

WRF Nesting – June 2009

WPS and WRF on *midnight.arsc.edu*

Pre-requisites

- Completion of the basic WRF Tutorial

Introduction

This document briefly outlines the issues in creating and executing nested WRF runs. The reader should be familiar with the basic WRF Tutorial notes provided separately.

The use of nested domains isn't much more complicated than running with a single nest. The only difficult part is deciding on the parameters for the nests. This example explores the steps necessary for modifying the Katrina Tutorial domain by inserting a 120x120 10km resolution nest roughly in the middle of the original nest. The following screen dump shows the relevant portions of *namelist.wps*.

In the *&share* section, note the following

- max_dom, the number of domains, is now set to 2
- The start_date and end_date entries now use two columns, so it's important to insure those fields are correct.

```
midnight (on mg57)
&share
wrf_core = 'ARW',
max_dom = 2,
start_date = '2005-08-28_00:00:00', '2005-08-28_00:00:00',
end_date = '2005-08-31_00:00:00', '2005-08-31_00:00:00',
interval_seconds = 21600
io_form_geogrid = 2,
/

&geogrid
parent_id = 1, 1,
parent_grid_ratio = 1, 3,
i_parent_start = 1, 10,
j_parent_start = 1, 10,
s_we = 1, 1,
e_we = 38, 49,
s_sn = 1, 1,
e_sn = 35, 49,
geog_data_res = '10m', '2m',
dx = 60000,
dy = 60000,
map_proj = 'mercator',
ref_lat = 25.0,
ref_lon = -85.0,
truelat1 = 25.0,
stand_lon = -85.0,
geog_data_path = '/datadir/WRF/geog'

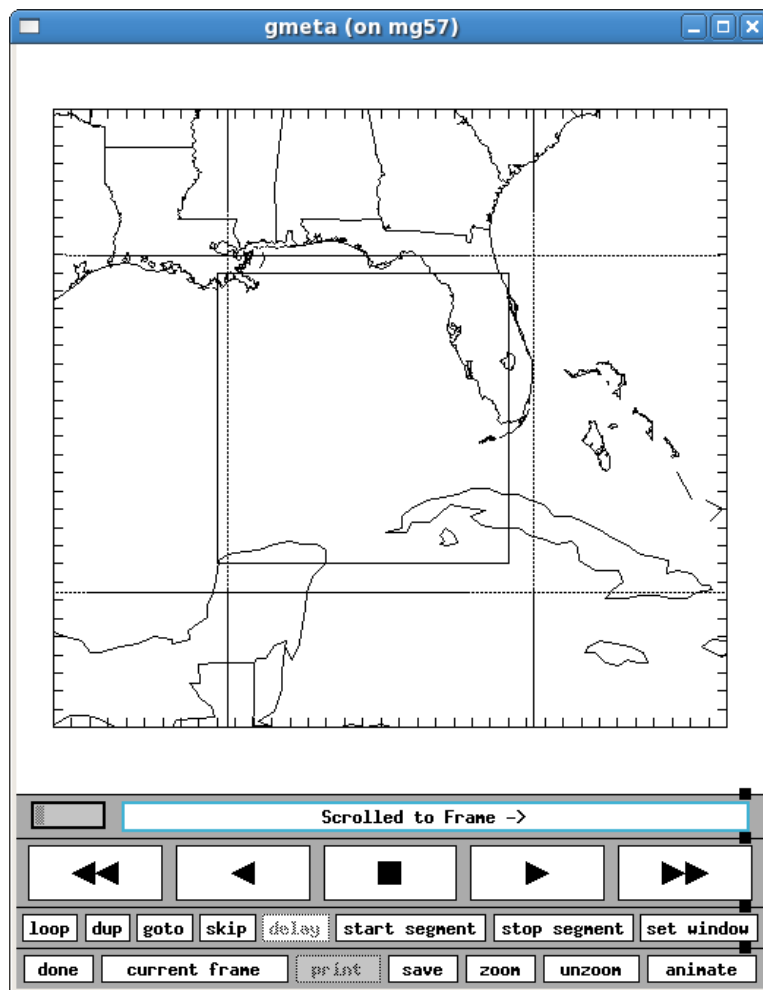
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```

In the *&geogrid* section, the second column is now relevant. The first column was addressed in the basic WRF Tutorial. Elements in the second column are interpreted as follows:

- parent_id – nest number of the parent nest
- parent_grid_ratio – the ratio of parent resolution to this nest's resolution – 3 is a typical value and indicates that if the resolution of the parent nest is 60km, then the resolution of this nest will be 20km.
- i_parent_start, j_parent_start – The location of the lower left corner of this nest, with respect to the parent domain's grid points. So, this indicates that our nest has a lower left corner at grid point (10,10) of the parent nest.
- s_we, e_we – The start and end points for this nest in the west-east direction, with respect to THIS nest's grid points. In this example, it indicates that the west-east component of this nest has 48 grid blocks, defined by 49 grid points numbered from 1 to 49. Since the ratio of parent-to-child grids is 3, this implies that the 48 grid blocks in this nest are equivalent to 16 grid blocks in the parent nest. Note that WRF documentation (and error messages if you get this wrong!) suggests that (e_we – s_we) must be one greater than an integer multiple of the parent-to-child grid ratio.

- s_sn, e_sn – Same as above, but in the south-north direction
- geog_data_res – this indicates which set of geography files to use. The 10m in column one refers to a resolution of 10 arc-minutes, which is 10 nautical miles near the equator. The 2m refers to a resolution of 2 arc-minutes.

Once you have *namelist.wps* set up, you can perform a preliminary inspection of the nested domain. The utility *util/plotgrids.exe* will look at your *namelist.wps* file and use the geographical information to produce a *gmeta* file. Using *idt* to view the file, you'll see something like the following:



Once you're happy with the domain configuration, you can run *geogrid.exe* just as before, and you'll see an output file for each nest – *geo_em.d01.nc* and *geo_em.d02.nc*, and these files may be viewed with standard netCDF file viewers (such as *ncview* and NCL)

Running *ungrib.exe* is the same as it was in previous examples, but again, you need to make sure that you have two columns filled in for start and end dates.

Running *metgrid.exe* is also the same as before. In this case, you will see two sets of output files

—
*met_em.d01** and *met_em.d02** - these represent the data from input files mapped to the two domains. When you run *real.exe*, you will need to copy (or make links to) all of these files into the WRFRun directory.

To run *real.exe* and *wrf.exe*, you'll modify *namelist.input* as before. In the *&time_control* section, just be sure to fill in the second column of entries.

```
midnight (on mg57)
&time_control
run_days           = 0,
run_hours          = 12,
run_minutes        = 0,
run_seconds        = 0,
start_year         = 2005, 2005, 2000,
start_month        = 08, 08, 01,
start_day          = 28, 28, 24,
start_hour         = 00, 00, 12,
start_minute       = 00, 00, 00,
start_second       = 00, 00, 00,
end_year           = 2005, 2005, 2000,
end_month          = 08, 08, 01,
end_day            = 28, 28, 25,
end_hour           = 12, 12, 12,
end_minute         = 00, 00, 00,
end_second         = 00, 00, 00,
interval_seconds   = 21600
input_from_file    = .true., .true., .false.,
history_interval   = 180, 60, 60,
frames_per_outfile = 1000, 1000, 1000,
restart            = .false.,
restart_interval   = 5000,
io_form_history    = 2,
io_form_restart   = 2,
io_form_input      = 2,
io_form_boundary   = 2,
debug_level       = 0
█
```

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In the *&domains* section, fill in the fields for column 2 as indicated below. These values follow from those in *namelist.wps*. Additionally, be sure to set *max_dom* to 2.

```

midnight (on mg57)
&domains
time_step                = 180.,
time_step_fract_num      = 0.,
time_step_fract_den      = 1.,
max_dom                  = 2.,
s_we                    = 1.,    1.,    1.,
e_we                    = 38.,   49.,   94.,
s_sn                    = 1.,    1.,    1.,
e_sn                    = 35.,   49.,   91.,
s_vert                  = 1.,    1.,    1.,
e_vert                  = 28.,   28.,   28.,
num_metgrid_levels      = 27
dx                      = 60000., 20000., 3333.,
dy                      = 60000., 20000., 3333.,
grid_id                 = 1.,    2.,    3.,
parent_id               = 0.,    1.,    2.,
i_parent_start          = 1.,    10.,   30.,
j_parent_start          = 1.,    10.,   30.,
parent_grid_ratio       = 1.,    3.,    3.,
parent_time_step_ratio  = 1.,    3.,    3.,
feedback                = 1.,
nproc_x                 = -1.,
nproc_y                 = -1.,
smooth_option           = 0
                                                                    55.2      32%

```

After modifying *namelist.input*, run *real.exe* as before. The output will be a single *wrfbdy_d01* (we only need to apply lateral boundary conditions on the outer nest), and two files for initial conditions on each of the nests, *wrfinput_d01* and *wrfinput_d02*.

Finally, run *wrf.exe* as before and note that there will be a separate output file for each nest.

With the current implementation of WRF on midnight, it might be necessary to run the parallel *wrf.exe* (not *wrf-serial.exe*) if you have more than one nest.