AHW (WRF-ARW): Set Up and Run

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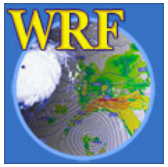
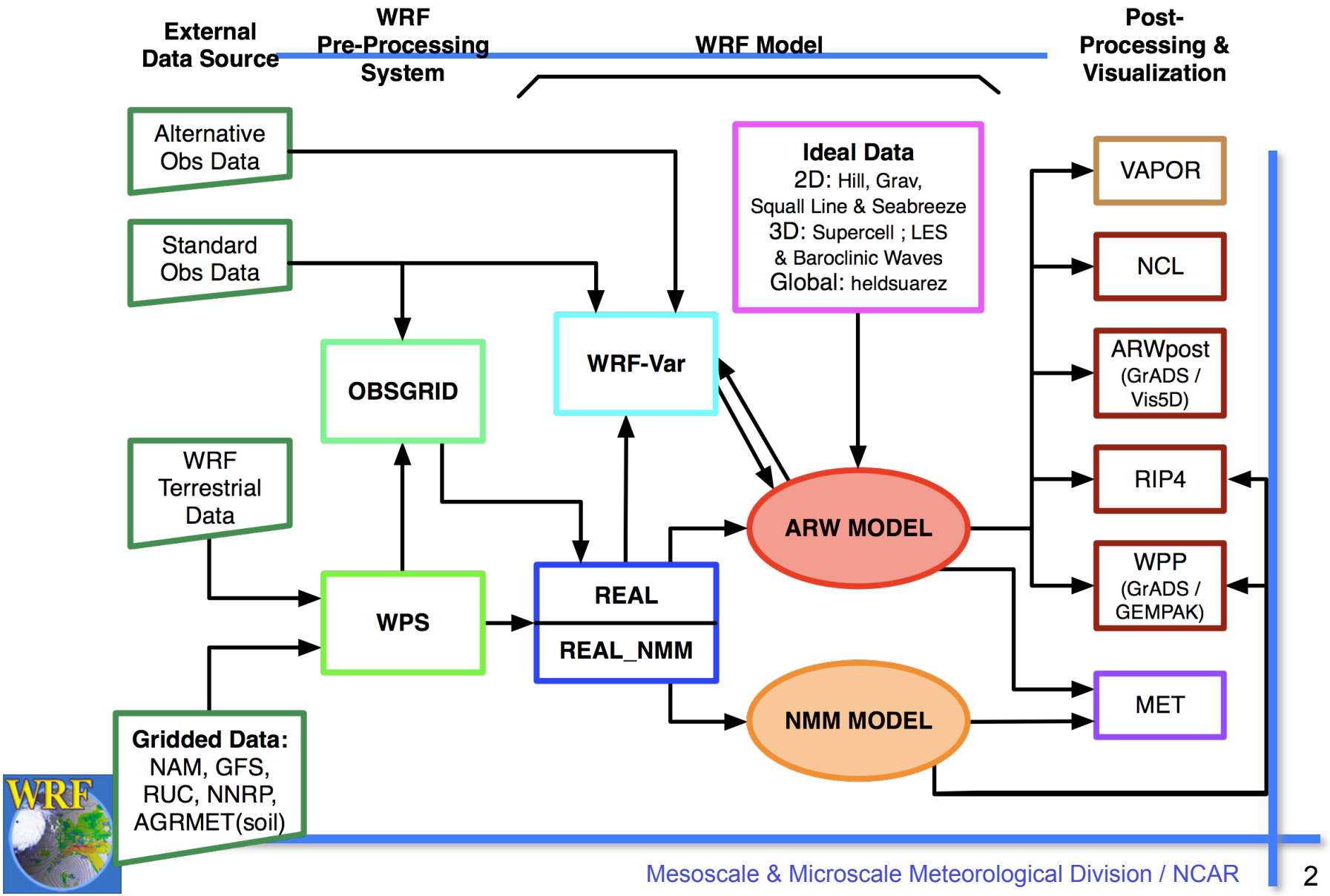


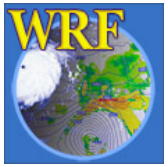
WRF Modeling System Flow Chart



WPS

- Run program *geogrid* to set the domain
  - Cover the storm track
  - Placement of the nests: may use fixed nests or storm-following nests
  - For fixed nests, process data for all domains
  - For storm-following nests, only process data for the coarse domain

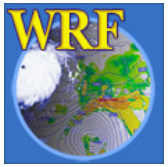
- May need to run program *ungrib* multiple times for data to use as initial conditions, boundary conditions, and SST
  - e.g combination of GFDL initial condition and GFS boundary condition



Key namelists

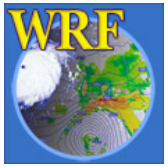
```
&ungrib
prefix  = `GFDL`,

&metgrid
fg_name              = `GFDL`,
constants_name       = `SST`, `MLD`,
```

If HYCOM ocean data is used to initialize the mixed layer depth, run the utility program to produce data in ungrib output format (or *'intermediate format'*)



Supported Data

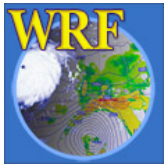
- Usual ones
  - GFS, FNL
  - ECMWF interim reanalysis (~ 80 km), both pressure, model level data available at NCAR
- Special ones
  - GFDL
    - use Vtable.GFDL
    - no surface RH and temperature, no soil data
    - use `use_surface = .false.` when running real.exe
  - HWRF (use Vtable.NAM; no soil data)



WRF-ARW Model

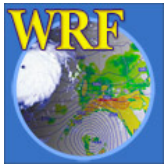
- Fixed nest
  - Simple to handle but may need to use large nest to cover the storm track for several days.
  - Can use nest input, hence better representation of terrain, land.

- Moving nests
  - Computationally efficient because of smaller nests. Useful for real-time application.

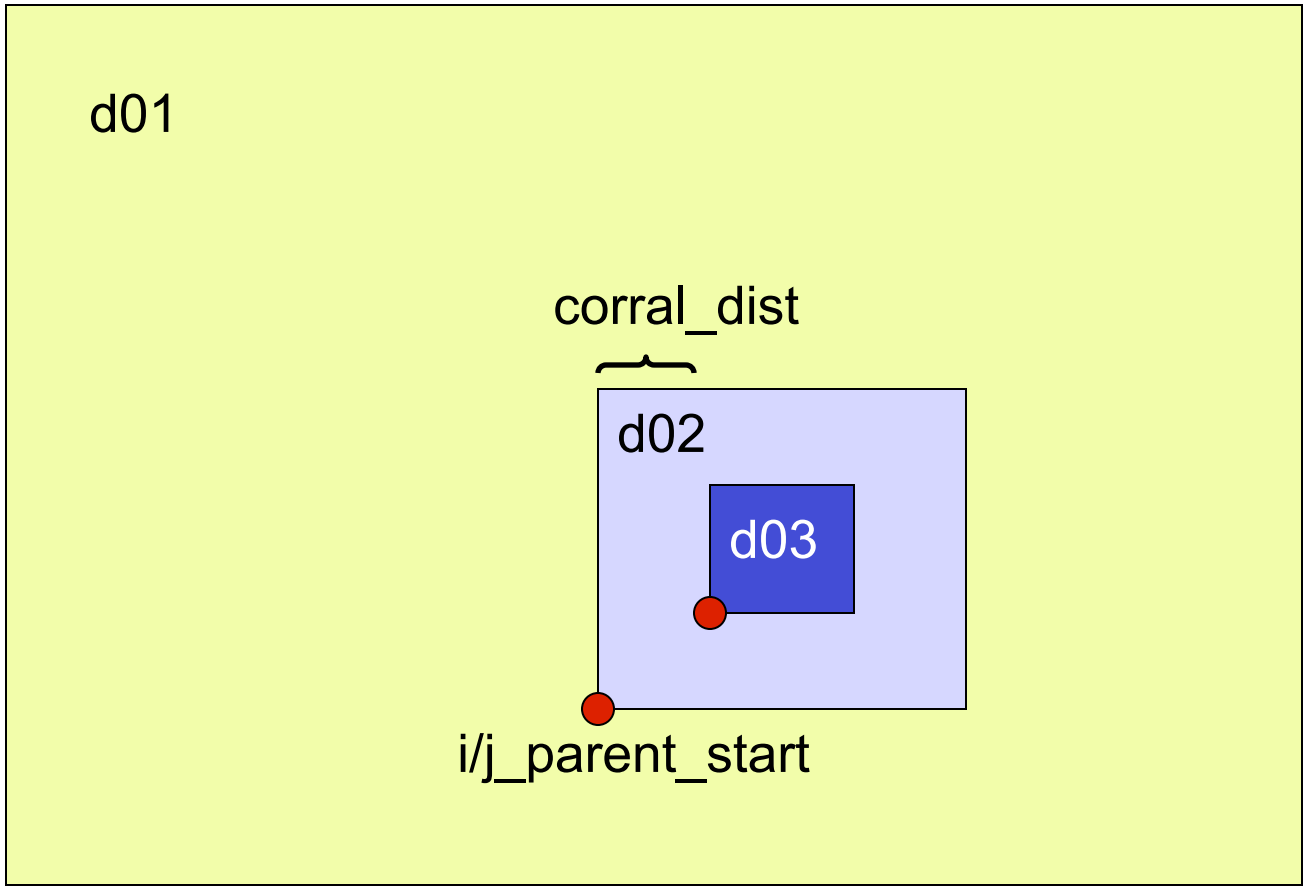


Key namelists

```
&time_control
input_from_file    = .true., .false., .false.,
frame_per_outfile = 1,  1,  1,

&domains
dx                                  = 12000, 4000, 1.3333,
dy                                  = 12000, 4000, 1.3333,
grid_id                             = 1,  2,  3,
parent_id                           = 0,  1,  2,
i_parent_start                      = 0, 54, 30,
j_parent_start                      = 0, 20, 30,
parent_grid_ratio                   = 1, 3, 3,
parent_time_step_ratio              = 1,3,3,
feedback                            = 1,
```



Domain Parameters

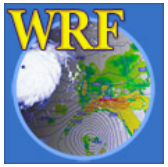


Key namelists

```
&domains
vortex_interval     = 15, 15, 15,
max_vortex_speed    = 40, 40, 40,
corral_dist         = 8,  12, 12,
track_level         = 70000,
time_to_move        = 720,
```

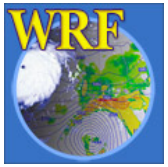
May use *corral_dist* to center an inner nest.

```
&physics
omlcall             = 1,
oml_hml0            = -50, ; >0: constant; <0: input
oml_gamma           = 0.15,
isftcflx            = 1,   ; 1: constant Z0q; 2: Garratt
```



Other Useful Options

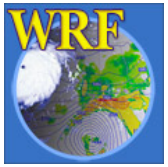
- Digital filter initialization
  - Can remove imbalance / noise generated by interpolation, data assimilation, introducing bogus data
  - Part of of WRF-ARW model
  - Use before running WRF model
  - Look for the namelists in *examples.namelist* file in *test/em_real/*



Other Useful Options

- Simple TC bogus option
  - Executable produced when compiling WRF (*serial* only)
  - Run with pressure-level input data from WPS only

```
&tc
insert_bogus_storm      = .true.,
remove_storm            = .false.,
                          ;for removing storm only
latc_loc                = 30.,
lonc_loc                = -70.,
vmax_meters_per_second  = 34.,
rmax                    = 120000., ;radius of max wind (m)
vmax_ratio              = .9,
     ;max speed scale factor, used to scale observed max wind
      appropriately on the model grid
```



Other Useful Options

- Simple TC bogus option (*cont*)
  - More parameters in the code: **`main/tc_em.F`**

`r_vor`: bogus typhoon and FG typhoon size, 300 km

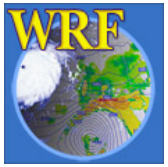
`r_vor2`: "outside" FG influence, 4x r_vor

`r_search`: how far to go to find FG vorticity max, 400 km

`humidity_max`: 95%, below 400 mb

`humidity_min`: 5%

`alpha`: decay factor for wind outside radius of max wind, set to -0.75



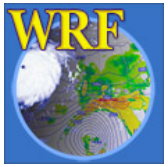
Running AHW

- Run the model executable by typing:

```
mpirun -np N -machinefile mach ./real.exe &
mpirun -np N -machinefile mach ./wrf.exe &
```

- Successfully running the model will create model *history* files, one for each domain and *one per time for the nests* (**frame_per_outfile=1,1,1**):

```
wrfout_d01_2005-08-27_00:00:00
wrfout_d02_2005-08-27_00:00:00
wrfout_d02_2005-08-27_03:00:00
wrfout_d02_2005-08-27_06:00:00
```



Check Output

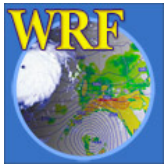
- Standard out and error files

  `rsl.out.*`

  `rsl.error.*`

- If successful, should see:

```
> tail rsl.out.0000
.....
wrf: SUCCESS COMPLETE WRF
```



Check Output

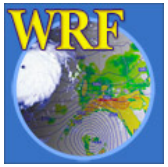
- For a vortex-following run, one gets model dump of vortex location, minimum SLP and max 10 m wind every 15 minutes

  `grep ATCF rsl.out.0000`

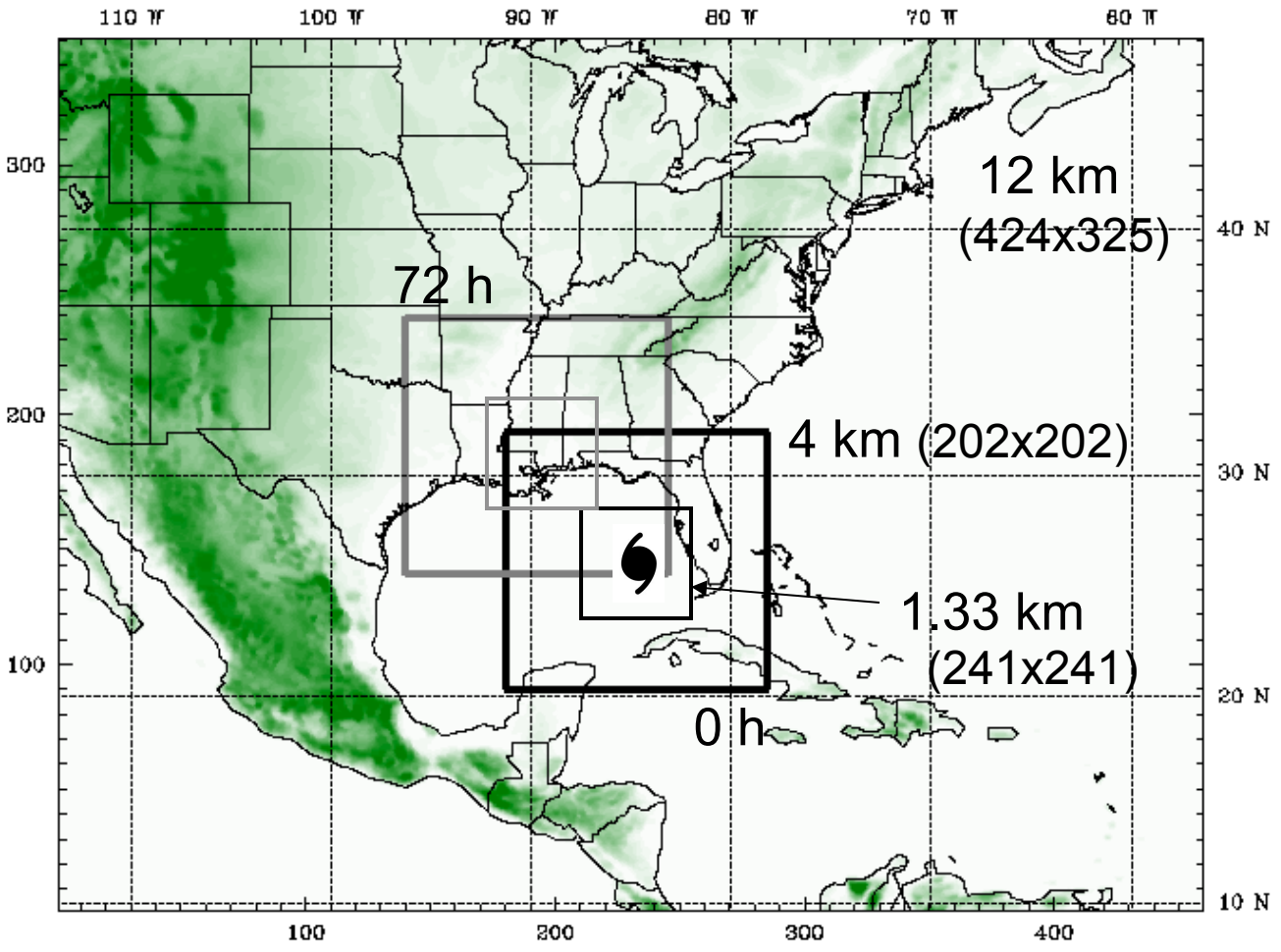
  will give:

```
ATCF 2005-08-28_00:01:00    25.65   -85.17  956.1   99.8
ATCF 2005-08-28_00:15:00    25.68   -85.17  956.0  100.0
ATCF 2005-08-28_00:30:00    25.75   -85.26  956.0  103.5
ATCF 2005-08-28_00:45:00    25.78   -85.27  955.5  104.6
ATCF 2005-08-28_01:00:00    25.82   -85.31  955.1  105.7
```

- Use ncl script to plot the track

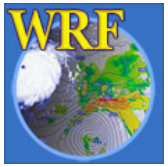


An Example of Domain Configuration



Note on Compile

- Make sure to select either *basic nest* (for fixed nests) or *vortex following* (for moving nests) compile options. Executables are created in **`WRFV3/main/`** directory:
  - **`real.exe`**
  - **`wrf.exe`**
  - **`ndown.exe`** **(for one-way nesting)**
  - **`tc.exe`** **(need to compile serially)**
- In the practice, pre-compiled code will be provided.



References

- Information on compiling and running WRF with nests, and a more extensive list of namelist options and their definition / explanations can be found in the User's Guide, Chapter 5, and run/README.namelist
- Start with namelist templates in test/ directory, and special namelists in example.namelist in test/em_real/
- Refer to Registry.EM
- ARW Tech Note