

CSU – RAMS

Standard Input Formats for Pressure Coordinate and Observational Data (Data Prep Stage)

This document contains detailed notes on how gridded pressure level datasets (such as NCEP-reanalysis, GFS analysis, NARR reanalysis, etc.), rawindsonde observations, and surface observations need to be formatted for being ingested into RAMS Isentropic analysis for creating variable initialization files (Var-files). “Dprep” or “DeGrib” software is made available for performing this data preparation.

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IMPORTANT – READ THIS FIRST

Note first that in order to create variable initialization files “varfiles” for RAMS case study simulations (when doing a RAMS execution with RUNTYPE = ‘MAKEVFILE’) you need to first create the dataprep “dp” files as shown here in the section on “Gridded Data File”. This takes gridded pressure level data (such as the NCEP/NCAR Reanalysis or ERA-Interim) and converts that GRIB data into the RALPH-2 format shown below in the “Gridded Data File” section. The code to do the creation of dp files from GRIB pressure level data is compiled and executed in the main RAMS distribution in directories bin.dp.grib1 and bin.dp.grib2, depending on whether your data is in GRIB-1 or GRIB-2 format. Note that only gridded pressure level data is needed for making dp files and the subsequent varfiles. The sections below on “Upper air observations file” and “Surface observations file” are for ingesting observed rawinsonde data and surface data as purely optional choices. Use of the rawinsonde and surface observations is ingested in RAMS via the section on “ODA” seen in the RAMSIN namelist. Typically, only the pressure level gridded data is used. Note that RAMS can handle gridded pressure level data in projections of latitude-longitude, Lambert-conformal, and polar stereographic. Others are not supported at this time.

Gridded Data File (ie. DataPrep or “DP” files

Following is a listing of the first few lines of a sample gridded pressure level data file.

```
2007  2  11 1200  0  26 360 181
1  1.00  1.00 -90.0 -180.0  90.0 179.0  0.000  0.000
 1000  975  950  925  900  850  800  750  700  650  600  550  500
    450  400  350  300  250  200  150  100  70  50  30  20  10
    0.90000  0.90000  0.80000  0.70000  0.60000  0.50000  0.50000  0.40000
    0.30000  0.20000  0.10000  0.00000  0.00000 -0.10000 -0.20000 -0.30000
```

Record	Field	Name	Description
1	1	Year	Integer – 4 digit year
	2	Month	Integer – 2 digit month
	3	Date	Integer – 2 digit date
	4	Time	Integer – 4 digit UTC data time
	5	Valid time increment	Integer – time past data time when data is valid (see below)
	6	# of pressure levels	Integer – number of vertical pressure level in dataset
	7	x-points	Integer – number of points in x-direction
	8	y-points	Integer – number of points in y-direction
2	1	Projection	Integer – projection flag 1 – latitude/longitude (LL) 2 – Lamber-conformal (LC) 3 – True polar-stereographic (PS) (assumes valid at 60N)
	2	x-spacing	Real – grid spacing in X-direction. Units depend on projection. LL – degrees, LC – meters, PS – meters (at 60N)
	3	y-spacing	Real – grid spacing in Y-direction. Units depend on projection

			LL – degrees, LC – meters, PS – meters (at 60N)
	4	Projection parameter	Real – projection dependent parameter LL, LC, PS – southwest latitude of grid (degrees)
	5	Projection parameter	Real – projection dependent parameter LL, LC, PS – southwest longitude of grid (degrees)
	6	Projection parameter	Real – projection dependent parameter LL, LC, PS – northeast latitude of grid (degrees)
	7	Projection parameter	Real – projection dependent parameter LL, LC, PS – northeast longitude of grid (degrees)
	8	Projection parameter	Real – projection dependent parameter LL – unused, LC – intersection/tangency latitude of projection (degrees), PS – tangency latitude of projection (degrees) (Set to 90.; only North hemisphere currently)
	9	Projection parameter	Real – projection dependent parameter LL – unused, LC – center longitude (degrees), PS – center longitude (degrees)
3	2+	Levels	Integer – level coordinates. Units dependent on vertical coordinate type flag. Must have as many values as Record 2 : field 6.

Notes:

- All data is space-delimited so that FORTRAN can do a free format, list-directed read. C can also read it without a specific format specification.

- The time field is the data time of the gridded data or when a particular forecast was started. The valid time increment is the amount of time past the data time when a forecast data is applicable. The increment is formatted in an hhhmm (h-hours,mminutes) format. As an example, consider the case of a 36 hour RAMS forecast starting at 1200 UTC. The initial field will have a data time of 1200 and the increment will be 0. The 12-hour forecast will have a data time of 1200 and an increment of 1200. The 36-hour forecast will have a data time of 1200 and an increment of 3600. All dates refer to the data time.

After the header information, the data is written as follows. Each variable at each level is written at a time. In FORTRAN, it is:

```
write(unit, format) ((data(i,j),i=1,num_x),j=1,num_y)
```

Each record then starts in the southwest corner (lower left) and proceeds row-wise.

Concerning the order of the data, first the lowest coordinate level is written with each variable following in the following order and units:

- east-west (u) velocity component (m/s)
- north-south (v) velocity component (m/s)
- temperature (K)
- geopotential height (m)
- relative humidity (fraction)

This set of variables is then written for each coordinate level up to the top of the data.

After the pressure level data is written, 6 surface fields follow written in the same way as the upper level fields:

- second soil level down, volumetric soil moisture (m³/m³) (typical 0-10cm depth from datasets)
- top soil level, volumetric soil moisture (m³/m³) (varies between datasets)
- second soil level down, soil temperature (K) (typically 0-10cm depth from datasets)
- top soil level, soil temperature (K) (varies between datasets)

- snow water equivalent (kg/m²)
- snow depth (m) (Some datasets give this and others do not. If not, we assume
snow depth = snow water equivalent x 10)

We apply dataset top soil level data to RAMS top soil level. Next we apply dataset next level down soil data to all lower soil levels in RAMS.

RAMS/ISAN currently assumes that the wind components are earth-relative for the lat-lon grid and grid-relative for the Lambert-Conformal and true polar-stereographic projections.

RAMS/ISAN will read and use the soil and snow data if they are in the data prep files. Otherwise the model will fill the variable initialization file with missing data values. In this case, user needs to make sure not to try and use soildata (ISOILDAT=1 in RAMSIN namelist) if its filled with missing data values. At runtime, RAMS will tell you if soil data is bad and the model will stop.

- A separate file must exist for each analysis time.

Upper air observations file

Following is a sample of the upper air observations file:

```

999999 2
1993 7 4 0000 01001 0024 0009 70.93000 -8.67000 9.00000
 97600.000 000 212.409 000 7.60 000 0.7883 000
 92500.000 000 653.065 000 4.80 000 0.8249 000
 85000.000 000 1338.865 000 1.00 000 0.8200 000
 70000.000 000 2871.519 000 -9.50 000 0.8591 000
 67900.000 000 3106.343 000 -11.30 000 0.9223 000
 63800.000 000 3583.331 000 -12.90 000 0.7672 000
 56100.000 000 4553.193 000 -19.10 000 0.5360 000
 50000.000 000 5400.000 000 -25.30 000 0.6762 000
 45700.000 000 6048.044 000 -29.30 000 0.7641 000
 40000.000 000 6986.854 000 -36.10 000 0.5949 000
 37300.000 000 7468.442 000 -39.90 000 0.4660 000
 35300.000 000 7843.197 000 -42.30 000 0.6018 000
 30300.000 000 8856.608 000 -51.10 000 0.5448 000
 30100.000 000 8899.660 000 -51.50 000 0.5433 000
 30000.000 000 8921.284 000 -51.30 000 0.4798 000
 27400.000 000 9519.279 000 -44.90 000 0.0555 000
 27000.000 000 9617.594 000 -45.10 000 0.0264 000
 25000.000 000 10134.874 000 -42.50 000 0.0085 000
 24100.000 000 10383.210 000 -41.50 000 0.0090 000
 20000.000 000 11650.147 000 -41.30 000 0.0090 000
 16500.000 000 12958.866 000 -40.90 000 0.0079 000
 15000.000 000 13605.299 000 -42.50 000 0.0085 000
 11900.000 000 15164.091 000 -44.50 000 0.0076 000
 10000.000 000 16332.646 000 -43.50 000 0.0080 000
 1334.000 000 7.72 000 65.00 000
 2867.000 000 6.17 000 45.00 000
 5400.000 000 5.14 000 45.00 000
 6980.000 000 12.35 000 55.00 000
 8910.000 000 12.35 000 75.00 000
10120.000 000 7.20 000 75.00 000
11640.000 000 5.66 000 90.00 000
13590.000 000 1.54 000 145.00 000
16320.000 000 1.54 000 260.00 000

```

```

1993 7 4 0000 01028      0038 0014 74.52000 19.01999 18.00000
100800.000 000      18.783 000      1.60 000 0.9715 000
100000.000 000      83.118 000      1.80 000 0.9437 000
98800.000 000      180.666 000      2.00 000 0.9576 000
95900.000 000      420.757 000      0.40 000 0.9570 000
89900.000 000      946.058 000      6.60 000 0.7868 000
87700.000 000      1149.788 000      7.00 000 0.3581 000

```

...

...

The file starts again with:

Record	Field	Name	Description
1	1	999999	marker to start a new file or new section of a file
	2	Version	Integer – dataset version number (this is version 2)

After this, there is a section for each observation:

Section	Field	Name	Description
Header	1	year	Integer – 4 digit year
	2	month	Integer – 2 digit month
	3	date	Integer – 2 digit date
	4	time	Integer – 4 digit UTC data time
	5	Station ID	Character – up to 8 characters
	6	# P levels	Integer – number of pressure levels where thermodynamic information is reported
	7	# Z levels	Integer – number of height levels where wind data is reported
	8	Station latitude	Real – station latitude (degrees)
	9	Station longitude	Real – station longitude (degrees)
	10	Station elevation	Real – station elevation (meters)
Presssure data	1	Pressure	Real – pressure (Pa)
	2	Pressure flags	Integer – 3 digit “quality” flag (see below)
	3	Geopotential height	Real – geopotential height (m)
	4	Geopotential height flags	Integer – 3 digit “quality” flag (see below)
	5	Temperature	Real – temperature (Celcius)
	6	Temperature flags	Integer – 3 digit “quality” flag (see below)
	7	Relative humidity	Real – relative humidity (fraction)
	8	Relative humidity flags	Integer – 3 digit “quality” flag (see below)
Height data	1	Height	Real – height above sea level (m)
	2	Height flags	Integer – 3 digit “quality” flag (see below)
	3	Wind speed	Real – wind speed (m/s)
	4	Wind speed flags	Integer – 3 digit “quality” flag (see below)
	5	Wind direction	Real – wind direction (degrees)
	6	Wind direction flags	Integer – 3 digit “quality” flag (see below)

Notes:

- Quality flags are a 3 digit code denoting what stages of quality control have been performed during the 3 stages of QC.

Some of the values are:

0 - not checked

9 - missing

5 - passed, good data

1 – checked, flagged as bad data

- Rawindsondes will generally have both the pressure and height level data reported. Wind profilers will only have the height levels, so these will have a 0 for the number of pressure levels.

- A separate file must exist for each analysis time.

Surface observations file

Following is a sample of the surface observations file:

```
999999 2
9
WINDSPEED    m/s
WIND_DIRECTION deg
TEMPERATURE   C
DEWPOINT      C
STN_PRES      Pa
SLP           Pa
6-HR_PCP      mm
24-HR_PCP     mm
CLOUD_COVER   fraction
1993 09 01 0000 71066 58.620 -117.170 338. 2.57 000 350. 000 \
 16.8 000 11.5 000 96710.0 000 100770.0 000 -999.0 000 0.0 000 .80 000
1993 09 01 0000 71068 56.620 -115.170 340. 2.57 000 350. 000 \
 16.8 000 11.5 000 96710.0 000 100770.0 000 -999.0 000 0.0 000 .80 000
.....
.....
```

**** Note that each observation line is actually all one record and is just broken up here for documentation purposes. The file starts with header information:

The file starts with header information:

Record	Field	Name	Description
1	1	999999	marker to start a new file or new section of a file
	2	Version	Integer – dataset version number (this is version 2)

After this, there is a line for each observation:

Section	Field	Name	Description
Surface	1	year	Integer – 4 digit year
	2	month	Integer – 2 digit month
	3	date	Integer – 2 digit date
	4	time	Integer – 4 digit UTC data time
	5	Station ID	Character – up to 8 characters
	6	Station latitude	Real – station latitude (degrees)
	7	Station longitude	Real – station longitude (degrees)
	8	Station elevation	Real – station elevation (meters)
	9+	Value/flag pairs	Real/integer – pairs of values and their quality flags. See below.

Notes:

- There must be as many value/flag pairs as specified in the header. Values are in the order specified in the header and are of the specified units in the header. ***This is a future capability; for now there only must be the first 5 variables in the units stated in the example above. All additional variables will currently be ignored.***

- A separate file must exist for each analysis time.