REGRID

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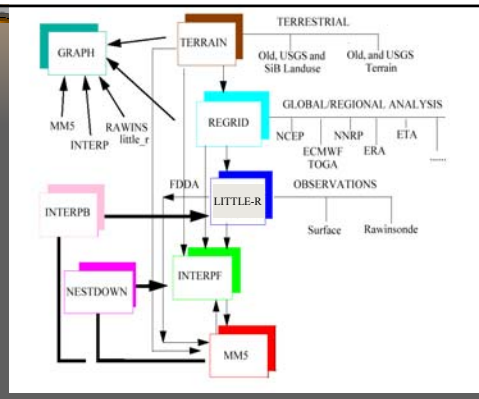


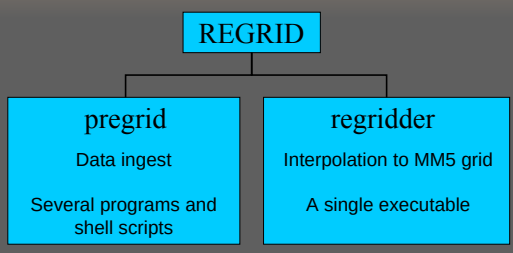
Purpose

- Read archived meteorological analyses/forecast
  - Traditionally, these have been global analyses
  - Now, these are often regional analyses and forecasts
- Interpolate to horizontal MM5 grid
  - two-dimensional interpolation
    - pressure-levels
    - surface level
- TC-Bogus

Purpose (Bonus notes – FREE)

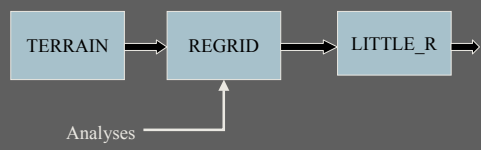
- Regional modeling is an initial and boundary value problem
  - Initial conditions required at model time zero
  - Lateral boundary conditions required for the *entire* simulation/forecast period
- REGRID, then, requires as input data for the *entire* simulation/forecast period
  - Instantaneous fields periodically (usually every 3-12 hours) from start time to end time
  - After the initial time, only the data in the boundary zone are used through the end of the forecast

Structure



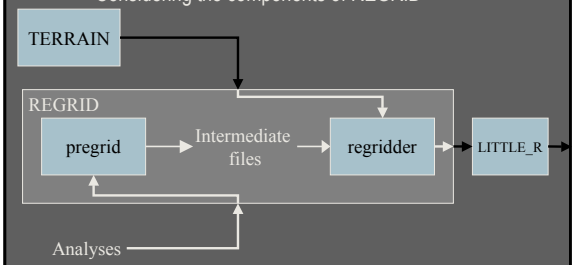
Structure

- Considering REGRID as a package:



Structure

- Considering the components of REGRID



Input to pregrid

- Meteorological analyses
  - Often GRIB
    - namely, GRIB edition 1 (and fairly "normal" GRIB, at that)
    - No support (yet) for GRIB edition 2
- Vtables
- Namelist

Output From pregrid

- Intermediate Files

Input to regridder

- Intermediate files from pregrid
- Terrain files (from program TERRAIN)
- Namelist
- Optional analyses of surface characteristics (REGRID Intermediate Format)

Output From regridder

- REGRID_DOMAIN#

Intermediate Data Format

- General format description
- File naming conventions
- File format
- Special field names

Intermediate Data Format

- General format description
  - 2D Horizontal slabs
  - Each slab contains a single level of a single variable
  - Any number of slabs may be written to a single file
  - Slabs in a given file need not be from the same data source, or on the same grid or map projection
  - All the slabs in a given file should represent data valid at a single instant in time

Intermediate Data Format

- File naming conventions
  - <prefix>:<yyyy-mm-dd_hh>
  - Examples:
    - ON84:1985-03-19_00
    - GDAS:2004-01-06_12
    - FILE:2001-01-01_00

Intermediate Data Format

- File format
  - Unformatted FORTRAN records (sequential access)
  - Four records for each horizontal slab:
    - Record 1: Format version number
    - Record 2: Common grid (map) information
      - HDATE, XFCST, FIELD, UNITS, DESC, XLVL, NX, NY, IPROJ
    - Record 3: Specific grid (map) information
      - startlat, startlon, delta-lat, delta-lon
      - startlat, startlon, delta-x, delta-y, truelat1
      - startlat, startlon, delta-x, delta-y, xlonc, truelat1, truelat2
      - startlat, startlon, delta-x, delta-y, xlonc, truelat1
    - Record 4: Horizontal slab

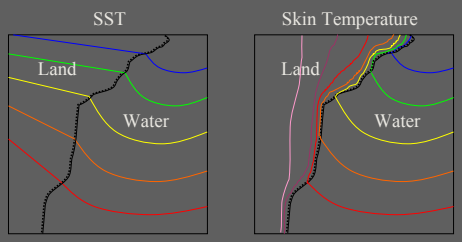
Intermediate Data Format

- Special field names
  - Certain field names are recognized for certain uses within the MM5 system (see tutorial notes for table).
  - Slabs identified by an unrecognized field name are simply interpolated horizontally and written out by regridder

T	*	Air Temperature (K)
U	*	Grid-relative u component of the horizontal wind (m s^{-1})
V	*	Grid-relative v component of the horizontal wind (m s^{-1})
RH	*	Relative Humidity (%)
HGT	*	Geopotential height (gpm)
PMSL	*	Sea-level pressure (Pa)
SST or TSEASFC	**	Sea-surface Temperature (K)
SKINTEMP	**	Skin Temperature (K)
SNOWCOVR		Binary flag: snow (1.0) or no snow (0.0) on the ground
SOILT<###>		Ground temperature of a layer below ground (K)
SOILM<###>		Soil Moisture of a layer below ground (m^3 m^{-3})
SEAICE		Binary flag: sea ice (1.0) or no sea ice (0.0) on the water
LANDSEA		Binary flag: land (1.0) or water (0.0)
SOILHGT		Terrain elevation of input data set (m)

WEASD		Water equivalent of accumulated snow depth (kg m^{-2})
SPECHUMD	▲	Specific Humidity (kg kg^{-1})
DEWPT	▲	Dewpoint (K)
DEPR	▲	Dewpoint depression (K)
VAPP	▲	Vapor Pressure (Pa)
GEOPT	▲	Geopotential (m^2 s^{-2})

SST and Skin Temperature



Pregrid Vtables

- How to tell pregrid what to access
  - Used mostly for GRIB datasets
  - GRIB conventions of referencing fields, level types, and levels are converted to MM5-system conventions of field name, units, and description.

Vtable examples

GRIB Code	Level Code	Level 1	Level 2	REGRID Name	REGRID Units	REGRID Description
11	100	*		T	K	Temperature
11	105	2		T	K	Temperature at 2 m

GRIB Code	Level Code	Level 1	Level 2	REGRID Name	REGRID Units	REGRID Description
11	100	*		T	K	Temperature
51	100	*		SPECHUMD	kg kg{-1}	
	100	*		RH	%	Relative Humidity

Vtable examples

GRIB Code	Level Code	Level 1	Level 2	REGRID Name	REGRID Units	REGRID Description
11	100	*		T	K	Temperature
33	100	*		U	m s{-1}	U
34	100	*		V	m s{-1}	V
51	100	*		SPECHUMD	kg kg{-1}	
52	100	*		RH	%	Relative Humidity
7	100	*		HGT	m	Height
11	105	2		T	K	Temperature
52	105	2		RH	%	Relative Humidity
33	105	10		U	m s{-1}	U
34	105	10		V	m s{-1}	V
130	102	0		PMSL	Pa	Sea-level Pressure

Pregrid Utility Programs

- gribprint [-v | -V] <*grib file*>
- plotfmt <*intermediate file*>
- get_ncep.deck
- get_on84.deck
- get_nnrp.deck
- get_era.deck

How to Run REGRID

1. Get the source code
2. Make the executables
3. Get the analysis files
4. Edit pregrid.csh
5. Make sure pregrid.csh is executable (chmod u+x pregrid.csh)
6. Run pregrid.csh
7. Check the output of pregrid
8. Edit regridder namelist file
9. Run regridder

How to Run REGRID

1. Get the source code
2. Make the executables
3. Get the analysis files
   b) Understand your data
4. Edit pregrid.csh
5. Make sure pregrid.csh is executable (chmod u+x pregrid.csh)
6. Run pregrid.csh
7. Check the output of pregrid
8. Edit regridder namelist file
9. Run regridder

Get the source code

- ftp://ftp.ucar.edu/mesouser/MM5V3/REGRID.TAR.gz
- gunzip REGRID.TAR.gz
- tar –xvf REGRID.TAR

- This makes top-level directory REGRID

Make the executables

- cd REGRID
- make
  - Many fairly common configurations are recognized by our makefiles
  - If the "make" does not make all executables, you may need to go into the makefile and tune some of the compiler and load options yourself

Get the analysis files

- From NCAR's archives
- From some other source of archives
- From real-time ftp sites

pregrid.csh

- Shell script designed as a higher-level user interface for the pregrid programs.

pregrid.csh

```
#!/bin/csh -f
# set echo

#
# Put your input files for pregrid into the directory you specify as Dat
#

set DataDir = /usr/tmp/username/REGRID

#
# Specify the source of 3-d analyses
#


  set SRC3D = ON84 # Old ON84-formatted NCEP GDAS analyses
# set SRC3D = NCEP # Newer GRIB-formatted NCEP GDAS analyses
# set SRC3D = GRIB # Many GRIB-format datasets


# InFiles:  Tell the program where you have put the analysis files,
# and what you have called them. If SRC3D has the value "GRIB",
# then the Vtables you specify below in the script variable VT3D will
# be used to interpret the files you specify in the ${InFiles} variabl

  set InFiles = ( ${DataDir}/NCEP* )
#
```

```
#
# Specify the source of SST analyses
#

# set SRCSST = ON84
# set SRCSST = NCEP
# set SRCSST = NAVY
  set SRCSST = $SRC3D

#
# InSST: Tell the program where the files with SST analyses are. Do
# this only if SST analyses are coming from files not named above in
# InFiles. If SRCSST has the value "GRIB", then the Vtables you
# specify below in the script variable VTSST will be used to interpret
# the files you specify in the ${InSST} variable.
#

  set InSST = ( )

#
# Select the source of snow-cover analyses (entirely optional)
#

  set SRCSNOW = $SRC3D
# set SRCSNOW = ON84
# set SRCSNOW = GRIB

# InSnow: Set InSnow only if the snow-cover analyses are from files
# not listed in InFiles. If SRCSNOW has the value "GRIB", then the
# Vtables you specify below in the script variable VTSNOW will be used
# to interpret the files you specify in the ${InSnow} variable.

  set InSnow = ()
#
```



```
#
# Select the source of soil model analyses (entirely optional)
#

# set SRCSOIL = $SRC3D

# InSoil: Set InSoil only if the soil analyses are from files
# not listed in InFiles. If SRCSOIL has the value "GRIB", then the
# Vtables you specify below in the script variable VTSOIL will be
# used to interpret the files you specify in the ${InSoil} variable.

# set InSoil = ()

#
# Build the Namelist
#
if ( -e ./pregrid.namelist ) then
  rm ./pregrid.namelist
endif
cat << End_Of_Namelist | sed -e 's/#.*//; s/ *$//' > ./pregrid.namelist
&record1
#
# Set the starting date of the time period you want to process:
#
 START_YEAR  = 1993 # Year (Four digits)
 START_MONTH = 03   # Month ( 01 - 12 )
 START_DAY   = 13   # Day ( 01 - 31 )
 START_HOUR  = 00   # Hour ( 00 - 23 )

 END_YEAR  = 1993   # Year (Four digits)
 END_MONTH = 03     # Month ( 01 - 12 )
 END_DAY   = 14     # Day ( 01 - 31 )
 END_HOUR  = 00     # Hour ( 00 - 23 )
```



```
#
# Define the time interval to process.
#
 INTERVAL = 43200 # Time interval (seconds) to process.
# This is most sanely the same as the time interval for
# which the analyses were archived, but you can really
# interpolate in time and/or skip over time periods for
# your regridding pleasure.

/
End_Of_Namelist

#
# Tell the pregrid programs which Vtables to use. Do this only
# if you have selected GRIB-formatted input using SRC___ = GRIB above.
# The directories referenced here are relative to REGRID/pregrid/.
#
# The Vtable files specified in VT3D will be applied to the files
# specified in the InFiles variable. Similarly, the Vtable files
# specified in VTSST, VTSNOW, and VTSOIL will be applied to the files
# listed above in InSST, InSNOW, and InSoil, respectively.
#
 set VT3D = ( grib.misc/Vtable.NNRP3D )
 set VTSST = ( grib.misc/Vtable.NNRPSST )
 set VTSNOW = ( grib.misc/Vtable.xxxxSNOW )
 set VTSOIL = ( grib.misc/Vtable.xxxxSOIL )

###########################################################################
###########################################################################
#####                                                                 #####
#####                END USER MODIFICATION                            #####
#####                                                                 #####
###########################################################################
###########################################################################
```

regridder namelist

- File resides in the “regridder” directory, called “namelist.input”

namelist.input RECORD1

- START_YEAR: 4-digit year
- START_MONTH: 2-digit month of year
- START_DAY: 2-digit day of month
- START_HOUR: 2-digit hour of day
- END_YEAR: 4-digit year
- END_MONTH: 2-digit month of year
- END_DAY: 2-digit day of month
- END_HOUR: 2-digit hour of day
- INTERVAL: Seconds between times to process

namelist RECORD1 example

```
&RECORD1
  START_YEAR  = 1993
  START_MONTH = 03
  START_DAY   = 13
  START_HOUR  = 00

  END_YEAR    = 1993
  END_MONTH   = 03
  END_DAY     = 14
  END_HOUR    = 00

  INTERVAL    = 43200
/
```

namelist.input RECORD2

- ptop_in_Pa:
  - Pressure level (in Pa) of the highest level you want to process. This level must exist in the input data.
- new_levels_in_Pa:
  - List of new pressure levels (not already in the input data) that you want to add to the regridder processing
- sst_to_ice_threshold:
  - SST below which the water will be considered sea-ice.
- linear_interpolation
  - Logical flag to use 4-point bilinear interpolation (.TRUE.) or 16-point overlapping parabolic interpolation (.FALSE.)

namelist RECORD2 example

```
&RECORD2
  ptop_in_pa       = 10000
  new_levels_in_Pa = 95000, 90000, 85000, 80000, 75000,
                     70000, 65000, 60000, 55000, 50000,
                     45000, 40000, 35000, 30000, 25000,
                     20000, 15000, 10000
  sst_to_ice_threshold = -9999
  linear_interpolation = .FALSE.
/
```


namelist.input RECORD3

- root:
  - What files to look for. A list of path-names to the intermediate files created by pregrid, up to but not including the ":". Date information is generated internally by regridder and tacked onto the root names you provide.
- constants_full_name:
  - The complete path-name of a file that has fields which are to be kept constant for all time periods.
- terrain_file_name:
  - The complete path-name of the terrain file created by program TERRAIN. Most often this will be "TERRAIN_DOMAIN1".

namelist RECORD3 example

```
&RECORD3
  root                = '../pregrid/FILE', ../pregrid/SNOW'
  constants_full_name = './SST_CONSTANT'
  terrain_file_name   = './TERRAIN_DOMAIN1'
/
```


namelist RECORD4 example

```
&RECORD4
  print_echo              = .FALSE.
  print_debug             = .FALSE.
  print_mask              = .FALSE.
  print_interp            = .FALSE.
  print_link_list_store   = .FALSE.
  print_array_store       = .FALSE.
  print_header            = .FALSE.
  print_output            = .FALSE.
  print_file              = .FALSE.
  print_f77_info          = .TRUE.
/
```


namelist RECORD5 example

```
&RECORD5
  insert_bogus_storm  = .TRUE.
  num_storm           = 3
  latc_loc            =  20.,  10.,  40.
  lonc_loc            = -50., -30., -60.
  vmax                =  50.,  45.,  20.
/
```

Complete regridder namelist

```
&record1
 start_year   =  1993
 start_month  =   03
 start_day    =  13
 start_hour   =  00
 end_year     =  1993
 end_month    =  03
 end_day      =  14
 end_hour     =  00
 interval     =  43200
/

&record2
 ptop_in_Pa        =  10000
 new_levels_in_Pa  =  97500 , 95000 , 92500 , 90000 ,
                      87500 , 85000 , 82500 , 80000 ,
                      77500 , 75000 , 72500 , 70000 ,
                      67500 , 65000 , 62500 , 60000 ,
                      57500 , 55000 , 52500 , 50000 ,
                      47500 , 45000 , 42500 , 40000 ,
                      37500 , 35000 , 32500 , 30000 ,
                      27500 , 25000 , 22500 , 20000 ,
                      17500 , 15000 , 12500 , 10000
 sst_to_ice_threshold  =  -9999
 linear_interpolation  =  .FALSE.
/
```



```
&record3
 root                 = '../pregrid/ON84'
                        '../pregrid/ON84_SST'
                        '../pregrid/ON84_SNOW'
 terrain_file_name    = '../../TERRAIN/TERRAIN_DOMAIN1' /
 constants_full_name = '../pregrid/SST_FILE:1993-03-13_00'
/

&record4
 print_echo      = .FALSE. ,
 print_debug     = .FALSE. ,
 print_mask      = .FALSE. ,
 print_interp    = .FALSE. ,
 print_link_list_store = .FALSE. ,
 print_array_store = .FALSE. ,
 print_header    = .FALSE. ,
 print_output    = .FALSE. ,
 print_file      = .FALSE. ,
 print_tc        = .FALSE. ,
 print_f77_info = .TRUE. /
```



```
&record5
 insert_bogus_storm = .FALSE.
 num_storm = 1
 latc_loc = 36.0
 lonc_loc = -35.0
 vmax_meters_per_second = 35.0
 rmax = 90000.0
 vmax_ratio = 0.75
/
```


Data

- REGRID has been used successfully with a variety of data sets, including:
- Archived data sets:
  - NCEP GDAS (Global Data Assimilation System)
  - NCEP/NCAR Reanalysis
  - NCEP EDAS (Eta Data Assimilation System)
  - ECMWF TOGA Analysis
  - ECMWF Reanalysis

Data

- Real-time data sets:
  - NCEP Eta analysis and forecast
  - NCEP AVN analysis and forecast