CLPX-Model: Rapid Update Cycle 40km (RUC-40) Model Output Reduced Data, Version 1

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:

Arsenault, K. 2004. *CLPX-Model: Rapid Update Cycle 40km (RUC-40) Model Output Reduced Data, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/J2K5LZWPH0F3. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT NSIDC@NSIDC.ORG

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NSIDC-0211

National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

1.1 Format

The RUC40 forecast model is an updated version of the generalized vertical coordinate model described by Bleck and Benjamin (1993). Modifications to improve the RUC40 included use of the code structure of the NCAR/Penn State Mesoscale Model version 5 (MM5, Grell et al. 1994). This allowed relatively easy transfer of MM5 parameterizations (cloud microphysics, radiation) into the RUC40 model.

The RUC40 model contains 42 model fields produced by the Mesoscale Analysis and Prediction System (MAPS) coupled modeling system at the NOAA Forecast Systems Laboratory (FSL).

The MAPS MORDS data set used here was obtained from NCAR's GCIP Model Output Archive Summary (http://rda.ucar.edu/datasets/ds609.1/). The files were untarred and collected together into monthly directories, but there are known gaps in the times in the archive from NCAR. These gaps are documented more below in the File Naming Convention section.

The numerical characteristics of the RUC40 mode include:

- Arakawa-C staggered horizontal grid (Arakawa and Lamb, 1977); u and v horizontal wind points are offset from mass points to improve numerical accuracy.
- No vertical staggering.
- Time step is 60 seconds at 40-km resolution.
- Positive definite advection schemes are used for the continuity equation (advection of pressure thickness between levels) and for horizontal advection (Smolarkiewicz 1983) of virtual potential temperature, and all vapor and hydrometer moisture variables.

RUC40 data are stored in individual ASCII data files, with one file per hour. Within each hourly file, 42 data variables are stored in row-major order, starting at the lower-left coordinate. Because the analysis runs at a 00Z initial time do not contain the full set of the 42 fields (described in the table below), the 00Z forecast run at time of 01Z was selected as the nearest time value to the 00Z analysis output.

Record #	Variable (:"level")	Name Description [Unit]
1	MSL	1hr fcst:"Mean sea level pressure (MAPS) [Pa]
2	PRES:sfc	1hr fcst:"Pressure [Pa]
3	HGT:sfc	1hr fcst:"Geopotential height [gpm]
4	TSOIL:sfc	1hr fcst:"Soil temp. [K]
5	SOILM:44-0 cm down	1hr fcst:"Soil moisture content [kg/m^2]
6	SOILM:0 cm down	1hr fcst:"Soil moisture content [kg/m^2]
7	WEASD:sfc	1hr fcst:"Accum. snow [kg/m^2]
8	TMP:2 m above gnd	1hr fcst:"Temp. [K]

Record #	Variable (:"level")	Name Description [Unit]
9	SPFH:2 m above gnd	1hr fcst:"Specific humidity [kg/kg]
10	UGRD:10 m above gnd	1hr fcst:"u wind [m/s]
11	VGRD:10 m above gnd	1hr fcst:"v wind [m/s]
12	APCP	0-1hr acc:"Total precipitation [kg/m^2]
13	ACPCP:sfc	0-1hr acc:"Convective precipitation [kg/m^2]
14	WEASD:sfc	0-1hr acc:"Accum. snow [kg/m^2]
15	SNOM:sfc	0-1hr acc:"Snow melt [kg/m^2]
16	SSRUN:sfc	0-1hr acc:"Storm surface runoff [kg/m^2]
17	LHTFL:sfc	0-1hr ave:"Latent heat flux [W/m^2]
18	SHTFL:sfc	0-1hr ave:"Sensible heat flux [W/m^2]
19	SHTFL	0 cm down 0-1hr ave:"Sensible heat flux [W/m^2]
20	SNOHF:sfc	0-1hr ave:"Snow phase-change heat flux [W/m^2]
21	CD:sfc	1hr fcst:"Drag coefficient [non-dim]
22	SHTFL:sfc	1hr fcst:"Sensible heat flux [W/m^2]
23	LHTFL:sfc	1hr fcst:"Latent heat flux [W/m^2]
24	CAPE:sfc	1hr fcst:"Convective Avail. Pot. Energy [J/kg]
25	PWAT:atmos col	1hr fcst:"Precipitable water [kg/m^2]
26	LCDC	1hr fcst:"Low level cloud cover [%]
27	MCDC	1hr fcst:"Mid level cloud cover [%]
28	HCDC	1hr fcst:"High level cloud cover [%]
29	DSWRF:sfc	0-1hr ave:"Downward short wave flux [W/m^2]
30	DLWRF:sfc	0-1hr ave:"Downward long wave flux [W/m^2]
31	USWRF:sfc	0-1hr ave:"Upward short wave flux [W/m^2]
32	ULWRF:sfc	0-1hr ave:"Upward long wave flux [W/m^2]
33	ALBDO:sfc	1hr fcst:"Albedo [%]
34	TSOIL:5 cm down	1hr fcst:"Soil temp. [K]
35	TSOIL:20 cm down	1hr fcst:"Soil temp. [K]
36	TSOIL:40 cm down	1hr fcst:"Soil temp. [K]
37	TSOIL:160 cm down	1hr fcst:"Soil temp. [K]
38	SOILW:sfc	1hr fcst:"Volumetric soil moisture [fraction]
39	SOILW:5 cm down	1hr fcst:"Volumetric soil moisture [fraction]
40	SOILW:20 cm down	1hr fcst:"Volumetric soil moisture [fraction]
41	SOILW:40 cm down	1hr fcst:"Volumetric soil moisture [fraction]
42	SOILW:160 cm down	1hr fcst:"Volumetric soil moisture [fraction]

There are several places in the time span of the data in which gaps are found, and these gaps are documented in two files: (1) in an Excel spreadsheet file called *ruc40-list.xls*, and (2) a text file called *RUC-all.out*. These two files provide a list by month of all the files that are contained in the untarred/unzipped monthly directories.

1.2 File and Directory Structure

RUC40 data are stored in individual ASCII data files, with one file per hour. For easier access, these hourly files have been tarred/gzipped by month (e.g., `200210.tar.gz` for October 2002 data). Fortran programs are provided in a directory named *programs*.

1.3 File Naming Convention

RUC40 data are stored in individual ASCII data files, with one file per hour. Within each hourly file, 42 data variables are stored in row-major order, starting at the lower-left coordinate. For easier access, the hourly ASCII files have been tarred/gzipped by month (e.g., `200210.tar.gz` for October 2002 data). After the files are gunzipped and untarred by month, RUC40 ASCII data files have file names in the following form: <year><month><day>.<time>. ruc40-mords.asc

example: `2002100204.ruc40-mords.asc`, where

year is the four-digit year the data were acquired, e.g., "2002"

month is the two-digit month of year the data were acquired, e.g., "10" is October

day is the two-digit day of the month the data were acquired, e.g., “02” for the 2nd day of October

hour is the two-digit UTC hour of the data, e.g., hour is 04Z in the example.

There are several places in the time span of the data in which gaps are found, and these gaps are documented in two files: (1) in an Excel spreadsheet file called `ruc40-list.xls`, and (2) a text file called `RUC-all.out`. These two files provide a list by month of all the files that are contained in the untarred/unzipped monthly directories.

1.4 Spatial Coverage

The RUC40 model covers the 40 km (approximate) Lambertian latitude/longitude grid over the Large-Regional Study Area (LRSA) in Colorado and Wyoming, USA.

Southern Latitude: 38.3940 N

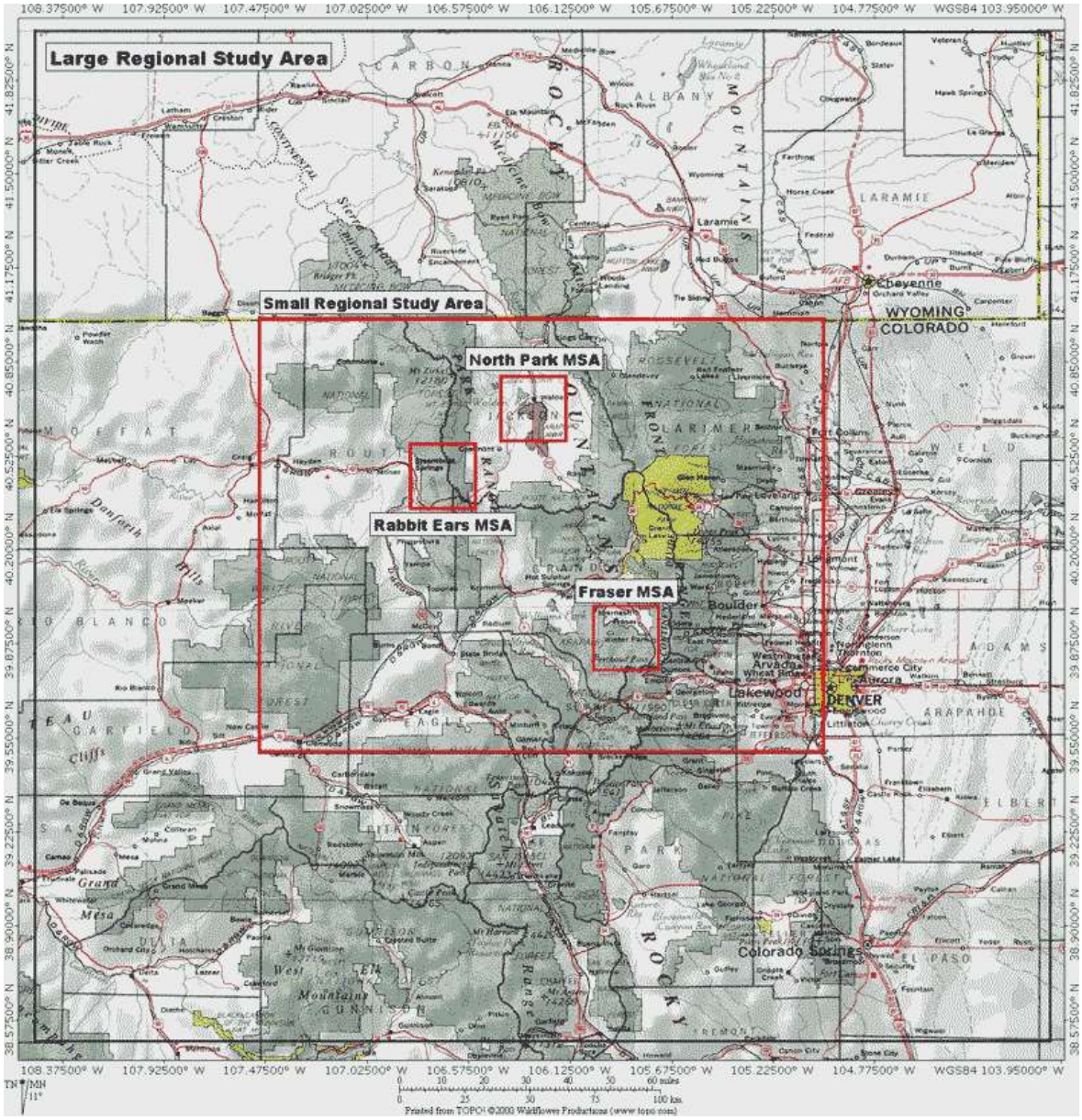
Northern Latitude: 42.5680 N

Western Longitude: 108.6150 W

Eastern Longitude: 103.9710 W

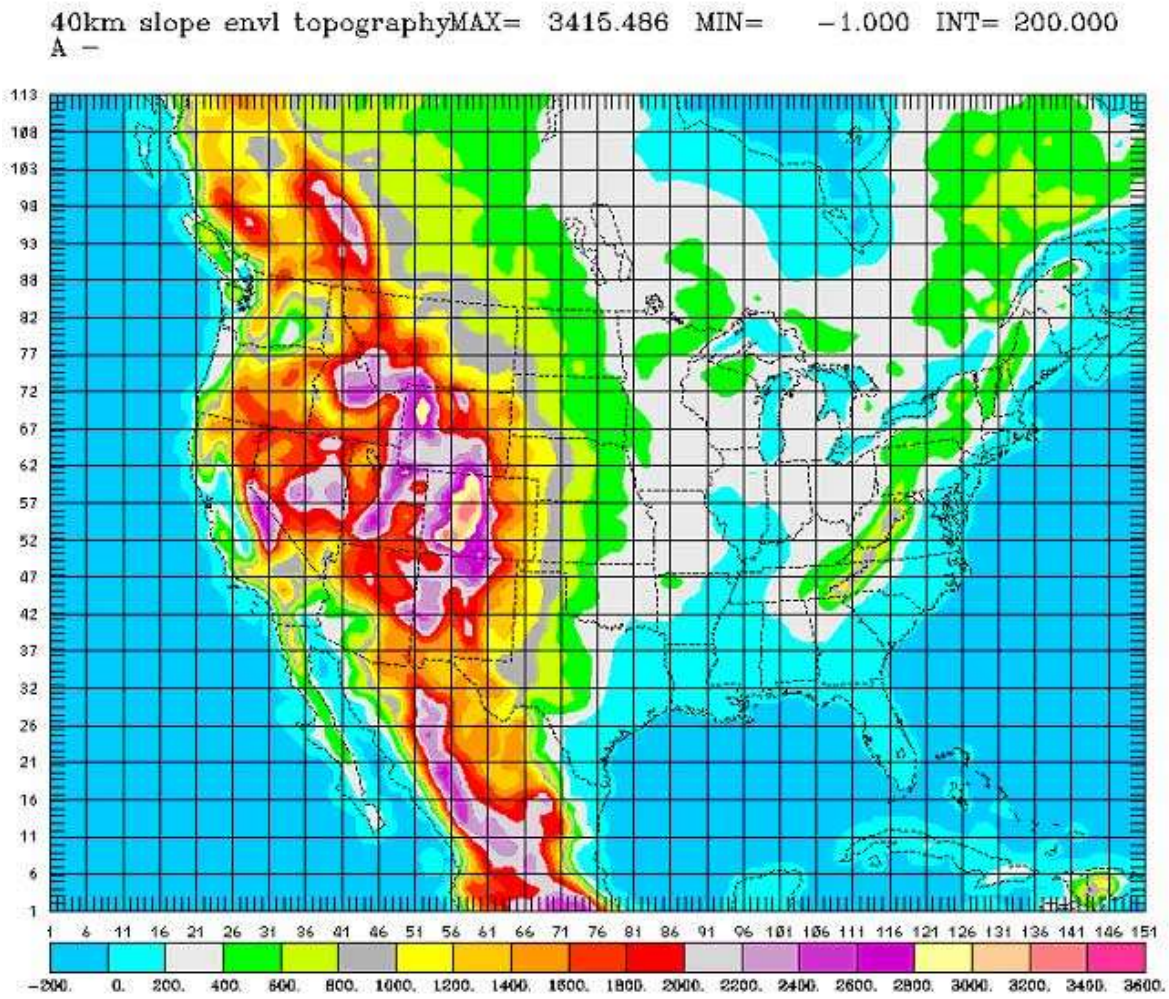
1.4.1 Spatial Coverage Map

The following map provides an overview of the observation site:



1.4.2 LRSA and MAPS MORDS (RUC40) Grid Description

The following figure shows the RUC40 domain, which is placed on a Lambert conformal projection and matches what is used for the AWIPS 212 National Weather Service (NWS) distribution grid. The mesh is rectangular on this projection, and its size is 151 by 113 grid points. The grid length is 40.635 km at 35°N. Due to the varying map-scale factor from the projection, the actual grid length in RUC40 varies from about 40.6 km at 35°N to 33 km at the north boundary.



A fortran program ("read-asc40.F90") is provided with this data set that reads the latitude/longitude descriptive ASCII file, 40kmlatlon.asc.txt. These files are provided so that users can see the original domain of the RUC40.

The lower left corner point is (1,1), and the upper right corner point is (151,113), as shown in the following table.

RUC-2 point	AWIPS-212 point	Latitude	Longitude
(1,1)	(23,7)	16.2810 N	126.1378 W
(1,113)	(23,119)	54.1731 N	139.8563 W
(151,1)	(173,7)	17.3400 N	69.0371 W
(151,113)	(173,119)	55.4818 N	57.3794 W

In the vertical dimension, there are four subsurface levels in the ground and one surface level, each corresponding to a depth of:

Layer 1: Ground surface level

Layer 2: 5 cm

Layer 3: 20 cm

Layer 4: 40 cm

Layer 5: 160 cm

RUC 40 data, originally in GRIB format and covering a central North American domain, were converted to ASCII format and subsetted to the LRSA domain. Outer bounds of this MAPS-LRSA domain are:

Lower Left : 38.3940°N, 108.6150°W

Lower Right : 38.3940°N, 103.9710°W

Upper Left : 42.5680°N, 108.6150°W

Upper Right : 42.5680°N, 103.9710°W

1.5 Temporal Coverage

The duration of the data set spans the period from 1 October 2002 through 30 June 2003, with a time step of 60 seconds.

1.6 Parameter or Variable

Parameters presented in this data set are relative humidity, sfc temperature, dew point, sea-level pressure, precipitation, snow accumulation, snow depth, categorical precipitation types, freezing levels, 3-h pressure change, CAPE/CIN, lifted index, helicity, precipitable water, soil moisture, tropopause pressure, vertical velocity, PBL depth, gust wind speed, cloud base height, cloud top height, cloud fraction, visibility, pressure of maximum equivalent potential temperature in column, convective cloud top height, and equilibrium level height.

The atmospheric prognostic variables of the RUC40 forecast model are:

- pressure thickness between levels
- virtual potential temperature
- horizontal wind components
- water vapor mixing ratio

- cloud water mixing ratio
- rain water mixing ratio
- ice mixing ratio
- snow mixing ratio
- graupel (rimed snow) mixing ratio
- number concentration for ice particles
- turbulence kinetic energy
- turbulent variance of potential temperature
- turbulent variance of water vapor mixing ratio
- turbulent covariance of potential temperature perturbations with water vapor mixing ratio perturbations

The soil prognostic variables (at six model levels) of the RUC40 forecast model are:

- soil temperature
- soil volumetric moisture content
- Other surface-related prognostic variables are snow water equivalent moisture and snow temperature.

2 SOFTWARE AND TOOLS

For the CLPX project, the RUC40 data have been converted from GRIB to ASCII format. Three sample fortran programs are provided for reading CLPX MAPS-MORDS ASCII gridded data:

- read-asc40.F90
- read-latlon.F90
- read-maps.F90

"*read-asc40.F90*" is a fortran program for reading the file "40kmlatlon.asc.txt," which is the original, full North American grid metafile for the RUC40. This file is useful for reference on how the data were downsized, and for anyone needing the arrays of points surrounding the CLPX domain.

"*read-latlon.F90*" is a fortran program for reading the actual latitude and longitude points that fit the (12,12) area. This program is in a table-format with the following structure:

Table Headers: ***lrsa-lon, lrsa-lat, maps-lon, maps-lat, lonval, latvar***

lrsa-lon : Values of 1,12 corresponding with longitude elements of the LRSA

lrsa-lat : Values of 1,12 corresponding with latitude elements of the LRSA

maps-lon : MAPS element values of 53,64 (of original 1,151) corresponding with longitude elements of the LRSA

maps-lat : MAPS element values of 54,65 (of original 1,113) corresponding with latitude elements of the LRSA

lonval : MAPS longitude values that correspond to each of the *lrsa-lon* (and *maps-lon*) elements

latvar : MAPS latitude values that correspond to each of the *lrsa-lat* (and *maps-lat*) elements

"*read-maps.F90*" is a fortran program for reading the 3-D array data: (VAR,X,Y)=(42,12,12), described as the total number of variables (42) by the total columns (12) and rows (12). This program is able to read all the ASCII-formatted files, accounting for all gaps in the times of the files.

3 REFERENCES AND RELATED PUBLICATIONS

Arakawa, A., and V.R. Lamb, 1977: Computational design of the basic dynamical processes of the UCLA general circulation model. Methods in Computational Physics, Vol. 17, Academic Press, 174-265, 337 pp.

Benjamin, S.G., J.M. Brown, K.J. Brundage, D. Devenyi, D. Kim, B.E. Schwartz, T.G. Smirnova, T.L. Smith, and A. Marroquin, 1997: Improvements in aviation forecasts from the 40-km RUC. Preprints, 7th Conference on Aviation, Range, and Aerospace Meteorology, Long Beach, February, 411-416.

Bleck, R., and S.G. Benjamin. 1993. Regional weather prediction with a model combining terrain-following and isentropic coordinates. Part I: model description. Mon. Wea. Rev. 121:1770-1785.

Grell, G.A., J. Dudhia, and D.R. Stauffer, 1994: A description of the fifth-generation Penn State/NCAR Mesoscale Model (MM5). NCAR Technical Note, NCAR/TN-398 + STR, 138 pp.

Smirnova, T.G., J.M. Brown, S.G. Benjamin, and D. Kim. 2000. Parameterization of cold-season processes in the MAPS land-surface scheme. J. Geophys. Res. 105, D3, 4077-4086.

Smirnova, T. G., J. M. Brown, and S. G. Benjamin. 1997. Evolution of soil moisture and temperature in the MAPS/RUC assimilation cycle. Preprints, 13th Conference on Hydrology, Long Beach, AMS, 172-175.

Smith, and F.-J. Wang. 1996. The 40-km 40-level version of MAPS/RUC. Preprints, 11th Conference on Numerical Weather Prediction, AMS, Norfolk, 161-163.

Smolarkiewicz, P.K., 1983: A simple positive-definite advection transport algorithm. Mon. Wea. Rev., 111, 479-486.

3.1 Related Data Collections

- AMSR-E Validation Data Sets

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5 DOCUMENT INFORMATION

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