
NHM Tutorial

Part I. Brief Usage of the NHM

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 - prepare the external files, compile the model and tools, and install the visualization tools
 - 2.1. Idealized Experiments
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Attention!

(NHM isn't completely free to use.)

- If you want to use the NHM **for research**, you have to send a letter to MRI/JMA and then you'll receive the NHM.
 - **for operational** usage, please contact JMA.
- If you need a sample form of the letter and more information, please contact Dr. Saito at MRI/JMA and download below.
 - http://www.mri-jma.go.jp/Project/Kashinhi_seasia/nhminfo/index.htm
- Contact Person (**for research** use of the NHM):
 - Dr. Tadashi Tsuyuki
Director, Forecast Research Department
Meteorological Research Institute
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1. Brief Usage of the NHM

- Requirements
 - Hardware
 - Software
- Brief Usage of the NHM
 - Directory structure of the NHM
 - Flow of the running the NHM
 - Preparation for running the NHM
 - Running the NHM
 - Visualize results





Requirements for running the NHM

- Hardware:
 - The NHM has been successfully installed to a number of **UNIX-based machines** from PCs to parallel super computers as listed in the next slide.
 - The physical memory size depends on the domain size of the experiment design. Approximately, **100 x 100 x 40 grids in x-y-z need 1.0GBytes physical memory** on a single processor run.
 - Even a virtual-machine on windows, we can run the NHM.



Requirements for running the NHM

- Software (compilers and libraries):
 - Most of the NHM source codes are written in **Fortran90** (C is partially used). **Fortran compiler is needed** for compiling the NHM. We have tested the NHM on several Fortran compilers, g95-fortran, gfortran, Intel-Fortran, PGI-Fortran, and others.
 - In case the NHM is executed on a **shared memory system**, any external libraries are not required. If a **distributed memory system** is selected, **the NHM needs a MPI library** for inter-node communication. (OpenMP is not used in the NHM.)
 - In some preprocesses to use the JMA operational NWP datasets, the NHM employs an exclusive library called **NuSDaS** (Numerical Prediction Standard Data-set System), which is included in the NHM source codes (This library is written in "C").



Requirements for running the NHM

- Software (constant data files):
 - Some external constant files, e.g., topography dataset (**GTOPO30**) and vegetation dataset (**GLCC**), may be needed to conduct a forecast experiment, and they can be downloaded from the USGS website. (The details are shown later.)
 - Compiling the NHM source codes is not so difficult, because configuration files for several systems are prepared as the NHM standard shell scripts.
 - NHM use “NuSDaS”, which is JMA original format. Visualization tool for NuSDaS are included in the NHM.
 - (The NHM can output GrADS format. But GrADS formatted results can not be used for a self-nesting. NuSDaS can be easily converted to GrADS.)



Tested system of running the NHM

- Achievement list of running the NHM

Machine (vendor)	CPU	OS	Compiler	MPI	notes
PC, WS	x86_64 (Intel64, AMD64), IA-32, IA-64,	Linux (redhat, fedora, centos, cygwin...)	PGI, g95, gfortran, Intel Fortran -7,8,9,10 Fujitsu Fortran	LAM, MPICH, fake (no-MPI)	-
PC, WS	IA32	Solaris 10	Sun Studio 11	no-MPI	-
HITACHI-SR11000	POWER5+	AIX	Vendor	Vendor	JMA operation
HITACHI-SR8000	Vendor	HI-UX / MPP	Vendor	Vendor	JMA ex-operation
NEC-SX6, SX8, Earth Simulator	Vendor	SUPER-UX	Vendor	Vendor	MRI / JMA operation (SX6)
Tsubame	AMD64	SuSE Linux 9	PGI	Voltaire MPI	Tokyo Tech
FUJITSU PRIMEPOWER	SPARC 64V	Solaris 10	Vendor	Vendor	MPI library has slightly problems
IBM p690	POWER5+	AIX	Vendor	Vendor	Hong Kong Obs.





Directory structure of the NHM

- Doc : documentations
- Module : source codes and libraries
- Ss : sample executable shell scripts
- Tools : format convertor, visualization tools
- Nusdef : not use directly
- Parm : not use directly



Nhm/Doc (written in html)

- Open "Nhm/Doc/index.html" by web-browser.
 - "English" and "Japanese" link
- En
 - namelists for NHM and preprocess
 - file format of preprocess files and constant files
 - variables in the NHM codes
- Jp
 - same as "En", but in Japanese.



Nhm/Ss

- Ideal : Idealized experiments
 - SC: warm bubble experiments after Sun and Crook(1997)
 - SCHAR_ET_AL: advection test of QV (similar test to Schar et al.(2002))
 - supercell: supercell experiment after Klemp and Wilhelmson(1981)
- Lmwv : Idealized experiments
 - for Mountain Wave in dry situation
 - for Orographic Precipitation by isolated mountain
- RF20km : Regional Forecast where you like in global by using GSM/JMA P-plane data. (also available, NCEP-GFS and JRA25)
- RFnest : 1-way self-nesting run by using NHM output in NuSDaS
- MF : Routine Forecast setting of JMA MSM-10km (2004.Sep - 2006.Feb)
- MF5km : Routine Forecast setting of JMA MSM-05km (used in 2006.Mar - 2007.Feb)
- MF5km33 : Routine Forecast setting of JMA MSM-05km for 33hr forecast (used in 2007.Mar - NOW)



Nhm/Tools

- **grib2nus** : File format converter from GRIB(1 and 2) to NuSDaS
And download tools for NCEP-GFS, JRA25,... are included.
- **pandah** : Plot tool for NuSDaS-formatted file (by NPD/JMA) and including "webpandah"
- **nus2grads**: convert tool from NuSDaS to GrADS with control file
- **nus2v5d** : File format converter from NuSDaS to VIS5D
- **Offline_MJ-SiB** : Offline MJ-SiB
- **gtopo_tool** : File format converter from original GTOPO30 to GTOPO30_JMA_format. (You don't need to use this tool, because converted GTOPO files are included.)



Nhm/Module

- Mk (including config. files)
- Src
 - JMANHM : NHM's source codes
 - PREPOST : pre- and post-process' source codes
 - pnusdas, nwplib : NuSDaS library
 - fakempi : fake library for non-MPI machine
- (Bin : made after the compile, and put loadmodules)



Preparation for running the NHM

- **For Initial and boundary conditions**
 - **NCEP-GFS**-Forecast and Analysis, **JRA25** (JMA-25yr-reanalysis) and **JMA global model (GSM)** data which is supplied by the Japan Meteorological Business Support Center (JMBSC) data are available as shown in the next slide. These data can be downloaded easily using prepared shell scripts (in “Nhm/Tools/grib2nus/”).
 - Additionally, since the NHM is an operational model in JMA, forecast and analysis data of JMA in the NuSDaS format can be used for initial and boundary conditions.





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

- **Convert GPV data to the NuSDaS format**
 - The preprocessing systems for the NHM **support the NuSDaS format only**. So, downloaded dataset have to be converted to the NuSDaS format, if original ones are in the GRIB (GRIB2) format.
 - Shell scripts for download and conversion are included in the NHM.



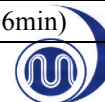
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Running the NHM

- When the GPV data in the NuSDaS format are prepared, it is time to run the NHM.
- Easy sample shell scripts for a forecast experiment is in the directory "Nhm/Ss/RF20km" with recommended namelists parameters. Shell scripts include to create a topography file, initial and boundary files and execute the model.
- Actual memory size and elapse time samples of the NHM

	Domain Size & Forecast Hour	Memory Size	Elapse Time
1MPI (1CPU) on Linux (Xeon quad 2.0GHz x 2, ifc10.1, lam 7.1.4)	201x201x40.dx20km. 12hr forecast (dt=75sec, 576steps)	3.4GB	12415sec (207min)
4MPI (4CPU) (same as above)	same as above	4.0GB (1.0GB x 4)	5458sec (91min)
1MPI (1CPU) on NEC-SX6	same as above	4.70GB	6092sec (102min)
8MPI (8CPU) on NEC-SX6	same as above	7.0GB (0.9GB x 8)	976sec (16min)

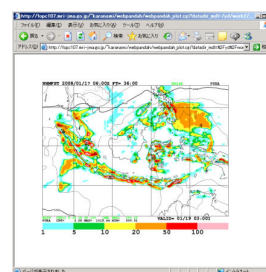
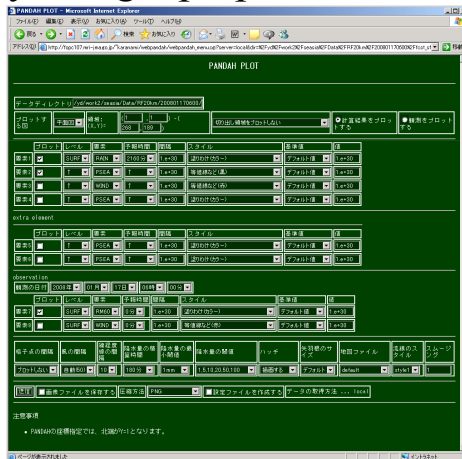
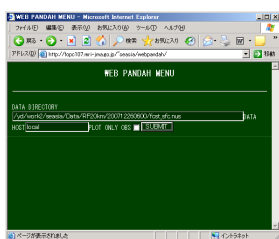


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Post-Process (visualization) for the NHM

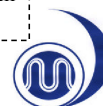
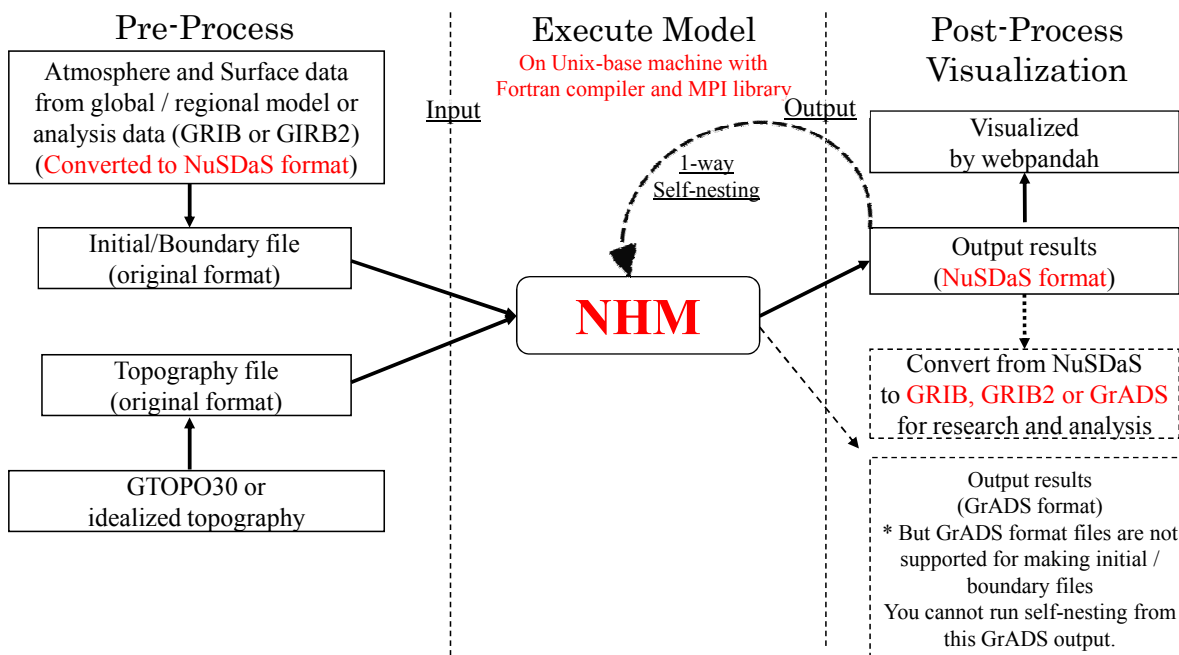
- The NuSDaS format data are easily visualized through the web browser by using a prepared software 'webpandah'.



- And more, a direct output in GrADS format is available or a transform from NuSDaS to GrADS is also available.)



NHM Flow-Chart





For Usability Improvement

- For easy handling NuSDaS data, we are now making a **converter from NuSDaS to GRIB, GRIB2**. In near future, we'll provide it for you. (“NuSDaS to GrADS” is already available.)
- And increasing available dataset (from "**Meteorological Research Consortium**" 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 "**mfboundary**" for boundary **around Japan only**.
- Data Assimilation system not opened yet, sorry.



Result samples of the NHM (comparing the WRF-ARW)

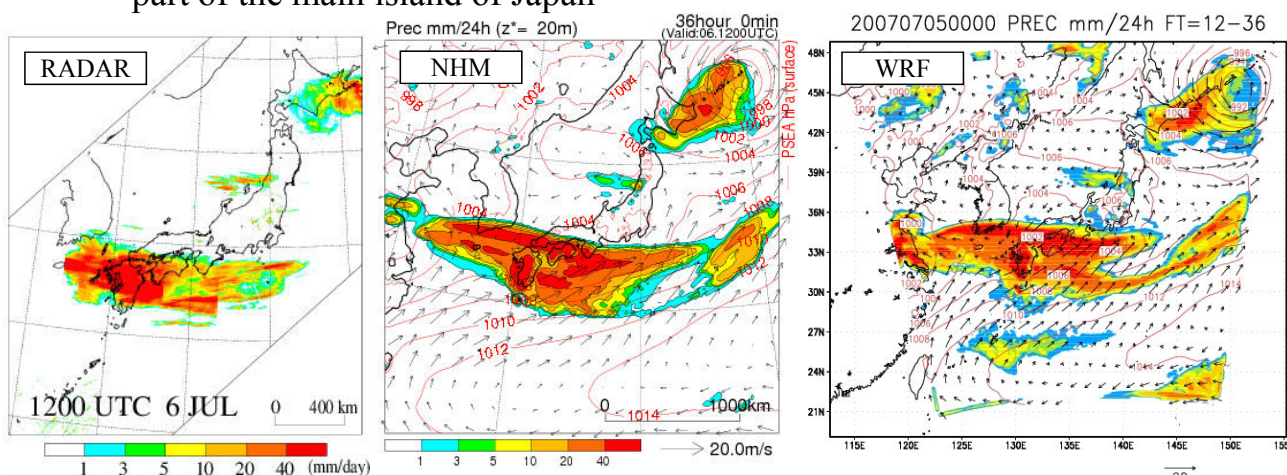
- Example result of the NHM run around Japan using **NCEP GFS forecast** data
- The grid number is 150 x 150 x 40 in x-y-z and the horizontal resolution is 20km.
- Elapse time was about **2hours for 36hr forecast** (dt=75sec, 1728steps) using 4 cores of the Xeon 2.0GHz.
- The 24-hour accumulated precipitation at 2007-Jul-06 12UTC is shown from initial time at Jul-05 00UTC.
- For reference, a result by the WRF-ARW model using same initial and boundary conditions is also indicated.





Result samples of the NHM (comparing the WRF-ARW)

- Comparing the radar observation, basically the **both models well reproduced** the distributions of the observed precipitation, while the NHM seems to predict the rainfall more precisely around the central part of the main island of Japan

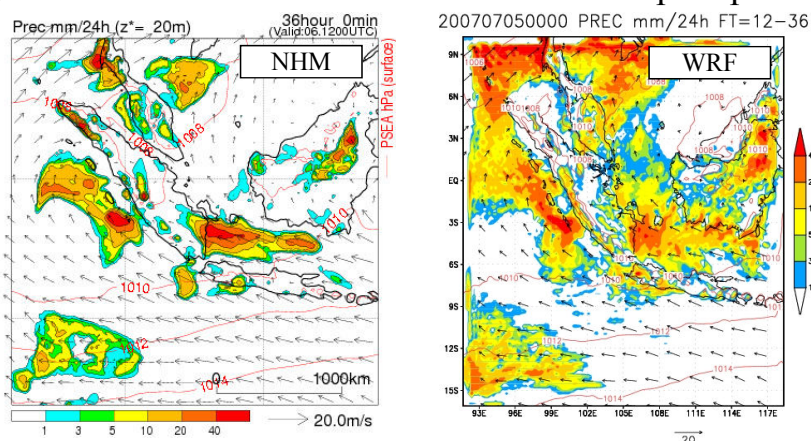


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Result samples of the NHM (comparing the WRF-ARW)

- The results of them around Indonesia at the same day.
- In this case, we haven't yet compared the results with radar observations, though the WRF-ARW seems to **overestimate** the precipitation.



- NHM (as well as WRF) has been mainly applied to the **mid-latitude** so far, and more tests should be done for the simulations in **low-latitude**.



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