User's Guide for the NMM Core of the Weather Research and Forecast (WRF) Modeling System Version 3

Chapter 4: WRF-NMM Initialization

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Introduction

The ***real_nmm.exe*** portion of the code generates initial and boundary conditions for the WRF-NMM model (***wrf.exe***) that are derived from output files provided by the ***WPS.*** Inputs required for the WRF-NMM model are not restricted to WPS alone. Several variables are defined/re-defined using the ***real_nmm*** part of the routines. For instance, the WRF-NMM core uses the definition of the Coriolis parameter in ***real_nmm***, rather than that in WPS.

The ***real_nmm*** program performs the following tasks:

- Reads data from the namelist
- Allocates space
- Initializes remaining variables
- Reads input data from the WRF Preprocessing System (WPS)
- Prepares soil fields for use in the model (usually vertical interpolation to the requested levels)
- Checks to verify soil categories, land use, land mask, soil temperature, and sea surface temperature are all consistent with each other
- Vertically interpolates to the models computational surfaces.
- Generates initial condition file
- Generates lateral condition file

The ***real_nmm.exe*** program may be run as a distributed memory job, but there may be no computational speed up since this program relies heavily on I/O and does few computations.

Initialization for Real Data Cases

The ***real_nmm.exe*** code uses data files provided by the WRF Preprocessing System (WPS) as input. The data processed by the WPS typically come from a previously run, large-scale forecast model. The original data are generally in "GriB" format and are ingested into the WPS by first using ***"ftp"*** to retrieve the raw GriB data from one of the national weather agencies anonymous ftp sites.

For example, a forecast from 2005 January 23 0000 UTC to 2005 January 24 0000 UTC which has original GriB data available at 3h increments will have the following files previously generated by the WPS:

met_nmm.d01.2005-01-23_00:00:00
met_nmm.d01.2005-01-23_03:00:00
met_nmm.d01.2005-01-23_06:00:00
met_nmm.d01.2005-01-23_09:00:00
met_nmm.d01.2005-01-23_12:00:00
met_nmm.d01.2005-01-23_15:00:00
met_nmm.d01.2005-01-23_18:00:00
met_nmm.d01.2005-01-23_21:00:00
met_nmm.d01.2005-01-24_00:00:00

The convention is to use "***met_nmm"*** to signify data that are output from the WPS and used as input into the ***real_nmm.exe*** program. The "***d01"*** part of the name is used to identify to which domain this data refers. The trailing characters are the date, where each WPS output file has only a single time-slice of processed data. The WPS package delivers data that are ready to be used in the WRF-NMM system.

The following statements apply to these data:

- The data adheres to the WRF IO API.
- The data has already been horizontally interpolated to the correct grid-point staggering for each variable, and the winds are correctly rotated to the WRF model map projection.
- 3-D meteorological data required from the WPS: ***pressure***, ***u***, ***v***, ***temperature***, ***relative humidity***, ***geopotential height***
- Optional 3-D hydrometeor data may be provided to the real program at run-time, but these fields will not be used in the coarse-grid lateral boundary file. Fields named: ***QR, QC, QS, QI, QG, QH, QNI*** (mixing ratio for rain, cloud, snow, ice, graupel, hail, and number concentration) are eligible for input from the metgrid output files.
- 3D soil data from the WPS: ***soil temperature***, ***soil moisture***, ***soil liquid*** (optional, depending on physics choices in the WRF model)
- 2D meteorological data from the WPS: ***sea level pressure***, ***surface pressure***, ***surface u and v***, ***surface temperature***, ***surface relative humidity***, ***input elevation***

- 2-D meteorological optional data from WPS: ***sea surface temperature***, ***physical snow depth***, ***water equivalent snow depth***
- 2D static data for the physical surface: ***terrain elevation***, ***land use categories***, ***soil texture categories***, ***temporally-interpolated monthly data***, ***land sea mask***, ***elevation of the input model's topography***
- 2D static data for the projection: ***map factors***, ***Coriolis***, ***projection rotation***, ***computational latitude***
- constants: ***domain size***, ***grid distances***, ***date***
- The WPS data may either be isobaric or some more-generalized vertical coordinate, where each column is monotonic in pressure
- All 3-D meteorological data (wind, temperature, height, moisture, pressure) must have the same number of levels, and variables must have the exact same levels. For example, it is not acceptable to have more levels for temperature (for example) than height. Likewise, it is not acceptable to have an extra level for the horizontal wind components, but not for moisture.

Running *real_nmm.exe*:

The procedure outlined below is used for single or multiple (nested) grid runs.

1. Change to the working directory of choice (***cd test/nmm_real*** or ***cd run***).

2. Make sure the files listed below reside in or are linked to the working-directory chosen to run the model (under ***WRFV3/run***, unless otherwise noted):

CAM_ABS_DATA
CAM_AEROPT_DATA
co2_trans
ETAMPNEW_DATA
ETAMPNEW_DATA_DBL
ETAMPNEW_DATA.expanded_rain
GENPARM.TBL
Grib2map.tbl
gribmap.txt
LANDUSE.TBL
MPTABLE.TBL
namelist.input ***(WRFV3/test/nmm_real)***
ozone.formatted
ozone_lat.formatted
real_nmm.exe
RRTM_DATA_DBL
RRTMG_LW_DATA
RRTMG_LW_DATA_DBL
RRTMG_SW_DATA
RRTMG_SW_DATA_DBL
SOILPARM.TBL

tr49t85
tr67t85
URBPARM.TBL
URBPARM_UZE.TBL
VEGPARM.TBL
wrf.exe

3. Make sure the ***met_nmm.d01**** files from the WPS either reside in or are linked to the working directory chosen to run the model. If nest(s) were run, also link in the ***geo_nmm_nest**** file(s).

4. Edit the ***namelist.input*** file in the working directory for dates, domain size, time step, output options, and physics options (see Chapter 5, Description of Namelist Variables section for details).

5. The command issued to run ***real_nmm.exe*** in the working directory will depend on the operating system.

On LINUX-MPI systems, the command is:

DM parallel build:	or	Serial build:
mpirun -np n real_nmm.exe		***./real_nmm.exe >& real_nmm.out***

where **"*n*"** defines the number of processors to use.

For batch jobs on some IBM systems (such as NCAR's IBM), the command is:

mpirun.lsf real_nmm.exe

and for interactive runs (Interactive MPI job is not an option on NCAR IBMs), the command is:

mpirun.lsf real_nmm.exe -rmpool 1 -procs n

where ***"n"*** stands for the number of processors (CPUs) to be used.

When ***real_nmm.exe*** is successful, the following files that are used by ***wrf.exe*** should be found in the working-directory:

wrfinput_d01	(Initial conditions, single time level data.)
wrfbdy_d01	(Boundary conditions data for multiple time steps.)

To check whether the run is successful, look for "SUCCESS COMPLETE REAL_NMM INIT" at the end of the log file (e.g.., ***rsl.out.0000***, ***real_nmm.out***).

The ***real_nmm.exe*** portion of the code does not input or output any file relevant to nested domains. Initial and boundary conditions for WRF-NMM nests are interpolated down from the parent grids during the WRF model run.

More details regarding the real data test case for 2005 January 23/00 through 24/00 is given in Chapter 5, Real Data Test Case.

Considerations for Recent Releases

- Since a new simple ocean model has been included in the WRF code, the old namelist option for activating an ocean mixed layer is no longer suitable. The variable OMLCALL has been switched to SF_OCEAN_PHYSICS.
- The default behavior of the base state has been modified. Starting with release version 3.5, the isothermal temperature is no longer zero. With this change, the base state temperature no longer gets colder than 200 K (default in the Registry, though a user can override this option with a namelist setting). This fixes the problem associated with layers being too thick near the model top. A side effect of thinning-out these model layers is that users may need to increase the number of vertical levels.
- The common availability of a valid seaice field in the input provided from the metgrid program has made obsolete the option to autoconvert "cold enough" water points to seaice. By default, the temperature at which water converts to seaice is now 100 K, a temperature cold enough that the option will never be triggered.