

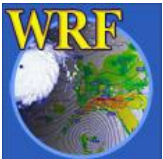
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# AHW (WRF-ARW): Set Up and Run

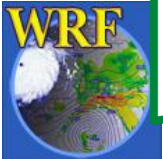
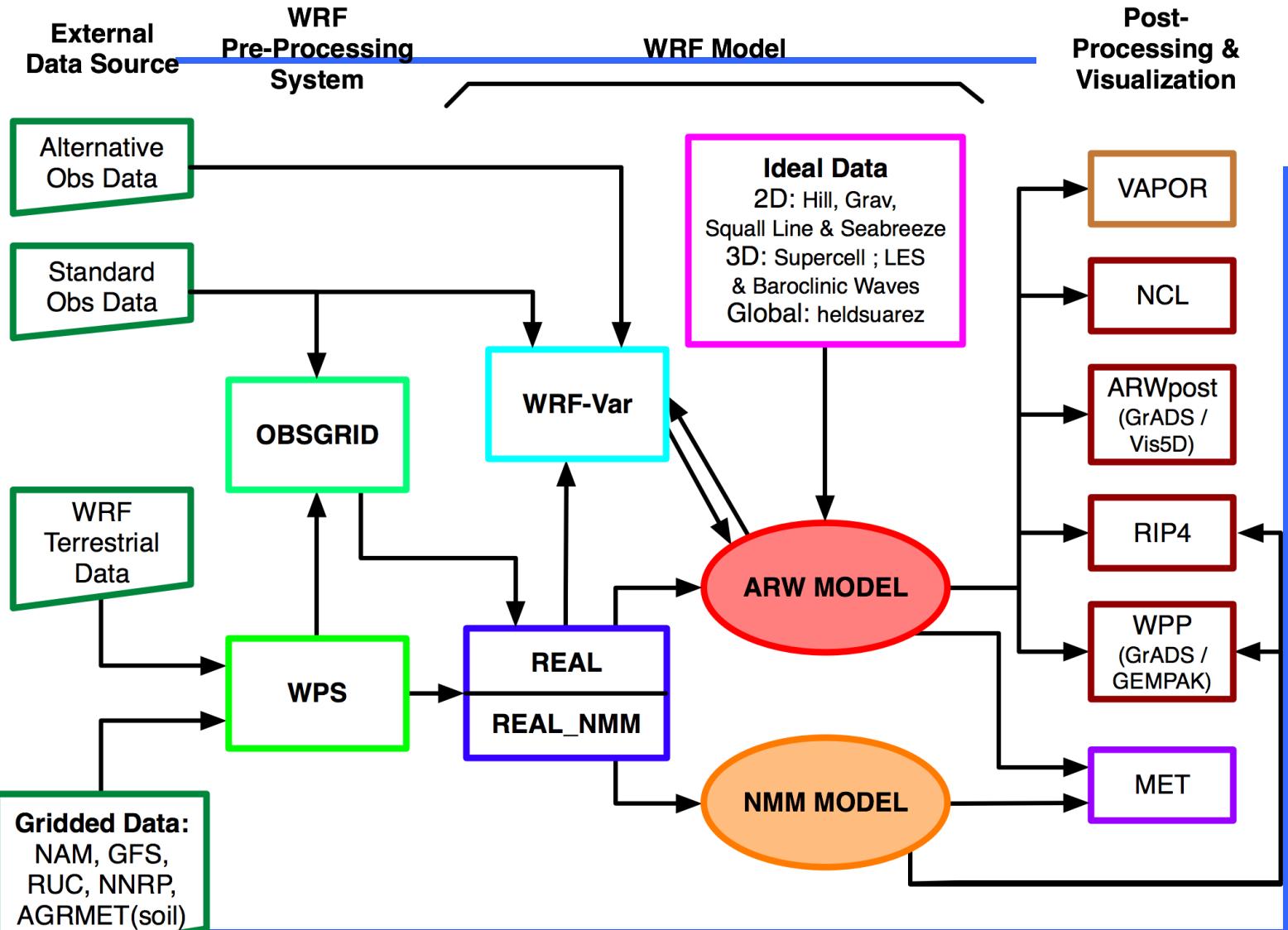
*Wei Wang*

*NCAR/NESL/MMM*

*Hurricane Tutorial, Apr 27 - 29, 2011*



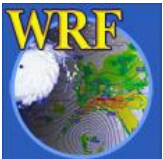
# WRF Modeling System Flow Chart



# WPS

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

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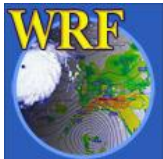
- Usual ones
  - o GFS, FNL
  - o ECMWF interim reanalysis (~ 80 km), both pressure, model level data available at NCAR
- Special ones
  - o GFDL
    - use Vtable.GFDL
    - no surface RH and temperature, no soil data
    - use `use_surface = .false.` when running real.exe
  - o HWRF (use Vtable.NAM;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



# WRF-ARW Model

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- 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

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## &time\_control

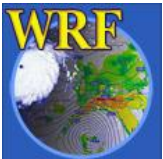
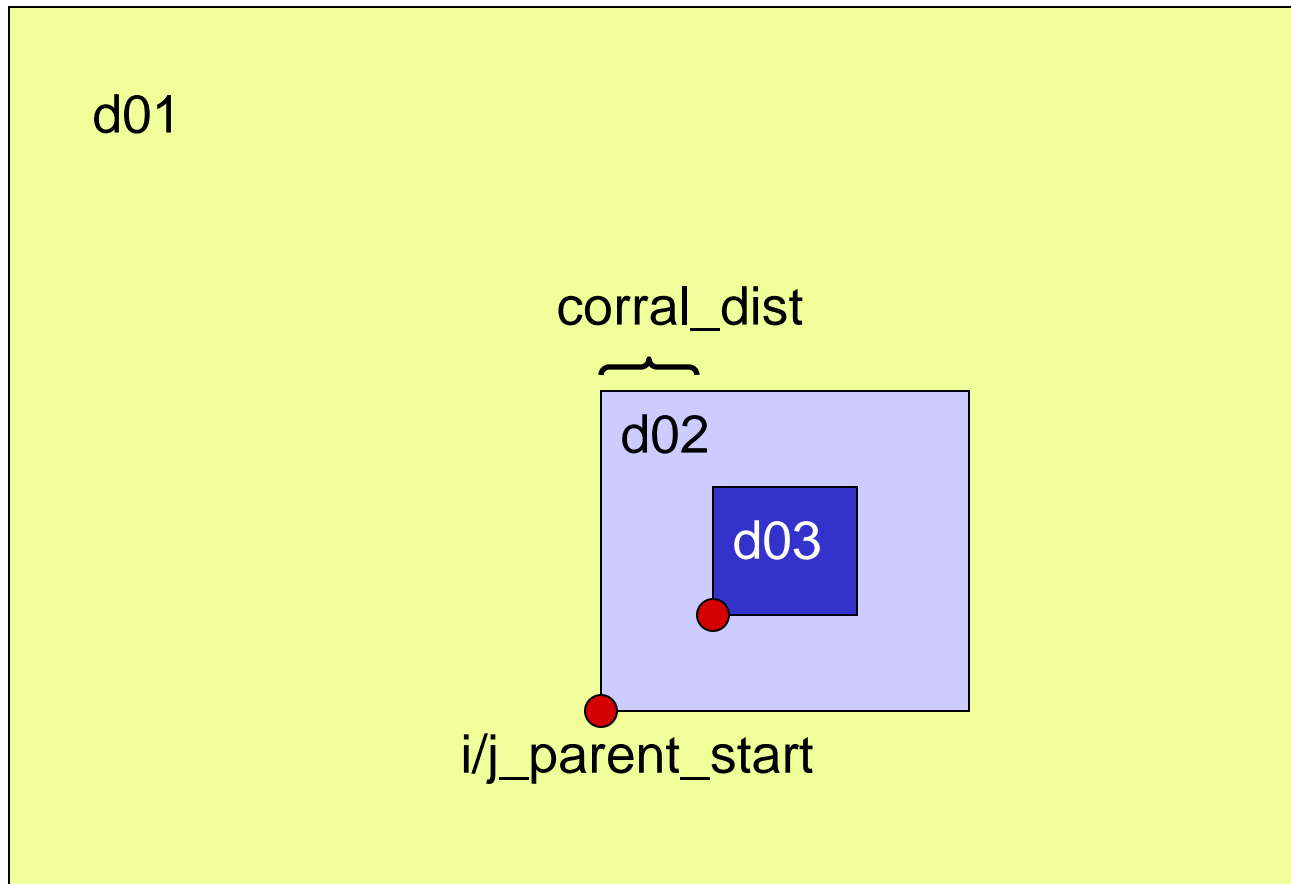
```
input_from_file    = .true., .false., .false.,  
frame_per_outfile = 1, 1, 1,
```

## &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

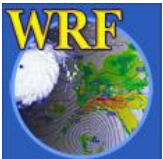
```
omlcall           = 1,  
oml_hml0          = -50, ; >0: constant; <0: input  
oml_gamma         = 0.15,  
isftcflx          = 1, ; 1: constant  $Z_{0q}$ ; 2: Garratt
```



# Other Useful Options

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



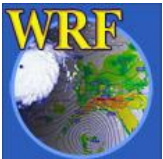
# Other Useful Options

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- 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

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

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

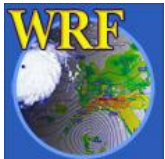
`r_vor2`: “outside” FG influence, 4x `r_vor`

`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

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- 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

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- Standard out and error files

`rsl.out.*`

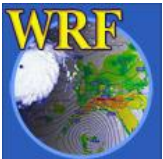
`rsl.error.*`

- If successful, should see:

```
> tail rsl.out.0000
```

```
.....
```

```
wrf: SUCCESS COMPLETE WRF
```



# Check Output

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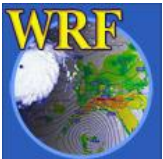
- For a vortex-following run, one gets model dump of vortex location, minimum SLP and max 10 m wind every 15 minutes

```
grep ATCF rsl.out.0000
```

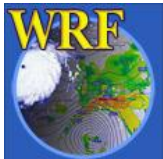
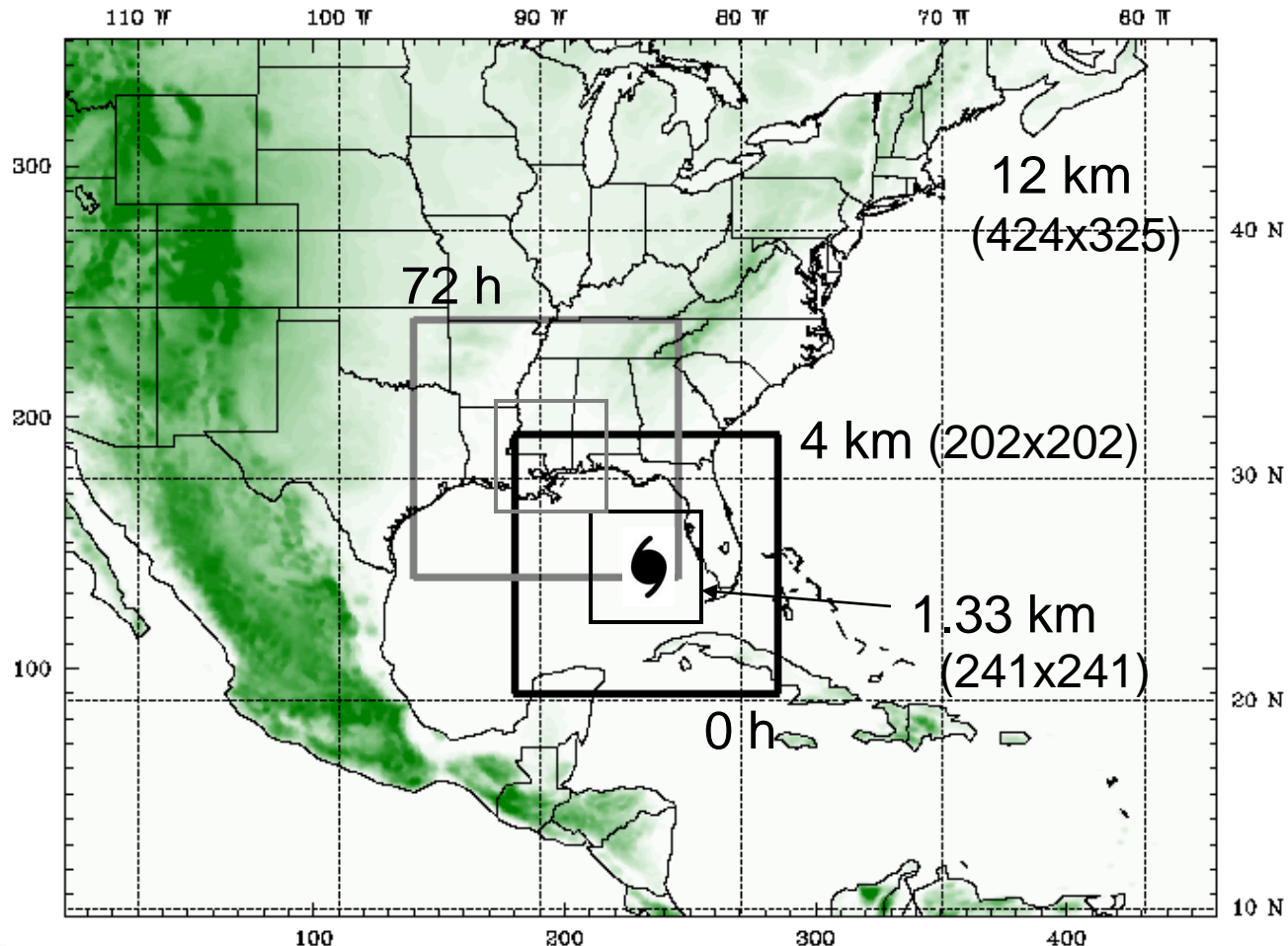
will give:

```
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



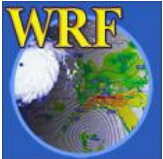
# An Example of Domain Configuration



# Note on Compile

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- 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

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- 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

