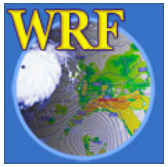
Analysis and Observation Nudging: Set Up and Run

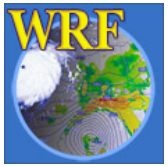
Wei Wang

NCAR/ESSL/MMM



Analysis Nudging

- Compile WRF (ARW) as usual
- Edit **`namelist.input`** file for nudging related options, **`&fdda`**
- No special data preparation needed
- Run **`real.exe`** to produce an additional file for domain 1, or files if you want to nudge the nest domains.



Preparing input files..

Edit these namelists before running **`real.exe`**:

```
grid_fdda = 1, 1,
    ; grid-nudging fdda on (=0 off)
gfdda_inname = "wrffdda_d<domain>"
    ; define fdda output file name
io_form_gfdda = 2,
    ; io format (2 = netCDF, default)
```

Running **`real.exe`** will produce:

```
wrfinput_d01, wrfbdy_d01, wrffdda_d01,
(wrfinput_d02, wrffdda_d02..)
```

Additional namelists for grid nudging

gfdda_interval_m = 360

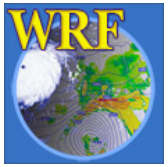
; time interval in minutes between analysis times

gfdda_end_h = 6

; time in hours to stop nudging after start of forecast

fgdt = 0

; calculation frequency (minutes) for grid-nudging (0=every step)



namelist **&fdda**

Nudging coefficients:

guv = 0.0003

; nudging coefficient for u and v (sec^{-1})

gt = 0.0003

; nudging coefficient for temp (sec^{-1})

gq = 0.0003

; nudging coefficient for qvapor (sec^{-1})

namelist **&fdda**

Nudging control in PBL:

if_no_pbl_nudging_uv = 0
; 1 = no nudging of u and v in the pbl, 0 = nudging in the pbl

if_no_pbl_nudging_t = 0
; 1 = no nudging of temp in the pbl, 0 = nudging in the pbl (*not recommended*)

if_no_pbl_nudging_q = 0
; 1 = no nudging of Qv in the pbl, 0 = nudging in the pbl (*not recommended*)

namelist **&fdda**

Another way to control nudging in lower levels:

For wind:

if_zfac_uv = 0

; 0 = nudge u and v in all layers, 1 = limit nudging to levels above k_zfac_uv

k_zfac_uv = 10

; 10 = model level below which nudging is switched off for u and v

namelist **&fdda**

For temperature and moisture:

if_zfac_t = 0

; 0 = nudge temp all layers, 1= limit nudging to levels above k_zfac_t

k_zfac_t = 10

; 10 = model level below which nudging is switched off for temp

if_zfac_q = 0

; 0 = nudge qvapor all layers, 1 = limit nudging to levels above k_zfac_q

k_zfac_q = 10

; 10 = model level below which nudging is switched off for Qv

namelist **&fdda**

Nudging control for dynamic initialization:

if_ramping = 0

; 0 = nudging ends as a step function, 1= ramping nudging down at end of period

dtramp_min = 60.0

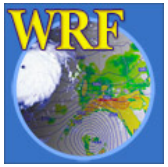
; time period in minutes for ramping function, 60.0=ramping starts at last analysis time, -60.0=ramping ends at last analysis time

Observation Nudging

- Compile WRF as usual
- Prepare observation data files (see more details at http://www.mmm.ucar.edu/users/wrfv2/nudging.html

➔ **OBS_DOMAIN101** (for domain 1)

OBS_DOMAIN201 (for domain 2)



namelist &fdda

In namelist record **`&time_control`**, add

`auxinput11_interval_s` = 120, 120,

; obs file input interval in seconds

`auxinput11_end_h` = 6, 6,

; obs data ending time in hours

namelist &fdda

Nudging control:

obs_nudge_opt = 1,1,

; obs nudging switch, = 1, on

max_obs = 150000,

; max number of obs used on a domain during any given time window

fdda_start = 0., 0.,

; nudging start time in minutes

fdda_end = 360., 360.,

; nudging end time in minutes

namelist &fdda

Nudging coefficients:

```
 obs_nudge_wind = 1,1,
    ; nudging switch for wind
 obs_coef_wind = 6.E-4,6.E-4,
    ; nudging coeffient for wind
 obs_nudge_temp = 1,1,  ; for temp
 obs_coef_temp = 6.E-4,6.E-4,
 obs_nudge_mois = 1,1,1,1,1  ; for Qv
 obs_coef_mois = 6.E-4,6.E-4,
```

namelist &fdda

Nudging controls:

obs_rinxy = 240.,240.,
; horizontal radius of influence

obs_rinsig = 0.1,
; vertical distance of influence

obs_twindo = 0.666667
; half time window for obs, in hours

obs_ionf = 2,
; frequency in coarse grid timesteps for obs input and error calculations

namelist &fdda

Nudging control for dynamic initialization:

obs_idynin = 0,

; DI switch, = 1, on

obs_dtramp = 40.,

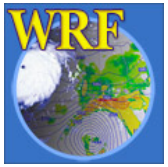
; time window in minutes over which nudging is ramping down from 1 to 0

namelist &fdda

Control for information printing in runtime:

```
obs_ipf_errob = .true.
obs_ipf_nudob = .true.
obs_ipf_in4dob = .true.
obs_npfi = 10,
```

; diagnostic prints in coarse grid timesteps



Namelist templates

- For grid analysis nudging: start with the namelist record and values in **`&fdda`** from `test/em_real/namelist.input.grid_fdda`
- For observation nuding: start with the namelist record and vaules in **`&fdda`** from `test/em_real/namelist.input.obs_fdda`

To run model

Run wrf.exe as usual:

./wrf.exe >& wrf.out &

or

mpirun -np *N* ./wrf.exe

➔ **wrfout_d<*domain*>_<*date*>**