX**

## **Part 3**

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## **Introduction**

This document describes the procedure for downloading and decoding the common reanalysis products, namely:

ERA40 1957-2002

JRA25 1979-present

NCEP Reanalysis 1948- present

NCEP Reanalysis 2 1979- present (also called NCEP2)

These global data are available 4 times per day and as daily and monthly averages. The data resolution is normally on a regular 2.5 x 2.5 degree latitude-longitude grid. However surface data (excluding mean sea level pressure) from the two NCEP Reanalysis products is on a Gaussian grid (about 1.9 degrees in latitude by 1.875 degrees in longitude). Climatologies (long-term averages) may also be available. The above web sites allow some manipulation of data and plotting capability.

Normally you select a time period (and in some cases a region), the variables that you require and the output format (GRIB or NetCDF). The ERA40 products may be output in either NetCDF or GRIB format (if you choose the former you also get a copy in the latter). The NCEP products are output in NetCDF only. My recommendation is to download the data in NetCDF format since it is more versatile e.g. it can be read directly into GrADS. Furthermore NetCDF files are platform-independent which means they can be read by software on any computer (SUN, Linux PC, Windows, Mac).

Since NetCDF is supported by many programs and packages you may directly read your data into these. However you may wish to convert a NetCDF file into CMP (conmap) format. The CMP file(s) may then be read and processed in a program of your own design. There is also a simple utility to convert CMP to a basic form of NetCDF so that this processed data may be read by another package.

## **Some general remarks about software**

Most of our software is available on both the SUNs (Solaris OS) and Linux machines. A program usually has the same name e.g. `grads`, and versions are normally similar in terms of release date. The only major exception at present is `conmap` on atlas – use `orthus` instead. In addition there are several versions of the `conmap` program in existence. On the Linux machines, use `conmap7`.

Generally speaking, you should use the Linux machines for your work.

However, atlas may be faster for IO intensive procedures such as decoding large GRIB or NetCDF files.

Some of the packages e.g. GrADS, are also available for a Windows PC or a Mac.

Note that binary files produced by Fortran and C programs on the SUNs ('big-endian') are incompatible with programs to process them on the Linux machines ('little-endian'). The most common instance of this problem is with conmap files. Use `binswap` on either 'end'. For example:

```
binswap -c pmsl.ncep.sun.cmp pmsl.ncep.linux.cmp
```

where `binswap` is run on the Linux machine.

The output file (`pmsl.ncep.linux.cmp`) can now be read on a Linux machine.

The reverse procedure is also true: a Linux conmap file may be converted on a SUN with `binswap`.

## 1. Downloading reanalysis data

### Downloading ERA40 data

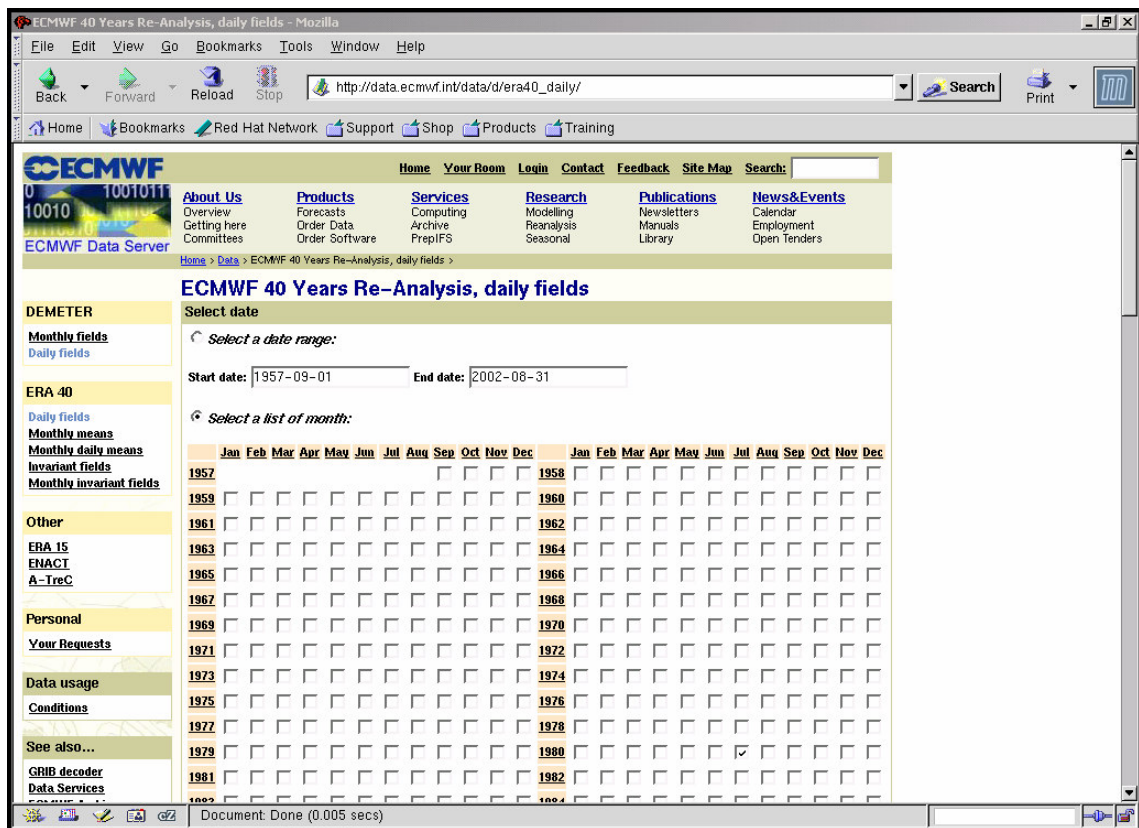
1. Normally you will keep your data files in your UNIX 'work' area e.g.

`/work18/kevin` Therefore connect to a UNIX machine with `ssh` and create an appropriate folder e.g. `/work18/kevin/era40/data`

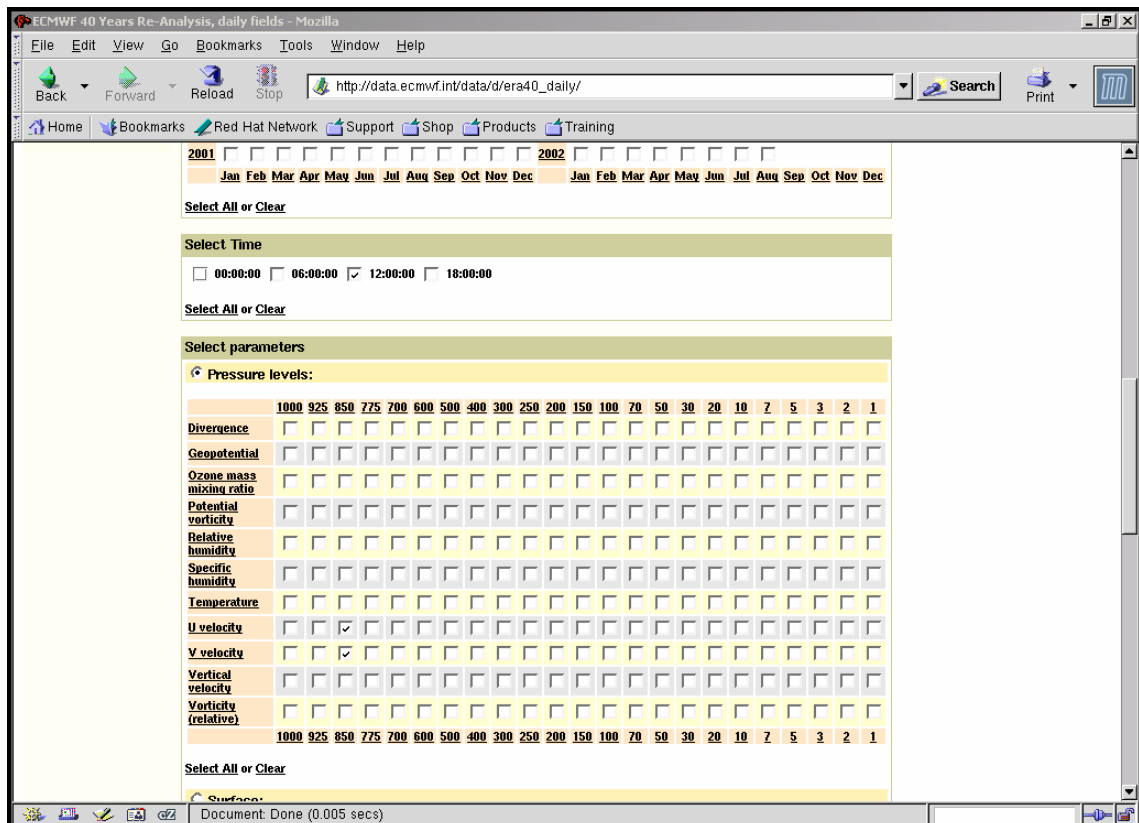
2. From an `xterm` window type: `mozilla &`

3. Goto to: [http://data.ecmwf.int/data/d/era40\\_daily/](http://data.ecmwf.int/data/d/era40_daily/)

4. Select a date range or list of months e.g. Jul 1980.



5. Select a time (e.g. 12 UTC) and the variables (parameters) that you want e.g. U and V winds at 850 hPa. Note: Choose either Pressure levels or Surface.



At the end of the page click on Retrieve NetCDF.

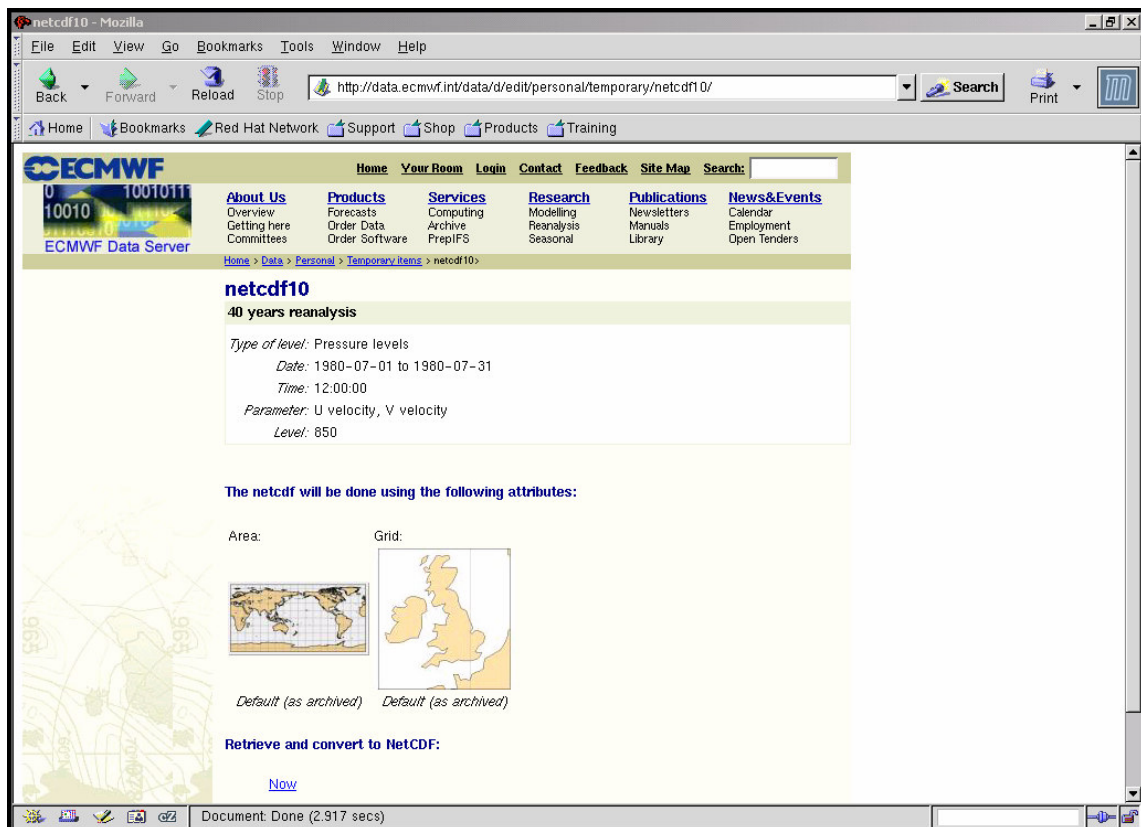
<input type="checkbox"/> Total precipitation	<input type="checkbox"/> Volumetric soil water layer 1	
<input type="checkbox"/> Volumetric soil water layer 2	<input type="checkbox"/> Volumetric soil water layer 3	
<input type="checkbox"/> Volumetric soil water layer 4		
<b>Select All or Clear</b>		
<input type="button" value="Retrieve GRIB"/>	<input type="button" value="Retrieve NetCDF"/>	<input type="button" value="Plot data"/>

**Note:**

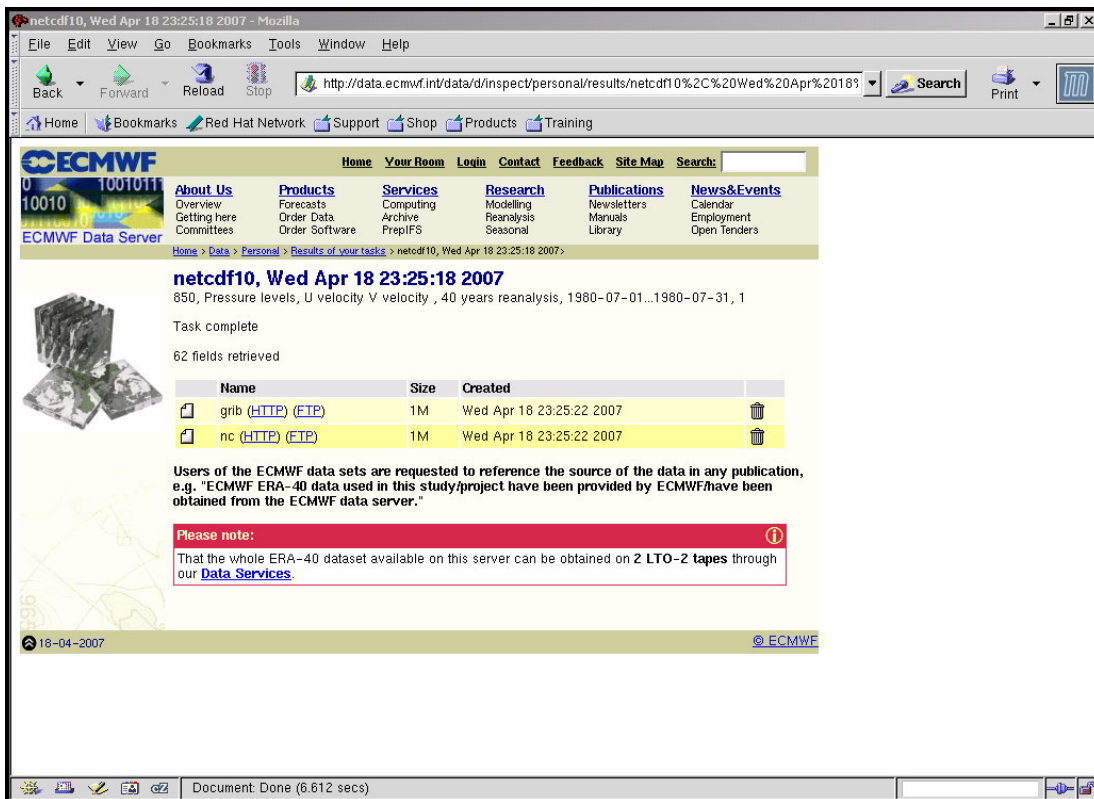
The provision of NetCDF is **experimental** and the format of produce **will change** in the future

**26th May 2004:** An improved, more CF compliant, version of NetCDF conversion tool was introduced.

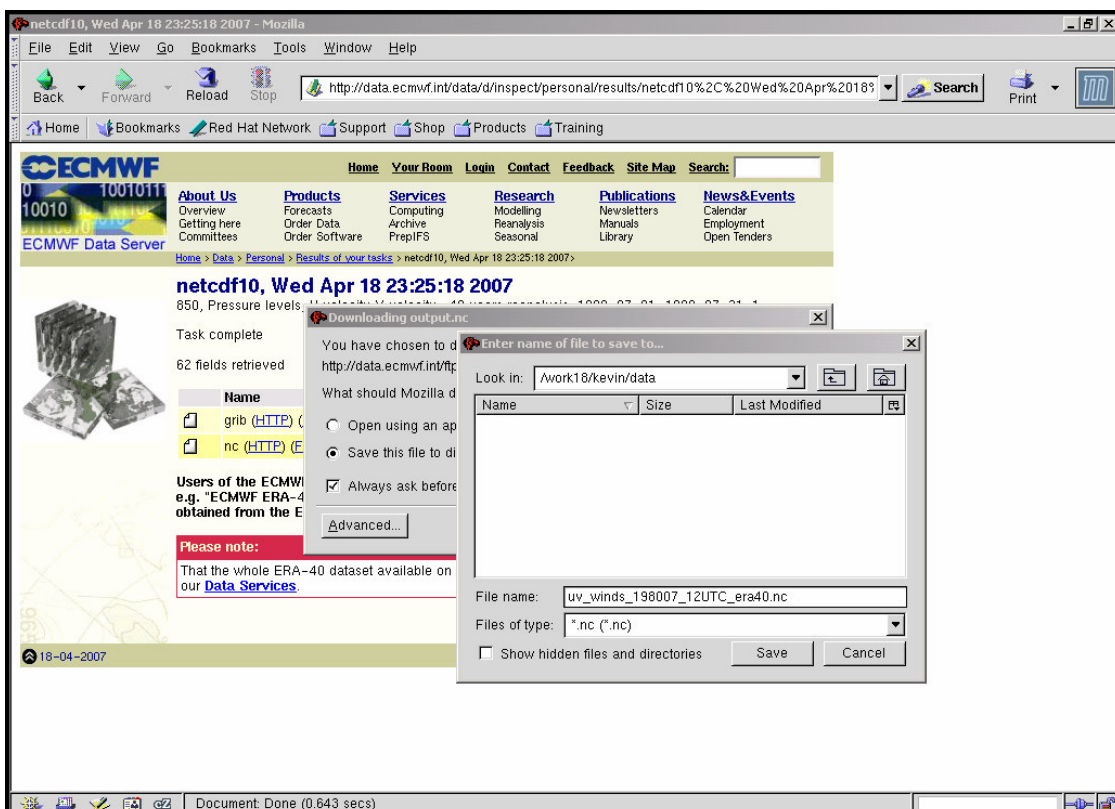
6. You may specify a smaller region by clicking the Area picture link (default: whole globe). The Grid picture link is set to a 2.5 x 2.5 degree grid (cannot be changed). Then click Now.







7. There may be a delay as data extraction occurs on the remote site. When complete you will see a page like this. Notice there is a GRIB copy too.



8. Click on the nc HTTP link. You can move to the folder that you want and give the file a suitable name (default: output.nc) via the Enter name ... dialog box.



9. The NetCDF file: uv\_winds\_198007\_12UTC\_era40.nc can now be read into a suitable package of converted to CMP format. Note: After you have successfully downloaded a file you may delete it from the ECMWF server by clicking on the ‘trash can’ icon

	Name	Size	Created	
	grib ( <a href="#">HTTP</a> ) ( <a href="#">FTP</a> )	1M	Wed Apr 18 23:25:22 2007	
	nc ( <a href="#">HTTP</a> ) ( <a href="#">FTP</a> )	1M	Wed Apr 18 23:25:22 2007	

10. The procedure may be repeated. For instance, selecting mean sea level pressure for the same period (Surface table). The file was saved as: pmsl\_198007\_12UTC\_era40.nc

Select All or Clear

Surface:

<input type="checkbox"/> 10 metre U wind component	<input type="checkbox"/> 10 metre V wind component
<input type="checkbox"/> 2 metre dewpoint temperature	<input type="checkbox"/> 2 metre temperature
<input type="checkbox"/> Boundary layer height	<input type="checkbox"/> Convective precipitation
<input type="checkbox"/> East-West surface stress	<input type="checkbox"/> Evaporation
<input type="checkbox"/> High cloud cover	<input type="checkbox"/> Ice surface temperature layer 1
<input type="checkbox"/> Ice surface temperature layer 2	<input type="checkbox"/> Ice surface temperature layer 3
<input type="checkbox"/> Ice surface temperature layer 4	<input type="checkbox"/> Latitudinal component of gravity wave stress
<input type="checkbox"/> Low cloud cover	<input checked="" type="checkbox"/> Mean sea level pressure
<input type="checkbox"/> Mean wave direction	<input type="checkbox"/> Mean wave period
<input type="checkbox"/> Medium cloud cover	<input type="checkbox"/> Meridional component of gravity wave stress
<input type="checkbox"/> North-South surface stress	<input type="checkbox"/> Runoff
<input type="checkbox"/> Sea-ice cover	<input type="checkbox"/> Significant wave height

## Downloading JRA25 data

This is the latest of the reanalysis products and requires registration for access. Please consult Kevin Key if you need to use this product. The data are in GRIB format but may be converted to NetCDF on our network using `xconv`.

## Downloading NCEP Reanalysis 2 (NCEP2) data

1. Normally you will keep your data files in your UNIX ‘work’ area e.g. /work18/kevinTherefore connect to a UNIX machine with `ssh` and create an appropriate folder e.g. /work18/kevin/ncep2/data


2. From an `xterm` window type: `mozilla &`

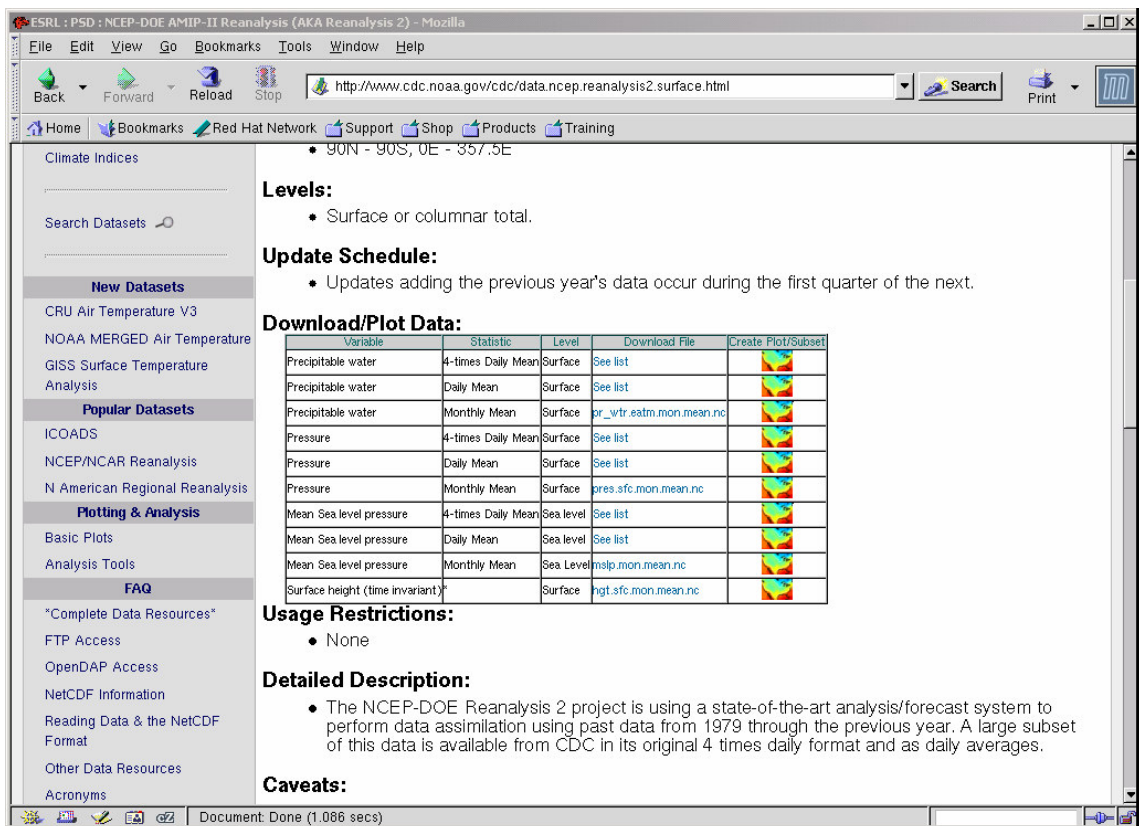
3. Go to to: <http://www.cdc.noaa.gov/cdc/data.ncep.reanalysis2.html>

On this page you will see a section with links to different kinds of variables.











**The NCEP-DOE Reanalysis 2 descriptions are subdivided into separate files**

- [Pressure](#)
- [Gaussian Grid](#)
- [Spectral Coefficients Data](#)
- [Surface Data](#)


4. As an example we want mean sea level pressure (‘SurfaceData ’ link in 3 above). Then click on the Create Plot/Subset icon  for ‘Mean Sea level pressure 4-times Daily Mean’.

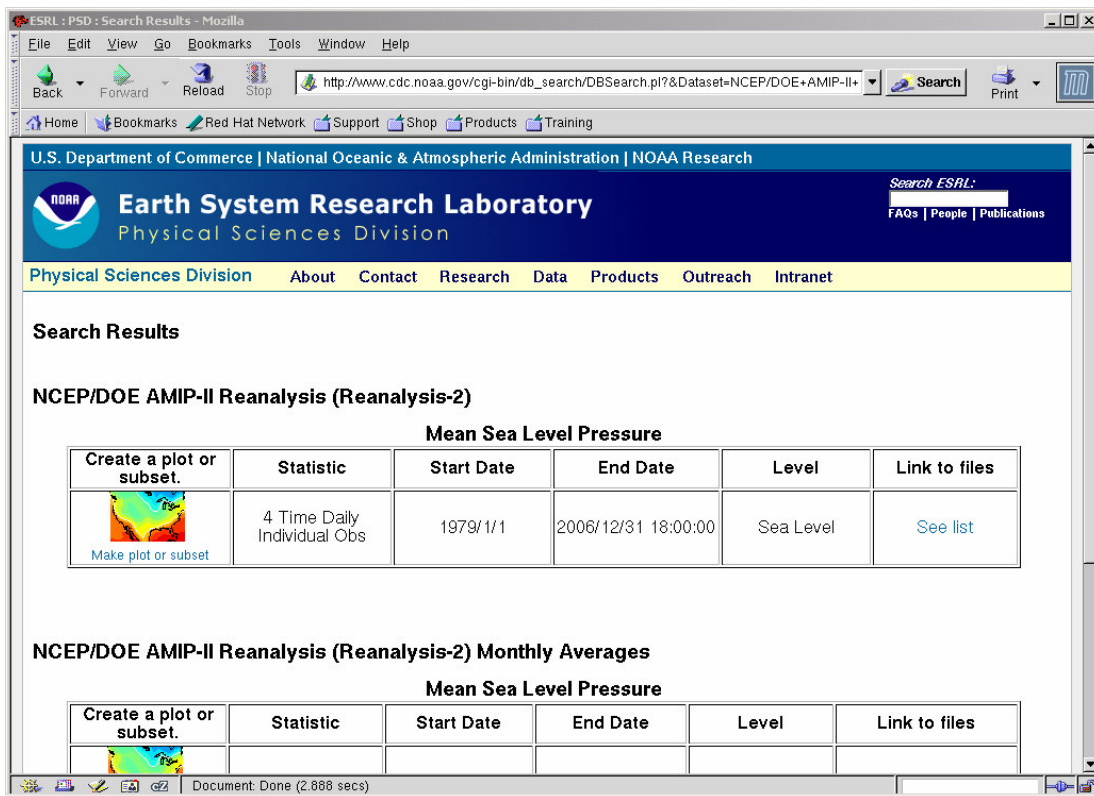


The screenshot shows a Mozilla browser window displaying the NCEP-DOE Reanalysis 2 data page. The address bar shows the URL: <http://www.cdc.noaa.gov/cdc/data.ncep.reanalysis2.surface.html>. The page content includes a search bar, navigation links, and a table of variables with download and plot options.

Variable	Statistic	Level	Download File	Create Plot/Subset
Precipitable water	4-times Daily Mean	Surface	<a href="#">See list</a>	
Precipitable water	Daily Mean	Surface	<a href="#">See list</a>	
Precipitable water	Monthly Mean	Surface	<a href="#">pr_wtr_eatm.mon.mean.nc</a>	
Pressure	4-times Daily Mean	Surface	<a href="#">See list</a>	
Pressure	Daily Mean	Surface	<a href="#">See list</a>	
Pressure	Monthly Mean	Surface	<a href="#">pres.sfc.mon.mean.nc</a>	
Mean Sea level pressure	4-times Daily Mean	Sea level	<a href="#">See list</a>	
Mean Sea level pressure	Daily Mean	Sea level	<a href="#">See list</a>	
Mean Sea level pressure	Monthly Mean	Sea Level	<a href="#">mslp.mon.mean.nc</a>	
Surface height (time invariant)		Surface	<a href="#">hgt.sfc.mon.mean.nc</a>	



5. Click on the link ‘Make plot or subset’ (beneath the graphic ).



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
Search ESRL:   
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**Search Results**


**NCEP/DOE AMIP-II Reanalysis (Reanalysis-2)**

**Mean Sea Level Pressure**

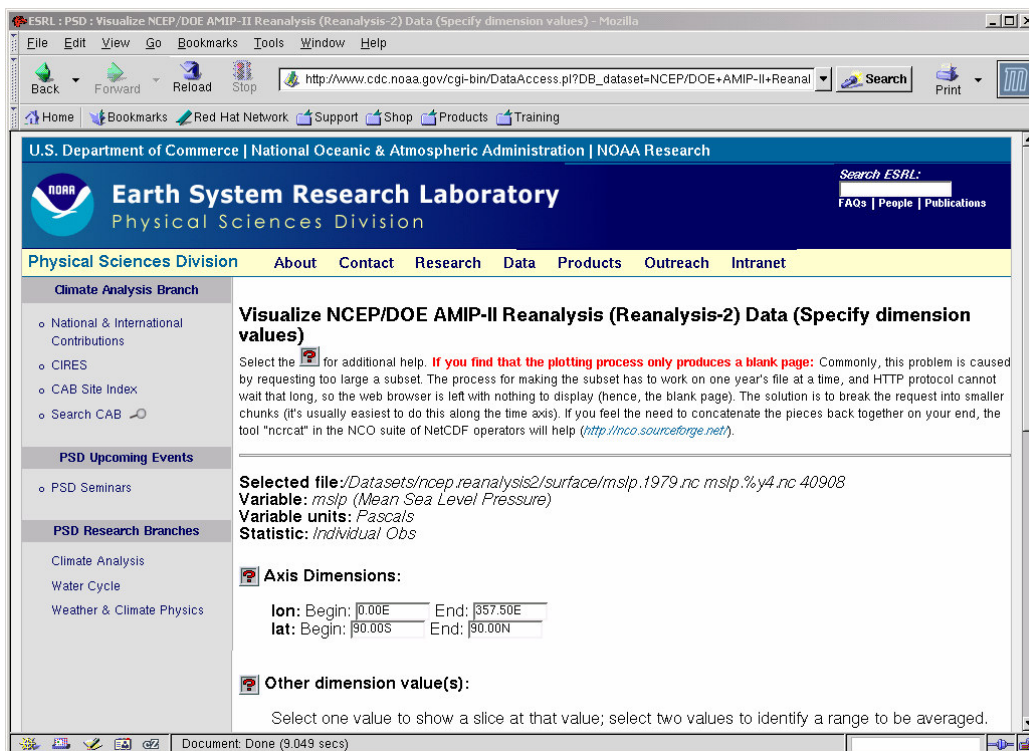
Create a plot or subset.	Statistic	Start Date	End Date	Level	Link to files
 Make plot or subset	4 Time Daily Individual Obs	1979/1/1	2006/12/31 18:00:00	Sea Level	<a href="#">See list</a>

**NCEP/DOE AMIP-II Reanalysis (Reanalysis-2) Monthly Averages**

**Mean Sea Level Pressure**

Create a plot or subset.	Statistic	Start Date	End Date	Level	Link to files
					

6. Leave the Axis Dimensions unchanged (whole globe). Under Other Dimension Value(s) set the ‘time’ dimension to cover July 1-4 1980 at 00,06,12,18 UTC. Under Output options, click the button for ‘Create a subset without making a plot’. Finally click  at the bottom of the page.



ESRL : PSD : Visualize NCEP/DOE AMIP-II Reanalysis (Reanalysis-2) Data (Specify dimension values) - Mozilla

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
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- Water Cycle
- Weather & Climate Physics

**Visualize NCEP/DOE AMIP-II Reanalysis (Reanalysis-2) Data (Specify dimension values)**

Select the  for additional help. **If you find that the plotting process only produces a blank page:** Commonly, this problem is caused by requesting too large a subset. The process for making the subset has to work on one year's file at a time, and HTTP protocol cannot wait that long, so the web browser is left with nothing to display (hence, the blank page). The solution is to break the request into smaller chunks (it's usually easiest to do this along the time axis). If you feel the need to concatenate the pieces back together on your end, the tool "ncrcat" in the NCO suite of NetCDF operators will help (<http://nco.sourceforge.net/>).

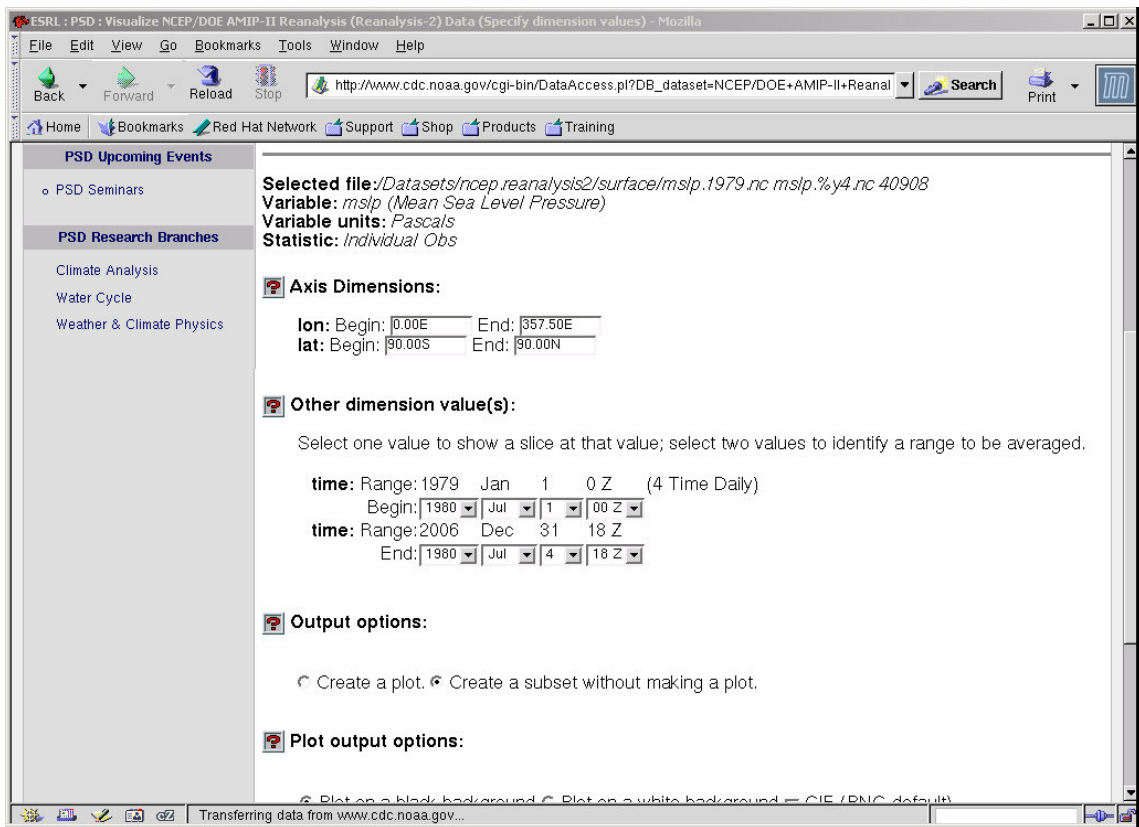
**Selected file:** /Datasets/ncep\_reanalysis2/surface/mslp.1979.nc  
**Variable:** mslp (Mean Sea Level Pressure)  
**Variable units:** Pascals  
**Statistic:** Individual Obs

**Axis Dimensions:**

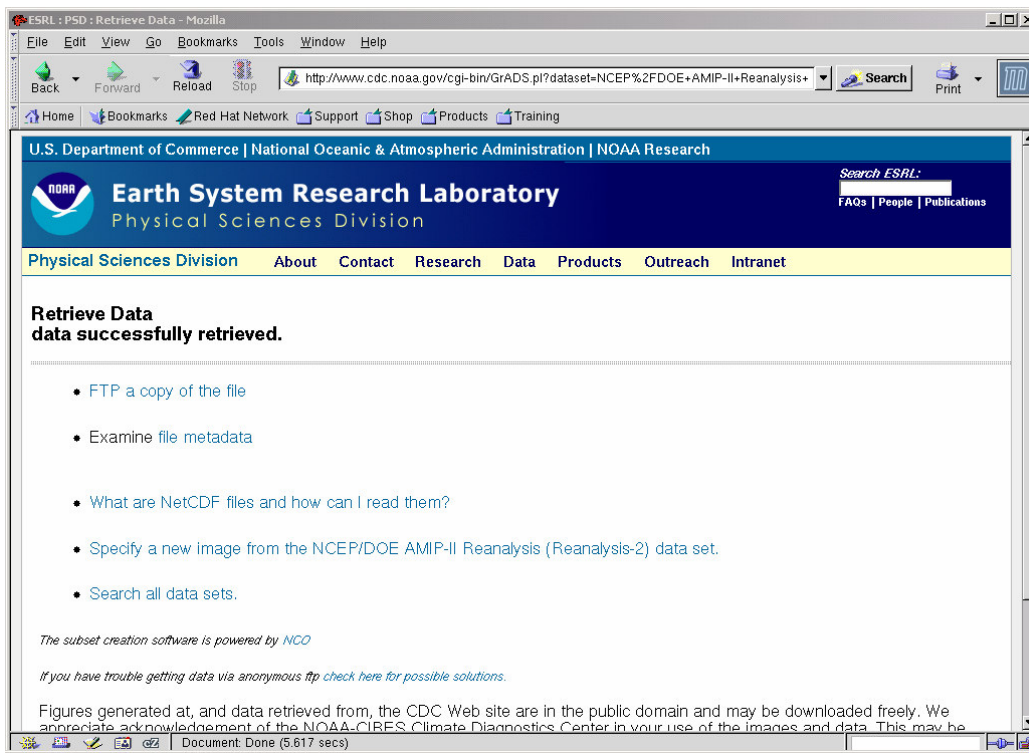
lon: Begin: 0.00E End: 357.50E  
lat: Begin: 90.00S End: 90.00N

**Other dimension value(s):**

Select one value to show a slice at that value; select two values to identify a range to be averaged.



7. There may be a delay while the data are being extracted at the remote site. When the extraction is complete the following screen will appear.



8. Click on the link to 'Examine the metadata'. This is a header dump (like ncdump). We

see that there are 16 maps (time is 16) and that the time range is correct.

ESRL : PSD : Metadata for /Public/www/128.250.120.93.107.17.49.49.nc - Mozilla

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**Metadata for /Public/www/128.250.120.93.107.17.49.49.nc**

**Dimensions:**

lon	144
lat	73
mslp	16 73 144
time	16

**Variables:**

**lon**

long_name	Longitude
standard_name	longitude_east
units	degrees_east
coordinate_defines	point
axis	x
actual_range	0 357.5

**lat**

long_name	Latitude
standard_name	latitude_north
units	degrees_north
coordinate_defines	point
axis	y
actual_range	90 -90

**mslp**

FillValue	-32767
GRIB_name	PRMSL
parent_stat	Other

ESRL : PSD : Metadata for /Public/www/128.250.120.93.107.17.49.49.nc - Mozilla

axis

axis	y
actual_range	90 -90

**mslp**

FillValue	-32767
GRIB_name	PRMSL
parent_stat	Other
dataset	NCEP/DOE AMIP-II Reanalysis (Reanalysis-2)
scale_factor	1
actual_range	96070 107140
unpacked_valid_range	77000 125000
var_desc	Mean Sea Level Pressure
precision	0
add_offset	109766
GRIB_id	2
long_name	6-Hourly Mean Sea Level Pressure
standard_name	pressure
units	Pascals
level_desc	Sea Level
missing_value	32766
least_significant_digit	-1
statistic	Individual Obs
valid_range	-32765 15235

**time**

long_name	Time
standard_name	time
units	hours since 1800-1-1 00:00:0.0
coordinate_defines	point
axis	t
actual_range	1980-07-01 00:00:00 1980-07-04 18:00:00
delta_t	0000-00-00 06:00:00

**Global Attributes:**

**source**

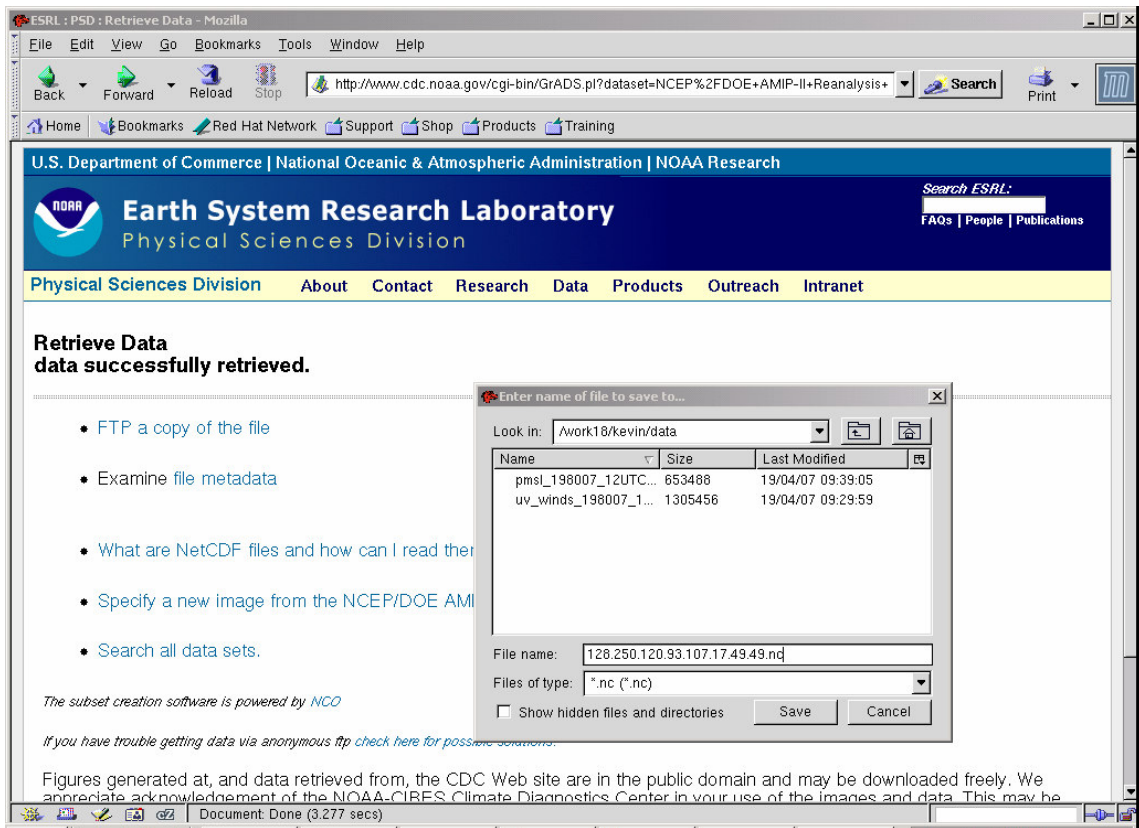
NCEP/DOE AMIP-II Reanalysis (Reanalysis-2) Model

**references**

<http://wesley.ncep.noaa.gov/reanalysis2/>  
<http://www.cdc.noaa.gov/cdc/data.ncep.reanalysis2.html>

9. Go back to the previous page and click on 'FTP a copy of the data'. You will see a dialog box with a generated unique name e.g. 128.250.120.93.107.17.49.49.nc. This

name may be replaced with a more meaningful one e.g. pmsl\_198007\_part\_ncep.nc.



10. The NetCDF file is now available for reading and data processing.

### Note for most recent NCEP Reanalysis 2 data (GRIB format)

The NOAA web site for NCEP Reanalysis 2 is supposed to be updated quarterly.

If you want data for the most recent period go to:

[http://nomad1.ncep.noaa.gov/ncep\\_data/index.html](http://nomad1.ncep.noaa.gov/ncep_data/index.html)

**NOMADS: NCEP server 3**

**Plots, Data, Points of Contact**

**last update to this web page:20060822**

**The following table list several data sets. By clicking on the appropriate command, you can (1) make plots, (2) FTP the files to your computer -- slice, dice and subset large files or (3) obtain documentation or (4) use the DODS(OPeN-DAP)/GDS server to get data values directly from our matrix of holdings. At this time, some options are not available (N/A).**

Data Set	freq	plot	ftp	http	doc	gds	contact 1	contact 2
<b>NCEP/DOE Reanalysis (Reanalysis-2)</b>								
Reanalysis-2 pressure level	4x daily	<a href="#">plot</a>	<a href="#">ftp2u</a> <a href="#">ftp</a>	<a href="#">http</a>	<a href="#">doc</a>	<a href="#">DODS</a>	Wesley.Ebisuzaki@noaa.gov	Jun.Wang@noaa.gov
Reanalysis-2 non-pressure level	4x daily	<a href="#">plot</a>	<a href="#">ftp2u</a> <a href="#">ftp</a>	<a href="#">http</a>	<a href="#">doc</a>	<a href="#">DODS</a>	Wesley.Ebisuzaki@noaa.gov	Jun.Wang@noaa.gov
Reanalysis-2 spectral sigma analyses	4x daily	N/A	<a href="#">ftp</a>	<a href="#">http</a>	<a href="#">doc</a>	N/A	Wesley.Ebisuzaki@noaa.gov	Jun.Wang@noaa.gov
Reanalysis-2 sfcml (to run model)	4x daily	N/A	<a href="#">ftp</a>	<a href="#">http</a>	<a href="#">doc</a>	N/A	Wesley.Ebisuzaki@noaa.gov	Jun.Wang@noaa.gov
Reanalysis-2 pressure level	monthly mean	<a href="#">plot</a>	<a href="#">ftp2u</a> <a href="#">ftp</a>	<a href="#">http</a>	<a href="#">doc</a>	<a href="#">DODS</a>	Wesley.Ebisuzaki@noaa.gov	Jun.Wang@noaa.gov
Reanalysis-2 non-pressure level	monthly mean	<a href="#">plot</a>	<a href="#">ftp2u</a> <a href="#">ftp</a>	<a href="#">http</a>	<a href="#">doc</a>	<a href="#">DODS</a>	Wesley.Ebisuzaki@noaa.gov	Jun.Wang@noaa.gov
Reanalysis-2 diabatic heating etc	monthly mean	<a href="#">plot</a>	<a href="#">ftp2u</a> <a href="#">ftp</a>	<a href="#">http</a>	<a href="#">doc</a>	<a href="#">DODS</a>	Wesley.Ebisuzaki@noaa.gov	Jun.Wang@noaa.gov
<b>NCEP/DOE Reanalysis (Reanalysis-2) Rotating Archive, latest analyses</b>								
Reanalysis-2 pressure level	4x daily rotating	<a href="#">plot</a>	<a href="#">ftp2u</a> <a href="#">ftp</a>	<a href="#">http</a>	<a href="#">doc</a>	<a href="#">DODS</a>	Wesley.Ebisuzaki@noaa.gov	Jun.Wang@noaa.gov
Reanalysis-2 non-pressure level	4x daily rotating	<a href="#">plot</a>	<a href="#">ftp2u</a> <a href="#">ftp</a>	<a href="#">http</a>	<a href="#">doc</a>	<a href="#">DODS</a>	Wesley.Ebisuzaki@noaa.gov	Jun.Wang@noaa.gov
Reanalysis-2 model init conditions	4x daily rotating	N/A	<a href="#">ftp2u</a> <a href="#">ftp</a>	<a href="#">http</a>	<a href="#">doc</a>	<a href="#">DODS</a>	Wesley.Ebisuzaki@noaa.gov	Jun.Wang@noaa.gov

Use the first two headings with ‘NCEP/DOE Reanalysis (Reanalysis-2)’ and the table entries ‘Reanalysis-2 pressure level’ and ‘Reanalysis-2 non-pressure level’. Click on the ‘ftp2u’ link in the column headed ‘ftp’. As an example, download mean sea level pressure for March 11-12 2007 (click ‘Reanalysis-2 pressure level’). The only output format is GRIB.

## Data Transfer: 6 hourly Reanalysis-2 pressure-level data FTP2U Page

### FTP2U

FTP2U allows you to subset GRIB files and will place the files either on our anonymous FTP server or FTP the data to your anonymous FTP server. Select the files and fill out any filtering information.

Select one or more files (size in bytes)

hgt.ctl 435  pgb.197901 188319266  pgb.197902 169572188  
 pgb.197903 185307578  pgb.197904 177875952  pgb.197905 185717546  
 pgb.197906 182022936  pgb.197907 190860542  pgb.197908 190709432

...

pgb.200703 188299556  pgb.ctl 3405  pres.ctl 470  
 rh.ctl 430  tmp.ctl 420  wind.ctl 518

You can also select files by entering a string below (\*=any-string ?=1 character).

### Grib Filter

Grib Filter: Many times you may only want a section of a huge data file. Rather than transferring the entire file, this section will allow you to select some or all (1) levels, (2) variables, and (3) dates of a GRIB file. The buttons represent common choices which may or may not be relevant to the files that you want transferred. For example choosing RH (relative humidity) would be pointless in file of sea-surface temperatures. In addition, not all possibilities are allowed. For example, suppose you only want the virtual temperature at the tropopause at 01Z. Too bad because you have to transfer the entire file.

**For GRIB data only.**

Select the levels desired:

all  1000 mb  925 mb  850 mb  700 mb  600 mb  500 mb  400 mb  300 mb  250 mb  200 mb  150 mb  
 100 mb  70 mb  50 mb  30 mb  20 mb  10 mb  atmos col  MSL  sfc

Select the variables desired:

all  ABSV  HGT  PRATE  PRES  RH  TMP  UGRD  VGRD  VVEL

Select the days of month desired:

all  0  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  
 25  26  27  28  29  30  31

Select the hours desired:

all  00  06  12  18

### Extract Subregion

File transfer times can be reduced by only transferring a subregion. You can use this section to extract a geographic subsection from a latitude-longitude GRIB file. Use negative numbers for south and west.

make subregion  left longitude  right longitude   
top latitude  bottom latitude

## Obtaining the Data

Your request will generate a data set. We can either (1) send the data our anonymous FTP server from which you can download the data or (2) FTP the data to your (anonymous) FTP server.


With the first method, you have to download the data within a preset time limit before the data are automatically deleted. THE SECOND METHOD IS NOT RECOMMENDED unless you have considered all the security implications and are willing to (a) send your FTP password over the internet in clear text, (b) have your FTP password saved in our web logs in clear text and (c) run an FTP server and (4) possibly make some holes in your firewall.

<input checked="" type="radio"/> Save results on nomad3.ncep.noaa.gov for downloading	<input type="radio"/> FTP the results to your anonymous ftp server <b>WARNING: This method will be stopped from using soon.</b>
Select file retention time: <input checked="" type="radio"/> 1 hour <input type="radio"/> 3 hour	Computer <input type="text" value="128.250.120.197"/>
	User ID <input type="text" value="anonymous"/>
	Password <input type="text"/>
	Directory <input type="text" value="/incoming_1hr"/>
	New name prefix <input type="text"/>
	leave blank for original names

Start download

Reset

ftp2you 0.7.9.9b and comments: Wesley.Ebisuzaki@noaa.gov, Jun.Wang@noaa.gov  
ggrib v2.3: Oyvind Breivik, Norwegian Meteorological Institute

Note the appropriate selections in the form above. We have chosen the data file pgb.200703 (March 2007), we have checked the MSL level, the PRES (pressure), variable, days 11 and 12. all hours and no changes to the region (whole globe). Now click the  button.



```
*****
pgb.200703 was copied to ftp://nomad3.ncep.noaa.gov/pub/NOMAD\_1hr/tdir19-1.28376/pgb.200703, 105792 bytes
grib filter=egrep '(PRES):' | egrep '(MSL):' | egrep 'd=.....(11|12)'
*****

Results were saved in ftp://nomad3.ncep.noaa.gov/pub/NOMAD\_1hr/tdir19-1.28376

Or http://nomad3.ncep.noaa.gov/datalink/ftp\_data/pub/NOMAD\_1hr/tdir19-1.28376
transferred 1 out of 1 files
```

Click the http link.

## Index of /datalink/ftp\_data/pub/NOMAD\_1hr/tdir19-1.28376

Name	Last modified	Size	Description
 <a href="#">Parent Directory</a>		-	
 <a href="#">pgb.200703</a>	19-Apr-2007 01:36	103K	

Apache/2.0.46 (Red Hat) Server at nomad3.ncep.noaa.gov Port 80

Now click on the pgb file link and save the file pgb.200703 to your UNIX folder. The file pgb.200703 can now be decoded to CMP format for data processing.

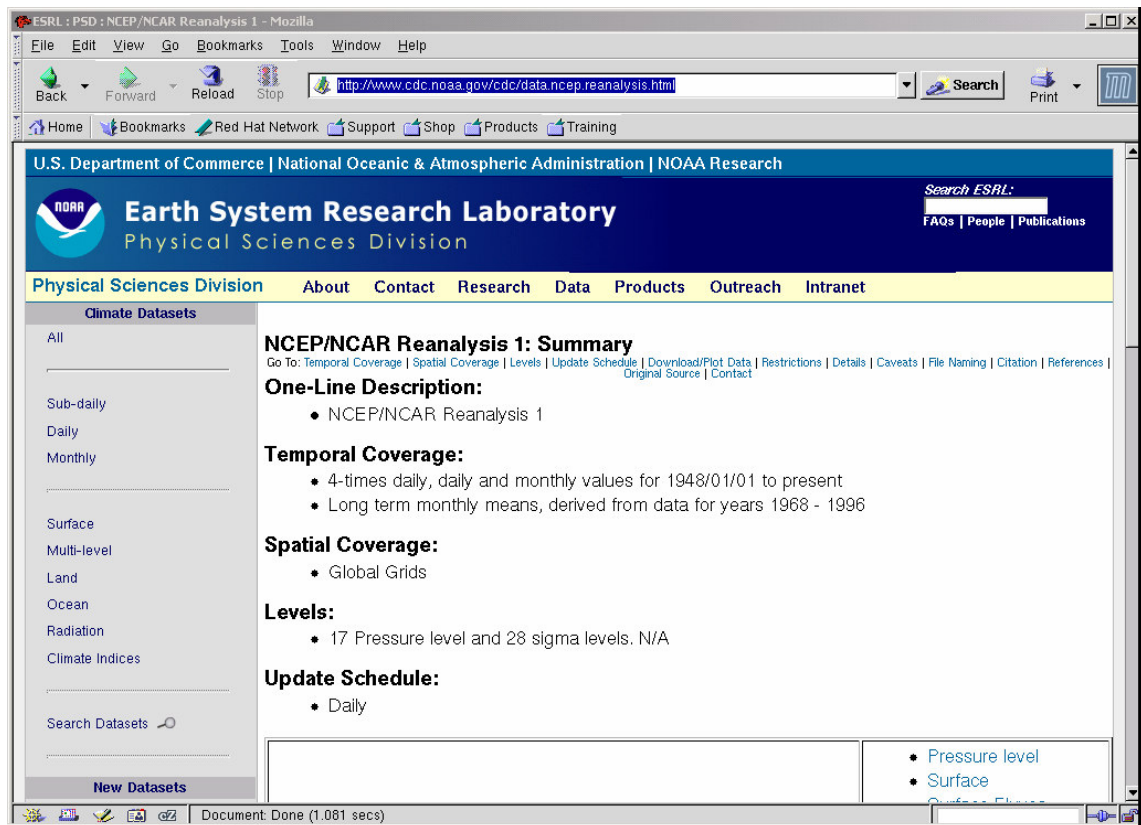
**Important:** Each time you fill in the form to select files for download, the names pgb.yyyymm (year-month) will be overwritten. Make sure that you download to separate folders or rename the pgb files before commencing a new download.

Note: For data spanning more than one month there will be multiple files. You can simply click and download them. Another way is to use 'anonymous' ftp (username: anonymous, password: your email address). For the folder on the remote site use everything in the index name from /pub e.g. /pub/NOMAD\_1hr/tdir19-1.28376 in this example.

```
110 kevin@cove:/work18/kevin/data> ftp nomad3.ncep.noaa.gov
Connected to nomad3.ncep.noaa.gov (140.90.198.158).
220 ProFTPD 1.2.10 Server (ProFTPD Default Installation)
[140.90.198.158]
Name (nomad3.ncep.noaa.gov:kevin): anonymous
331 Anonymous login ok, send your complete email address as your
password.
Password: keay@unimelb.edu.au
230 Anonymous access granted, restrictions apply.
Remote system type is UNIX.
Using binary mode to transfer files.
ftp> cd /pub/NOMAD_1hr/tdir19-1.28376
250 CWD command successful
ftp> dir
227 Entering Passive Mode (140,90,198,158,209,247).
150 Opening ASCII mode data connection for file list
-rw-r--r--  1 nobody  nobody    105792 Apr 19 05:36 pgb.200703
226 Transfer complete.
ftp> get pgb.200703      (for multiple files: mget pgb.*)
local: pgb.200703 remote: pgb.200703
227 Entering Passive Mode (140,90,198,158,209,251).
150 Opening BINARY mode data connection for pgb.200703 (105792 bytes)
226 Transfer complete.
105792 bytes received in 1.29 secs (80 Kbytes/sec)
ftp> quit
221 Goodbye.
```

## Downloading NCEP Reanalysis data


1. Normally you will keep your data files in your UNIX 'work' area e.g. /work18/kevinTherefore connect to a UNIX machine with `ssh` and create an appropriate folder e.g. /work18/kevin/ncep/data
2. From an `xterm` window type: `mozilla &`
3. Goto to: <http://www.cdc.noaa.gov/cdc/data.ncep.reanalysis.html>

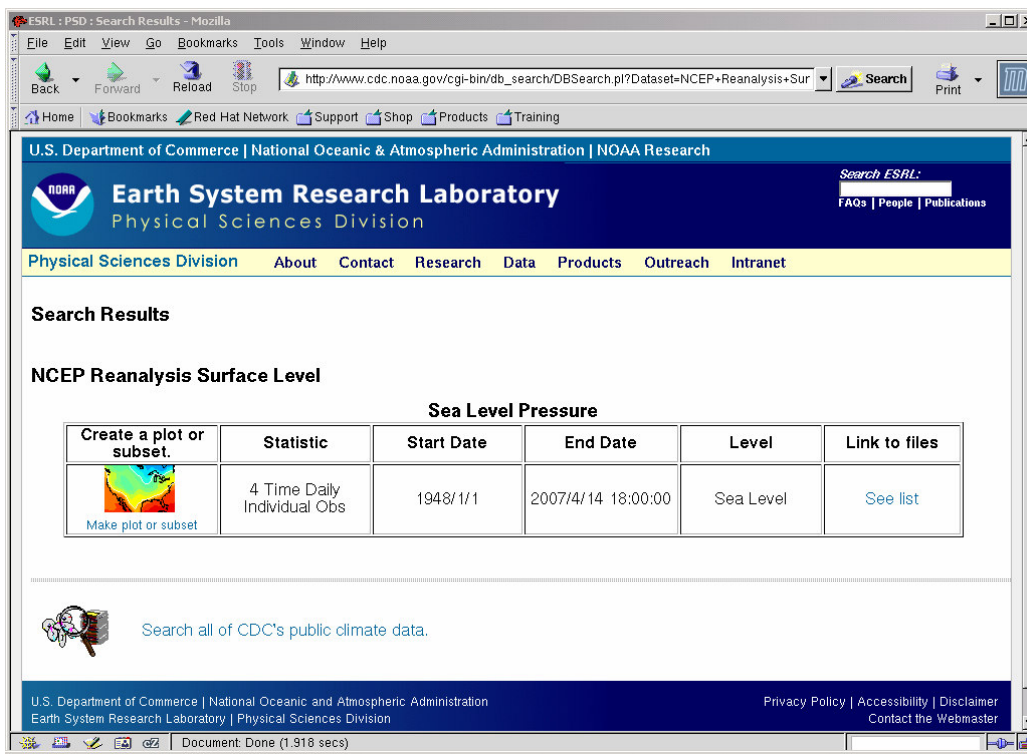


Choose a category from the right pane e.g. Surface, for mean sea level pressure.

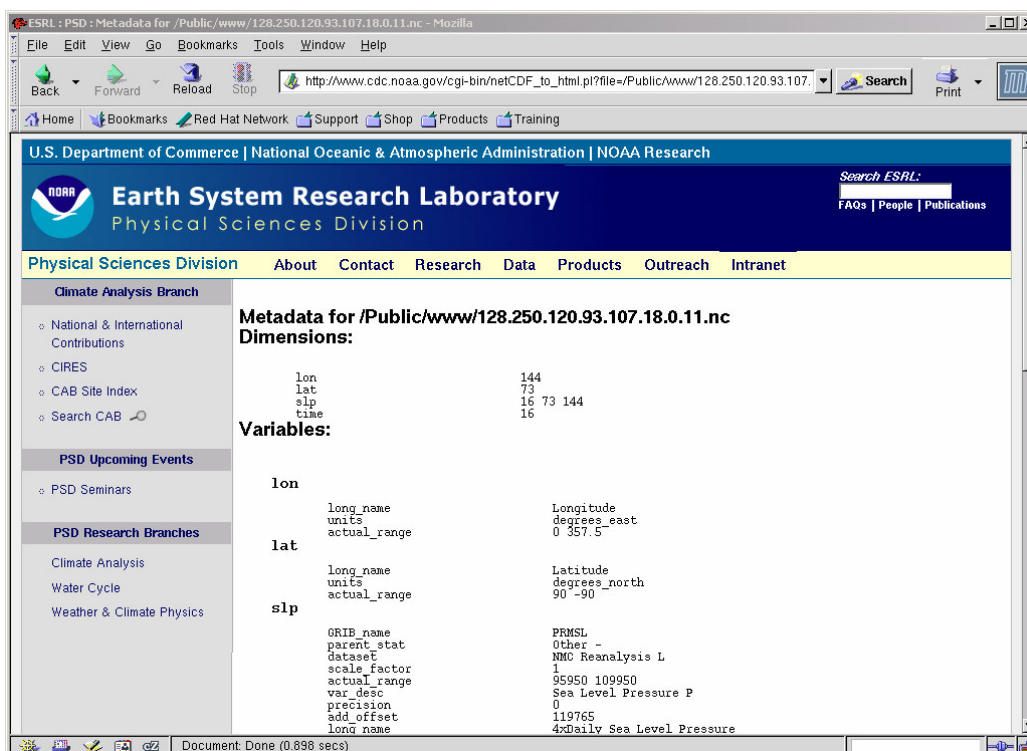
<p><b>We have separated the data documentation into seven sections:</b></p>	<ul style="list-style-type: none"><li>• Pressure level</li><li>• Surface</li><li>• Surface Fluxes</li><li>• Other Fluxes</li><li>• Tropopause</li><li>• Derived Data</li><li>• Spectral Coefficients</li></ul>
---	--

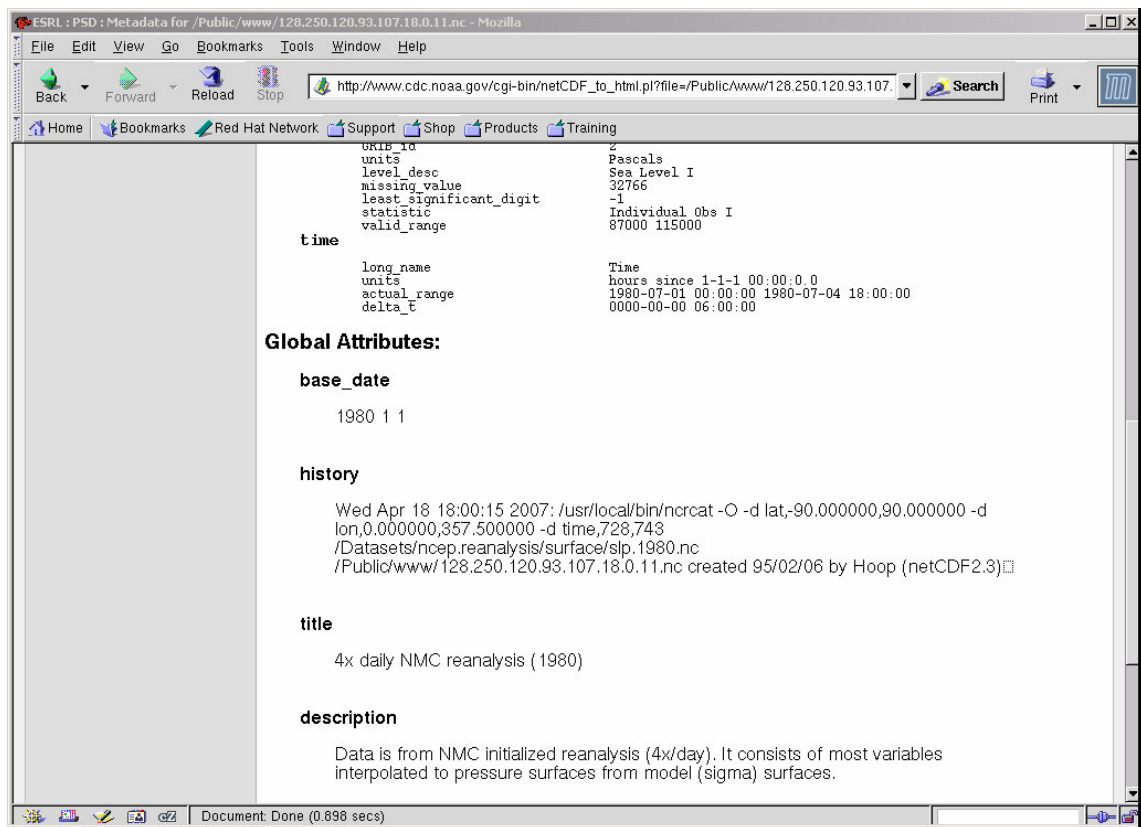


4. Click on the link 'Make plot or subset' (beneath the graphic ). From this point the procedure is the same as for the NCEP Reanalysis 2 case.



5. As in the NCEP Reanalysis 2 case you can select a time period and region – choose July 1-4 1980 for all 4 times. After the data has been extracted at the remote site check the metadata. Then save the file to your UNIX folder as: pmsl\_198007\_part\_ncep.nc





6. The NetCDF file is now available for reading and data processing.

## 2. Decoding reanalysis data

### Decoding NetCDF data to CMP ('conmap') format

The program `read_nc2cmp` can handle common NetCDF files, especially the reanalysis products.

Usage: For brief help: `read_nc2cmp`  
and for some examples: `read_nc2cmp -help`

```
read_nc2cmp: Version 2.0 (Feb 12 2007)
```

```
Usage: read_nc2cmp [--help] [-D idbg] [-i ncfile] [-o cmpfile] [-d  
"lon,lat,time"]
```

```
[-u uservar] [-g gridtype] [-l levelvar] [-L ilev] [-r rtype] [-s  
uscal] [-v vtype]
```

```
[-U units] [-m no_maps] [-p udunits] [-M "map1,map2"]
```

```
D: 0= None 1= Basic 2= Verbose 3= Print dimension arrays to file  
fort.10
```

```
Note: Max. sizes of text variables
```

```
gridtype: 10 rtype: 5 vtype: 8 units: 8
```

```
--help: Gives some examples
```

#### Some examples

Many of the default settings of the options will be correct for common reanalysis products. The `-d` option is set for NCEP and NCEP2 by default, assuming that the longitude, latitude and time variables are named `lon`, `lat` and `time`.

If you are unsure, use `ncdump` e.g. `ncdump -h hgt.1980.nc`, to check the NetCDF file header for the names of dimensions and variables – these are case-sensitive e.g. SLP is not the same as `slp`.

#### (1) ERA40 with no level variable

The output from `ncdump` for `hgt.2002.Jun.500hPa.nc` in folder `ncdata` is:

```
netcdf hgt.2002.Jun.500hPa {  
dimensions:  
    longitude = 144 ;  
    latitude = 73 ;
```

```

        time = UNLIMITED ; // (120 currently)
variables:
    float longitude(longitude) ;
        longitude:units = "degrees_east" ;
        longitude:long_name = "longitude" ;
    float latitude(latitude) ;
        latitude:units = "degrees_north" ;
        latitude:long_name = "latitude" ;
    int time(time) ;
        time:units = "hours since 1900-01-01 00:00:0.0" ;
        time:long_name = "time" ;
    short z(time, latitude, longitude) ;
        z:scale_factor = 0.217434325978148 ;
        z:add_offset = 51602.802096924 ;
        z:_FillValue = -32767s ;
        z:missing_value = -32767s ;
        z:units = "m**2 s**-2" ;
        z:long_name = "Geopotential" ;

// global attributes:
        :Conventions = "CF-1.0" ;
        :history = "2006-05-11 03:18:51 GMT by mars2netcdf-0.92" ;
}

```

**Hence:**

```

read_nc2cmp -i ncdata/hgt.2002.Jun.500hPa.nc -o j.cmp
-d "longitude,latitude,time" -u z -D 3 -r ERA40 -m 2

```

The user variable is geopotential (z) and the three basic dimensions are named longitude, latitude and time.

The dataset is ERA40 and as a test we will output the first two maps. Omit -m option to get all maps.

-D is the debug option; 3 prints the dimensions to a file called fort.10. You can omit -D option.

Note: For ERA40 geopotential, the program will divide by  $g = 9.807 \text{ m s}^{-2}$  to give geopotential height (m).

## (2) ERA40 with a level variable

The output from ncdump for hgt.200208.nc in folder ncdata is:

```
netcdf hgt.200208 {
dimensions:
    longitude = 144 ;
    latitude = 73 ;
    levelist = 23 ;
    time = UNLIMITED ; // (62 currently)
variables:
    float longitude(longitude) ;
        longitude:units = "degrees_east" ;
        longitude:long_name = "longitude" ;
    float latitude(latitude) ;
        latitude:units = "degrees_north" ;
        latitude:long_name = "latitude" ;
    int levelist(levelist) ;
        levelist:units = "millibars" ;
        levelist:long_name = "pressure_level" ;
    int time(time) ;
        time:units = "hours since 1900-01-01 00:00:0.0" ;
        time:long_name = "time" ;
    short z(time, levelist, latitude, longitude) ;
        z:scale_factor = 7.53787087081502 ;
        z:add_offset = 241940.397676004 ;
        z:_FillValue = -32767s ;
        z:missing_value = -32767s ;
        z:units = "m**2 s**-2" ;
        z:long_name = "Geopotential" ;

// global attributes:
    :Conventions = "CF-1.0" ;
    :history = "2006-05-08 06:31:19 GMT by mars2netcdf-0.92" ;
}
```

There are 23 levels. If you use ncdump -v levelist then you can see the levels:

```
levelist = 1, 2, 3, 5, 7, 10, 20, 30, 50, 70, 100, 150, 200, 250, 300, 400,
```

```
500, 600, 700, 775, 850, 925, 1000 ;
```

If you want the 500 hPa level then you require `levelist(17)`.

Hence:

```
read_nc2cmp -i ncdata/hgt.200208.nc -o j.cmp
-d "longitude,latitude,time" -u z -D 3 -r ERA40 -l levelist -L 17 -m 2
```

### (3) NCEP2 with no level variable

The output from `ncdump` for `hgt.58.0500.nc` in the current folder is:

```
netcdf hgt.58.0500 {
dimensions:
    time = 1460 ;
    lat = 73 ;
    lon = 144 ;
variables:
    double time(time) ;
        time:units = "hours since 1-1-1 00:00:0.0" ;
        time:long_name = "Time" ;
        time:actual_range = 17154744., 17163498. ;
        time:delta_t = "0000-00-00 06:00:00" ;
    float lat(lat) ;
        lat:units = "degrees_north" ;
        lat:actual_range = 90.f, -90.f ;
        lat:long_name = "Latitude" ;
    float lon(lon) ;
        lon:units = "degrees_east" ;
        lon:long_name = "Longitude" ;
        lon:actual_range = 0.f, 357.5f ;
    short hgt(time, lat, lon) ;
        hgt:long_name = "4xDaily Geopotential height" ;
        hgt:actual_range = -513.f, 32308.f ;
        hgt:valid_range = -700.f, 35000.f ;
        hgt:units = "m" ;
        hgt:add_offset = 32066.f ;
        hgt:scale_factor = 1.f ;
```

```

    hgt:missing_value = 32766s ;
    hgt:precision = 0s ;
    hgt:least_significant_digit = 0s ;
    hgt:GRIB_id = 7s ;
    hgt:GRIB_name = "HGT" ;
    hgt:var_desc = "Geopotential height\n",
    "H" ;
    hgt:dataset = "NMC Reanalysis\n",
    "L" ;
    hgt:level_desc = "Multiple levels\n",
    "F" ;
    hgt:statistic = "Individual Obs\n",
    "I" ;
    hgt:parent_stat = "Other\n",
    "-" ;
}

```

Hence:

```

read_nc2cmp -i hgt.58.0500.nc -o j.cmp -d "lon,lat,time" -u hgt
-D 2 -r NCEP2 -m 2

```

Note that the variable is called `hgt` and the dataset is `NCEP2`. The `-D` option with 2 gives some extra information. Leave out the `-m` option to give all maps.

For `NCEP2` or `NCEP` data you probably just need to change the `-u` option (and `-v` and `-U` options for variables other than geopotential height). See (4) below.

Look at the `ncdump` of the file (`ncdump -h yourfile.nc`) and check. In the above example, under `Variables`:

```

short hgt(time, lat, lon) o

```

Hence the variable is `hgt => -u hgt`

#### (4) NCEP with a level variable

The variable is specific humidity.

```

netcdf shum.2005.500 {
dimensions:
    lon = 144 ;
    lat = 73 ;
    level = 1 ;
    time = UNLIMITED ; // (1460 currently)
variables:
    float level(level) ;
        level:units = "millibar" ;
        level:actual_range = 500.f, 500.f ;
        level:long_name = "Level" ;
        level:positive = "down" ;
        level:GRIB_id = 100s ;
        level:GRIB_name = "hPa" ;
    float lat(lat) ;
        lat:units = "degrees_north" ;
        lat:actual_range = 90.f, -90.f ;
        lat:long_name = "Latitude" ;
    float lon(lon) ;
        lon:units = "degrees_east" ;
        lon:long_name = "Longitude" ;
        lon:actual_range = 0.f, 357.5f ;
    double time(time) ;
        time:units = "hours since 1-1-1 00:00:0.0" ;
        time:long_name = "Time" ;
        time:actual_range = 17566752., 17575506. ;
        time:delta_t = "0000-00-00 06:00:00" ;
    short shum(time, level, lat, lon) ;
        shum:long_name = "4xDaily specific humidity" ;
        shum:valid_range = -1.e-04f, 0.06543f ;
        shum:actual_range = 0.f, 0.009062f ;
        shum:units = "kg/kg" ;
        shum:add_offset = 0.032666f ;
        shum:scale_factor = 1.e-06f ;
        shum:missing_value = 32766s ;
        shum:precision = 6s ;
        shum:least_significant_digit = 5s ;

```



```

shum:GRIB_id = 51s ;
shum:GRIB_name = "SPFH" ;
shum:var_desc = "Specific humidity\n",
"Q" ;
shum:dataset = "NMC Reanalysis\n",
"L" ;
shum:level_desc = "Multiple levels\n",
"F" ;
shum:statistic = "Individual Obs\n",
"I" ;
shum:parent_stat = "Other\n",
"- " ;

// global attributes:
:Conventions = "COARDS" ;
:title = "4x daily NMC reanalysis (2005)" ;
:history = "Wed May 31 18:13:10 2006: /usr/local/bin/ncrcat -O -d
level,500.000000 -d lat,-90.000000,90.000000 -d lon,0.000000,357.500000 -d
time,0,1459 /Datasets/ncep.reanalysis/pressure/shum.2005.nc
/Public/www/128.250.120.93.150.18.13.8.nc\n",
"created 2005/01/03 by Hoop (netCDF2.3)" ;
:description = "Data is from NCEP initialized reanalysis\n",
"(4x/day). It consists of most variables interpolated to\n",
"pressure surfaces from model (sigma) surfaces." ;
:platform = "Model" ;
}

```

Based on the above NetCDF header dump the following command will create a concatenated (multi-map) conmap file with a useful header for each map:

```

read_nc2cmp -i shum.2005.500.nc -o j.cmp -d "lon,lat,time" -u shum -D 2
-r NCEP -m 2 -l level -L 1 -v SHUM500 -U "'kg/kg'"

```

We set the variable name in the conmap header to be SHUM500 (-v) and the units to be kg/kg (-U) (note the extra single quotes to ensure that the / is treated as text).

## (5) NCEP Mean sea level pressure

Consider the header dump of the NetCDF file slp.2004.nc i.e. `ncdump -h slp.2004.nc`

```

netcdf slp.2004 {
dimensions:
    lon = 144 ;
    lat = 73 ;
    time = UNLIMITED ; // (1464 currently)
variables:
    float lat(lat) ;
        lat:units = "degrees_north" ;
        lat:actual_range = 90.f, -90.f ;
        lat:long_name = "Latitude" ;
    float lon(lon) ;
        lon:units = "degrees_east" ;
        lon:long_name = "Longitude" ;
        lon:actual_range = 0.f, 357.5f ;
    double time(time) ;
        time:units = "hours since 1-1-1 00:00:0.0" ;
        time:long_name = "Time" ;
        time:actual_range = 17557968., 17566746. ;
        time:delta_t = "0000-00-00 06:00:00" ;
    short slp(time, lat, lon) ;
        slp:long_name = "4xDaily Sea Level Pressure" ;
        slp:valid_range = 87000.f, 115000.f ;
        slp:actual_range = 92700.f, 111370.f ;
        slp:units = "Pascals" ;
        slp:add_offset = 119765.f ;
        slp:scale_factor = 1.f ;
        slp:missing_value = 32766s ;
        slp:precision = 0s ;
        slp:least_significant_digit = -1s ;
        slp:GRIB_id = 2s ;
        slp:GRIB_name = "PRMSL" ;
        slp:var_desc = "Sea Level Pressure\n",
    "P" ;
        slp:dataset = "NMC Reanalysis\n",
    "L" ;
        slp:level_desc = "Sea Level\n",
    "I" ;
        slp:statistic = "Individual Obs\n",

```

```

    "I" ;
        slp:parent_stat = "Other\n",
    "-" ;

// global attributes:
    :Conventions = "COARDS" ;
    :title = "4x daily NMC reanalysis (2004)" ;
    :base_date = 2004s, 1s, 1s ;
    :history = "created 2004/01/03 by Hoop (netCDF2.3)" ;
    :description = "Data is from NMC initialized reanalysis\n",
"(4x/day). It consists of most variables interpolated to\n",
"pressure surfaces from model (sigma) surfaces." ;
    :platform = "Model" ;
}

```

(1) To decode maps 5-8 of this mean sea level pressure file use the following command:

```
read_nc2cmp -i slp.2004.nc -o jj.cmp -u slp -r NCEP -v PMSL -s 0.01 -M "5,8"
```

The pressure variable is named `slp` (`-u` option).

We need to scale the pressure in Pa to hPa i.e. apply a scaler of 0.01 (`-s` option).

The `-r` and `-v` options are for setting the conmap header for the cyclone tracking scheme but may be used for general purposes. The `-M` option gives the map range to be decoded i.e. maps 5-8.

The screen output during program execution is:

```

NOTE: User scaler:  0.00999999978
Output map range:  5 - 8
NetCDF file opened successfully (ncid= 3)
Inquiring about variables ...
Reading longitudes ...
Reading latitudes ...
Reading times ...
Reading attributes ...
No. of maps to be extracted:  4
Reading user variable ...

```

```

      5:PMSL                                NCEP      20040102 0000    MB
2.5x2.5DEG

      6:PMSL                                NCEP      20040102 0600    MB
2.5x2.5DEG

      7:PMSL                                NCEP      20040102 1200    MB
2.5x2.5DEG

      8:PMSL                                NCEP      20040102 1800    MB
2.5x2.5DEG

NetCDF file closed successfully (ncid= 3)

Output conmap file: jj.cmp

Finished!

```

The file `jj.cmp` contains the four decoded maps.

(2) The first 10 maps may be decoded with:

```
read_nc2cmp -i slp.2004.nc -o jj.cmp -u slp -r NCEP -v PMSL -s 0.01 -m 10
```

(3) The entire file (1464 maps) may be decoded with:

```
read_nc2cmp -i slp.2004.nc -o pmsl.2004.cmp -u slp -r NCEP -v PMSL -s 0.01
```

## Decoding GRIB data to CMP ('conmap') format

This is achieved using a combination of `wgrib` and `readgribn7`. The former was written by Wesley Ebisuzaki of NOAA and the latter by Kevin Keay.

`wgrib` produces a binary file called `dump` comprising the selected maps of the GRIB file as well as a list of the map headers (redirected to a header file). The binary file and the header file are input to `readgribn7` which then outputs the data in CMP format.

The latitude and longitude arrays need to be known to `readgribn7`. The default is for the regular 2.5 x 2.5 degree grid which suits most reanalysis products. The most notable exception is the Gaussian grid used for some of the NCEP Reanalysis variables (use the `-G` option).

Note: You should check for the file called `dump` when you have finished and delete it (the file may be quite large in some cases).

The two commands `wgrib` and `readgribn7` will be described, followed by some examples.

### **wgrib**

Documentation: <http://www.cpc.ncep.noaa.gov/products/wesley/wgrib.html>

For help: `wgrib`

Portable Grib decoder for NCEP/NCAR Reanalysis etc.

it slices, dices v1.7.3.1 (8-5-99) Wesley Ebisuzaki

usage: `wgrib [grib file] [options]`

Inventory/diagnostic-output selections

`-s/-v` short/verbose inventory  
`-V` diagnostic output (not inventory)  
(none) regular inventory

Options

`-PDS/-PDS10` print PDS in hex/decimal  
`-GDS/-GDS10` print GDS in hex/decimal  
`-verf` print forecast verification time  
`-ncep_opn/-ncep_rean` default T62 NCEP grib table  
`-4yr` print year using 4 digits

Decoding GRIB selection

`-d [record number|all]` decode record number  
`-p [byte position]` decode record at byte position  
`-i` decode controlled by stdin (inventory list)  
(none) no decoding

Options

`-text/-ieee/-grib/-bin` convert to text/ieee/grib/bin (default)  
`-nh/-h` output will have no headers/headers (default)  
`-H` output will include PDS and GDS (-bin/-ieee only)  
`-append` append to output file  
`-o [file]` output file name, 'dump' is default

Only a few of the options are commonly used. Use `-4yr` to print four digit years. Older data may only have two-digit years in the GRIB header. Also note the `-Y2K` option in `readgribn7`.

The `-d` option is useful.

To decode all maps: `-d all`

To decode a specific map number e.g. map 123 => `-d 123`

To list the map numbers and other information: `wgrib gribfile`

e.g. `wgrib test.grib >! maps.lis`

Additional information is given by the `-v` or `-V` option

e.g. `wgrib -v test.grib >! maps.lis`

The `-i` option can be used in conjunction with `grep` or `egrep` to select a set of maps. In this case we have `wgrib ... | grep ... | wgrib` i.e. `wgrib` is used twice with `grep` or `egrep` acting as a pipe. You can even have multiple instances of `grep`

e.g. `... | grep ... | grep ... | ...`

## **readgribn7**

The program is primarily designed for the reanalysis products. If you have a custom grid e.g. a regional model product, then use the `-o` option to specify the grid. The default grid is the regular 2.5 x 2.5 degree grid. Use the `-G` option for NCEP or NCEP2 Gaussian grid data.

For help: `readgribn7`

Usage: `readgribn [-g gaussfile]`

`[-n nceptfile][--deflGNU][--c cid] [--cyc][--ncep2][--Y2K] -h hdr`

Note: For a Gaussian grid either `-g` or `-G` must be

specified (default: 2.5x2.5 deg. grid)

Options:

`-c cid`: Output file is: `cid.yy[yy]mddhh.cmp`

`-d`: Debug

`-e`: Extra information in conmap header (ignored if `-cyc` specified)

`-f`: Output file is: `dump.yy[yy]mddhh.cmp`

(useful if renaming is required later)

`-g gaussfile`: Gaussian grid is specified in file `gaussfile`

`-h hdr`: `wgrib` output corresponding to `wgrib` extracted binary file 'dump'

`-l`: Output filename is lowercase (default: mixed)

`-n nceptfile`: Use descriptions specified in file `nceptfile`

`-G`: Gaussian grid is specified in file: `/home/kevin/grib/gaussgrid.dat`

`-N`: Use descriptions specified in file:  
`/home/kevin/grib/reanal_ncep.table.txt`

`-O "latinc,loninc,lat1,lat2,lon1,lon2"` : user general lon-lat grid

`-U "lat1,lat2,lon1,lon2"` : user grid (subset of  
regular 2.5x2.5 deg. grid only)

```
-cyc: Output conmap header compatible with cyclone tracking scheme
-era40: Output conmap header for ERA40 (default: NCEP)
-ncep2: Output conmap header for NCEP2 (default: NCEP)
-Y2K: If 2 digit year is in range 00-20 assumes
      4 digit year of form 20?? (default: year is 19??)
```

## Some examples

### (1) NCEP MSLP data

```
wgrib -d all msl.200201.grib >! hdr
readgribn7 -h hdr -l
```

### (2) Gaussian surface data

```
wgrib -d all icec.grib
readgribn7 -G -h hdr.ICEC.sfc
```

### (3) Example using record numbers and NCEP2

```
wgrib -d 123 msl.1979010106.grib >! hdr
readgribn7 -h hdr -ncep2
(output file: PRES.ncep2.79010106.cmp)
(if -l given: pres.ncep2.79010106.cmp)
```

### (4) ... and for the cyclone tracking scheme

```
readgribn7 -h hdr -ncep2 -cyc
(output file: PMSL.ncep2.79010106.cmp)
(note PMSL instead of PRES)
```

### (5) Example using `wgrib -i` and a multiple record grib file

```
wgrib uv.grib | wgrib -i uv.grib >! hdr.uv
readgribn7 -h hdr.uv -ncep2
```

(this will produce a series of CMP files)

## (6) NCEP MSLP data

```
wgrib flx.lola.grib.mean.clim.y58-97 | grep PRES | \  
grep MSL | grep 58010100 | wgrib -i flx.lola.grib.mean.clim.y58-97 >! hdr  
readgribn7 -h hdr
```

Note: \ at the end of a line means that the next line is a continuation of the command.

## Converting GRIB data to NetCDF format

This may be accomplished with the program `xconv`.

The documentation is available from: <http://www.met.rdg.ac.uk/~jeff/xconv/>

Type: `xconv`

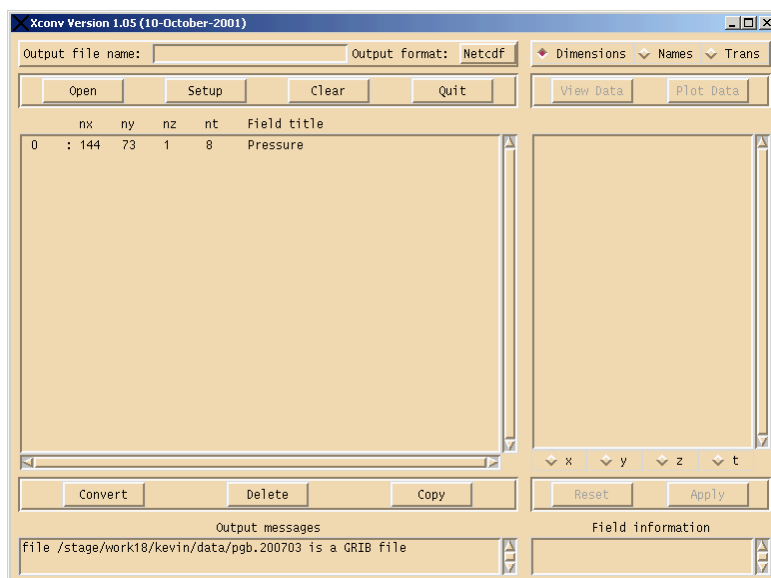
and a graphical interface will appear. Select the desired GRIB file. After it has been read, double-click on (highlight) the variables that you want to output. Finally, specify an output filename and ensure that 'Output format' is set to NetCDF.

In this example we will convert the GRIB file `pgb.200703` to NetCDF.

Type: `xconv`

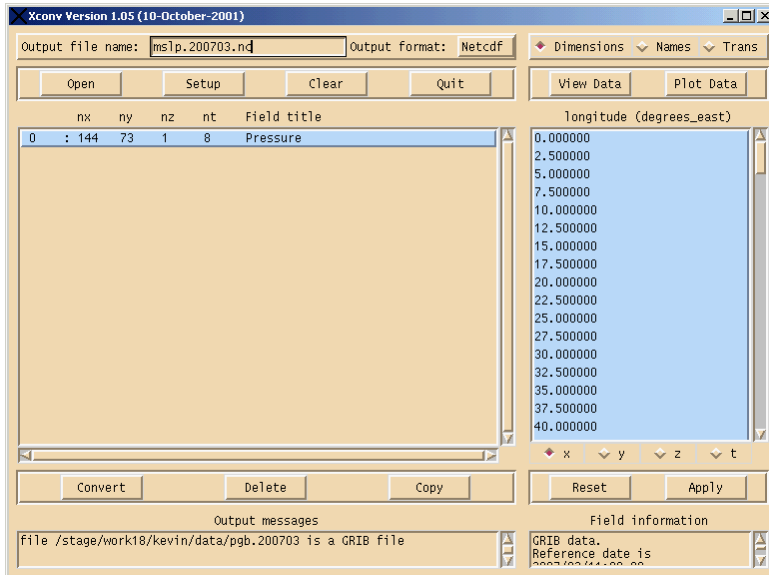
Click the Open button. Select: `pgb.200703` and click Load.

After the file has been loaded, click Dismiss (after loading, a message appears in the 'Output messages' box).





Now double-click the entry for Pressure. The entry will be highlighted, plus there will be information about the dimensions in the right pane and in the ‘Field information’ box. Then give: mslp.200703.nc as the output file name. The output format should be set to NetCDF by default.



Finally, click on Convert. Some messages will appear in at least the ‘Output messages’ box. Then click Quit.

The NetCDF file mslp.200703.nc is now available for reading into suitable software e.g. GrADS.