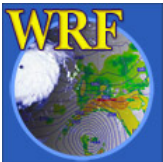


WRF ARW

Runtime Options (namelists)

Wei Wang



Fortran namelist

- Fortran 90 namelist is used to configure a run without recompiling the code
- Fortran 90 namelist has very specific format, so edit with care:

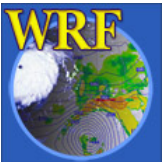
&namelist-record - start

/ - end

- As a general rule:

Multiple columns: domain dependent

Single column: value valid for all domains



namelist.input

Eight namelist records:

&time_control

&domains

&physics

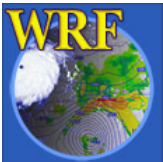
&dynamics

&bdy_control

&namelist_quilt

&fdda

&grib2



&time_control

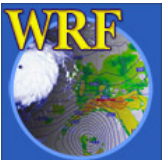
Run time control:

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 (and BC file interval):

interval_seconds (real only)



&time_control

Output control:

history_interval: output frequency in minutes

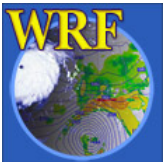
frame_per_outfile: output times per file

restart: whether this is a restart run

restart_interval: how often to write restart file

io_form_history/restart/initial/boundary:

IO format (mostly set to 2 for netCDF; Other options:
1 – binary; 4 – PHDF5; 5 – GriB 1; 10 - GriB 2)



&time_control

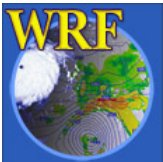
For a restart run, set:

`start_year, start_day, start_hour,`
`start_minute, start_second, end_year`

`restart = .true.`

`io_form_restart = 2`

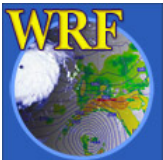
`io_form_restart = 102` - write/read in patch size



Sample of registry.io_boilerplate

Example 1: time control

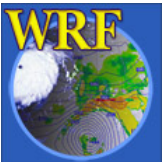
```
rconfig integer history_interval_mo namelist,time_control  
max_domains 0 h "history_interval_mo" "" "MONTHS"  
rconfig integer history_interval_d namelist,time_control  
max_domains 0 h "history_interval_d" "" "DAYS"  
rconfig integer history_interval_h namelist,time_control  
max_domains 0 h "history_interval_h" "" "HOURS"  
rconfig integer history_interval_m namelist,time_control  
max_domains 0 h "history_interval_m" "" "MINUTES"  
rconfig integer history_interval_s namelist,time_control  
max_domains 0 h "history_interval_s" "" "SECONDS"
```



Sample of registry.io_boilerplate

Example 2: time control

```
rconfig integer history_begin_y namelist,time_control max_domains 0  
  h "history_begin_y" "" "YEARS from start of run"  
rconfig integer history_begin_mo namelist,time_control max_domains  
  0 h "history_begin_mo" "" "MONTHS from start of run"  
rconfig integer history_begin_d namelist,time_control max_domains 0  
  h "history_begin_d" "" "DAYS from start of run"  
rconfig integer history_begin_h namelist,time_control max_domains 0  
  h "history_begin_h" "" "HOURS from start of run"
```



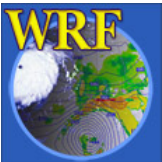
&time_control

Nest input control:

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

fine_input_stream: how nest domain input is used: = 0 – all input used; = 2 – only static input and masked fields are used - this option allows a nest to start at a later time.

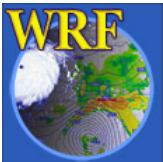
(see “Nesting” talk)



&time_control

Debug option:

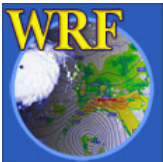
debug_level: values from 0 – 500 give
increasing amount of prints



&time_control

If SI is used:

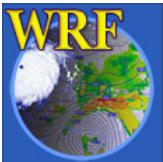
```
auxinput1_inname =  
  "wrf_real_input_em.d<domain>.<date>"
```



&domains

Domain dimension control:

- s_we**: always set to 1 (**s**: start; **we**: west-east)
- e_we**: domain dimension in x direction (staggered; **e**: end)
- s_sn**: always set to 1 (**sn**: south-north)
- e_sn**: domain dimension in y direction (staggered)
- s_vert**: always set to 1 (**vert**: vertical)
- e_vert**: domain dimension in z (full η levels, staggered)
- dx, dy**: (**dx=dy**) grid distance in meters
- ztop**: only used in idealized case to set model top



&domains

real.exe only:

must specify:

num_metgrid_level: number of incoming data levels (use ncdump -h to find out)

optional:

force_sfc_in_vinterp: number of levels to use surface data, default is 1

eta_levels: 1. to 0.; if not provided, **real.exe** will compute the levels

p_top_requested : pressure top, default is 50 mb



&domains

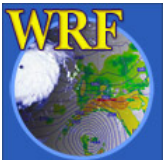
real.exe only, optional:

interp_type: in pressure or log pressure

lagrange_order: linear or quadratic

lowest_lev_from_sfc: logical, whether surface data is used to fill the lowest model level values

zap_close_levels: delta p where a pressure level is removed in vertical interpolation



&domains

Time step control:

time_step: integer, typically $6 \times dx$ (where dx is in km)

time_step_fract_num : numerator for fractional time step

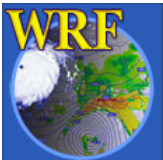
time_step_fract_den: denominator for fractional time step

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

`time_step = 15`

`time_step_fract_num = 1`

`time_step_fract_den = 2`



&domains

Nest control: (also see “Nesting” talk)

max_dom: how many domains to run

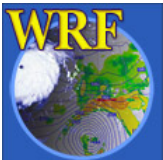
grid_id, parent_id: domain identifier

i_parent_start, j_parent_start: starting indices of nest domain in parent domain coordinate

parent_grid_ratio, parent_time_step_ratio: parent-nest grid and time-step ratios; integer only

feedback = 0, 1

smooth_option = 0, 1 or 2



&domains

Moving nest control: (*special compile required*)

Two options available:

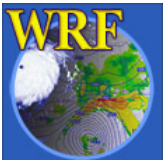
- specified move: only one grid cell move at a time
num_moves, **move_id**, **move_interval**,
move_cd_x, **move_cd_y**
- automatic move: use a vortex-following algorithm,
applicable for hurricane tracking

vortex_interval (default 15 min)

max_vortex_speed (default 40 m/s)

corral_dist (default 8 coarse grid cells)

- ▪ (see “Nesting” lecture)



&physics

Seven major physics categories:

mp_physics: 0, 1, 2, 3, 4, 5, 6, 8, 98, 99

ra_lw_physics: 0, 1, 3, 99

ra_sw_physics: 0, 1, 2, 3, 99

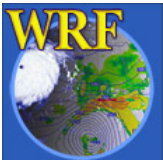
sf_sfclay_physics: 0, 1, 2

sf_surface_physics: 0, 1, 2, 3 (set before running **real** or **ideal**, need to match with **num_soil_layers** variable)

ucm_call = 0, 1

bl_pbl_physics: 0, 1, 2, 99

cu_physics: 0, 1, 2, 3, 99



&physics

Physics call time control:

radt: for radiation calls (e.g. 10 min for 10 km grid)

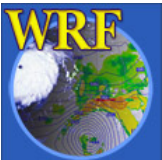
blat: for surface and PBL calls (set to 0 for ARW)

cut: for cumulus calls

Negative moisture variable control:

mp_zero_out: 0, 1, or 2

mp_zero_out_thresh: 1E-8



&physics

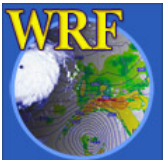
Other useful ones:

surface_input_source: whether to use WRFSL landuse and soil cat data, or from GrIB file

num_soil_layers: different values for different **sf_surface_physics** options (set before running **real** or **ideal**)

Sea-ice temperature control:

seaice_threshold: 271 K (default); grid changed to seaice when temperature falls below this value



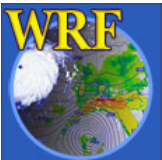
&physics

Sea-surface temperature update control: allow SST to be updated during a model run

sst_update: 0 – no SST update
1 – update SST

Set before running **real.exe**, and this will create an additional output: **wrflowinp_d01**

To use the file in **wrf.exe**, in **&time_control**, add
auxinput_inname = “wrflowinp_d01”
auxinput_interval = 360



&physics

Sensitivity tests:

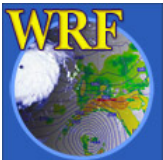
isfflx: 0, or 1 - switch off fluxes

icloud: 0, or 1 - cloud effect on radiation

Grell-Devenyi cumulus scheme control:

maxiens, maxens, maxens2, maxens3:

ensemble member dimensions for multiple closures and multiple parameter controls. Leave them as they are.



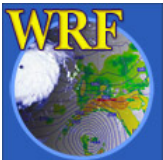
&dynamics

Diffusion/filter options:

diff_opt=1, km_opt=4: recommended for real data cases

w_damping: real-time runs only, used to control excessive vertical motion

damp_opt, zdamp, dampcoef: upper level damping controls. **damp_opt = 1** works for real-data cases, with **dampcoef = 0.01 - 0.1**

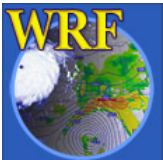


&dynamics

Diffusion options:

diff_6th_opt : 0, 1, or 2, 6th order numerical diffusion

diff_6th_factor: values ranges 0 - 1, with 1 corresponding to complete removal of 2 DX wave in one time step



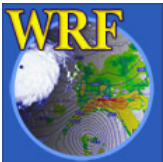
&dynamics

Positive definite advection scheme:

`pd_moist = .true. or .false.`

`pd_scalar = .true. or .false.`

`pd_tke = .true. or .false.`



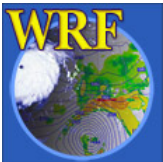
&dynamics

Other filter options:

smdiv: divergence damping control (~ 0.1)

emdiv: external mode control (~ 0.01)

epssm: coeff for vertically implicit off-centered acoustic step (~ 0.1)



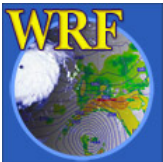
&dynamics

Base state parameter control: set before running **real.exe**:

base_temp: default value is 290 K

base_pres: default value is 100000 Pa

base_lapse: default value is 50 K from 1000 to 400 mb

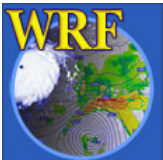


&dynamics

Other options:

non_hydrostatic: set to false to enable
hydrostatic option

time_step_sound: number of sound time steps
in a model time step



&bdy_control

Four choices:

Open_xs, open_xe

symmetric_xs, symmetric_xe

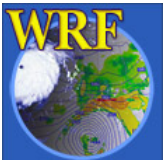
periodic_xs, periodic_xe

specified (real-data only, and set before running **real.exe**)

spec_bdy_width: = spec_zone + relax_zone

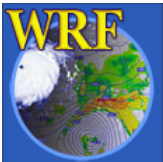
spec_zone: = 1 (should not change)

relax_zone: = 4 (can be varied)



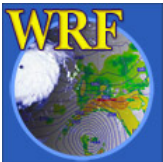
&fdda

Control how grid and observational nudging are done (see 'Analysis and Observation Nudging' talks tomorrow)



&grib2

Control how GriB 2 files are written. Defaults available.



&namelist_quilt

Parallel I/O control:

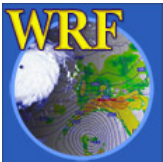
nio_tasks_per_group (>0): allow IO to be done on separate processors. Performance improvement for large domain runs. A value of 2 to 4 works well.



Recommended

Start with the namelist or namelists in a particular test directory, and make modifications.

For example, in **test/em_real/**, there are
namelist.input.jan00 - 30 km case
namelist.input.jun00 - 10 km case



Recommended

If you work with SI data, look for
test/em_real/namelist.input.si

If you would like to try grid nudging, look for
test/em_real/namelist.input.fdda_grid

