NICAM tutorial summary

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About this document

The document contains a set of easy-to-follow instruction that we will be using in this introductory lecture on a Non-hydrostatic Icosahedral Atmosphere Model (NICAM). Since a formal tutorial document, nicam_tutorial-vl2012.txt, can be bit confusing and tricky for first-timers, this is created to make life easier for such people who just want to run NICAM simulations. Keep in mind that "nicam_tutorial-vl2012.txt" includes detailed information about how to execute a simulation in NICAM; therefore, you may want to refer to the formal document if you need to know more about it.

A flow chart of this lecture is as follows. You are

A-1. coping NICAM source files and templates of environments,
A-2. making NICAM binaries,
B. creating "mnginfo file",
C. generating icosahedral mesh,
D. computing weights of a lat-lon interpolation,
E. generating vertical mesh,
F. setting topography and land surface conditions,
G. making O3 data,
H. generating initial conditions of Atmosphere, Ocean and Land,
I. making SST data,
J. making sea ice and snow data,
K. computing reference states in vertical,
L. running NICAM main program,
M. and converting data from icosahedral mesh to lat-lon mesh.

At a glance, this could be a huge task. But, do not worry. You can finish the task quite easily by just following the list of commands here.

A. Preparing NICAM

At the beginning, we are making the NICAM binary files on the Linux

machine named “nicamgate.” Thus we will first login to a nicamgate, then, move to the computing node as below.

i. $ ssh -X (your account)@nicamgate.aori.u-tokyo.ac.jp

ii. $ ssh -X compute0 (or compute1)

Then, following commands will be used to move to your work directory and copy files that will be needed in executing NICAM.

iii. $ cd /data1/(your account)

iv. $ cp /data1/tutorial/nicam_src_20111214.tar.gz ./

v. $ cp /data1/tutorial/reg_nicam_gl05_rl00-20111117.tar.gz ./

vi. $ cp /data1/tutorial/nicam_tutorial-vl2012.txt ./

Make links to two data directories that are used as external data sets.

vii. $ ln -s /data1/tutorial/NICAM_DATABASE

viii. $ ln -s /data1/tutorial/FNL

Unzip and extract tar files.

ix. $ tar zxvf nicam_src_20111214.tar.gz

x. $ tar zxvf reg_nicam_gl05_rl00-20111117.tar.gz

The directory “NICAM” includes Fortran/C source files and configure files to make binaries. The directory “reg_nicam_gl05_rl00” is the template of the NICAM execution environment.

Now, move into “NICAM” directory and create a “Mkinclude” file. Mkinclude is used to describe special settings of a computer and is used during a compilation. Here, we already have such a templete “Mkinclude.vl”, so just copy a Mkinclude.vl to Mkinclude.

xi. $ cd NICAM

xii. $ ln -s Mkinclude.vl Mkinclude

Edit Mkinclude for your environment by using Emacs.

xiii. $ emacs Mkinclude

Here, only line that needs to be edited is on a line 2 “TOPPATH=”. It must be changed to be “TOPPATH=/data1/(your account)/NICAM”. If you have modified a file, then save and execute make in a x-terminal as below.

xiv. $ make

You may wait for a while to create binaries and objects under the

directory bin/. When the make process has been finished, type "$ ls bin/ | wc -l". If count is 73, your make is successful. If not, please let us know.

B. Making "mnginfo"

"mnginfo" describes how to redistribute NICAM grid points to individual computing nodes in its parallel execution. The detail of the rule is not the focus of this lecture and we will finish this task by typing only two lines.

i. $ cd /data1/(your account)/reg_nicam_gl05_rl00/mnginfo
ii. $ ../../NICAM/bin/mkmnginfo

Now, you have a file "rl00-prc000005.info" in the directory.

C. Generating icosahedral mesh

Prof. Satoh may teach you about the icosahedral grid, so again we will not talk about a grid structure in NICAM. Instead, we will focus on the task to generate "concentrated" icosahedral grid.

At first, we are generating the standard icosahedral grid.

i. cd /data1/(your account)/reg_nicam_gl05_rl00/grid/hgrid
ii. mpirun -np 2 ../../../NICAM/bin/mkgrid

You can check the generated mesh by typing as follows:

iii. view_ico.exe setview.cnf-_grid

Then, stretching a grid towards the North Pole.

iv. mpirun -np 2 ../../../NICAM/bin/transgrid
v. $ view_ico.exe setview.cnf-_s10grid

And, moving a center of the stretch to the area of our interest.

vi. $ mpirun -np 2 ../../../NICAM/bin/rotategrid
vii. $ view_ico.exe setview.cnf-_rotate

Next step is to redefine computing nodes to increase computational accuracy and stability.

viii. $ mpirun -np 2 ../../../NICAM/bin/mkgcgrid
ix. $ view_ico.exe setview.cnf-grid

D. Computing latitude-longitude interpolation weights

Creating a map that translates from NICAM-grids to a latitude-longitude. Computing an interpolation weights of lat-lon scheme for each grid points and will be used for data analysis after you finish NICAM execution (e.g. in an ico2ll.cnf). Those interpolated-weights are generated as follows.

i. $ cd /data1/(your account)/reg_nicam_gl05_rl00/grid/llmap
ii. $ mpirun -np 2 ../../../NICAM/bin/mkllmap

E. Generating vertical mesh

Vertical mesh can be generated much easier than the horizontal mesh. Only two commands are needed here.

i. $ cd /data1/(your account)/reg_nicam_gl05_rl00/grid/vgrid
ii. $ ../../../NICAM/bin/mkvlayer

F. Setting topography and land surface conditions

Topography data and land surface conditions for MATSIRO-based data are generated as follows.

i. $ cd /data1/(your account)/reg_nicam_gl05_rl00/external_data/MATSIRO
ii. $ mpirun -np 2 ../../../NICAM/bin/mklanddata2

G. Making Ozone data

Ozone data is made as follows.

i. $ cd /data1/(your account)/reg_nicam_gl05_rl00/external_data/O3
ii. $ mpirun -np 2 ../../../NICAM/bin/mko3

H. Generating initial conditions

First, we need to convert an original initial data set to a format assumed by NICAM. We will create such programs that do exactly that, as below.

i. $ cd /data1/(your account)/reg_nicam_gl05_rl00/local/src
ii. $ emacs Makefile

The only line to be edited is a line 4 where a NICAM_TOPDIR must be changed to "NICAM_TOPDIR=/data1/(your account)/NICAM". After saving a Makefile, type following commands in the terminal.

iii. $ cd ../

iv. $ make

Now you have six programs (conv_lnd, conv_ocn, conv_ocn_ndg, conv_prs, conv_prs_ndg, swap_by_clmsnw) under bin/.

Initial conditions can be generated as follows.

v. $ cd /data1/(your account)/reg_nicam_gl05_rl00/initial_data

vi. $ sh mk_atm.sh ../../FNL/fnl_20090701_00_00_c

vii. $ sh mk_ocn.sh ../../FNL/fnl_20090701_00_00_c

viii. $ sh mk_lnd.sh ../../FNL/fnl_20090701_00_00_c

ix. $ cd ATM

x. $ ../../../NICAM/bin/mkinit_atm

xi. $ cd ../OCN

xii. $ ../../../NICAM/bin/mkinit_ocn

xiii. $ cd ../LND

xiv. $ ../../../NICAM/bin/mkinit_lnd

I. Making SST data for a nudging

You can make SST data as follows.

i. $ cd /data1/(your account)/reg_nicam_gl05_rl00/nudging_data

ii. $ sh mk_sst.sh ../../FNL/fnl_20090

iii. $ cd OCN

iv. $ mpirun -np 2 ../../../NICAM/bin/mkgisst

To check SST data generated, you may use following commands.

v. $ view_ico.exe setview.cnf-sst

J. Making sea ice and snow data

Following the previous section, we will make three more data sets.

vi. $ cd ../OCN_CLM

vii. $ mpirun -np 2 ../../../NICAM/bin/mkgisst

K. Computing reference states

Vertical reference states are used to linearize acoustic and gravity waves. Reference states can be computed and stored as follows.

i. $ cd /data1/(your account)/reg_nicam_gl05_rl00/refstate

ii. $ ../../NICAM/bin/mkbsstate

L. Computing reference states

Now, you can finally run a NICAM main program! It took quite a sometime to get here. Well, only two commands are needed here.

i. $ cd /data1/(your account)/reg_nicam_gl05_rl00/run

ii. $ mpirun -np 2 ../../NICAM/bin/nhm_driver

Wait for a while until the NICAM program has been finished. (Your execution is limited to a very short period because of weak machine power of "nicamgate". We are sorry about that.)

M. Converting data to latitude-longitude grid

Because the structure of the icosahedral grid is a little bit weird, it would be easier to analyze data on latitude-longitude grid. To do so, we need to convert NICAN output data to latitude-longitude grid.

i. $ cd check

ii. $ ../../../NICAM/bin/ico2ll

Data analysis using a graphic tool "GrADS" is one of the topics of the tomorrow lecture.

END

Thank you for your cooperation.

Acknowledgement

I thank Dr. Uchida for significantly improving English of this document.