# WRF-NMM Standard Initialization: namelist details

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# Overview

- Examine a WRF-NMM SI namelist file. What is important, and what can be ignored?
- Brief descriptions of the E-grid, the rotated latitude-longitude map projection, and the hybrid vertical coordinate (as time allows).

# WRF-NMM SI namelist, big picture

- Namelist file is comprised of six separate groupings:
  - project_id
  - filetimespec
  - hgridspec
  - sfcfiles
  - interp_control
  - si_paths

# **project_id, filetimespec**: not very critical

```
&project_id
 SIMULATION_NAME = ‘My Domain’
 USER_DESC = 'WRF User'
/

&filetimespec
 START_YEAR = 2003
 START_MONTH = 03
.
.
.
 END_SECOND = 00,
 INTERVAL = 10800
/
```

Provides “ownership” info that is written to the output file metadata.

Controlled (over-written) by perl scripts when running the SI.

# **hgridspec**: where the horizontal grid is defined

```
&hgridspec
 NUM_DOMAINS = 1,
 XDIM = 60,1
 YDIM = 139,1
 PARENT_ID = 1
 RATIO_TO_PARENT = 1
 DOMAIN_ORIGIN_PARENT_X = 1
 DOMAIN_ORIGIN_PARENT_Y = 1
 MAP_PROJ_NAME = 'rotlat',
 MOAD_KNOWN_LAT = 40.0,
 MOAD_KNOWN_LON = -105.0,
 MOAD_KNOWN_LOC = 'center'
 MOAD_STAND_LATS = 40.0, 0.0,
 MOAD_STAND_LONS = -105.0
 MOAD_DELTA_X = 0.1541
 MOAD_DELTA_Y = 0.1408
 SILAVWT_PARM_WRF = 0.
 TOPTWVL_PARM_WRF = 0.
/
```

# **hgridspec**: where the horizontal grid is defined (cont.)

```
&hgridspec
 NUM_DOMAINS = 1,

 XDIM = 60,1
 YDIM = 139,1


 PARENT_ID = 1
 RATIO_TO_PARENT = 1
 DOMAIN_ORIGIN_PARENT_X = 1
 DOMAIN_ORIGIN_PARENT_Y = 1


 MAP_PROJ_NAME = 'rotlat',
```

**YDIM must be ODD.** Only first number is relevant if there is a list.

Nesting related elements do not apply to this version of the SI

The rotated lat-lon projection (rotlat) is the only one used with the WRF-NMM SI.

# **hgridspec**: where the horizontal grid is defined (cont.)

**(cont.)**

**MOAD_KNOWN_LAT = 40.0,**
**MOAD_KNOWN_LON = -105.0,**
**MOAD_KNOWN_LOC = 'center'**
**MOAD_STAND_LATS = 40.0**
**MOAD_STAND_LONS = -105.0**

**MOAD_DELTA_X = 0.1541**
**MOAD_DELTA_Y = 0.1408**

SILAVWT_PARM_WRF = 0.
TOPTWVL_PARM_WRF = 0.
/

NMM grid location always defined by a center lat/lon. "MOAD_KNOWN" and "MOAD_STAND" values should be the same.

Grid spacing specified in fractions of a degree.

Topography smoothing controls from the ARW SI don't apply here.

# **sfcfiles**: specifies location of static datasets

```
&sfcfiles
 TOPO_30S = '/u/mp/sigeog/topo_30s',
 LANDUSE_30S = '/u/mp/sigeog/landuse_30s',
 SOILTYPE_TOP_30S = '/u/mp/sigeog/soiltype_top_30s',
 SOILTYPE_BOT_30S = '/u/mp/sigeog/soiltype_bot_30s',
 GREENFRAC = '/u/mp/sigeog/greenfrac',
 SOILTEMP_1DEG = '/u/mp/sigeog/soiltemp_1deg',
 ALBEDO_NCEP = '/u/mp/sigeog/albedo_ncep',
 MAXSNOWALB = '/u/mp/sigeog/maxsnowalb',
 ISLOPE = '/u/mp/sigeog/islope',
/
```

The “parent” directory will automatically be set in the namelist if the environmental variable GEOG_DATAROOT is defined when the SI is installed.

# **interp_control**: hinterp methods, vertical coord, etc.

```
&interp_control
 NUM_DOMAINS = 1,
 DOMAIN_ID_LIST = 1,
 PTOP_PA = 5000,
 HINTERP_METHOD = 1,
 LSM_HINTERP_METHOD = 0,
 NUM_INIT_TIMES = 1,
 INIT_ROOT = 'ETA',
 LBC_ROOT = 'ETA',
 LSM_ROOT = 'ETA',
 CONSTANTS_FULL_NAME = '',
 VERBOSE_LOG = .false.,
 OUTPUT_COORD = 'NMMH',
 LEVELS = 1.00, .994, .982, .968, .950, .930,
          .908, .882, .853, .821, .788, .752, .715,
          .677, .637, .597, .557, .517, .477, .438,
          .401, .365, .330, .298, .268, .240, .214,
          .188, .162, .137, .114, .091, .068, .045,
          .022, .000
 OUTPUT_VARS = 2,
 OUTPUT_FILE_TYPE = 'WRF',
/
```

# **interp_control**: hinterp methods, vertical coord, etc.

```
&interp_control

 NUM_DOMAINS = 1,
 DOMAIN_ID_LIST = 1,

 PTOP_PA = 5000,
 HINTERP_METHOD = 1,
 LSM_HINTERP_METHOD = 0,

 NUM_INIT_TIMES = 1,

 INIT_ROOT = 'ETA',
 LBC_ROOT = 'GFS',
 LSM_ROOT = 'ETA',
CONSTANTS_FULL_NAME = '',

 VERBOSE_LOG = .false.,
```

interp_method:
0 = nearest neighbor
1 = 4 point
2 = 16 point

specifies the source model to be used for various purposes. Must match filenames produced by grib_prep.

Setting to .true. provides VERY detailed information in the hinterp and vinterp log files.

# **interp_control**: hinterp methods, vertical coord, etc.

```
&interp_control

OUTPUT_COORD = 'NMMH',


 LEVELS = 1.00, .994, .982, .968, .950, .930,
          .908, .882, .853, .821, .788, .752, .715,
          .677, .637, .597, .557, .517, .477, .438,
          .401, .365, .330, .298, .268, .240, .214,
          .188, .162, .137, .114, .091, .068, .045,
          .022, .000



 OUTPUT_VARS = 2,
 OUTPUT_FILE_TYPE = 'WRF',

/
```

‘NMMH’ specifies the hybrid vertical coordinate

LEVELS sets the number and relative depth of model levels for both the terrain-following AND the isobaric portions of the hybrid coord.

‘WRF’ specifies netCDF output files – needed for compatibility with the “real_nmm” code.

# si_paths: location of gribprep output files

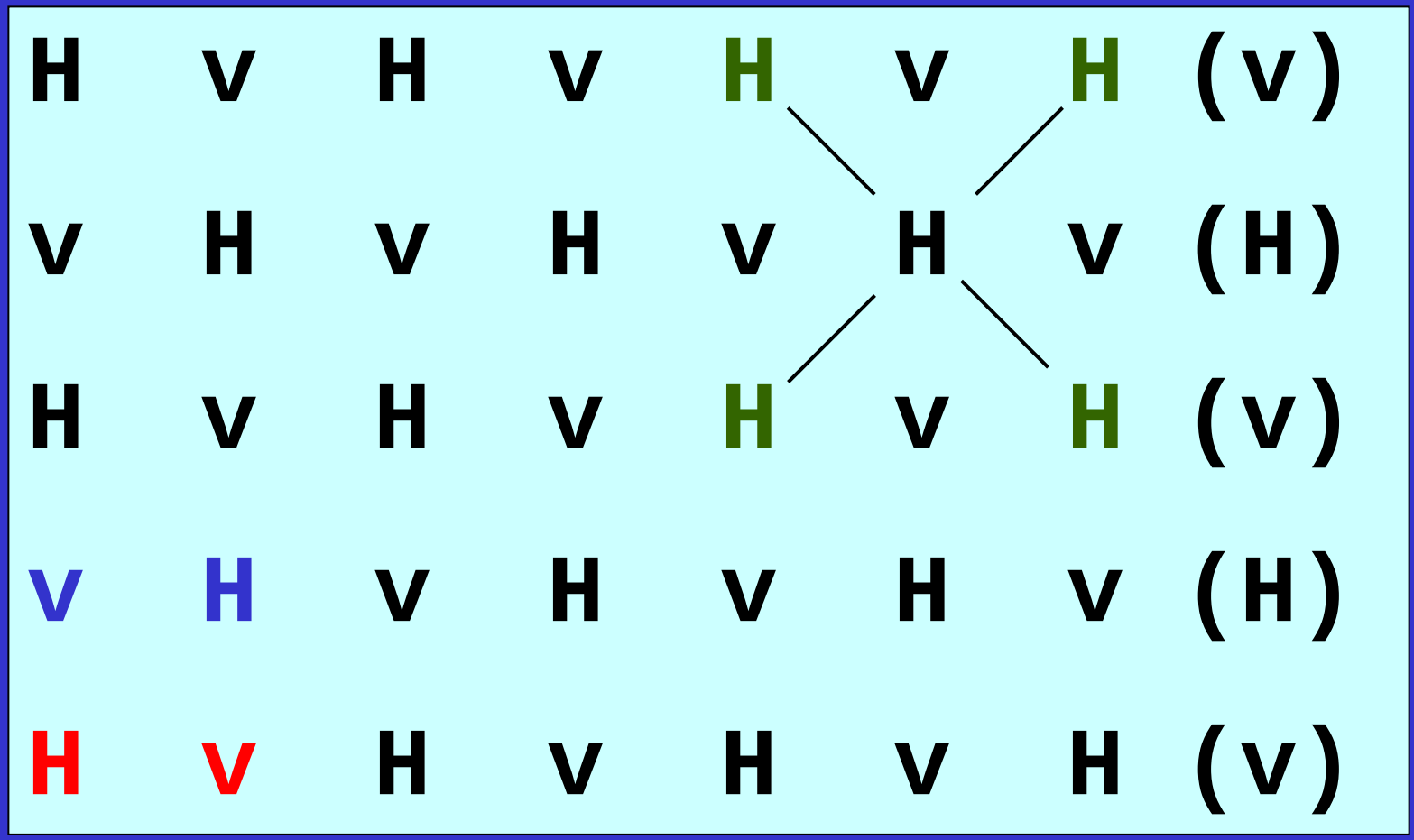
```
&si_paths

 ANALPATH = '/emc2/wx20py/tut/installdtc/extdata/extprd',
 LBCPATH = '/emc2/wx20py/tut/installdtc/extdata/extprd',
 LSMPATH = '/emc2/wx20py/tut/installdtc/extdata/extprd',
 CONSTANTS_PATH = '/emc2/wx20py/tut/installdtc/extdata/extprd',

/
```

The “parent” directory will be set automatically in the namelist if the environmental variable EXT_DATAROOT is defined when the SI is installed.

# Brief description of some NMM-specific items

- The E-grid stagger
- The rotated latitude/longitude map projection
- The hybrid vertical coordinate

# The E-grid stagger




XDIM=4, YDIM=5

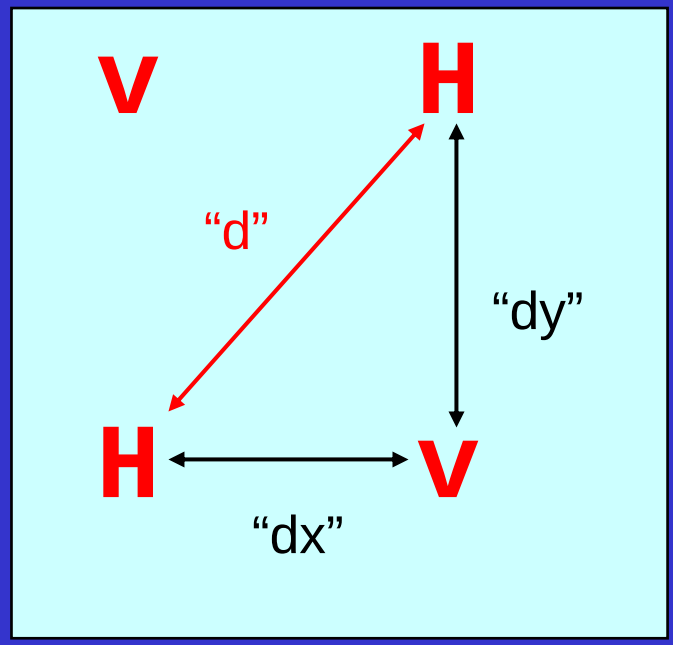
H=mass point, v=wind point

# The E-grid stagger

- Note that due to the indexing convention, the X dimension is half as large as would be expected from a C-grid domain (XDIM typically quite a bit smaller than YDIM for the E-grid).

- “Think diagonally” – finite differences are computed along the shortest distance between adjacent points, which is along the diagonals.

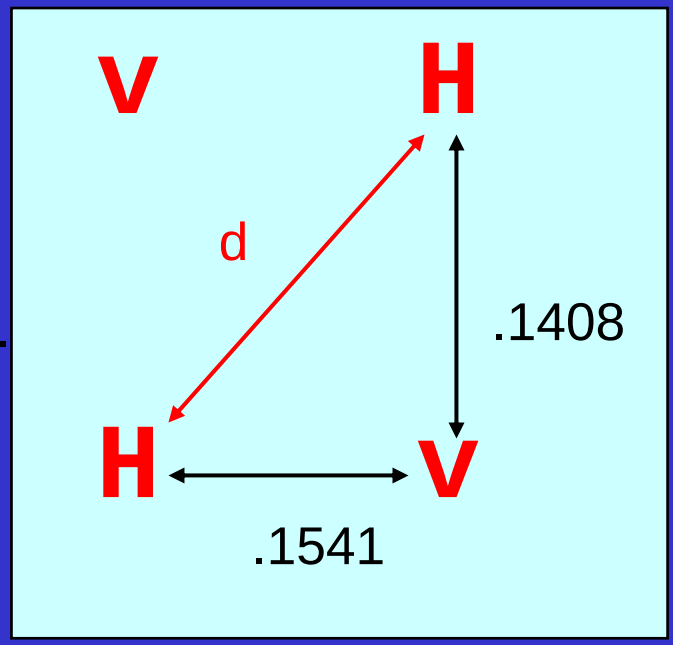
# The E-grid stagger (cont.)




- conventional grid spacing "d" is the diagonal distance between two mass variable (H) points.

- grid spacing in the WRF-NMM SI namelist are the "dx" and "dy" values, specified in fractions of a degree.

# The E-grid stagger (cont.)

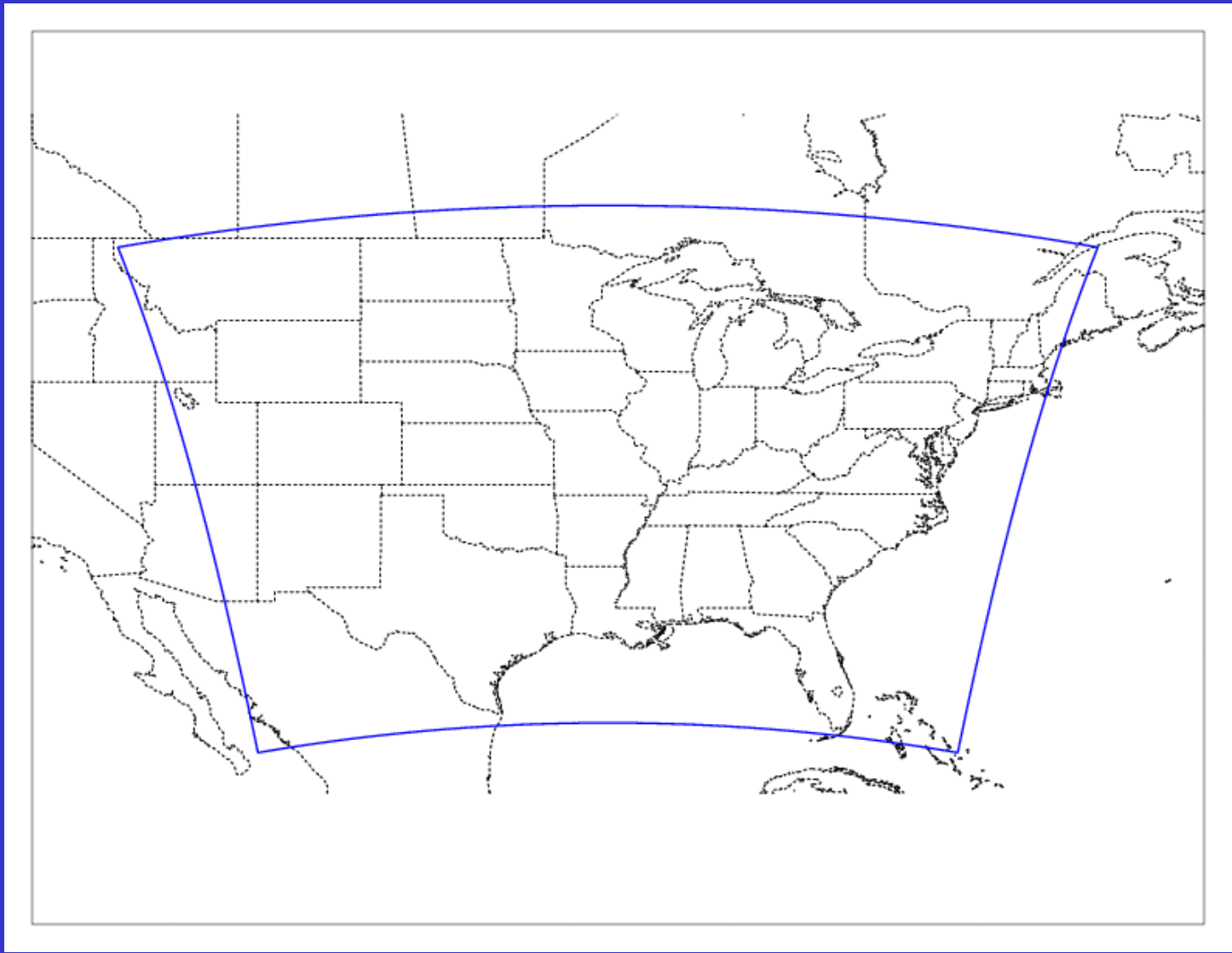



- d ~= sqrt ($0.1541^2$+$0.1408^2$) * (111 km/deg) = 23 km

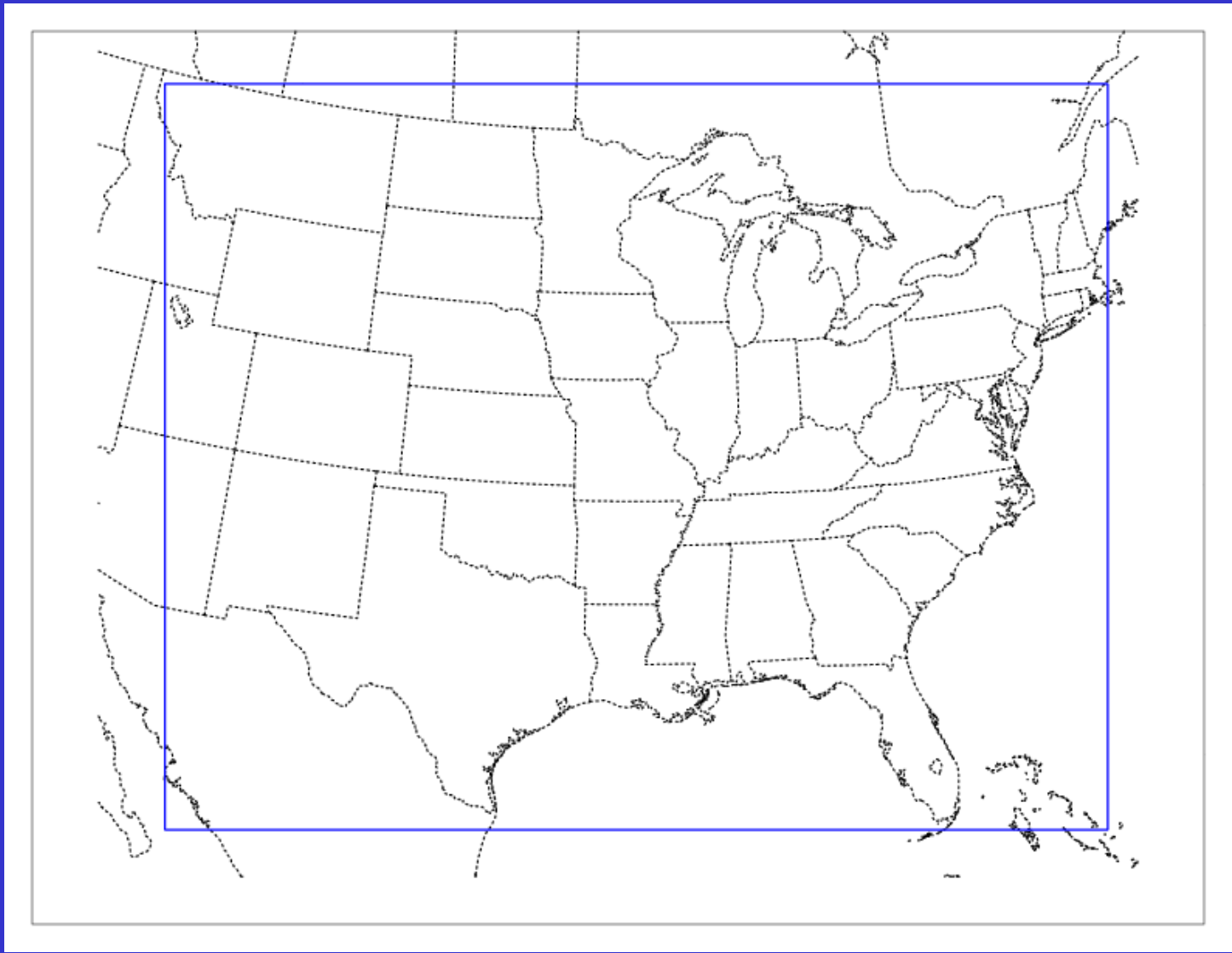
- The GUI takes input grid spacing in km and automatically computes the angular distances for the namelist (phew).

# ‘rotlat’:  the rotated latitude-longitude projection

- Rotates the latitude/longitude grid such that the intersection of the equator and prime meridian is at the center of the model domain.
- This rotation minimizes the convergence of meridians over the domain.
- Within the rotated framework, grid spacing is constant over the entire domain.



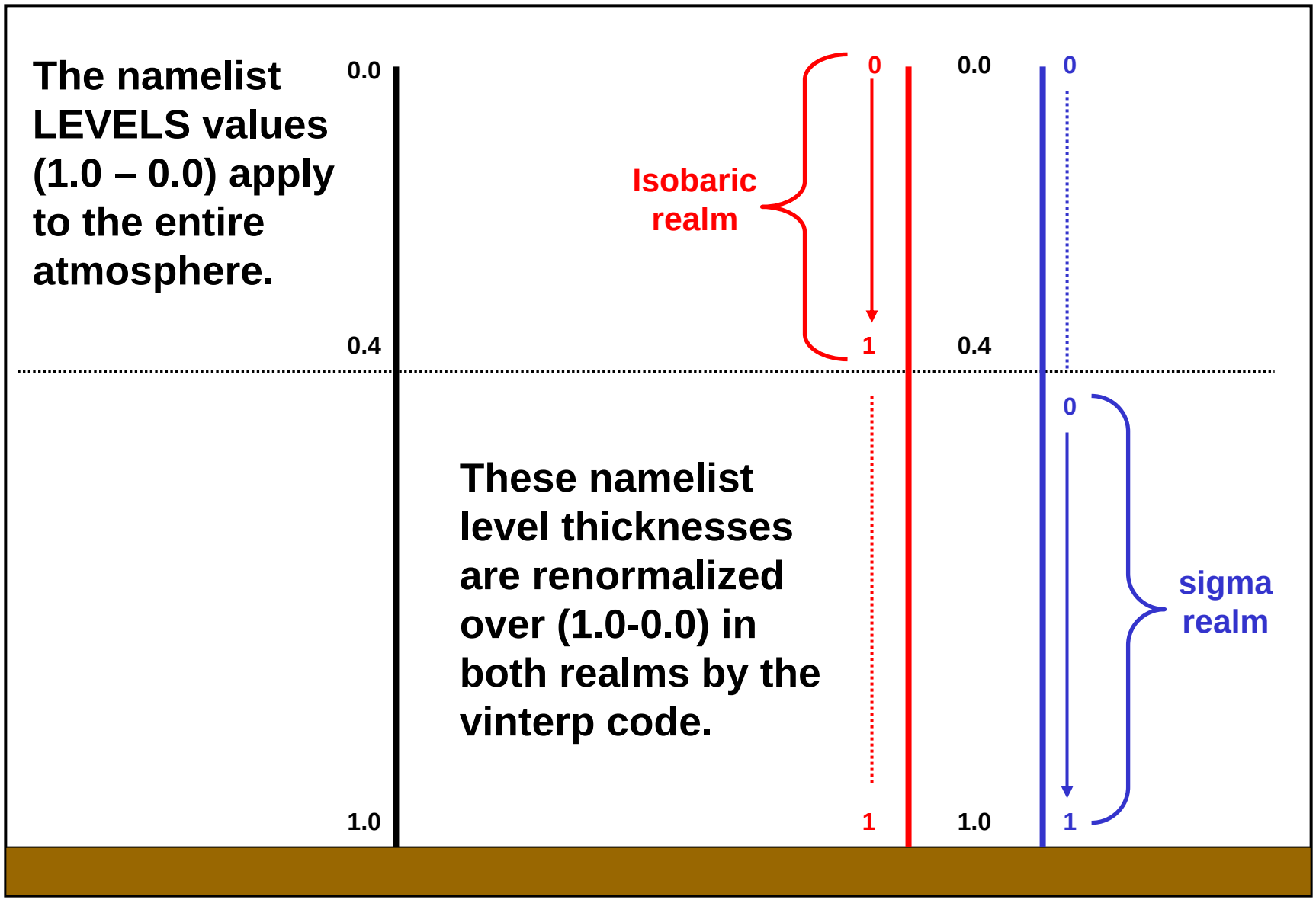
NMM rotlat domain (center 38N, 92W) projected on regular lat/lon map

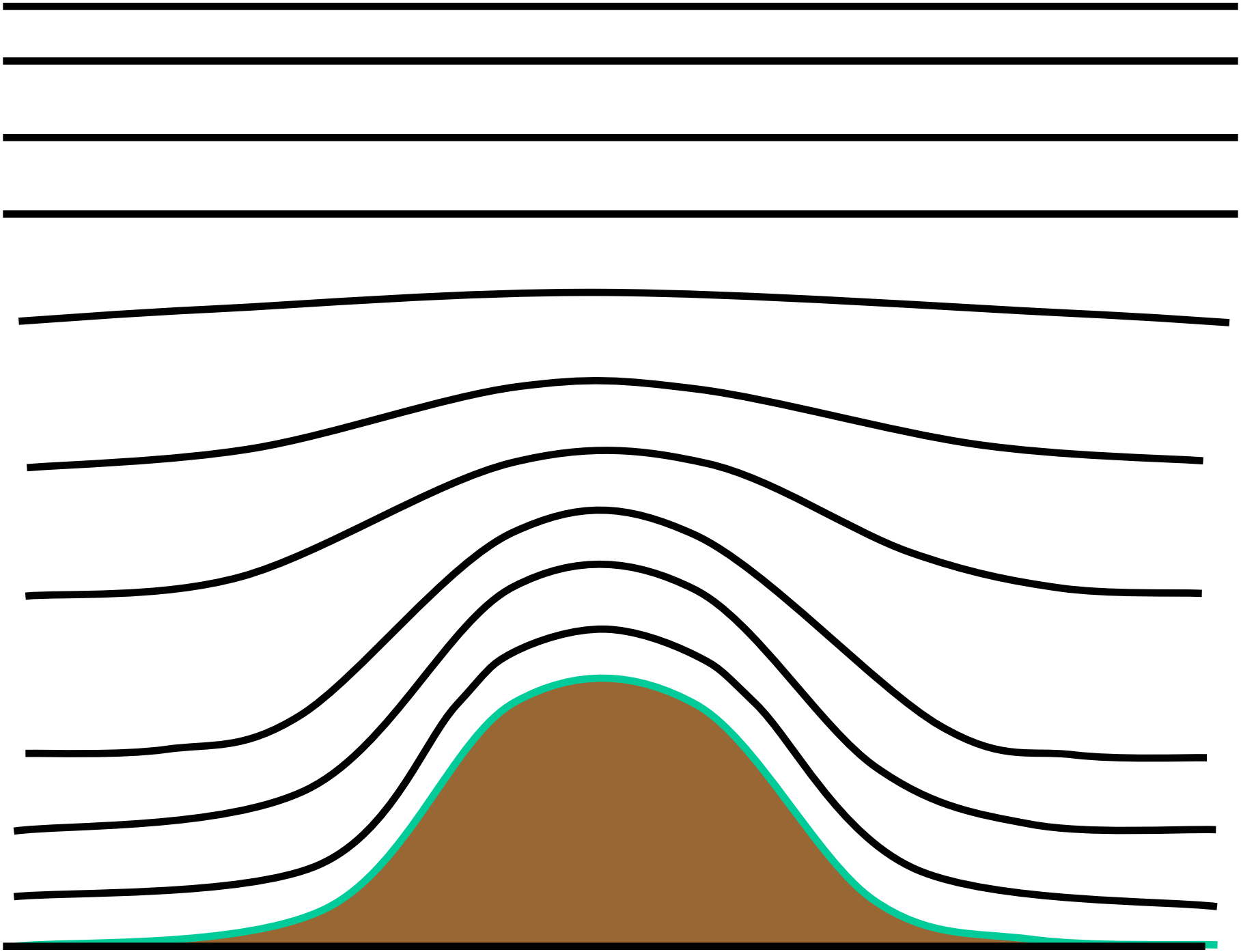


Same domain projected on a similarly rotated lat/lon map background

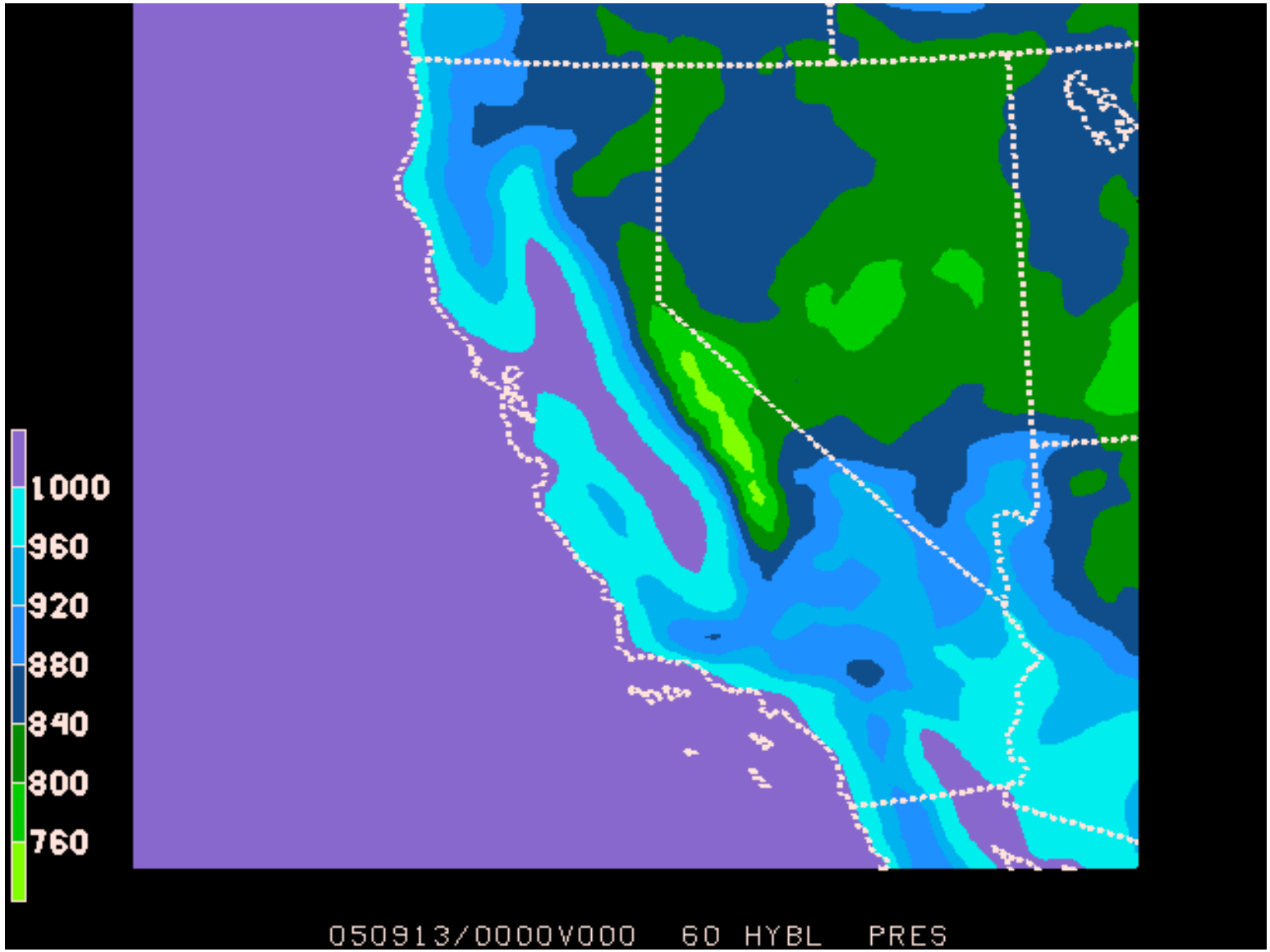
# ‘nmmh’ :  the hybrid vertical coordinate

- At the namelist level, the hybrid coordinate is identical to a sigma coordinate.  Non-dimensional (from 1 to 0) interface values define the model layers and relative depths.
- Internally, the WRF-NMM SI vertical interpolation code uses these values to define two vertical regions:
  - terrain-following sigma layers near the ground
  - a relaxation with increasing altitude from terrain following to isobaric; purely isobaric layers from ~420 hPa to the model top.

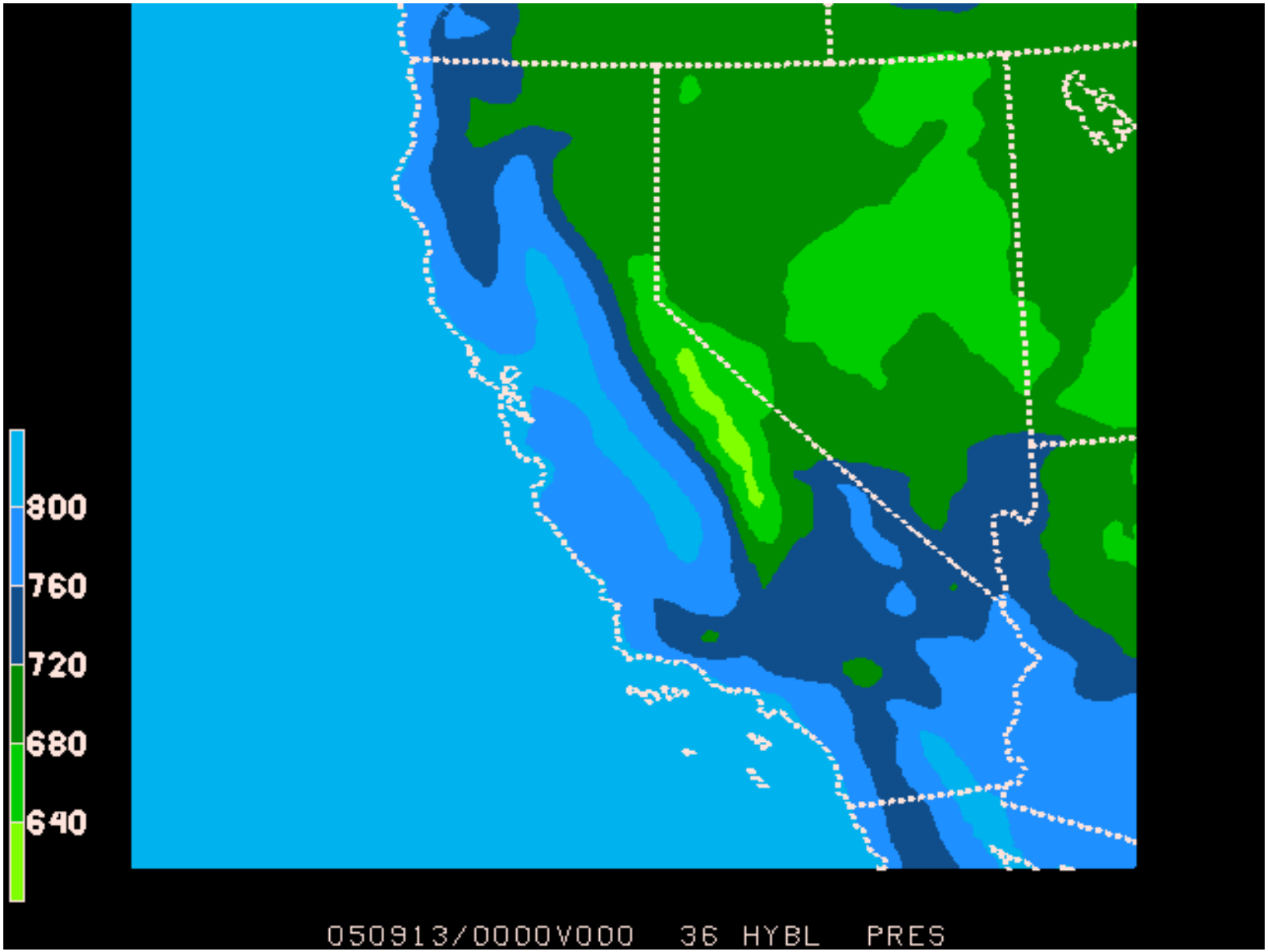

The namelist LEVELS values (1.0 – 0.0) apply to the entire atmosphere.
0.0
0.4
1.0
0
1
Isobaric realm
0.0
0.4
1.0
0
1
sigma realm
These namelist level thicknesses are renormalized over (1.0-0.0) in both realms by the vinterp code.



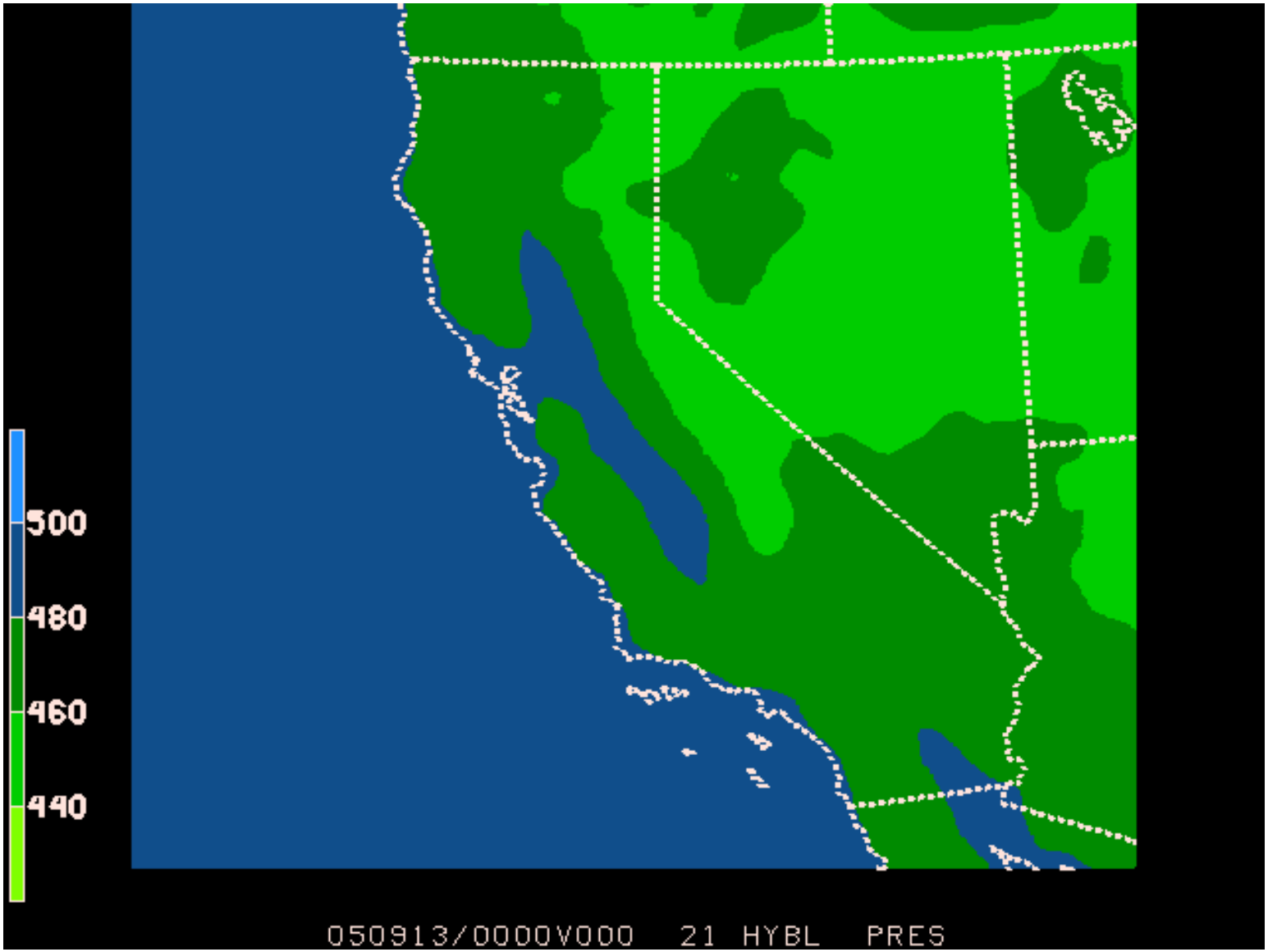
# NMM model level pressures




cint=40 hPa, lowest model level (60 levels total)




cint=40 hPa, 24 levels above ground




cint=**20** hPa, 39 levels above ground (nearly isobaric)