NHM Tutorial
Part. III. Realistic Simulations

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2. Practical Exercise

2.2. Realistic Experiments

- Realistic Weather Simulation Using Global analysis (or forecast) data and GTOPO30 as topography.

- We can use the following dataset.
  - NCEP-GFS forecast and analysis
  - JRA25 (JMA-25yr-reanalysis) & JCDAS (semi-realtime reanalysis)
  - JMA global model data supplied by the Japan Meteorological Business Support Center (JMBSC)

Available Global Dataset for the NHM

Data Set	Period	Resolution	File format
NCEP GFS Forecast	2007Apr ~ now (the last 6 months?)	1.0 x 1.0 degree global every 6hr, 180hr/3hr forecast	GRIB
NCEP GFS Analysis	2004Mar ~ last month	1.0 x 1.0 degree global every 6hr	GRIB
JRA25 (& JCDAS)	**1979Jan ~ now**	1.25 x 1.25 degree global every 6hr	GRIB
JMBSC (**JMA GSM Forecast**) (not including land-surface, sst and soil data)	2004Apr ~ 2007Nov20	1.25 x 1.25 degree global (thinned grid) every 6hr	GRIB
	2007Nov21 ~ now	0.5 x 0.5 degree global every 6hr	GRIB2

- Of course, NuSDaS formatted data from JMA are available. But they are not able to be downloaded freely.
  (e.g. Meso-Analysis, Global-Analysis, Global-forecast in NuSDaS)

Nhm/Tools/grib2nus including Download and Convert tools

- (See “README” file)
- step 1. Configure
- (This tools need compiled pnusdas)
- $> sh configure -c ../../Module/Mk/config/pc/config.[xxx]

- step 2. make load-module for convertor
- $> make

Nhm/Tools/grib2nus including Download and Convert tools

- step 3. get data (JMBSC, NCEP1d_fct, NCEP1d_anl or JRA25)
  - Change date in the “**TIMECARD**” <- initial time
    yyyy mm dd hh min
  - “**get_ncep1d_anl.sh**”, “**get_ncep1d_fct.sh**”, “**get_jra.sh**” and “**get_jmbsc.sh**” are prepared.
  - In default setting, these shells download the files for 48hr-forecast. As to your needs, you have to change the range of forecast for saving the download time. It is written in the head of each shell script.
  - $> sh get_ncep1d_fct.sh (or get_ncep1d_anl.sh, or get_jra.sh …)
    - Download time depends on the Internet speed and forecast time.
  - save files at Nhm/Data/ncep1d_fct(or jra, jmbsc)/${DATE:yyyymmddhhmn}

Nhm/Tools/grib2nus including Download and Convert tools

- step 4. convert GRIB(or GRIB2) data to NuSDaS
  - "**jmbsc2nus.sh**", "**jra2nus.sh**", "**ncep1d2nus_anl.sh**" and "**ncep1d2nus_fct.sh**" are prepared.
    - $> sh ncep1d2nus_fct.sh (or jra2nus.sh ….)
  - Don't change **TIMECARD** when you are downloading the dataset.
  - And these shell scripts expect that the downloaded files are located at "Nhm/Data/ncep1d_fct(or jra, jmbsc)/${DATE:yyyymmddhhmn}" which is the default value of the download tools.
  - NuSDaS files are output into the same directory at the downloading. ("fcst_p.nus", "fcst_sfc.nus" are made.)

Nhm/Ss/RF20km

- (See "README" file)
- Edit "**TIMECARD**" same as downloaded DATE
- Edit "**parm.sh**" for your environments
- Select the appropriate "pre.sh" in "all.sh" for the downloaded data.
- And run the "all.sh". show the contents of all.sh
  - $> sh setup.sh # set directories, etc
  - $> sh mkcnst.sh # make orography file
  - $> sh mksfccnst.sh # make surface constant files like albedo, etc
  - $> sh pre_jmbsc.sh [pre_jra.sh, pre_ncep1d_anl.sh, pre_ncep1d_fct.sh] # make initial and boundary files
  - $> sh fcst.sh (attention! Check MPI process number) # start the forecast
  - $> sh end.sh # move result files
- (And you can execute 1-way nesting-run in 5km (or more fine mesh) by using the results of RF20km)

Nhm/Ss/RF20km/parm.sh

- Edit parm.sh for your environments
  - # directory
  - **DIRNAME=RF20km #set experiment name**
  - **NHMDIR=/home/seasia/Nhm #set your ${NHM} directory**
  - MYDIR=${NHMDIR}
  - BINDIR=${MYDIR}/Module/Bin
  - **SHDIR=${MYDIR}/Ss/${DIRNAME}**
  - CSTDIR=${MYDIR}/Const
  - PARMDIR=${MYDIR}/Parm/${DIRNAME}
  - TOPODIR=${MYDIR}/Data/${DIRNAME}
  - JGWKDIR=${MYDIR}/Work/${DIRNAME}
  - DATADIR=${MYDIR}/Data/${DIRNAME}
  - INPUTDIR=${MYDIR}/Tools/grib2nus/data

Nhm/Ss/RF20km/parm.sh

- Edit parm.sh for your environments
  - # model parameters
  - **IDT=75 # set dt about dx (in km) * 3~5 & can divide 600**
  - **FTEND=12 # forecast hour**
  - **KTDEL=3 # interval hour of boundary file**
    "6" for JMBSC, JRA, NCEP_anl. "3" for NCEP_fct
  - # ---- parameter for domain
  - **NX=201 # grid number in x-direction**
  - **NY=201 # grid number in y-direction**
  - **NZ=40 # grid number in z-direction**

Nhm/Ss/RF20km/parm.sh

- Edit parm.sh for your environments
  - **NPROJC='MER ' # map projection (in south-hemisphere, "MER" only)**
    - **"LMN" and "PSN" are available. Don't change "4 digit character".**
  - **DX=20000.0000 # horizontal resolution in x-direction**
  - **DY=20000.0000 # horizontal resolution in y-direction**
  - **MDLTOP=23000. # model top height in (m)**
  - **SLAT=60.0000 # standard latitude for map projection (out of use in Lambelt)**
  - **SLON=140.0000 # standard longitude for map projection**
  - **FLATC=36.0 # latitude at center of domain**
  - **FLONC=140.0 # longtitude at center of domain**

  - XI=-999.9999 # x-grid point of true Lat. and Lon. ("-999" means out of use)
  - XJ=-999.9999 # y-grid point of true Lat. and Lon. ("-999" means out of use)
  - XLAT=-999.9999 # true latitude at (XI,XJ) ("-999" means out of use)
  - XLON=-999.9999 # true longitude at (XI,XJ) ("-999" means out of use)

Nhm/Ss/RF20km/parm.sh

- ### Usually DO NOT CHANGE BELOW ###
  - #parameter for boundary dumping area
  - automatically set 4% of domain size, respectively.
  - **#IWDTH=6 #domain of just using topography of outer model**
  - **#IMERG=6 #domain of merging topography between outer model and inner model**
  - IDIFX=`expr $IWDTH + $IMERG`

  - #start level of Rayleigh dumping : about NZ * 0.8
  - automatically set 80% of grid number in vertical.
  - **#KZDST=32**
- **End edit parm.sh**

Nhm/Ss/RF20km/

setup.sh, mkcnst.sh, mksfccnst.sh, pre_[jbmsc].sh

- setup.sh
  - **automatically** make domain card and work directory from “parm.sh”.
  - **automatically** set NuSDaS_definition files from “parm.sh”.
- mkcnst.sh
  - **automatically** make topographic data (mftopo) from GTOPO30
- mksfccnst.sh
  - **automatically** make land surface parameter file, if it is needed.
- pre_[jbmsc].sh
  - **automatically** make initial and boundary files.
  - output files; mfin(initial file), mfex(boundary file), ptgrd (surface parameter), mfhm(topographic data), [sst (for self-nesting)]

Nhm/Ss/RF20km/fcst.sh

- “fcst.sh” includes namelists for the setting of the NHM
  - link constant files
  - preparing the NuSDaS output
  - read the namelist for the NHM
    - If you want to change the namelists, over-write here.
    - The details of the namelist are describes in “**Doc/En/namelist/fcst.sh_namelist.html**”
  - execute the NHM (with MPI, check MPI-process!)
  - output the forecast

Nhm/Ss/RF20km/end.sh

- “end.sh”
  - Move output data to output directory.
    - ->DATADIR=${MYDIR}/Data/${DIRNAME}
    - If the same "DIRNAME" already exist, automatically change the name of pre-exist directory and then move new results.
  - Clean up work directories

- After the check of the whole shell scripts, Start forecast!

Start forecast!

- At the first time, execute each shell script in "all.sh" step by step.
  - $> sh setup.sh
  - $> sh mkcnst.sh
  - $> sh mksfccnst.sh
  - $> sh pre_jmbsc.sh [or, pre_jra.sh, pre_ncep1d_anl.sh, pre_ncep1d_fct.sh]
  - $> sh fcst.sh (attention! MPI process number)
    running at "${NHM}/Work/RF20km"
    - You can see progress in the command below.
      tail -f ${NHM}/Work/RF20km/log.fcst_nfx.${PID}
  - $> sh end.sh
    output at "${NHM}/Data/RF20km"

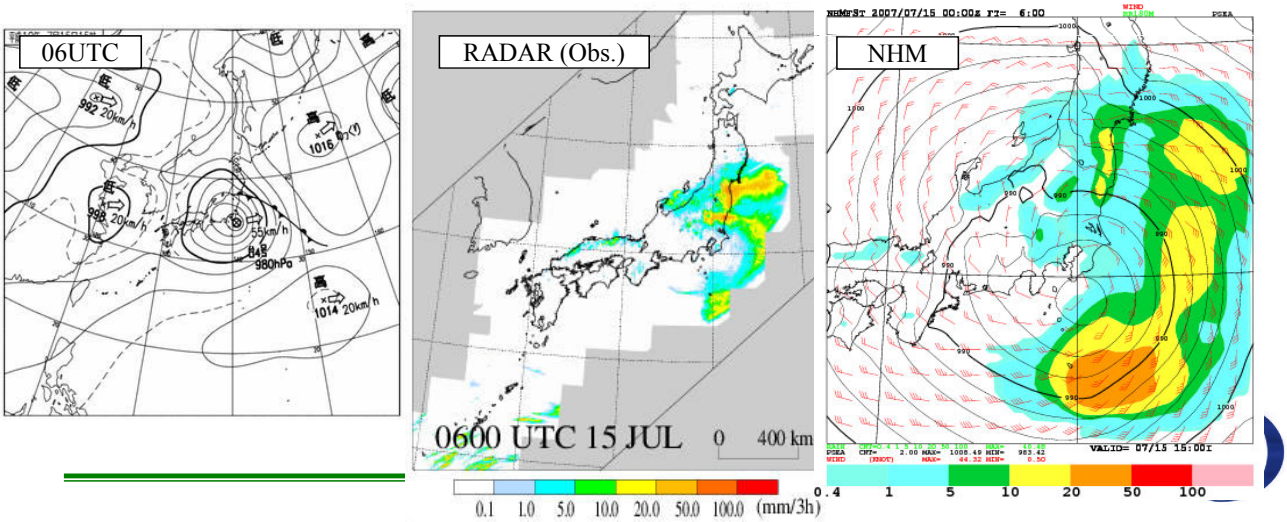
Visualization by webpandah

- NuSDaS output files:
  - fcst_const.nus : surface constant file (height, sl, lat, lon...)
  - fcst_land.nus : skintemp, sst, landuse
  - fcst_mdl.nus : model-plane forecast variables
  - fcst_p.nus : p-plane forecast (and diagnostic) variables
  - fcst_sfc.nus : surface forecast (and diagnostic) variables

  - #for monitor
  - fcst_phy2m.nus : 2-D physical variables monitor
  - fcst_phy3m.nus : 3-D physical variables monitor

Result of realistic experiment

- Initial time is 2007-Jul-15 00UTC. Typhoon "MAN-YI" hit Japan.
- For 6hr forecast around Japan (51x51x40 with 20km in horizontal) 10miniutes need on this machine.
- So, I have already done this simulation.



Nhm/Ss/RFnest

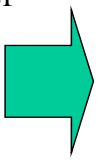
(Using results of RF20km execute 1-way nesting-run in 5km)

- 1-way self-nesting shell script.
  (NHM is available 1-way nesting only)
- Almost same as RF20km.
- (See “README” file)
- Edit "**TIMECARD**" same as target initial DATE
- Edit "**parm.sh**" for your environments
  - Change “INPUTDIR” for results of RF20km
  - set “KTLAG” and “FTEND”
  - and check another settings as in “RF20km/parm.sh”
- If you want to run once more, copy "RFnest" and rewrite "TIMECARD" and "parm.sh".

Single precision-run

- If you have a limitation of CPU-time for continuous run, you should use "single precision mode". (Default is double.)
- Using "single", you have to change source code in NHM and recompile NHM.
- Change Nhm/Module/Src/JMANHM/vardef.f90 as below.

```
module vardef
 ***skip***
 !  integer(4), parameter ::r_size = kind(0.0e0)
 integer(4), parameter :: r_size=kind(0.0d0)
end module vardef
```



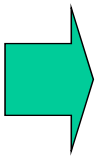
```
module vardef
 ***skip***
 integer(4), parameter ::r_size = kind(0.0e0)    < remove "!"
 ! integer(4), parameter :: r_size=kind(0.0d0)   < add "!"
end module vardef
```

- But some fortran compilers make errors in single precision mode… sorry we can not solve this problem.

Restart-run

- If you have a limitation of CPU-time for continuous run, you should use "restart-run".
- Using "restart", you have to change some parameters in "fcst.sh".
- First of all, you have to prepare special fcst.sh for restart.

"all.sh" for normal-run
sh setup.sh
sh mkcnst.sh
sh mksfccnst.sh
sh pre_[jra, ncep].sh
sh fcst.sh
sh end.sh

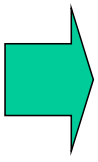


"all.sh" for restart-run
sh setup.sh
sh mkcnst.sh
sh mksfccnst.sh
sh pre_[jra, ncep].sh
sh fcst_1.sh
sh fcst_[2, 3, 4, …].sh
sh fcst_end.sh …
sh end.sh

- Details are shown in the next slide.

fcst.sh for 1st-run (fcst_1.sh)
(output restart files only)

"fcst.sh" for normal-run
&NAMPAR
ITST=1,ITEND=${ITEND},ITOUT=5000, ITCHK=1,
……
&NAMFIL
……
IMT_RS_OUT=-1, output_ninfo = 0, ibase_fake=0,
……



"fcst_1.sh" for (1st) restart-run
&NAMPAR
ITST=1,ITEND=${1st restart end in timestep},ITOUT=5000, ITCHK=1,
……
&NAMFIL
……
IMT_RS_OUT=1, output_ninfo = 0, ibase_fake=0,
……

Then, restart-files are output in ${work} directory in each mpi-processes

fcst.sh for 2nd-run (fcst_[2, 3,4, …].sh)
(input and output restart files)

"fcst.sh" for normal-run
&NAMPAR
ITST=1,ITEND=${ITEND},ITOUT=5000, ITCHK=1,
……
&NAMFIL
……
IMT_RS_OUT=-1, output_ninfo = 0, ibase_fake=0,
……

"fcst_2.sh" for (2nd) restart-run
&NAMPAR
ITST=${1st restart end in timestep},ITEND=${2nd restart end in timestep},ITOUT=5000, ITCHK=1,
……
&NAMFIL
……
IMT_RS_OUT=1,
IMT_RS_IN=1, output_ninfo = 0, ibase_fake=0,
……

fcst.sh for final-run (fcst_end.sh)
(end of restart, input restart files only)

"fcst.sh" for normal-run
&NAMPAR
ITST=1,ITEND=${ITEND},ITOUT=5000, ITCHK=1,
……
&NAMFIL
……
IMT_RS_OUT=-1, output_ninfo = 0, ibase_fake=0,
……

"fcst_end.sh" for end of restart-run
&NAMPAR
ITST=${previous restart end in timestep},ITEND=${forecast end in timestep},ITOUT=5000, ITCHK=1,
……
&NAMFIL
……
IMT_RS_IN=1, output_ninfo = 0, ibase_fake=0,
……

Note for restart-run

- Don't change FTEND in parm.sh from normal run. FTEND show the whole forecast hour in restart.
  - each forecast hour of fcst_[1,2,..].sh is set in ITEND.
- Initial and boundary files are same as normal (continuous) run. You have to prepare whole period for restart-run.
- Don't change MPI-process number in each restart run.
- Restart files are output in ${work} directory and overwrite in each restart run by the same name for each MPI-process.

under-constructing now

- Execute NHM from "Meteorological Research Consortium" dataset (for collaborative research member with MRI/JMA only)
  - now available "RSMC125 weekly ensemble forecast (50 members, 1.25degree resolution, 12hourly interval)" global forecast data set
  - now available "GANAL (20km resolution, 6hourly interval)" for initial and boundary on global analysis.
  - constructing to use "monthly ensemble forecast (50 members, 2.5degree resolution, 6hourly interval, once a week)" global forecast data set
  - now available "**MANAL** (10km resolution, 3hourly interval)" for initial and "mfboudary" for boundary **around Japan only**.
- Preparing a convertor from NuSDaS to GRIB and GRIB2. ("NuSDaS to GrADS" is already available.)