WRF Essentials

Corey M. Trujillo
corey.trujillo@colorado.edu

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1 Prerequisites

You should be comfortable working on Prospero and should know what WRF is. This tutorial gives step by step instructions on how to run WRF, but does not go into details about WRF - see the WRF user site for that: `http://www2.mmm.ucar.edu/wrf/users/`.

If you are already familiar with running WRF on Prospero, see Section 2 for a brief overview of the necessary commands.

2 Downloading WRF

Starting with version 4, WRF can be downloaded with git. Make sure you get both WRF and WPS:

```
git clone https://github.com/wrf-model/WRF
```

```
git clone https://github.com/wrf-model/WPS
```

Previous versions are also available on the WRF User's site: `http://www2.mmm.ucar.edu/wrf/users/`.

3 Compiling WRF

It's good practice to start with a clean before compiling

```
./clean -a
```

```
./configure
```

This will give you a menu of options. Select option 15 (ifort compiler with icc (dmpar)). Select the basic nesting option (1) and if all goes well, you should be ready to compile:

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

The `em_real` indicates the use of real physics (as opposed to ideal) and `>& compile.log&` sends the process to the background and puts the output in a file called `compile.log`.

You can check out the status of the job by running `tail -f compile.log`.

If all goes well, you should have three executables in the `main/` directory: `ndown.exe`, `real.exe` and `wrf.exe`.

There have been problems compiling on the compute nodes and on multiple cores. If you are missing `real.exe` and/or get an error in your log file that looks something like this:

```
real_em.f90(12): error #7002: Error in opening the compiled module file.
Check INLUDE paths.
```

try compiling on only one core with the `-j 1` flag, or try compiling on the head node.

4 Compiling WPS

Start by configuring WPS. Check the `configure.wps` file to make sure the `WRF_DIR` variable is set to the proper WRF directory. If it's not, you may need to change the `WRF_DIR` variable in `arch/preamble`.

```
cd ../WPS
```

```
./configure
```

Select option 19: Intel Compiler (dmpar)

```
./compile
```

If all goes well, you should have `geogrid.exe`, `ungrib.exe`, and `metgrid.exe` all linked in the WPS directory. If you're missing one or more of the executables, try compiling on one

core on the head node.

5 Geogrid

5.1 Data

Datasets for WPS versions 3 and 4 is already on Prospero in directories `/met1/WRF/DATA/geogv3/` and `/met1/WRF/DATA/geog/`, respectively.

If you are operating on another cluster or need to download these data, see the WRF user's site.

5.2 Running Geogrid

Edit the `namelist.wps` file so that `geog_data_path = '/met1/WRF/DATA/geog/'` for version 4. Then run geogrid:

```
ncl util/plotgrids_new.ncl
```

Ensure domain looks right.

```
./geogrid.exe
```

The output should read "Successful completion of geogrid" if all goes well when it finishes and you should have a file called `geo_em.d*.nc` for each domain.

6 Ungrib

6.1 Data

Before running ungrib, you need to make sure that you have all the data you need and that you link the proper variable table.

6.1.1 Obtaining Data

Meteorological data are available from a variety of sources to be used with WRF via WPS. See the `/met1/WRF/DATA` directory on Prospero for what is already downloaded there.

To obtain data from NCAR Research Data Archive (`https://rda.ucar.edu/`), create an account, then navigate to the data you want. The site offers an option to use a `.csh` script to download the data, which is especially useful when downloading to Prospero. Copy the automatically generated text into a `.csh` file on Prospero and run it:

```
./download.csh <password>
```

where `download.csh` is the name of the file and you pass your password as an argument. Use a backslash before special characters if your password won't go through.

NCEP North American Mesoscale data are used by Pablo Saide's group and can be obtained at `https://rda.ucar.edu/datasets/ds609.0/index.html#!description`.

6.1.2 Linking the Data

Now you need to link the data into the `WPS/` directory.

```
./link_grib.csh /met1/WRF/DATA/NAM/201308
```

You can change the file location and name as needed. It is also important to link the actual files, not just the directory, although you don't need an asterisk at the end, just give the common portion of the file name. After this command, you should have a GRIB file for each time step of your data.

6.1.3 Linking Vtable

Now you need to link the correct Variable Table (Vtable)

```
ln -sf ungrib/Variable_Tables/Vtable.NAM Vtable
```

You should now have a link in your `WPS/` directory to the appropriate Vtable called `Vtable`.

6.1.4 Executable

Now execute ungrib with

```
./ungrib.exe
```

The output should say "Successful Completion of Ungrib" if all goes well and you should have files named `FILE:<Date and Time>` for each time step. These are intermediate files that will be used by metgrid to produce the meteorological files.

6.2 Metgrid

Now run metgrid

```
./metgrid.exe
```

This should leave you with `met_em.d*` files. These are the meteorological input files for WRF.

7 Running WRF

Go to the directory where you want to run. Usually `WRF/test/em_real` or `WRF/run` and the executables you need should already be linked there.

```
cd ../WRF/test/em_real
```

Link the metgrid files with

```
ln -sf ../../../WPS/met_em.d01.2013-08-2* .
```

Change the path as necessary. Ensure that the namelist.input file is correct.

7.1 Interactive Runs

You need to run WRF on a compute node. If the job is sufficiently short, you may want to run an interactive job:

```
qsub -IVX -l nodes=1:ppn=24
```

```
./real.exe&
```

Check `rsl.out.0000` and `rsl.error.0000` files for errors. If all goes well, `SUCCESS COMPLETE REAL_EM IN` will appear at the end of the rsl files.

Then run the WRF executable you

```
mpirun ./wrf.exe&
```

Follow outputs and errors with

```
tail -f rsl.error.0000
```

If all goes well, you should be left with a series of `wrfout` files which contain your outputs.

7.2 Queued Job

If you expect the job to take a long time, you will likely want to send the job to the queue. The following script can be used to run WRF from the queue.

```
#!/bin/sh
#PBS -l nodes=1:ppn=24
#PBS -m abe -M corey.trujillo@colorado.edu
#PBS -W umask=007
#PBS -V
#PBS -q default

# Change run directory location!!
cd $PBS_O_WORKDIR

# Run GEOS-Chem
date > log
pwd >> log
./real.exe >> log
date >> log
mpirun -np 24 -f $PBS_NODEFILE ./wrf.exe >> log
date >> log
grep '' log
exit 0
```

This script will ask for a job in the default queue (`-q`) with 24 cores on 1 node (`-l`), email me when it starts, finishes, or if there is an error (`-m`), assign permissions (`-W`), forward variables

(-V), change to the proper directory, then run `real.exe` and `wrf.exe`. This script can be stored in a single location then called from the directory you want to run WRf. For example, you could store it in `~/bin` and run it from your WRF run directory:

```
qsub ~/bin/RunWRF.sh -N WRFv4
```

where `-N` allows you to name the job. This way you don't have to alter the script for every job.

8 Quick and Dirty

This section gives only the necessary commands to compile WRF without explanation.

```
cd WRF/

./clean -a

./configure
```

Select option 15

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

cd ../WPS/

./configure
```

Select option 19

```
./compile
```

Check `namelist.wps`

```
ncl utils/plotgrids_new.ncl

./geogrid.exe

./link_grib.csh /met1/WRF/DATA/NAM/201308

ln -sf ungrib/Variable_Tables/Vtable.NAM Vtable

./ungrib.exe
```

```
./metgrid.exe
```

```
cd ../WRF/test/em_real/
```

Check `namelist.input`

```
ln -sf ../../../WPS/met_em.d01.2013-08-2* .
```

```
qsub ~/bin/RunWRF.sh -N WRFv4
```