Installing WRF & WPS

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Installing Steps

- *Check system requirements*
- Installing Libraries
- Download source data
- Download datasets
- Compile WRFV3
- Compile WPS

Check System Requirements

- For the lab session, it is mandatory to have a Fortran (GNU) compiler on the system (Version 4.4.0, or later).

  Check this by typing

  (for csh):

  ```
  gcc --version
  ```

- Download test tar file, unpack tar file, and run tests to determine that the Fortran compiler is built correctly, and is compatible with the C compiler

http://www.mmm.ucar.edu/wrf/users/prepare_for_compilation.html

To verify that the Fortran compiler is built properly, and that it is compatible with the C compiler, there are a few simple tests that should be run. Download this tar file, which contains the tests. Once the tar file is unpacked, there will be 8 tests available. The directions for issuing these tests are below.

1. **Fixed Format Fortran: Test: TEST_1_fortran_only_fixed.f**
   Type the following in the command line:
   gfortran TEST_1_fortran_only_fixed.f
   and then issue:
   a.out
   The following should print out to the screen:
   SUCCESS test 1 fortran only fixed format

2. **Free Format Fortran: TEST_2_fortran_only_free.f90**
   Type the following in the command line:
   gfortran TEST_2_fortran_only_free.f90
   and then issue:
   a.out
   The following should print out to the screen:
   Assume Fortran 2003: has FLUSH, ALLOCATABLE, derived type, and ISO C Binding
   SUCCESS test 2 fortran only free format

3. **C: TEST_3_c_only.c**
   Type the following in the command line:
   gcc TEST_3_c_only.c
   and then issue:
   a.out
   The following should print out to the screen:
   SUCCESS test 3 C only

4. **Fortran Calling a C Function (our gcc and gfortran have different defaults, so we force both to always use 64 bit [-m64] when combining them): TEST_4_fortran+c_c.c, *and* TEST_4_fortran+x_f.f90**
   Type the following in the command line:
   gcc -c -m64 TEST_4_fortran+c_c.c
   and then:
   gfortran -c -m64 TEST_4_fortran+c_f.f90
   and then:
   gfortran -m64 TEST_4_fortran+c_f.o TEST_4_fortran+c_c.o
   and then issue:
   a.out
   The following should print out to the screen:
   C function called by Fortran
   Values are xx = 2.00 and ii = 1
   SUCCESS test 4 fortran calling c

Additional Necessary Requirements

- Scripting languages:
  - csh
  - perl
  - sh

- UNIX commands:

ar	head	sed	awk
hostname	sleep	cat	ln
sort	cd	ls	tar
cp	make	touch	cut
mkdir	tr	expr	mv
uname	file	nm	wc
grep	printf	which	gzip
rm			

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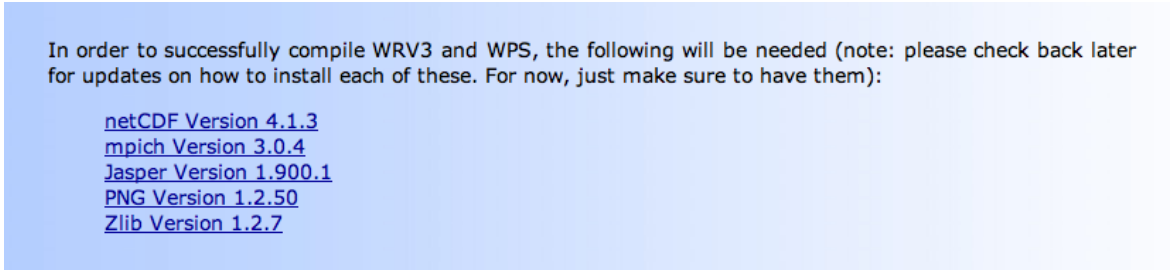
Installing Libraries

- Download tar files:
  - http://www.mmm.ucar.edu/wrf/users/prepare_for_compilation.html


In order to successfully compile WRV3 and WPS, the following will be needed (note: please check back later for updates on how to install each of these. For now, just make sure to have them):

netCDF Version 4.1.3
mpich Version 3.0.4
Jasper Version 1.900.1
PNG Version 1.2.50
Zlib Version 1.2.7

- NetCDF (needed by WRF and WPS)
- Optional libraries for GRIB2 met data support
  - JasPer (JPEG 2000 "lossy" compression library)
  - PNG ("lossless" compression library)
  - Zlib (compression library used by PNG)
- Optional MPI library:
  - MPICH2

Installing Libraries

- Installation of these libraries (MPICH2, NetCDF, JasPer, zlib, and libpng) is NOT part of the WPS and WRF installation scripts
- VERY IMPORTANT!
  - Make sure these libraries are installed using the same compilers as will be used to install WRF and WPS
- The installation process of these libraries will be covered in Friday's lab session!

Installing Libraries: MPICH2

- In principle, any implementation of the MPI-2 standard should work with WRF; however, we have the most experience with MPICH

```
setenv DIR directory-where-your-tar-files-are
setenv CC gcc
setenv CXX g++
setenv FC gfortran
setenv FCFLAGS -m64      # FCFLAGS may be needed on some systems
setenv F77 gfortran
setenv FFLAGS -m64       # FFLAGS may be needed on some systems

tar xzvf mpich-3.0.4.tar.gz   # no '.gz' if downloaded to most Macs
cd mpich-3.0.4
./configure --prefix=$DIR/mpich
make
make install
setenv PATH $DIR/mpich/bin:$PATH
cd ..
```

Installing Libraries: NetCDF

- *(Assuming environment variables from MPICH install are already set)*

```
tar xzvf netcdf-4.1.3.tar.gz       # no '.gz' if downloaded to most Macs
cd netcdf-4.1.3
./configure --prefix=$DIR/netcdf --disable-dap  --disable-netcdf-4 --
disable-shared
make
make install
setenv PATH $DIR/netcdf/bin:$PATH
setenv NETCDF $DIR/netcdf
cd ..
```

Installing Libraries: zlib

- *(Assuming environment variables from MPICH install are already set)*

```
tar xzvf zlib-1.2.7.tar.gz          # no '.gz' if downloaded to most Macs
cd zlib-1.2.7
./configure --prefix=$DIR/zlib
make
make install
cd ..
```

Installing Libraries: libpng

- *(Assuming environment variables from MPICH install are already set)*

```
tar xzvf libpng-1.2.50.tar.gz      # no '.gz' if downloaded to most Macs
cd libpng-1.2.50
./configure --prefix=$DIR/libpng
make
make install
cd ..
```

Installing Libraries: JasPer

- *(Assuming environment variables from MPICH install are already set)*

```
tar xzvf jasper-1.900.1.tar.gz     # no '.gz' if downloaded to most Macs
cd jasper-1.900.1
./configure --prefix=$DIR/jasper
make
make install
cd ..
```

Installing Steps

- Check system requirements
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- *Download source data*
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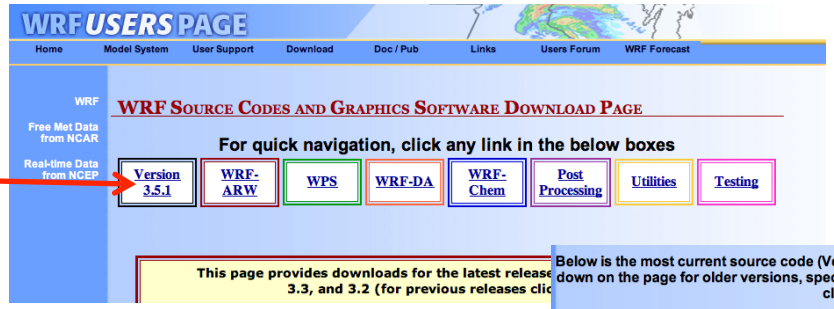
Download WRF & WPS Code

- Download WRF & WPS source code from:

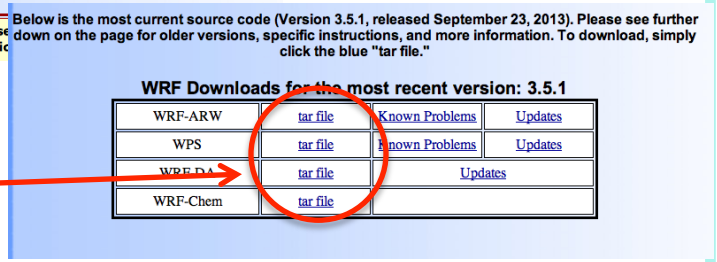
  http://www2.mmm.ucar.edu/wrf/users/download/get_source.html

  – Click 'New User,' register and download, or
  – Click 'Returning User,' enter your email, and download

Step 1:
Click here for the latest released code (recommended)

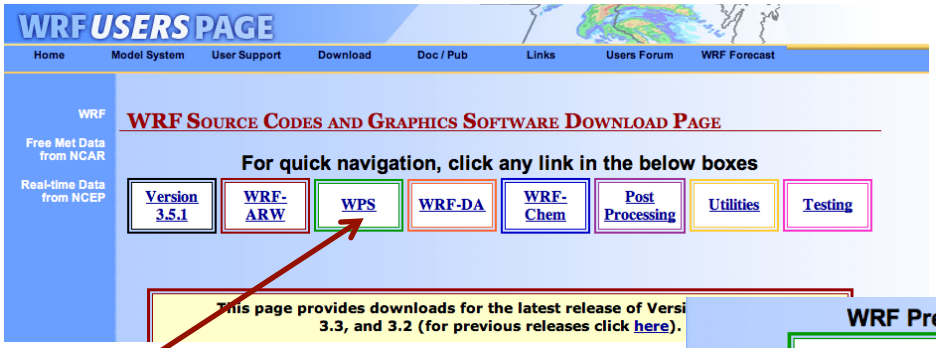


Step 2:
Click on tar files to download



Download Static Geographical Data

- From the WRF Download page: http://www.mmm.ucar.edu/wrf/users/download/get_sources.html



Step 1: Click 'WPS' box

Step 2: Click 'here' to get geography data

WRF Preprocessing System (WPS) Code Downloads

Version 3.5.1	September 23, 2013	tar file
Version 3.5	April 18, 2013	tar file
Version 3.4.1	August 16, 2012	tar file
Version 3.4 (Updated)	June 5, 2012	tar file
Version 3.4	April 6, 2012	tar file
Version 3.3.1	September 22, 2011	tar file
Version 3.3	April 6, 2011	tar file
Version 3.2.1	August 18, 2010	tar file
Version 3.2	April 2, 2010	tar file

****IMPORTANT: Before running WPS, you will need to download the WPS Geography data, which you can find here.**
(Terrain and landuse data for all resolutions has been updated since the release of Version 3.5.1. The corrections are specific to the poles and International Dateline)

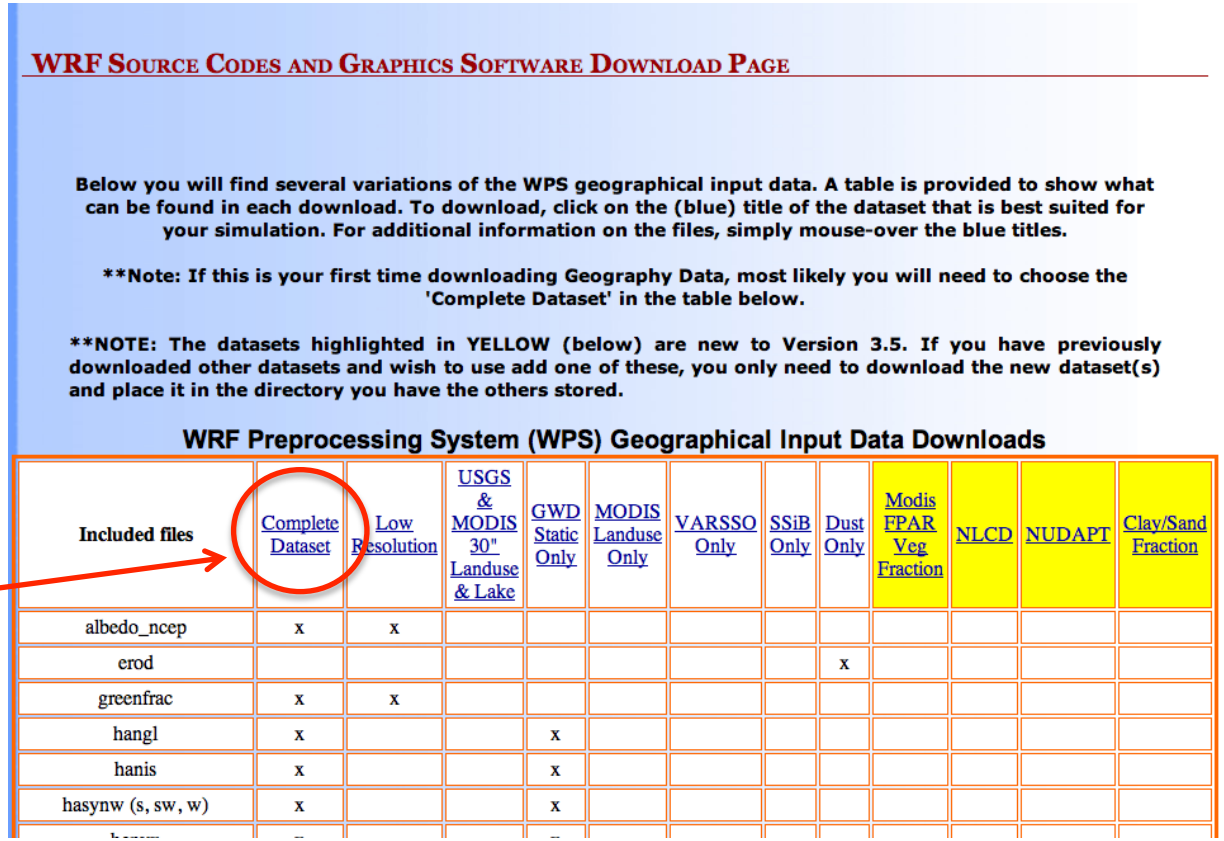
Download Static Geographical Data

- Geographical Input and Data Download Page:

http://www.mmm.ucar.edu/wrf/users/download/get_sources_wps_geog.html

geog.tar.gz
~ 15 GB when uncompressed

This is the one you want



WRF Source Codes and Graphics Software Download Page

Below you will find several variations of the WPS geographical input data. A table is provided to show what can be found in each download. To download, click on the (blue) title of the dataset that is best suited for your simulation. For additional information on the files, simply mouse-over the blue titles.

****Note: If this is your first time downloading Geography Data, most likely you will need to choose the 'Complete Dataset' in the table below.**

****NOTE: The datasets highlighted in YELLOW (below) are new to Version 3.5. If you have previously downloaded other datasets and wish to use add one of these, you only need to download the new dataset(s) and place it in the directory you have the others stored.**

WRF Preprocessing System (WPS) Geographical Input Data Downloads

Included files	Complete Dataset	Low Resolution	USGS & MODIS 30" Landuse & Lake	GWD Static Only	MODIS Landuse Only	VARSSO Only	SSiB Only	Dust Only	Modis FPAR Veg Fraction	NLCD	NUDAPT	Clay/Sand Fraction
albedo_ncep	x	x										
erod								x				
greenfrac	x	x										
hangl	x			x								
hanis	x			x								
hasynw (s, sw, w)	x			x								

Directory Structure

- You should have all tar files needed for building WRF & WPS

- Your directory structure should be something like:

  *Path_to_directory/*Build_WRF> ls -1

WPSV3.5.1.TAR.gz	(WPS source code)
WRFV3.5.1.TAR.gz	(WRF source code)
geog.tar.gz	(WPS geography static data)
jasper-1.900.1.tar.gz	(WPS compression lib)
libpng-1.2.50.tar.gz	(WPS compression lib)
mpich-3.0.4.tar.gz	(distributed memory run-time lib)
netcdf-4.1.3.tar.gz	(I/O lib for WRF and WPS)
zlib-1.2.7.tar.gz	(WPS compression lib)

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- *Download datasets*
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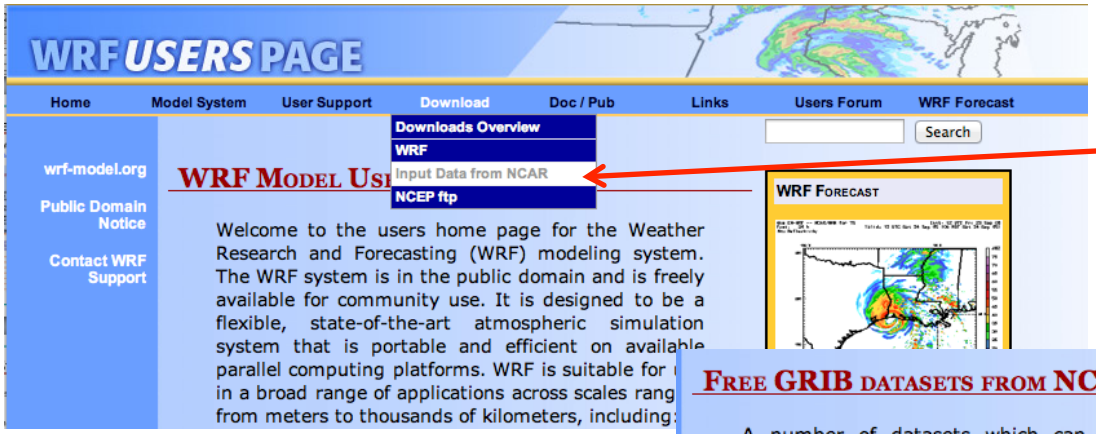
Download Datasets

- From the WRF Users' page: http://www.mmm.ucar.edu/wrf/users/



Step 1: Click Download, then scroll down and click 'Input Data from NCAR'

Step 2: Click the dataset you wish to use (for this example, we will use 'FNL from GFS')

Free GRIB datasets from NCAR/DSS

A number of datasets which can be used as input to WPS can now be downloaded directly from the NCAR/CISL web site:

- You must register with a user name and password to access the data
- Only a limited number of datasets are available online
- Click on the 'Data Access' tab once on the page
- The data is free for all users to download

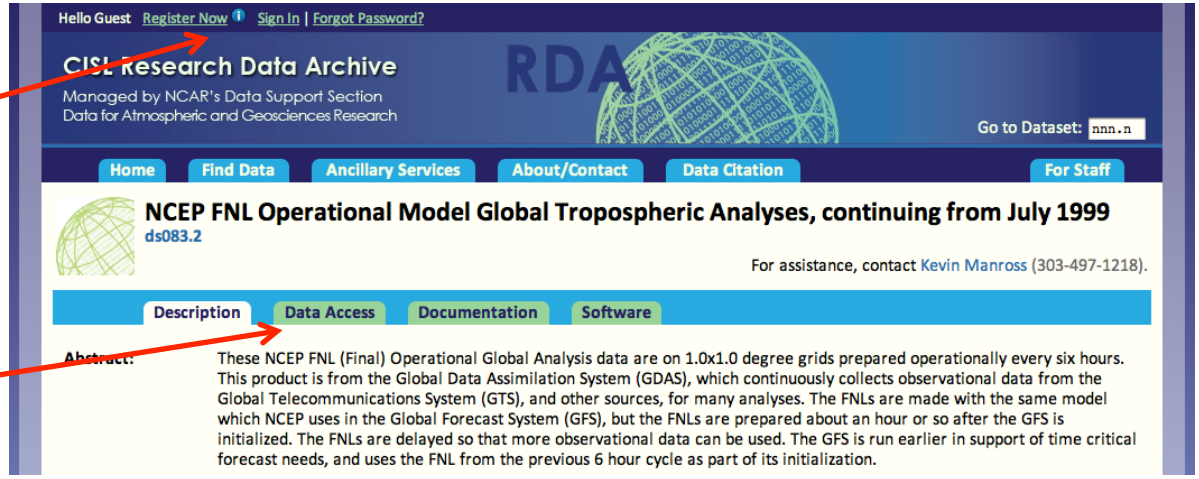
Available GRIB datasets: *(for input to WPS)*

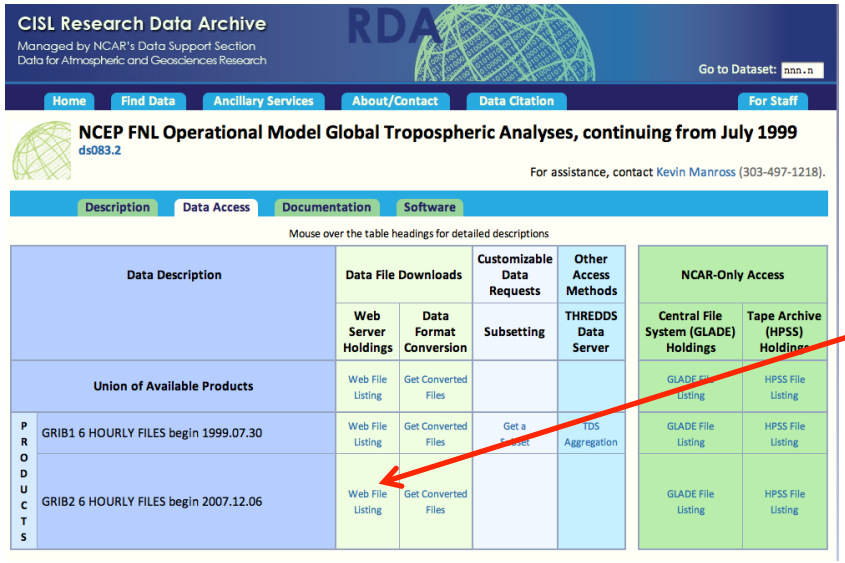
- NCEP Final Analysis (FNL from GFS) (ds083.2): 1 degree resolution, every 6 hours
  - http://rda.ucar.edu/datasets/ds083.2/
- NCEP/NCAR Reanalysis (ds090.0): 2.5 degree resolution, every 6 hours
  - http://rda.ucar.edu/datasets/ds090.0/
- NCEP GRIB GDAS (ds083.0): 2.5 degree resolution, every 12 hours. - you may be able to use it if your entire domain stays in one hemisphere.
  - http://rda.ucar.edu/datasets/ds083.0/
- NCEP Eta/NAM (ds609.2): 40 km resolution, every 6 hours.
  - http://rda.ucar.edu/datasets/ds609.2/

Download Datasets (continued)

Step 3: Register, or sign in, if you already have an account

Step 4: Click 'Data Access'

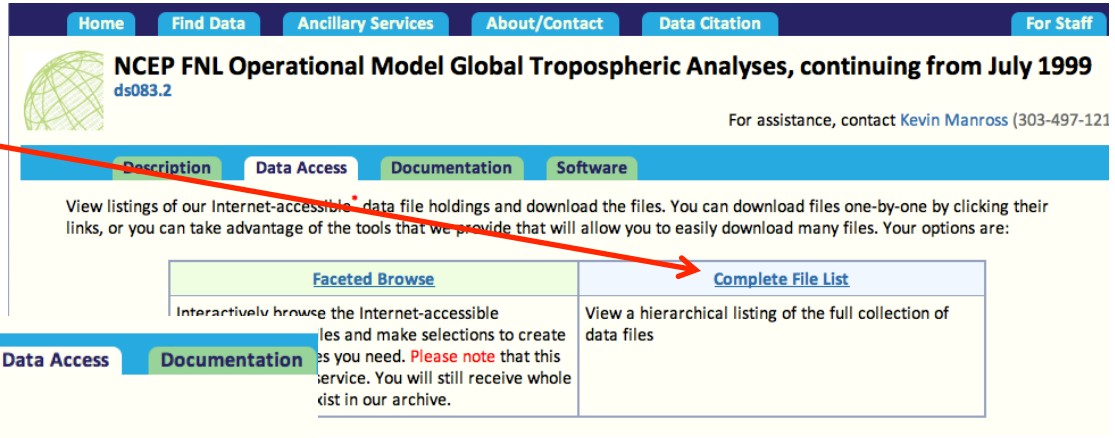


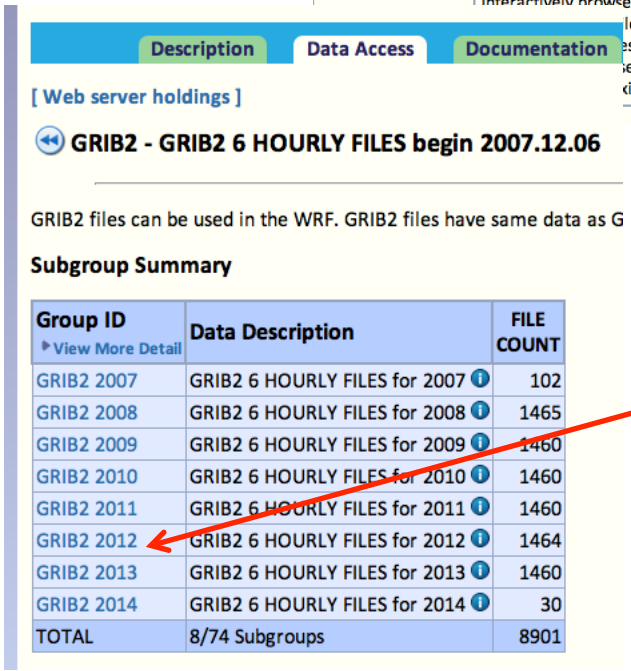


Step 5: Click 'Web File Listing' for the span of years you need

Download Datasets (continued)

Step 6: Click 'Complete File List'

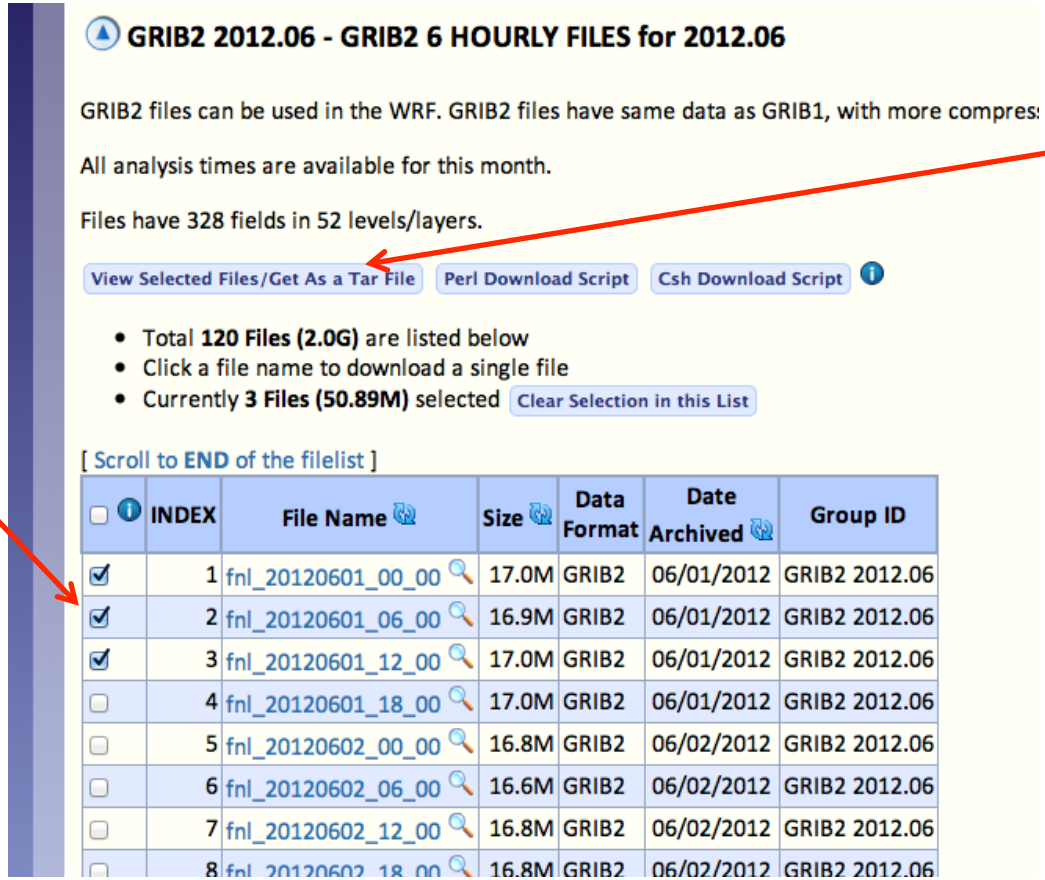




Step 7: Click the year you need. After this, You will click the month you need (not shown)

Download Datasets (continued)

Step 8: Click a box for each time span that you need



GRIB2 2012.06 - GRIB2 6 HOURLY FILES for 2012.06

GRIB2 files can be used in the WRF. GRIB2 files have same data as GRIB1, with more compres

All analysis times are available for this month.

Files have 328 fields in 52 levels/layers.

View Selected Files/Get As a Tar File | Perl Download Script | Csh Download Script

- Total **120 Files (2.0G)** are listed below
- Click a file name to download a single file
- Currently **3 Files (50.89M)** selected Clear Selection in this List

[Scroll to **END** of the filelist]

	INDEX	File Name	Size	Data Format	Date Archived	Group ID
☑	1	fnl_20120601_00_00	17.0M	GRIB2	06/01/2012	GRIB2 2012.06
☑	2	fnl_20120601_06_00	16.9M	GRIB2	06/01/2012	GRIB2 2012.06
☑	3	fnl_20120601_12_00	17.0M	GRIB2	06/01/2012	GRIB2 2012.06
☐	4	fnl_20120601_18_00	17.0M	GRIB2	06/01/2012	GRIB2 2012.06
☐	5	fnl_20120602_00_00	16.8M	GRIB2	06/02/2012	GRIB2 2012.06
☐	6	fnl_20120602_06_00	16.6M	GRIB2	06/02/2012	GRIB2 2012.06
☐	7	fnl_20120602_12_00	16.8M	GRIB2	06/02/2012	GRIB2 2012.06
☐	8	fnl_20120602_18_00	16.8M	GRIB2	06/02/2012	GRIB2 2012.06

Step 9: Once you have chosen All your times, click on the 'View Selected Files/Get As a Tar File' button To download one tar file with all your Dates/times

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- *Compile WRFV3*
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Before Compiling

- Check where your netCDF library and include file are. If it is not in the usual location (i.e., */usr/local/netcdf),* then use the NETCDF environment variable to set the path. e.g., for a C-shell environment:

```
setenv NETCDF /where-netcdf-is
```

- Unpack your remaining tar files:

You should now have the following directories:

```
gunzip WPSV3.5.1.TAR.gz
tar -xf WPSV3.5.1.TAR  ------------->   WPS

gunzip WRFV3.5.1.TAR.gz
tar -xf WRFV3.5.1.TAR  ------------->   WRFV3

gunzip geog.tar.gz
tar -xf geog.tar  ------------------->  WPS_GEOG
```

*Useful Tip:
Create another directory inside here, called 'TAR_FILES' and place all the tar files in there to keep things organized.

Compile WRFV3

- It is important to compile WRFV3 **first**, before WPS
  - WPS makes use of the external I/O libraries in the *WRFV3/external* directory
  - The libraries are built when WRF is installed

- Two steps to compiling:

  1) Create a configuration file for your computer and compiler

  ```
  ./configure
  ```

  2) Compile the code

  ```
  ./compile test_case >& log.compile
  ```

Step 1: Configure for WRFV3

- Inside the WRFV3/ directory, type: **`./configure`**

```
checking for perl5... no
checking for perl... found /usr/bin/perl (perl)
Will use NETCDF in dir: /usr/local/netcdf
PHDF5 not set in environment. Will configure WRF for use without.
configure:  WRF operating system set to "Linux" via environment variable $WRF_OS
configure:  WRF machine set to "i686" via environment variable $WRF_MACH
$JASPERLIB or $JASPERINC not found in environment, configuring to build without grib2 I/
    O...
------------------------------------------------------------------------
Please select from among the following supported platforms.

  1.  Linux i486 i586 i686, gfortran compiler with gcc  (serial)
  2.  Linux i486 i586 i686, gfortran compiler with gcc  (smpar)
  3.  Linux i486 i586 i686, gfortran compiler with gcc  (dmpar)
  4.  Linux i486 i586 i686, gfortran compiler with gcc  (dm+sm)
  5.  Linux i486 i586 i686, g95 compiler with gcc  (serial)
  6.  Linux i486 i586 i686, g95 compiler with gcc  (dmpar)
  7.  Linux i486 i586 i686, PGI compiler with gcc  (serial)
  8.  Linux i486 i586 i686, PGI compiler with gcc  (smpar)
  9.  Linux i486 i586 i686, PGI compiler with gcc  (dmpar)
  10.  Linux i486 i586 i686, PGI compiler with gcc  (dm+sm)
  11.  Linux x86_64 i486 i586 i686, ifort compiler with icc  (serial)
  12.  Linux x86_64 i486 i586 i686, ifort compiler with icc  (smpar)
  13.  Linux x86_64 i486 i586 i686, ifort compiler with icc  (dmpar)
  14.  Linux x86_64 i486 i586 i686, ifort compiler with icc  (dm+sm)

Enter selection [1-16] :

Compile for nesting? (1=basic, 2=present moves, 3=vortex following) [default 1]:
```

- Output from configuration: a file called ‘configure.wrf’

Step 2: Compile WRFV3

- In the WRFV3/ directory, type:

  `./compile em_case >& log.compile`

Important in case there are compile problems

Where **`em_case`** is one of the following
(type **`./compile`** to see all options)

`em_real` (3d real case)

3d Ideal:
- `em_quarter_ss`
- `em_b_wave`
- `em_les`
- `em_heldsuarez`
- `em_tropical_cyclone`

2d Ideal:
- `em_hill2d_x`
- `em_squall2d_x`
- `em_squall2d_y`
- `em_grav2d_x`
- `em_seabreeze2d_x`

`em_scm_xy` (1d ideal)

- Compilation should take about 20-30 mins

Successful Compilation

- If the compilation is successful, you should find these executables in **`WRFV3/main`** (non-zero size):

  Real data case:

  `wrf.exe` – model executable

  `real.exe` – real data initialization

  `ndown.exe` – one-way nesting

  `tc.exe` – for tc bogusing (serial only)

  Ideal case:

  `wrf.exe` – model executable

  `ideal.exe` – ideal case initialization

  ***Note: Each ideal case compile creates a different executable, but with the same name**

- These executables are linked to 2 different directories (**`WRFV3/run`** and **`WRFV3/test/em_real`**). You can go to either place to run WRF.

Important Error Message

- If you do not have the executables, and you look in the log.compile file and find this error:

  / Copyright (C) 1991-2013 Free Software Foundation, Inc.*

  1

  Error: Non-numeric character in statement label at (1)

  fail.f:1.2:

- This is an error involving your version of CPP. We have created a fix for that, so come talk to us (or email us at wrfhelp@ucar.edu), and we will help you correct the problem.

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- *Compile WPS*

Compile WPS

- Once WRFV3 is successfully compiled, change directory to WPS prior to compiling

```
cd ../WPS
```

- Two steps to compiling WPS, as well:

  1) Create a configuration file for your computer

```
./configure
```

  2) Compile the code

```
./compile >& log.compile
```

Step 1: Configure for WPS

- Inside the WPS/ directory, type: **`./configure`**

```
Will use NETCDF in dir: /usr/local/netcdf-pgi
$JASPERLIB or $JASPERINC not found in environment. Using /usr/local for library paths...
------------------------------------------------------------------------
Please select from among the following supported platforms.
   1.  Linux i486 i586 i686, PGI compiler     (serial)
   2.  Linux i486 i586 i686, PGI compiler     (serial_NO_GRIB2)
   3.  Linux i486 i586 i686, PGI compiler     (dmpar)
   4.  Linux i486 i586 i686, PGI compiler     (dmpar_NO_GRIB2)
   5.  Linux i486 i586 i686, Intel compiler     (serial)
   6.  Linux i486 i586 i686, Intel compiler     (serial_NO_GRIB2)
   7.  Linux i486 i586 i686, Intel compiler     (dmpar)
   8.  Linux i486 i586 i686, Intel compiler     (dmpar_NO_GRIB2)
   9.  Linux i486 i586 i686, g95    (serial)
  10.  Linux i486 i586 i686, g95    (serial_NO_GRIB2)
  11.  Linux i486 i586 i686, g95    (dmpar)
  12.  Linux i486 i586 i686, g95    (dmpar_NO_GRIB2)
  13.  Linux i486 i586 i686, gfortran     (serial)
  14.  Linux i486 i586 i686, gfortran    (serial_NO_GRIB2)
  15.  Linux i486 i586 i686, gfortran    (dmpar)
  16.  Linux i486 i586 i686, gfortran    (dmpar_NO_GRIB2)
Enter selection [1-16] :
```

- Choose to compile WPS **serially** (even if you compiled WRFV3 in parallel), unless you plan to use very large domains

  *NOTE: If you compile WPS in parallel, ungrib.exe must still be run serially

- Output from configuration: a file called 'configure.wps'

Step 2: Compile WPS

- In the WPS/ directory, type:

```
./compile >& log.compile
```

- Compilation should only take a few minutes

- If successful, these executables should be in your WPS/ directory (and they are linked, respectively, from their source code directories):

```
geogrid.exe -> geogrid/src/geogrid.exe
ungrib.exe -> ungrib/src/ungrib.exe
metgrid.exe -> metgrid/src/metgrid.exe
```

./clean -a

- The ‘./clean –a’ command is something that should be used when you have made corrections to your configure.wrf file, configure.wps file, or any changes to the registry. If you have made any of these changes, or if you plan to recompile your code from scratch, you must issue a ‘clean –a’ before recompiling.

- If you made any changes to any subroutines within the code, you will need to recompile your code, but you do NOT need to issue the ‘clean –a’ command, nor do you need to reconfigure. You will simply just recompile. This compilation should take a lot less time than a clean compile.

Questions?