How to Set Up and Run WRF (*real.exe* & *wrf.exe*)?

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Outline

- How to download, compile and run WRF code?
- Input and output files
- Check output
- WRF namelist (runtime options)

How to download and compile WRF?

- Download WRF source code from *http://www.mmm.ucar.edu/wrf/users/downloads.html*
- What you get is

  `WRFV2.0.2.TAR.gz`
- After **`gunzip`** and **`untar`**, you should see a directory **`WRFV2/`**
- cd to **`WRFV2/`** directory, and you should see ..

WRFV2 Directory

```
Makefile
README
README_test_cases
clean
compile
configure
Registry/
arch/
dyn_em/
dyn_exp/
external/
frame/
inc/
main/
phys/
run/
share/
test/
tools/
```

How to Compile

Type

./configure

Hint: If you need to define the path to netCDF, do it before typing **'configure'** using the environment variable NETCDF. e.g.

setenv NETCDF /usr/local/lib32/r4i4

How to Compile

```
checking for perl5... no
checking for perl... found /usr/local/bin/perl (perl)
Will use NETCDF in dir: /usr/local/netcdf
PHDF5 not set in environment. Will configure WRF for use without.
------------------------------------------------------------------------
Please select from among the following supported platforms.

   1.  Compaq OSF1 alpha           (single-threaded, no nesting)
   2.  Compaq OSF1 alpha           (single-threaded, nesting using RSL without MPI)
   3.  Compaq OSF1 alpha SM        (OpenMP, no nesting)
   4.  Compaq OSF1 alpha SM        (OpenMP, nesting using RSL without MPI )
   5.  Compaq OSF1 alpha DM        (RSL_LITE, MPICH, no nesting)
   6.  Compaq OSF1 alpha DM        (RSL, MPICH, allows nesting)
   7.  Compaq OSF1 alpha DM/SM     (RSL, MPICH, OpenMP, allows nesting)
   8.  Compaq OSF1 alpha DM/SM     (RSL, DECMPI, OpenMP, allows nesting)
   9.  Compaq OSF1 alpha DM        (RSL, MPICH, RSL IO, MCEL EXPERIMENTAL)
  10.  Compaq OSF1 alpha DM/SM     (BUILD FOR AUTODOC ONLY -- DO NOT USE TO COMPILE
   CODE)

Enter selection [1-10] : 1
```


How to Compile

This will create a file called

configure.wrf

Hint: You can edit this file to change compile option

Hint: In V2.0, compile options are provided for a number of platforms. You may edit

arch/configure.defaults

to add a new option.

How to Compile

Type one the following command to compile:

```
compile
compile em_real
compile em_b_wave
compile em_hill2d_x
compile em_quarter_ss
compile em_squall2d_x
compile em_squall2d_y
compile em_grav2d_x
```

Typing one of the above will produce both initialization and model executables

How to Compile

Type **`compile em_real`**

If compile is successful, you should have three executables built in directory main/:

- **`real.exe`**
- **`ndown.exe`** (used for one-way processing)
- **`wrf.exe`**

And these executables are linked to **`./test/em_real/`** or **`./run/`** directory

How to Compile

If you type

`compile em_quarter_ss`

you'd have

`ideal.exe`

`wrf.exe`

linked to **`./test/em_quarter_ss/`**

Hint: If you use a Linux, make sure your netCDF library is installed using PGI compiler

WRFV2/test directory

```
em_b_wave/
em_grav2d_x/
em_hill2d_x/
em_quarter_ss/
em_real/
em_squall2d_x/
em_squall2d_y/
```

WRFV2/run directory

```
LANDUSE.TBL
ETAMPNEW_DATA
RRTM_DATA
SOILPARM.TBL
VEGPARM.TBL
tr49t67
tr49t85
tr67t85
namelist.input        - require editing
real.exe -> ../main/real.exe
wrf.exe -> ../main/wrf.exe
ndown.exe -> ../main/ndown.exe
```

namelist.input

Before running **`real.exe`** or **`ideal.exe`**, and **`wrf.exe`**, edit **`namelist.input`** file for runtime options

A complete list of namelist and their explanations can be found in

`WRFV2/run/README.namelist`

And in the User's Guide (p6-19 – 6-28)

How to Run real.exe?

To run on single or OpenMP systems, type

`ideal.exe`

for a idealized case, and

`real.exe`

for real-data cases.

To run on parallel system, typically type

`mpirun –np N real.exe`

where *N* is the number of processors

How to Run wrf.exe?

To run on single or OpenMP systems, type

`wrf.exe` or **`wrf.exe >& wrf.out`**

for all case, and on system using mpich, type

`mpirun –np N wrf.exe`

Hint: On IBMs, the MPI run command is

`poe wrf.exe` for batch job or

`poe wrf.exe –rmpool | -procs 4`

for interactive job

Output from mpirun

The standard-out and error will go into the following files for MPI runs:

`show_domain_0000:`	*domain-deposition info*
`rsl.out.0000`	**`rsl.error.0000`**
`rsl.out.0001`	**`rsl.error.0001`**
`rsl.out.0002`	**`rsl.error.0002`**
`rsl.out.0003`	**`rsl.error.0003`**

There are one pair of files for each running processor

WRF Files

Input to **real.exe**:

wrf_real_input_em.d01.yyyy-mm-dd_hh:00:00

Output from **real.exe**:

wrfinput_d01 and

wrfbdy_d01

WRF Files

Output from wrf.exe (by default):

wrfout_d01_ yyyy-mm-dd_hh:00:00

If restart is activated:

wrfrst_d01_yyyy-mm-dd_hh:00:00

Check Output

Check run log file:

wrf: SUCCESS COMPLETE WRF

Use **ncdump**

ncdump –v Times wrfout_d01_*

to check output times. Or

ncdump –v U wrfout_d01_*

to check a particular variable (U)

Use **read_wrf_nc.f** (see “Graphics Tools” lecture)

namelist.input

Six namelists:

&time_control

&domains

&physics

&dynamics

&bc_control

&namelist_quilt

As a general rule:

Multiple columns: domain dependent

Single column: value valid for all domains

&time_control

Run time control:

`run_days,run_hours, run_minutes, run_seconds` (WRF coarse grid only)

`start_year, start_day, start_hour, start_minute, start_second, end_year, end_day, end_hour, end_minute, end_second` (real and WRF, esp. for nest)

Input data interval control:

`interval_seconds` (real only)

&time_control

Output control:

`history_interval:` output frequency in minutes

`frame_per_outfile:` used to split output files

`Restart:` whether this is a restart run

`restart_interval:` used to write restart file

`io_form_history/restart/initial/boundary:` IO format (mostly set to 2 for netCDF)

&time_control

Nest input control:

`input_from_file:` whether one would use wrfinput_d0n (n>1) as input.

Hint: if you want to input fine grid terrain and landuse now, this is the option to use.

&domains

Time step control:

`time_step:` integer

`time_step_fract_num :` numerator for fractional time step

`time_step_fract_den:` denominator for fractional time step

Example: if one would specify time step of 15.5 sec, set

```
time_step = 15
time_step_fract_num = 1
time_step_fract_den = 2
```

&domains

Domain dimension control:

- **s_we:** always set to 1
- **e_we:** domain dimension in x direction (non-staggered)
- **s_sn:** always set to 1
- **e_sn:** domain dimension in y direction (non-staggered)
- **s_vert:** always set to 1
- **e_vert:** domain dimension in z (full η levels)
- **dx, dy: (dx=dy)** grid distance in meters
- **ztop:** only used in idealized case to set model top

&domains

Nest control:

- **max_dom:** how many domains to run
- **grid_id, level, parent_id, I_parent_start, j_parent_start, parent_grid_ratio, parent_time_step_ratio, feedback, smooth_option**

(see “Real Data Initialization” lecture)

&physics

Seven major physics categories:

```
mp_physics: 0,1,2,3,4,5,6,98,99
ra_lw_physics: 0,1,99
ra_sw_physics: 0,1,2,99
sf_sfclay_physics: 0,1,2
sf_surface_physics: 0,1,2,3
bl_pbl_physics: 0,1,2,99
cu_pbl_physics: 0,1,2,3,99
```

&physics

Call time control:

- **radt:** for radiation calls
- **bldt:** for surface and PBL calls
- **cudt:** for cumulus calls

&physics

Other useful ones:

- **`surface_input_source:`** whether to use WRFSI landuse and soil cat data, or from GRIB file
- **`num_soil_layers:`** different values for different sf_surface_physics options

Sensitivity tests:

- **`isfflx`**
- **`icloud`**

&physics

Grell-Devenyi control:

- **`maxiens, maxens, maxens2, maxens3:`** ensemble member dimensions for multiple closures and multiple parameter controls

&dynamics

Diffusion options:

- **`diff_opt, km_opt:`** typically not required when dx > 10 km
- **`w_damping:`** real-time only, used to control excessive vertical motion
- **`damp_top, zdamp, dampcoef:`** mostly used in idealized simulations. Not always work in real-data cases. In real-data cases, ptop is recommended to be placed at least at 50 mb (or ~ 20 km)

Recommended Options for dx < 10 km

Some explicit diffusion is required, esp. under extreme convective conditions:

&dynamics

- **`diff_opt = 1`**
- **`km_opt = 4`**
- **`w_damping = 1`** (for real-time runs)

&dynamics

Other options:

- **`non_hydrostatic:`** set to false to enable hydrostatic option
- **`time_step_sound:`** may be altered when time step is very much larger than 6*DX

&bc_control

Four choices:

- **`Open_xs, open_xe`**
- **`symmetric_xs, symmetric_xe`**
- **`periodic_xs, periodic_xe`**
- **`Specified`** (real-data only)
  - **`spec_zone`**
  - **`relax_zone`**

&namelist_quilt

Parallel I/O control:

- **`nio_tasks_per_group (>1):`** allow IO to be done on separate processors