Introduction to GrADS

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Endalkachew Bekele
NOAA/CPC/International Desks

Outline

- GrADS Tutorial Files
- Introduction
- GrADS Control/Descriptor File
- Displaying Variables
- GrADS Script
- Exercises

1. GrADS Tutorial Files

- Make sure you have the GrADS tutorial files on your machine
- Use your Cygwin/linux terminal to download files:

curl –o ftp://ftp.cpc.ncep.noaa.gov/International/11ITWCVP_Ankara2019/Endalk/grads_excercise.tar.gz
wget ftp://ftp.cpc.ncep.noaa.gov/International/11ITWCVP_Ankara2019/Endalk/grads_excercise.tar.gz

- Unpack the files, using:

tar –xvf grads_excercise.tar.gz

- Move to the GrADS Exercise directory:

```
cd grads_excercise/
```

- Type **ls** to see list of the files:

```
cbar.gs                                gfs_sample.ctl
define_colors.gs                       gfs_sample.grb2
gefs_precip_week1_20190127.ctl         gfs_sample.grb2.idx
gefs_precip_week1_20190127.dat         gribmap.exe*
gefs_Precip_week1_week2_climo.ctl      model.ctl
gefs_Precip_week1_week2_climo.dat      model.dat
```

2. Introduction

- GrADS – Grid Analysis and Display System
  - Used for analyzing and displaying gridded data
- Advantages of using GrADS
  - Free
  - Easy to install and use
  - Very good documentation and users support (http://cola.gmu.edu/grads/gadoc/gadocindex.html)
- Input files
  - Binary
  - GRIB (WMO standard Gridded Binary)
  - Data with Self descriptive files such netcdf
  - OPeNDAP and GDS based data – Remote/online access of metedata and subset of data … you can open access and analyze data with out downloading it to your local computer:

https://nomads.ncep.noaa.gov:9090/dods/gfs_0p50/gfs20190415/gfs_0p50_00z

3. GrADS Control/Descriptor File

- GrADS requires an intermediate file to open a regular binary or GRIB data
- This intermediate file in text format is known as control or descriptor file
- It contains meta information about the main binary or GRIB data:
  - Data file name
  - Vertical and horizontal dimension
  - Time dimension
  - Ensemble dimension
  - List of variables in the file
- Change directory to grads_tutorial folder

cd grads_excercıse

- Using npp (cygwin users) or gedit (Linux users) open model.ctl

npp model.ctl& or **gedit model.ctl&**

3. GrADS Control/Descriptor File (Cont.)

```
DSET   ^model.dat          name of the main binary file
OPTIONS little_endian      Data byte order (default is little_endian)
UNDEF  -2.56E33            missing value
TITLE 5 Days of Sample Model Output          Data title
XDEF 72 LINEAR  0.0 5.0              longitude dimension and grid resolution
YDEF 46 LINEAR  -90.0 4.0            Latitude dimension and grid resolution
ZDEF 7 LEVELS 1000 850 700 500 300 200 100  vertical dimension  and resolution
TDEF 5 LINEAR 02JAN1987 1DY          Time dimension
VARS 8          Number of variables
ps     0   99   Surface Pressure
u      7   99   U Winds
v      7   99   V Winds
hgt    7   99   Geopotential Heights
tair   7   99   Air Temperature
q      5   99   Specific Humidity
tsfc   0   99   Surface Temperature
p      0   99   Precipitation
ENDVARS
```

4. Displaying Variables

- On your cygwin/Linux terminal, type **ls** to see list of files, and make sure that **model.dat** (the main binary file) and **mode.ctl** (its descriptor or control) files are available.
- Type **grads –p** to initiate the grads package, with a portrait oriented display window
  - The display window opens

4. Displaying Variables (cont.)

- Type GrADS commands in logical order
  - open model.ctl
  - q file

ps 0 99 Surface Pressure

u 7 99 U Winds

v 7 99 V Winds

hgt 7 99 Geopotential Heights

tair 7 99 Air Temperature

q 5 99 Specific Humidity

tsfc 0 99 Surface Temperature

p 0 99 Precipitation

4. Displaying Variables (cont.)

- Type GrADS commands in logical order
  - **d ps** (displays surface pressure plots on the display window)
  - set geographical domain for your country

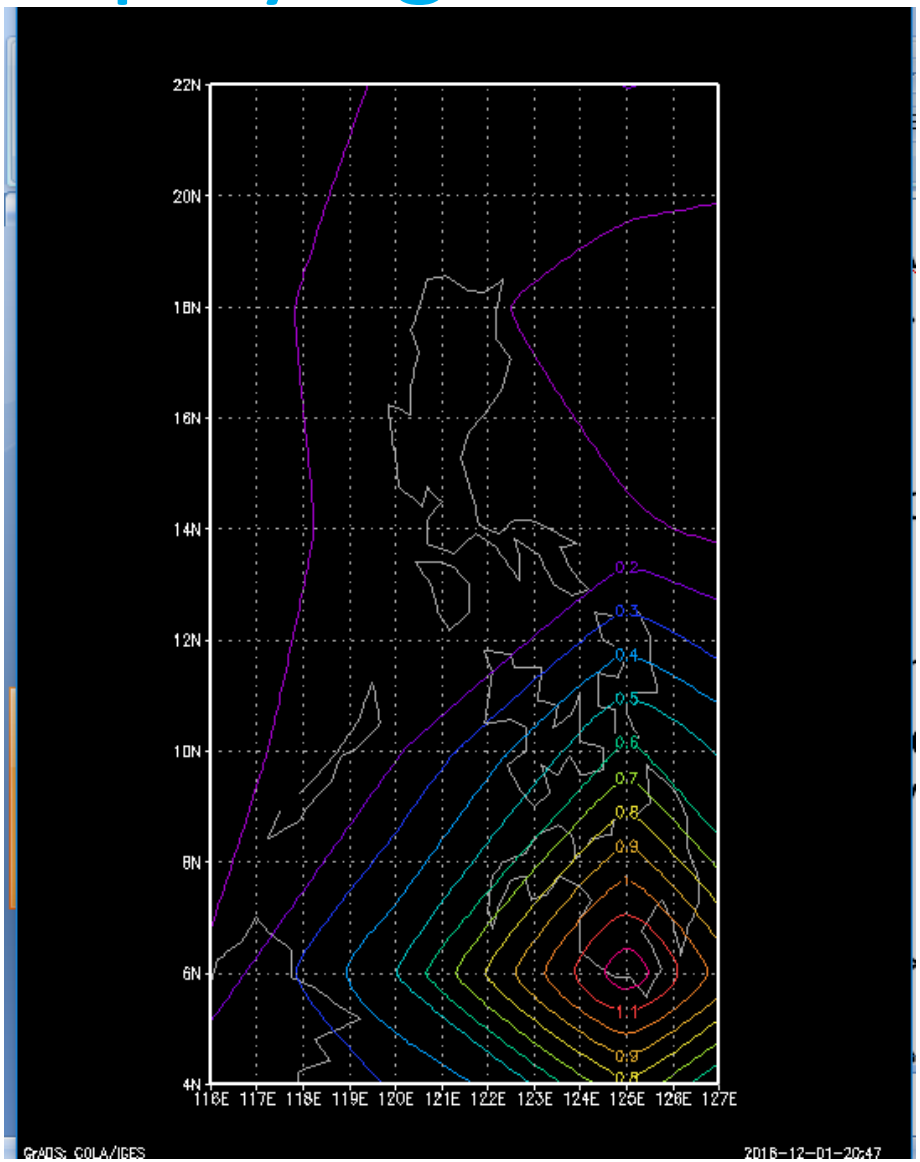
  Set lat 4 22

  Set lon 116 127
  - Type **c** to clear the plot on the display window before we make another plot
  - Type **d ps**
  - Instead surface pressure, plot rainfall for Jan 4, 1987

4. Displaying Variables (cont.)

- Type GrADS commands in logical order
  - c
  - **set t 3** or **set time 4jan1987**
  - **d p**
  - The rainfall unit in this data is mm/sec, and need to change it to mm/day
  - Type **c**
  - **d p*60*60*24**

4. Displaying Variables (cont.)



4. Displaying Variables (cont.)

- Type GrADS commands in logical order
  - Type **Set gxout shaded** to change the graphics output from contour to shaded colors
  - Type **set mpdset hires** to add high resolution boundary map to your display, and type **c** to clear the previous display
  - **d p*60*60*24**
  - Type **cbar** to add color legend to your plot
  - Type **set display color white** to change display background color to white
  - Clear the previous display, and redisplay it to reflect the new changes (**c; d p*60*60*24; cbar**)

4. Displaying Variables (cont.)

- Type GrADS commands in logical order
  - Type **set grads off** to remove GrADS logo and dates in the display window and redisplay (**c; d p*60*60*24; cbar)**
  - Use our own color scale
  - RGB based color definitions in opengrads

21 to 29 gives light yellow to dark red

31 to 39 light green to dark green

41 to 49 light blue to dark blue

71 to 79 light brown to dark brown

4. Displaying Variables (cont.)

- Type GrADS commands in logical order
  - Type **define_colors** to activate the RGB color definition script on your current display
  - Clear the previous display and remove the GrADS logo (**c; set grads off)**
  - Type **set clevs 3 6 9 12 16 18 21 24 27 30** to define contour levels for your display
  - Type **set ccols 0 32 34 36 44 46 21 23 25 27 29** to enter the color of your choice
  - redisplay (**d p*60*60*24; cbar)**

4. Displaying Variables (cont.)

```
'open model.ctl'
'set lat 4 22'
'set lon 116 127'
'set display color white'
'c'
'set mpdset hires'
'set gxout shaded'
'set grads off'
'define_colors'
'set clevs 3 6 9 12 15 18 21 24 27 30'
'set ccols 0 32 34 36 44 46 21 23 25 27 29'
'd p*60*60*24'
'cbar'
'draw title Daily rainfall; valid Jan 4, 1987'
'printim test.png'
```

5. GrADS Script

Use your npp or gedit to type the following GrADS commands,:
npp grads_test1.gs or **gedit grads_test1.gs**

'open model.ctl'

'set lat 4 22'

'set lon 116 127'

'set display color white'

'c'

'set mpdset hires'

'set gxout shaded'

'set grads off'

'define_colors'

'set clevs 3 6 9 12 15 18 21 24 27 30'

'set ccols 0 32 34 36 44 46 21 23 25 27 29'

'd p*60*60*24'

'cbar'

'draw title Daily rainfall; valid Jan 4, 1987'

'printim test.png'

- Save and Exit

5. GrADS Script (cont)

- On your terminal, type **ls** to check if your **grads_test1.gs** file is available
- Run your GrADS script in portrait display orientation

grads –pc grads_test1.gs

Exercise 1 (questions)

1. From the **grads_tutorial** directory, use your text editor (npp or gedit) to open **gfs_sample.ctl**, and examine structure of the data (its dimension, variable names …)
2. **Write two GrADs scripts that display horizontal wind divergence at 850-hPa and 200-hPa over your country, for 12Z of Aug 15, 2017.**
   - **Overlay wind vectors on your divergence plot**
   - **Use your own color definitions**
   - **Please refer to GrADS documentation page for a reference**

   Use 1e05 factor to have unit scale conversion in the divergence plot

Exercise 1 (Answer)

```
'open gfs_sample.ctl'
'set lat -10 40'
'set lon 90 140'
'set display color white'
'c'
'set mpdset hires'
'set gxout shaded'
'set grads off'
'define_colors'
'set lev 850'
'set time 12Z15aug2017'
'set clevs -8 -6 -4 -2 2 4 6 8'
'set ccols 49 47 45 43 0 63 65 67 69'
'd hdivg(ugrdprs,vgrdprs)*1e05'
'd skip(ugrdprs,3,3);vgrdprs'
'cbar'
'draw title 850-hPa Wind and Divergence; 12Z Aug 15 2017'
'printim div_850.png'
```

Exercise 1 (Answer)

```
'open gfs_sample.ctl'
'set lat -10 40'
'set lon 90 140'
'set display color white'
'c'
'set mpdset hires'
'set gxout shaded'
'set grads off'
'define_colors'
'set lev 200'
'set time 12Z15aug2017'
'set clevs -8 -6 -4 -2 2 4 6 8'
'set ccols 69 67 65 63 0 43 45 47 49'
'd hdivg(ugrdprs,vgrdprs)*1e05'
'd skip(ugrdprs,3,3);vgrdprs'
'cbar'
'draw title 200-hPa Wind and Divergence; 12Z Aug 15 2017'
'printim div_200.png'
```

Exercise 2 (question)

- **Use the following files in this exercise:**

gefs_precip_week1_20190127.ctl

gefs_precip_week1_20190127.dat

gefs_Precip_week1_week2_climo.ctl

gefs_Precip_week1_week2_climo.dat

  - Write two GrADs scripts that plot GEFS **week-1 total rainfall forecast** and **GEFS rainfall forecast anomaly** for a week of 27 January 2019 (week that begins on January 27, 2019)

```
'open gefs_Precip_week1_week2_climo.ctl'
'set lat 4 22'
'set lon 116 127'
'set time 27jan'
'define clm=week1'
'close 1'
'open gefs_precip_week1_20190127.ctl'
'set lat 4 22'
'set lon 116 127'
'set time 27jan2019'
'define for=rain'
'set display color white'
'c'
'set mpdset hires'
'set gxout shaded'
'set grads off'
'define_colors'
'set clevs 10 12 30 40 50 60 70 80 90 100'
'set ccols 0 32 34 36 44 46 21 23 25 27 29'
'd for'
'cbar'
'draw title GEFS Week-1 Total; valid Jan 27-Feb 2
2019'
'printim total.png'
```

```
'open gefs_Precip_week1_week2_climo.ctl’
'set lat 4 22'
'set lon 116 127‘
‘set time 27jan
‘define clm=week1’
‘close 1’
‘open gefs_precip_week1_20190127.ctl’
'set lat 4 22'
'set lon 116 127‘
‘set time 27jan2019’
‘define for=rain’
‘define anom = for – clm’
'set display color white'
'c'
'set mpdset hires'
'set gxout shaded'
'set grads off'
'define_colors'
'set clevs -50 -40 -30 -20 -10 10 20 30 40 50'
'set ccols 79 77 75 73 71 0 31 33 35 37 39'
'd anom'
'cbar'
'draw title GEFS Week-1 Anomaly; valid Jan 27-Feb 2
2019'
'printim anom.png‘
```