

VI.5.4-NDFD2RFS NATIONAL DIGITAL FORECAST DATABASE (NDFD) TO OFS  
FUTURE MEAN AREAL TEMPERATURE (FMAT) PREPROCESSOR  
(NDFD2RFS)

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Background

The National Digital Forecast Database (NDFD) [\[Hyperlink\]](#) contains gridded forecasts of sensible weather elements (e.g., cloud cover, maximum temperature).

Program NDFD2RFS is a future mean areal temperature preprocessor using NDFD grid based temperature layers (NDFD-FMAT) that is an alternative to the current way of calculating future MAT (See 'Section II. Future Data Period' in II.7-OFS-MAT [\[Hyperlink\]](#)).

Similar to the OFS MAPX Preprocessor [\[Hyperlink\]](#) , which produces input data for lumped hydrologic models from grid based data, NDFD2RFS reads NDFD temperature grids, computes a spatial average over a basin and writes basin averaged temperature values to the OFS Processed Data Base [\[Hyperlink\]](#). NDFD2RFS also temporally averages instantaneous, maximum and minimum temperature grids to compute 6 hour future MAT (FMAT).

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Temperature Data

NDFD2RFS processes instantaneous, maximum and minimum NDFD temperature grids. Each NDFD instantaneous temperature grid contains forecast temperatures for lead-times at 3 hour intervals for the first 72 hours

and at 6 hour intervals for days 3 through 7. Maximum and minimum temperature grids have 7 day's of data at 24 hour intervals. The forecasted daily maximum temperature is defined as the maximum temperature between 0700-1900 Local Standard Time and the forecasted daily minimum temperature is the minimum temperature between 1900-0800 Local Standard Time. Forecasts always start for a basis time of 0, 3, 6, 9, 12, 15, 18 or 21Z and end at the 0Z valid time on day 7. There is no restriction on how often WFOs update the forecasts. The temperature grids are defined in degrees Fahrenheit and are issued on a 5 KM grid spatial resolution.

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### Algorithm

A 6 hour MAT is defined as the average temperature across any given area during a 6 hour period. NDFD2RFS uses the algorithm currently in NWSRFS for calculating 6 hour MAT when instantaneous, maximum and minimum temperature data are available.

The first part of the algorithm is for NDFD2RFS to extract the relevant portions of the data. The steps used by NDFD2RFS to extract the data are:

1. Reads the OFS Preprocessor Parametric Data Base to determine which MAT areas have an associated basin
2. Reads the HRAP line segment definition for each basin in found in step 1
3. Converts the HRAP points found in step 2 to latitude/longitude points
4. Using a nearest neighbor algorithm, extracts instantaneous, maximum and minimum temperature values from the NDFD grid for each point in found in step 3

For a given basin and NDFD temperature layer (Figure 1 [\[Hyperlink\]](#)), each HRAP point in the basin's line segment representation is converted to a latitude/longitude coordinate. The latitude/longitude points are used to query the NDFD grid and extract a temperature dataset for the closest NDFD pixel. Figure 2a [\[Hyperlink\]](#) and Figure 2b [\[Hyperlink\]](#) shows an example for a grid of instantaneous values. The process is repeated for all valid times through 0Z on day 7. The same process is used to extract maximum and minimum temperature NDFD values.

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### **Temporal Averaging**

After extracting an instantaneous, maximum and minimum temperature dataset for each HRAP point, temporal averaging for each pixel occurs in two steps.

In step 1 the 6 hour pixel mean is computed by applying a 25% weight to the instantaneous forecast values at the 6 hour synoptic lead-times, a 50% weight to forecast values at the 3 hour synoptic lead-

times and summing the 3 points within a given 6 hour period (Figure 3 [[Hyperlink](#)]). NDFD2RFS computes an intermediate 3 hour instantaneous forecast grid for days 3 through 7 (forecasts during these times are at 6 hour intervals).

In step 2 the computed 6 hour means for each pixel are adjusted to maintain consistency between the computed daily maximum/minimum 6 hour means and NDFD's daily maximum/minimum value for each pixel. Because NDFD maximum temperatures are assumed to occur between approximately 0 and 12Z and minimum temperatures are assumed to occur between approximately 12 and 24Z, if the daily 6 hour maximum computed in step 1 occurs between 0 and 12Z and/or the daily 6 hour minimum occurs between 12 and 24Z, a weighted average of the NDFD maximum/minimum value and the maximum/minimum value computed in step 1 is used. The weight assigned to the NDFD maximum/minimum value depends on whether the maximum/minimum data is for valid times during the first 72 hours (when instantaneous data available at 3 hour intervals). Maximum/minimum adjustments to 6 hour means with lead-times between 0 and 72 hours use a 0.75 weight for the mean computed in step 1 and a 0.25 weight for the NDFD maximum/minimum value. For longer lead-times, the mean computed in step 1 and the maximum/minimum NDFD value are assigned equal weight. In Figure 4 [[Hyperlink](#)] the 12Z maximum computed mean at a given pixel is adjusted from 74 to 75.5 or 74 to 77 for NDFD data with lead-time less than or greater than 72 hours respectively.

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## **Spatial Averaging**

For each 0, 6, 12 and 18Z valid time for days 0 to 7, NDFD2RFS spatially averages all the 6 hour FMAT pixel values in a basin to compute a basin wide FMAT (Figure 5 [[Hyperlink](#)]). These values are then written to the future portion of the MAT time series in the OFS Processed Data Base [[Hyperlink](#)].

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## Program Execution Information

Program NDFD2RFS can be run using the script ofs (see Chapter I.2-UNIX-OFS [[Hyperlink](#)]) as follows:

```
ofs -p ndfd2rfs -o [output_file_name]
```

The program does not use a control input file so the '-i' option is not needed.

Program NDFD2RFS uses the following apps\_defaults tokens:

```
ndfd2rfs_input . . . the directory where the following NDFD
                    temperature grids are located:
                        ds.maxt.bin - maximum temperature grid
                        ds.mint.bin - minimum temperature grid
                        ds.temp.bin - instantaneous temperature
```

		grid
ndfd2rfs_output	. .	default is \$ofs_files/\$ofs_level/ndfd the directory where the log file (ndfd2rfs_log.HHMMSS_api where HHMMSS is the execution hour, minute and second) is to be written; default is \$ofs_output/\$LOGNAME
ndfd2rfs_log_level	.	logging level used to determine the information written to the log file; valid values are 0, 20, 50 and 80; default is 0
ofs_level	. . . . .	the OFS file set to be used

To execute the program a value for the token ndfd2rfs\_input must be specified (there is no default value). The directory pointed to by ndfd2rfs\_input and the NDFD temperature grids with the names specified below must already exist.

The information written to file ndfd2rfs\_log\_HHMMSS\_api for the logging levels is described in Table 1 [[Hyperlink](#)].

Table 1. Information written to log file for each logging level

<u>Description</u>	Logging Level <u>1</u> /			
	<u>0</u>	<u>20</u>	<u>50</u>	<u>80</u>
Apps Defaults Tokens and values	X	X	X	X
Start and end date for NDFD instantaneous, minimum and maximum temperature data	X	X	X	X
Start and end time of NDFD2RFS execution	X	X	X	X
OFS MAT Processed database information:				
o start of observed data				X
o start of future data	X	X	X	X
o end of future data				X
Errors causing NDFD2RFS to quit	X	X	X	X
OFS basin identifiers		X	X	X
Interpolation method for extracting NDFD values			X	X
All 6 hour FMAT values for each basin			X	X
Inserted 6 hour FMAT values for each basin			X	X
Number of HRAP line segments in each basin			X	X
NDFD2RFS diagnostics				
o opening and closing files				X
o entering and exiting a routine				X
o success and failure of executing a routine				X

Notes:

1/ 'X' indicates item will be displayed in log file.

Figure 1. Basin outline overlaid on NDFD Instantaneous temperature grid at 0Z on day 7

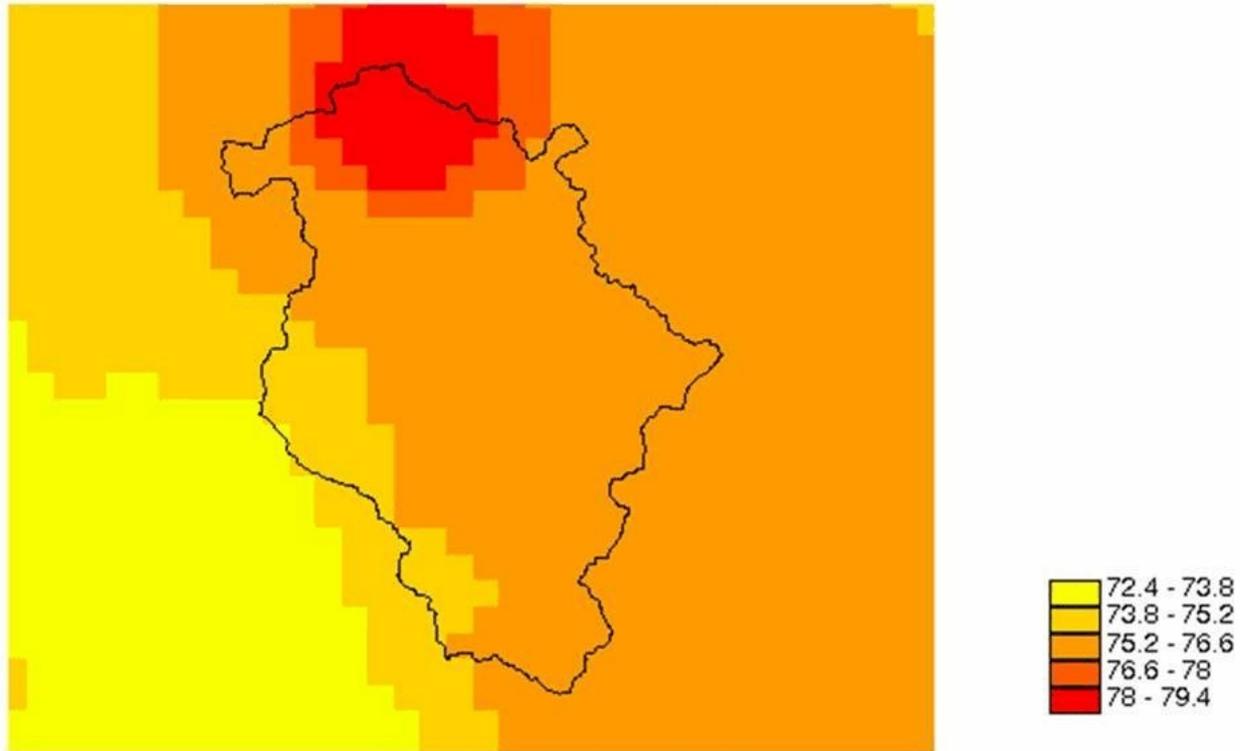


Figure 2a. Latitude/longitude points used to query the NDFD grid

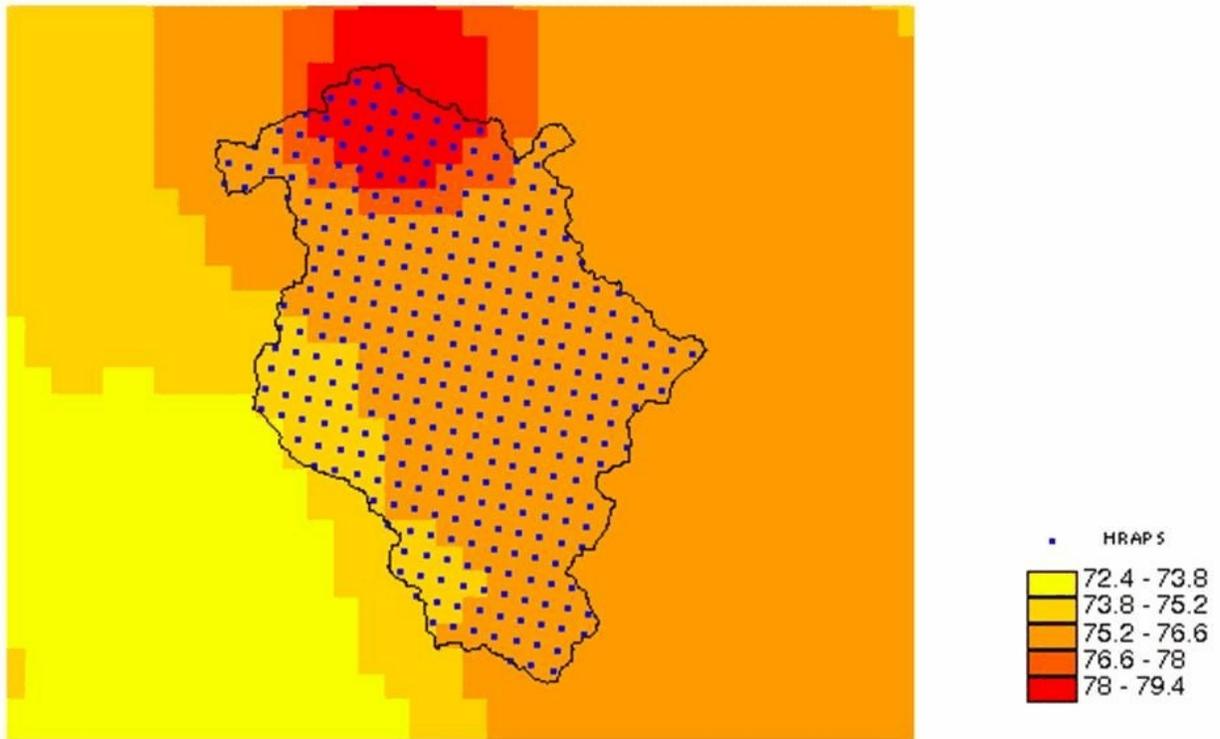


Figure 2b. Extracted instantaneous temperatures

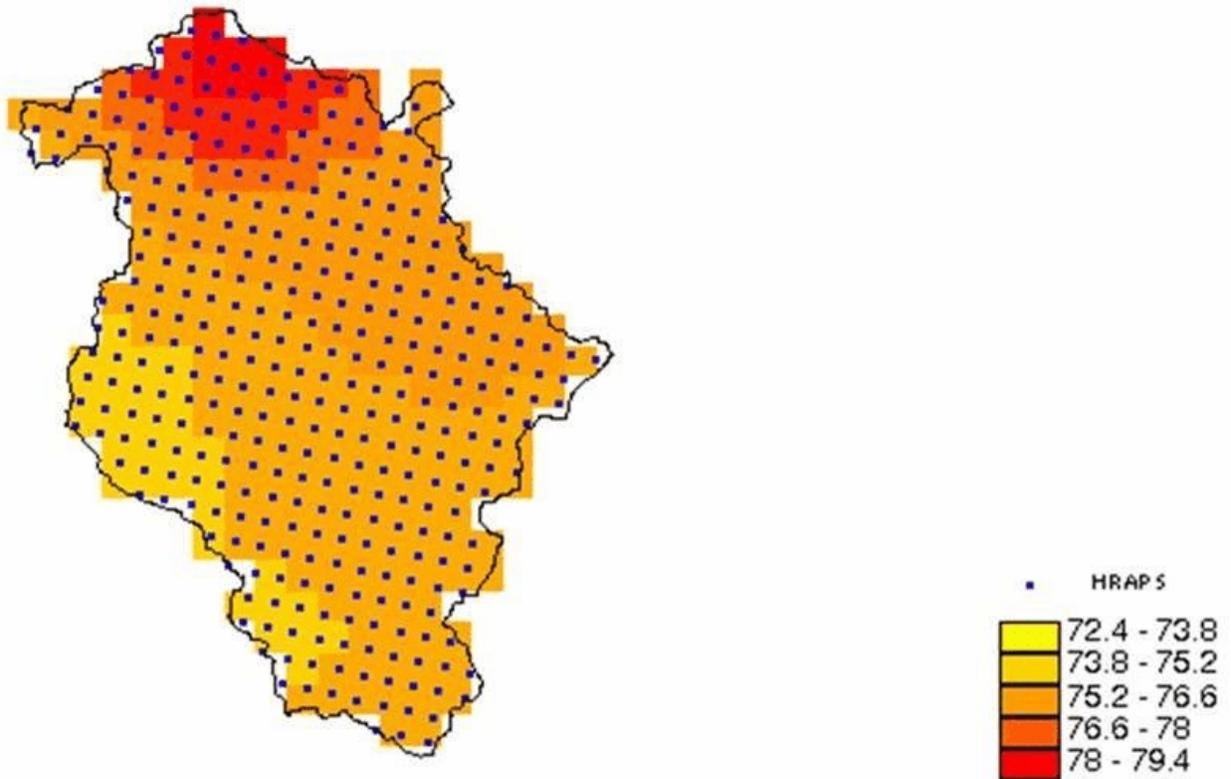


Figure 3. Step 1: compute 6 hour means for each pixel using 3 hour instantaneous values

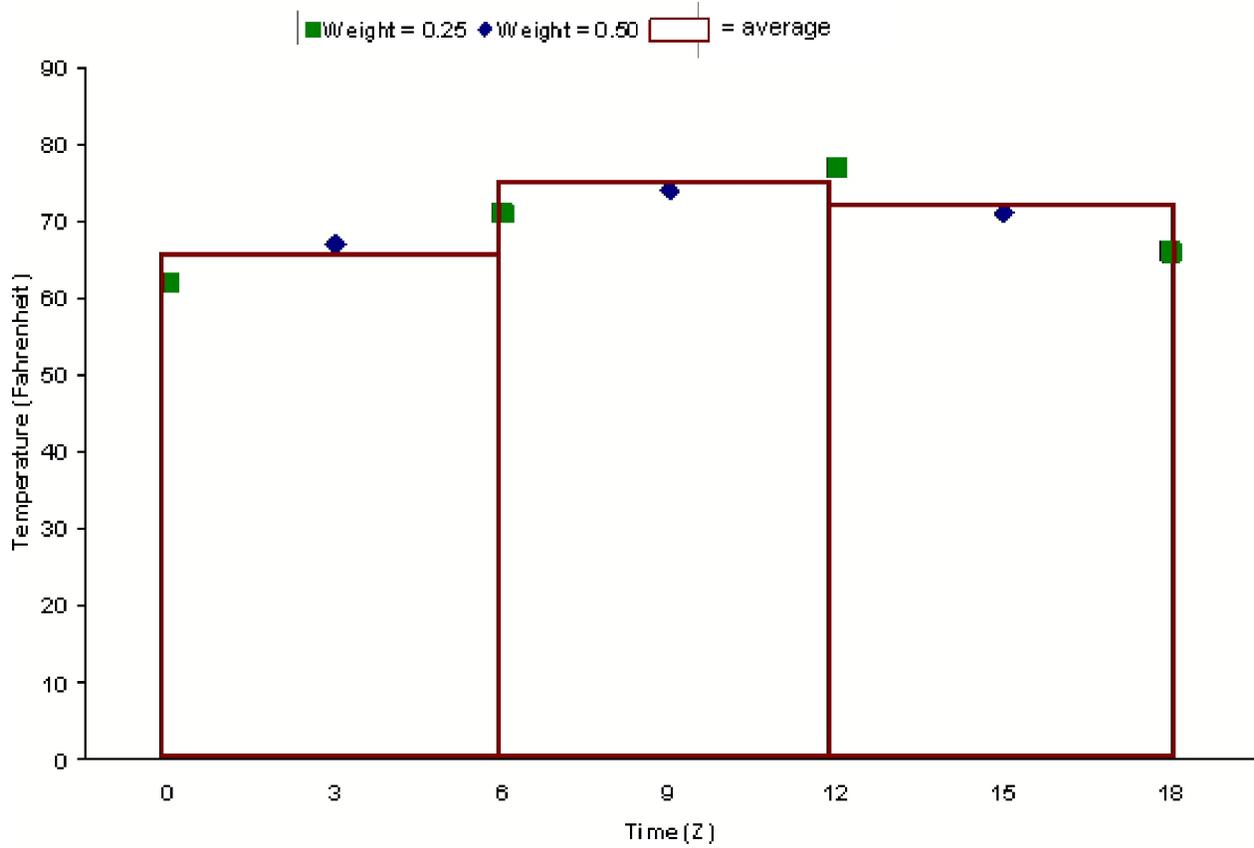


Figure 4. Step 2: adjust maximum FMAT at each pixel based on NDFD maximum value (same procedure used for adjusting minimum FMAT based on NDFD minimum value)

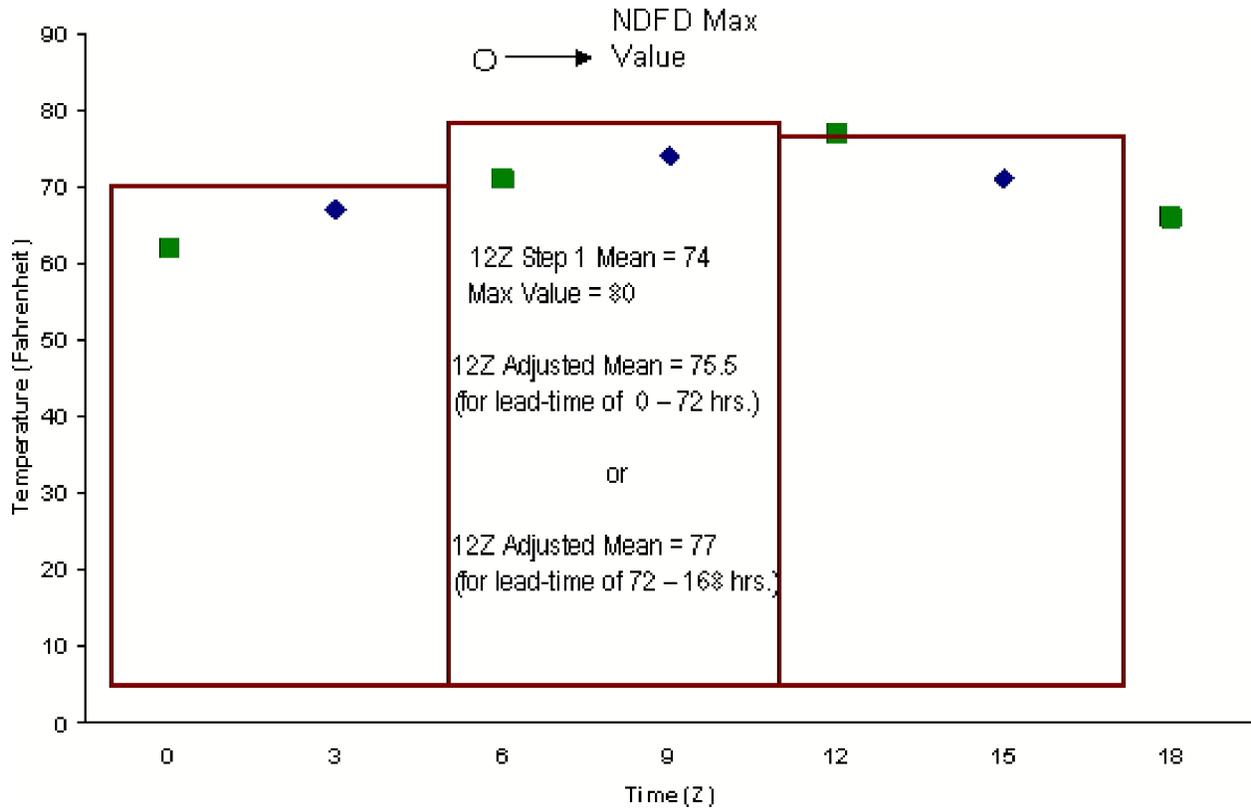
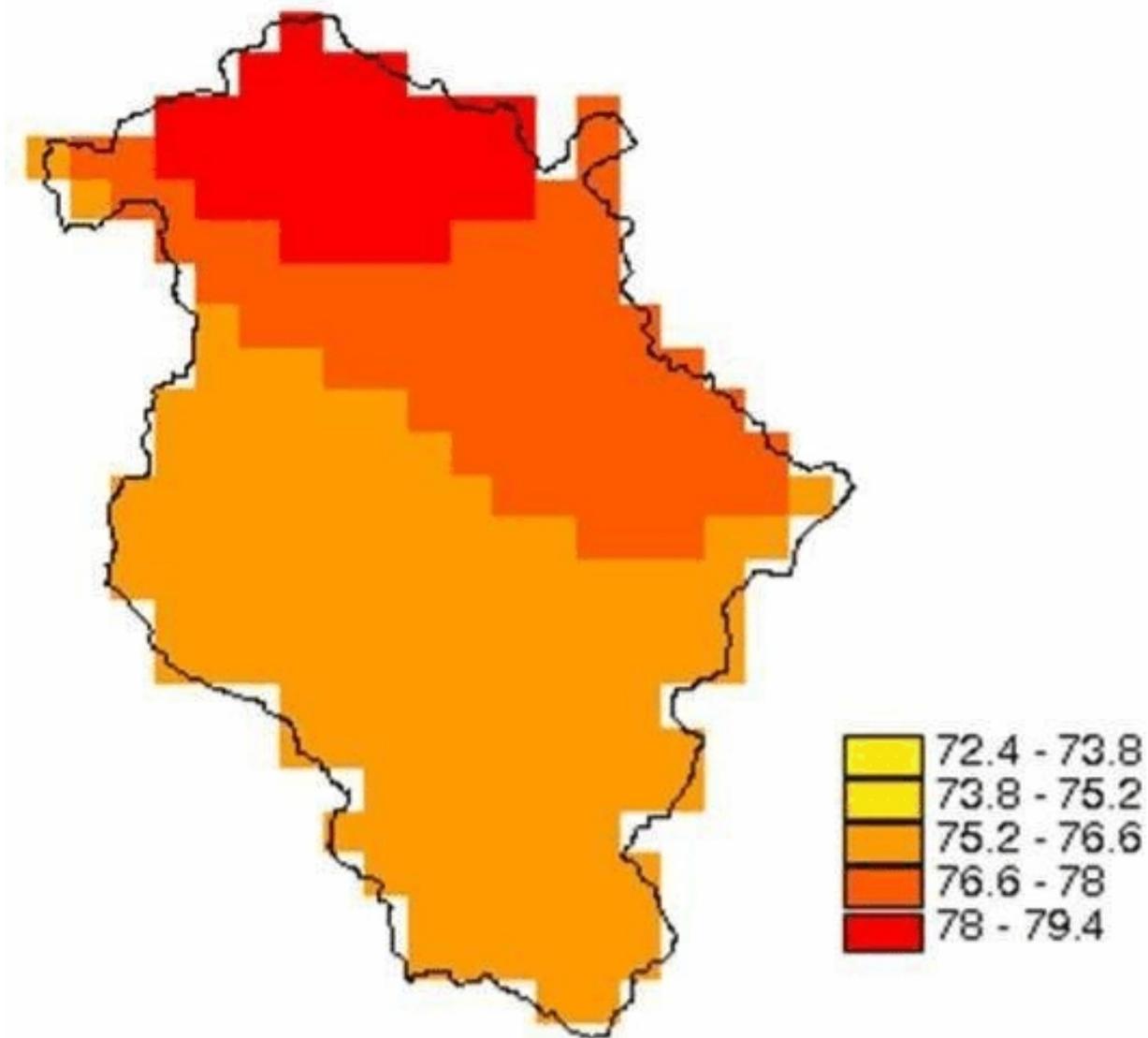


Figure 5. 6 hour FMAT after maximum/minimum adjustment

$$\text{FMAT} = 18345.36/245 = 74.9$$



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