Historical Weather Data for Fire Planning Analysis from the North American Regional Reanalysis Dataset

January 2008

IMPORTANT NOTICE: DATA GENERATED FROM THIS PROJECT WILL BE BENEFICIAL IN PERFORMING CLIMATOLOGICAL OR HISTORICAL TYPE ANALYSES, BUT CAUTION SHOULD BE USED IF ATTEMPTING TO RELATE THESE DATA TO A SPECIFIC DAILY FIRE EVENT.

The National Centers for Environmental Prediction's (NCEP's) North American Regional Reanalysis (NARR) is a long-term, dynamically consistent, high-resolution, high-frequency, atmospheric and land surface hydrology dataset for the North American domain (Mesinger *et al* 2006). At a 32-km spatial resolution and 3-hourly temporal resolution, the NARR provides a complete dataset that has the potential to be used as a source of surface weather data for fire planning and management purposes. The NARR is a modeled dataset from 1979-present that incorporates data from rawinsondes, dropsondes, pibals, aircraft, selected surface stations, and geostationary satellites. It also incorporates high-resolution data from a variety of other sources such as the NCEP / Climate Prediction Center (CPC), Canadian, and Mexican precipitation network including modeled data from the Parameter-elevation Regression on Independent Slopes Model (PRISM) (Daly et al 1994).

Historically, the wildfire community has depended upon station data, in particular the Remote Automated Weather Station (RAWS) network, to provide surface weather conditions at point locations. The spatial distribution of these stations is too coarse to adequately represent the surface weather conditions everywhere in the US. Using the NARR data set allows for more complete coverage with an equal spatial distance of 32 km. Though this spatial resolution may be considered too coarse for some data needs, particularly in the complex terrain regions of the US, it provides reasonable weather information for analyses where ground stations are lacking. Analysis comparing surface weather variables between RAWS and NARR indicates that there is strong correlation, particularly with temperature, humidity, and incoming solar radiation (Hall and Brown 2006). These correlations are weaker for precipitation and wind, but these elements can still be used in creating a FPA weather dataset.

Table 1 provides a list of confidence based upon the correlation analysis. In the table, dividing the percent value by 100 will yield the correlation value. The percent values represent the overall average confidence, not necessarily what the correlation might have been on a specific day. Confidence is additionally subdivided by season where some seasons have higher correlations for each variable than other seasons. Depending upon the RAWS, correlations might be quite high or low for a given day even if the average correlation is high. Thus, caution should be used when relating the NARR values to a specific daily fire event.

Table 1. Percent confidence in model derived values for temperature, relative humidity, wind speed and average amount precipitation for three time scales.

	Average Percent of Confidence for Air Temperature		
	Daily	10-Day	30-Day
All months	93	97	97
December-February	78	85	94
March-May	85	93	94
June-August	78	89	87
September-November	85	96	96

	Average Percent of Confidence for Relative Humidity		
	Daily	10-Day	30-Day
All months	72	76	75
December-February	64	64	61
March-May	69	71	64
June-August	66	72	67
September-November	68	82	81

	Average Percent of Confidence for Wind Speed		
	Daily	10-Day	30-Day
All months	44	45	42
December-February	49	50	47
March-May	43	45	40
June-August	35	39	37
September-November	49	43	34

	Average Percent of Confidence for Precipitation Amount		
	Daily	10-Day	30-Day
All months	57	72	75
December-February	57	70	72
March-May	64	77	77
June-August	56	69	78
September-November	64	79	89

Historical daily weather data from NARR was compiled for every grid cell within the spatial domain of NARR. Figure 1 provides an example of relative humidity for a particular day using NARR data. Output is provided in the 1972 standard weather station inventory data format (WXOBS72A; .fwx filename extension; Table 2). This format includes temperature, relative humidity, wind speed, and wind direction for 1300 LT. Because the NARR is only provided at 3-hourly intervals (i.e., 00 UTC, 03 UTC, 06 UTC, 09 UTC, 12 UTC, 15 UTC, 18 UTC, and 21 UTC), locations ≥ -102º (eastern US) meridian used the 18 UTC NARR to represent 1300 LT, and locations < -102º (western US) used the 21 UTC NARR to represent 1300 LT.

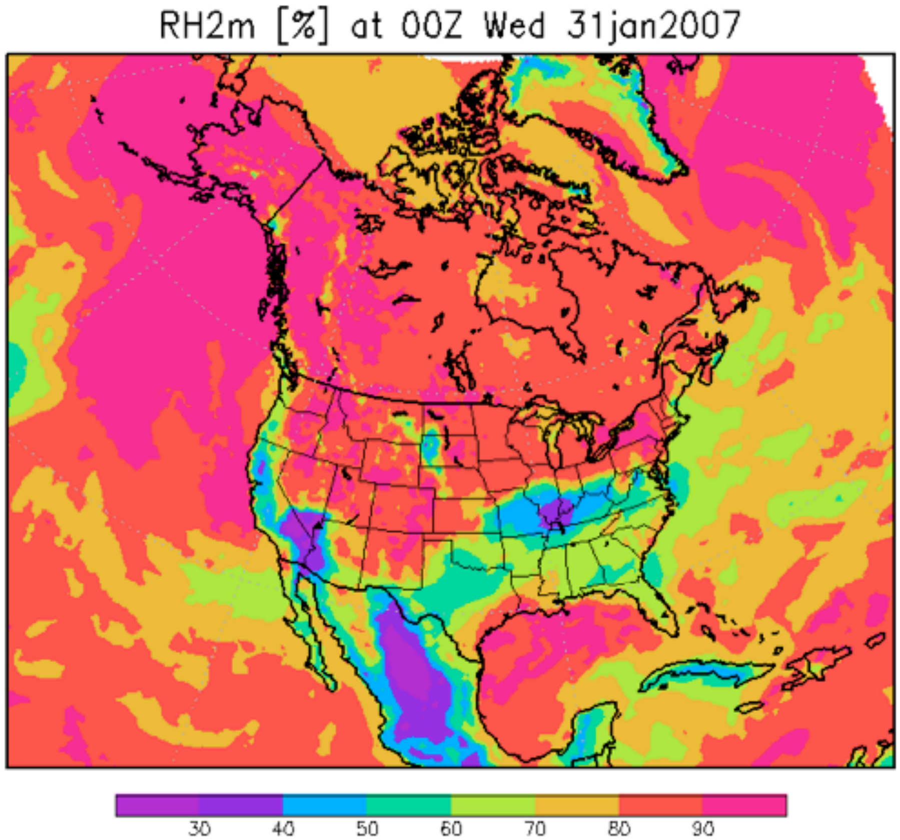

Figure 1. Example relative humidity from NARR representing the spatial domain.

The WXOBS72A format also includes 24-hour weather information including the maximum and minimum relative humidity and temperature, and the 24-hour precipitation amount and hours of duration. For locations ≥ -102º (eastern US), these 24-hour observations were compiled from the 21 UTC values from the previous day through the 18 UTC values of the current day. For locations < -102º (western US), the 24-hour observations were compiled from the 00 UTC values of the current day through the 21 UTC values of the current day. For every 3-hourly NARR value that had precipitation ≥ 0.01", one-hour duration was accumulated. Therefore, a 24-hour period does not exceed 8 hours of precipitation duration. This allows for assuming a "worst-case" scenario for fire danger. The 0.01" threshold was determined from comparative analysis with RAWS precipitation values.

State of the weather (SOW) is given only three categories (clear=0, overcast=3, and precipitating=6) and was based upon the ratio of actual downward shortwave radiation (DSW) with the potential DSW on a clear day. The potential DSW is a function of day of year and latitude. If the ratio (i.e., actual DSW / potential DWS) was ≥

50%, then a SOW of 0 (clear) was assigned. If it was < 50%, a SOW of 3 (overcast) was assigned. If the 3-hourly NARR precipitation amount closest to 1300 LT was ≥ 0.02”, then a SOW of 6 (rain) was assigned.

Table 2. WXOBS72A weather station inventory format for included variables

Field	Field Name	Columns
1	Station Number (RRRCCC; where RRR is the row number from the south and CCC is the column number from the west)	1-6
2	Year	7-8
3	Month	9-10
4	Day	11-12
5	State of the Weather (0=clear; 3=overcast; 6=precipitation)	13
6	Dry Bulb Temperature (F)	14-16
7	Relative Humidity (%)	17-19
11	Wind Direction (8-pt)	28
12	Wind Speed (mph)	29-31
16	Maximum Temperature (F)	39-41
17	Minimum Temperature (F)	42-44
18	Maximum RH (%)	45-47
19	Minimum RH (%)	48-50
20	Season Code	51
21	Precipitation Duration (Hrs)	52-53
22	Precipitation Amount (hundredths of an inch)	54-57
24	Relative Humidity Variable (2=%)	61

Historical weather data from NARR in the WXOBS72A format can be accessed via the web (http://www.wrcc.dri.edu/fpa). Latitude and longitude coordinates are entered in the fields provided either manually or by a series of clicks on a Google™ map. Users can zoom in and navigate around the map using the mapping tools on the left-hand side of the display. Other options are for users to enter in either the 6-digit NWS identification number for a WIMS station or the WIMS station name of their choosing and the map will zoom into that station Data is downloaded to the user’s computer in the WXOBS72A format with an .fwx filename extension. Station identification numbers are 6-digits where the first 3 digits represent the row number (from the south) and the second 3 digits represent the column number (from the west) of the selected grid point. The data file names will include the six-digit ID and text to indicate that it is from the gridded dataset: nnnnnn_gridded.fwx.

Future work is planned to perform more statistical validation on the historical NARR weather data to historical RAWS and other operational datasets that have a high level of data quality. It would also be desirable to develop and provide an associated station catalogue for each grid point that includes fuel model, green-up date, climate and slope classes, etc.

Changes made for the January 2007 data release:

1. In the *.fwx format, precipitation is only provided out to the hundredth digit. However, data that was used to develop those output files had much greater precision. Therefore, the output files were often state a precipitation duration > 0 and state of the weather equal to 6 when the precipitation amount was 0.00". Algorithms were modified to only increment duration when the precipitation amount was > 0.005"; state of the weather was reassigned to 6 when the precipitation amount was > 0.02".

Changes made for the September 2007 data release:

1. Original wind speeds were based upon incorrect unit conversion algorithms. The error was corrected.

Changes made for the March 2008 data release:

1. There was an error in the computation of precipitation duration. This error was corrected.

References

Daly, C., R. P. Neilson, D. L. Phillips, 194: A statistical-topographic model for mapping climatological precipitation over mountainous terrain. *J. of Appl. Meteor.*, **33**, 140-158.

Hall, B. L. and T. J. Brown, 2006: Comparison of weather data from the Remote Automated Weather Station network and the North American Regional Reanalysis, *Proceedings for the 14th Sumposium on Meteorological Observation and Instruments*, Amer. Meteor. Soc., 5 pp.

Mesinger, F. and Co-authors, 2006: North American Regional Reanalysis, *Bull. Of Amer. Meteor. Soc.*, March, 343-360.