

# Using GrADS to visualize NICAM output

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## About this document

The document describes how to visualize simulation results of Non-hydrostatic Icosahedral Atmosphere Model (NICAM) through a use of Grid Analysis and Display System (GrADS) software. This visualization software “GrADS” has been developed and updated by a Center for Ocean-Land-Atmosphere Studies (COLA) and its current version is at 2.0.1. You can obtain official documents from a GrADS’ website (<http://www.iges.org/grads/downloads.html>), which offers some tutorials on how to get used to (<http://www.iges.org/grads/gadoc/tutorial.html>). Furthermore, another useful tip can be seen on a “GrADS Commands Quick Reference Card ([http://www.iges.org/grads/gadoc/reference\\_card.pdf](http://www.iges.org/grads/gadoc/reference_card.pdf))”, which provides lists of available commands and can be used for a quick reference. If you want to know more about this subject, you may refer to the manual (<ftp://grads.iges.org/grads/beta/doc/gadoc151.pdf>) for details.

However, our aim here is not to study on GrADS itself, but to use GrADS to visualize outputs from a NICAM simulation. Thus all the necessary commands are listed in order, and you can finish the exercise by simply following them. We are hoping that, after you are done with this class, you should be able to draw

- contour plots, shaded plots, and vector plots on longitude-latitude cross section,
- contour plots on latitude-height cross section, and
- contour plots on longitude-time cross section

from NICAM output data.

### A. Starting up

We will first login to a server, then, move to a computing node.

- i. `$ ssh -X (your account)@nicamgate.aori.u-tokyo.ac.jp`
- ii. `$ ssh -X compute0 (or compute1)`

Then, we will move to a directory contains some sample data files.

- iii. `$ cd /data1/tutorial/NICAM_OUTPUT/global`

Starting up GrADS by typing

iv. `$ grads`

then, you will see a separate black window on your display. If you exit GrADS, just type

v. `> quit`

here “>” means a command prompt of GrADS, while “\$” means a shell command prompt.

B. Opening a data description file (file that describes what kind of data set it contains)

A NICAM output data set used here is “ms\_u.dat”, where “m” means multi-level, “s” means snapshot, and “u” means a zonal wind. The structure of the data is described in a description file “ms\_u.ctl”. If you want to know more about what data formats GrADS can handle, please refer to a manual. Anyhow, now to access an “ms\_u.dat” file, we open ms\_u.ctl by typing as below in a X-terminal

i. `> open ms_u.ctl`

You can look up what type of data set you just opened by typing “> q file”.

C. Longitude-latitude cross sections

You can make a simple contour plot by typing

i. `> d ms_u` (or `> display ms_u`)

Horizontal distribution of zonal wind at 80 m height is plotted on the GrADS window. To change vertical level from 80 m to 1570 m (“q file” command has an info on number of vertical levels that data set has), typing as below.

ii. `> set z 8` (or `> set lev 1570`)

iii. `> d ms_u`

To reset window to blank, enter

iv. `> c` (or `> clear`)

If you want to focus on East Asia, enter

v. `> set lon 100 150`

vi. > set lat 20 60

and type "> d ms\_u" again. The longitude and latitude ranges are set to 100E-150E and 20N-60N, respectively. Not only you can freely choose geographical location that you seek, also can choose a temporal scale. For example, to plot a zonal wind at second time level, enter

vii. > set t 2

If two numbers are given next to a "> set t" command, as in

viii. > set t 1 24

GrADS will display an animated plot of those two time levels and between. When you cannot remember a current time level (or space dimensions), use

ix. > q time (> q dims)

We can also compute time- and space-averages in GrADS, by using "ave" (average) and "aave" (area average) functions. We will have some examples below.

x. > d ave(ms\_u,t=1,t=24)

xi. > d aave(ms\_u,lon=100,lon=150,lat=20,lat=60)

Now, we are going to plot a shaded figure of a temperature. To reset all of the current settings to defaults, enter

xii. > reinit

then, open a description file of temperature data,

xiii. > open ms\_tem.ctl

To change a plot type from a default of contour plot to a shaded plot, type

xiv. > set gxout shaded

When you want to return to a contour plot, type "> set gxout contour". To draw a field of temperature, enter

xv. > d ms\_tem

If you need to add a color bar, enter

xvi. > cbar.gs

Next is a vector plot of zonal and meridional winds. Reset and open three description files as below.

- xvii. > reinit
- xviii. > open ms\_u.ctl
- xix. > open ms\_v.ctl
- xx. > open ms\_tem.ctl

To make a vector plot, type

- xxi. > d ms\_u.1;ms\_u.2

To reduce vector density, use function “skip” as below.

- xxii. > d skip(ms\_u.1,3,2);ms\_v.2

Wind vectors can be colored by adding temperature to the third dimension.

- xxiii. > d skip(ms\_u.1,3,2);ms\_v.2;ms\_tem.3

#### D. Latitude-height cross section

To reset GrADS settings while keeping current data files, enter

- i. > reset

To draw a latitude-height cross section, first fixing a longitude by

- ii. > set lon 0

then allowing multi-levels in a height

- iii. > set z 1 30

and type

- iv. > d ms\_u

GrADS can output a latitude-height cross-section of zonal wind by drawing a zonal mean of zonal wind

- v. > d ave(ms\_u,lon=0,lon=360)

and superimposed by zonal mean of temperature

- vi. > d ave(ms\_tem.3,lon=0,lon=360)

now, you see a well-known thermal wind relationship between a zonal wind and temperature.

#### E. Longitude-time cross section

The last exercise is to plot a longitude-time cross section of outgoing-longwave-radiation (OLR), which is a proxy of upper-level clouds. Reset settings to defaults and open description file of OLR.

- i. > reinit
- ii. > open ss\_lwu\_toa.ctl

Fixing a latitude to 0

- iii. > set lat 0

and allowing a time to move from 1 to 72 levels

- iv. > set time 1 72

also plotting an averaged OLR value between 10S and 10N as below.

- v. > d ave(ss\_lwu\_toa,lat=-10,lat=10)

In this plot, time is advancing forward. But, if you rather want to check in a reverse order, type

- vi. > set yflip on

then type “d ave(ss\_lwu\_toa,lat=-10,lat=10)” again.

#### F. Save image in file

To save image in a file, use “printim” command of GrADS.

- i. > printim ~/a.png

Now, you have a graphic file “a.png” in your home directory. To check this file, use “display” command as

- ii. \$ display ~/a.png

Then exit a GrADS by (> quit).