The Development and Application of RAWS Statistical Guidance to Improve NFDRS Forecast Verification

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Introduction

The purpose of this paper is to explain the procedures that were used at WFO Medford to create and apply statistics from Remote Automated Weather Stations (RAWS) to improve the National Fire Danger Rating System (NFDRS) point forecast. NFDRS 2100Z observations come into the WFO via AWIPS on a daily basis. These observations contain meteorological information from each of the RAWS that serves a verification source for the NFDRS point forecast (FWM). Because of the large number of point forecasts WFO Medford is required to issue (62) and the short period of time we have to quality control these forecasts (30 minutes), we investigated the use of RAWS statistics as a means of identifying potential errors in our NFDRS point forecasts. This, in turn, should improve our verification scores and produce a more accurate forecast for our fire weather clients.

Methodology

Producing the statistics for the RAWS sites involved a four step process. First, a complete inventory of RAWS observational data was downloaded. Statistics were then created for each RAWS site. The statistical data files were made available inside the AWIPS firewall. Lastly, Python code was added to the FWM_MFR_Overrides utility to read and apply the statistics.

Step 1. Downloaded a complete inventory of RAWS observational data

Step 1a. The Western Region Climate Center website

An archive of RAWS data can be found on the Western Regional Climate Center website (http://raws.dri.edu – Figure 1). Navigating to the area of interest via the online map will produce a list of RAWS sites lying in or near a particular geographic area. Clicking on an individual RAWS site on the map will then display the complete inventory of data available for that site (Figure 2). Clicking "Data Lister" will bring up a webpage with pull down menus that can be used to download the data. The data examined in this case was May 1 through October 31 for all years in which data was available. This period constitutes the fire weather season at WFO Medford.

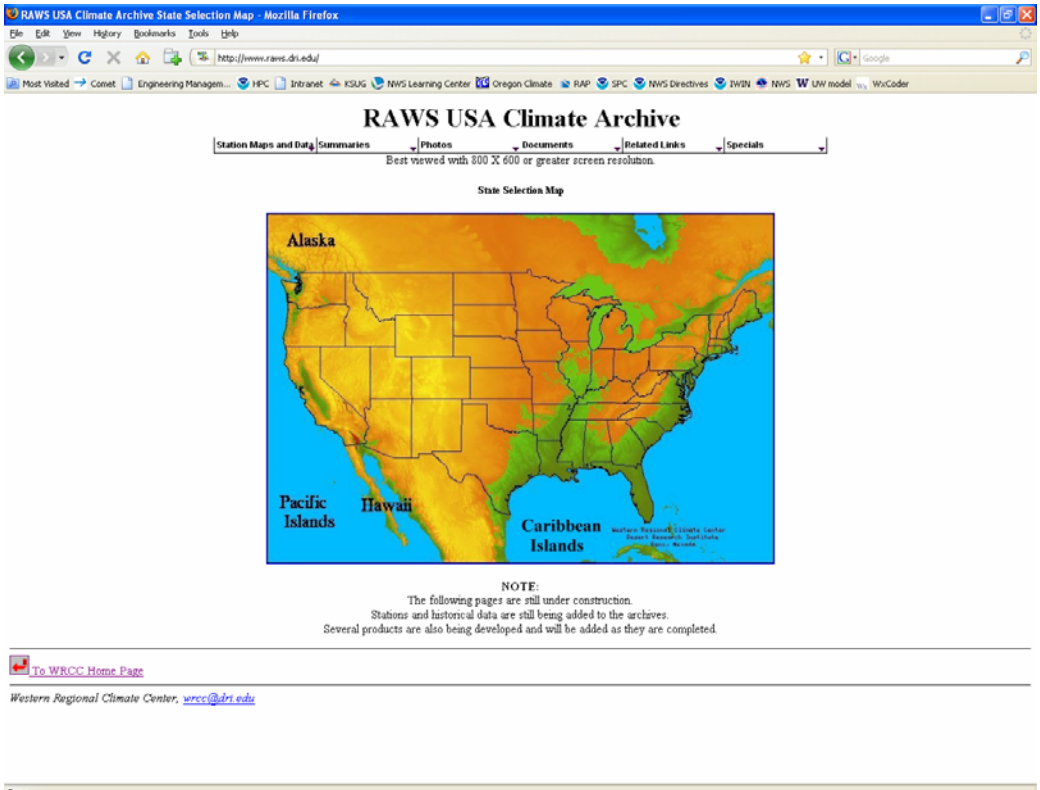


Figure 1. The Western Region Climate Center RAWS archive website.

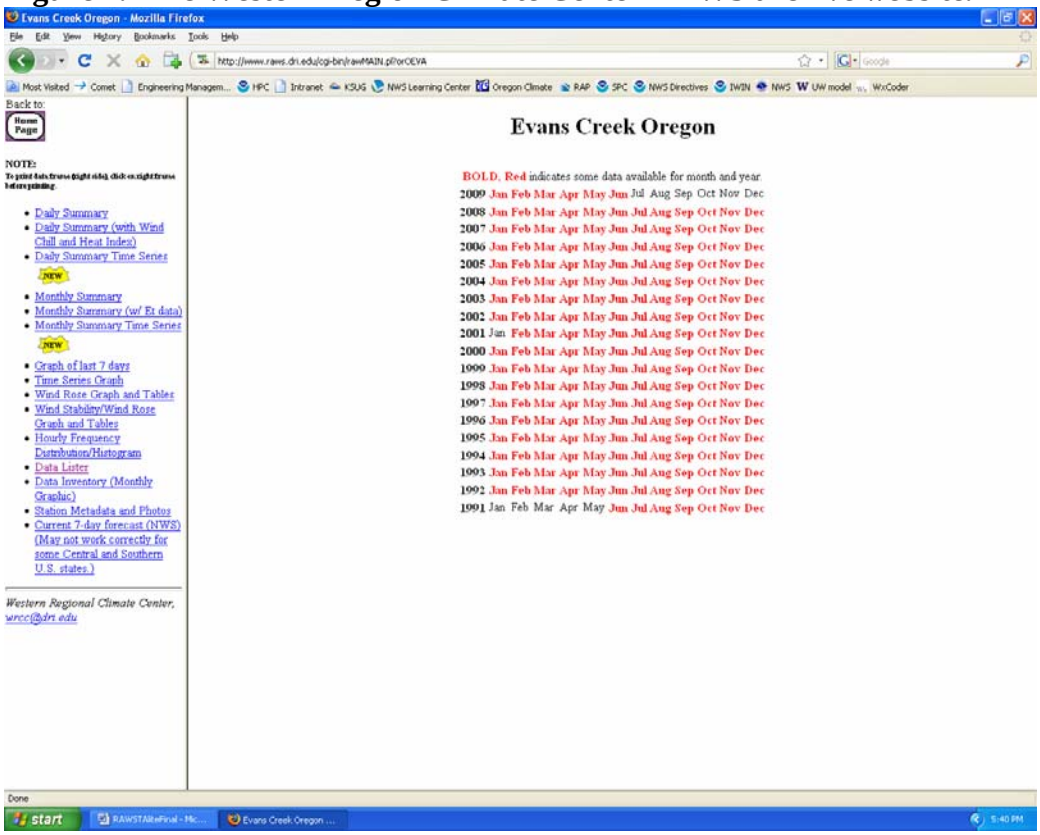


Figure 2. Complete inventory for Evans Creek, Oregon RAWS.

Step 1b. Download RAWS data

On the "Data Lister" page, a series of pull down menus are available. Each parameter had to be selected correctly in order to download and produce the statistics correctly. Table 1 also explains each parameter while Figures 3 and 4 are screen captures of all the parameters correctly selected.

Parameter	**Option Selection**	**What/Why?**
Set the starting date	First day in inventory	Select beginning inventory date
Set the ending date	Last day in inventory	Select ending inventory date
Password access to data more than 30 days old	Entered password	Obtained from WRCC/Medford SOO
Data format	Excel (.xls)	Format need for PivotTables/calculations
Data source	Original	Original data needed
Represent missing data as:	M	M does not interfere in calculating statistics
Include data flags	No	Do not need flags
Date format	MM/DD/YYYY hh:mm	Selected for readability
Time format	LST 0-23	Desired time format
Table header	Column header short descriptions	Selected for readability
Field delimiter	Comma (,)	Needed for Excel to work
Select the units	English	Selected for readability
Subinterval start date	May 01	Beginning of MFR fire wx season
Subinterval end date	October 31	End of MFR fire wx season
Starting hour	13	Hour used to match NFDRS/trend times

Table 1. Pull down menu parameter selections on the Data Lister webpage.

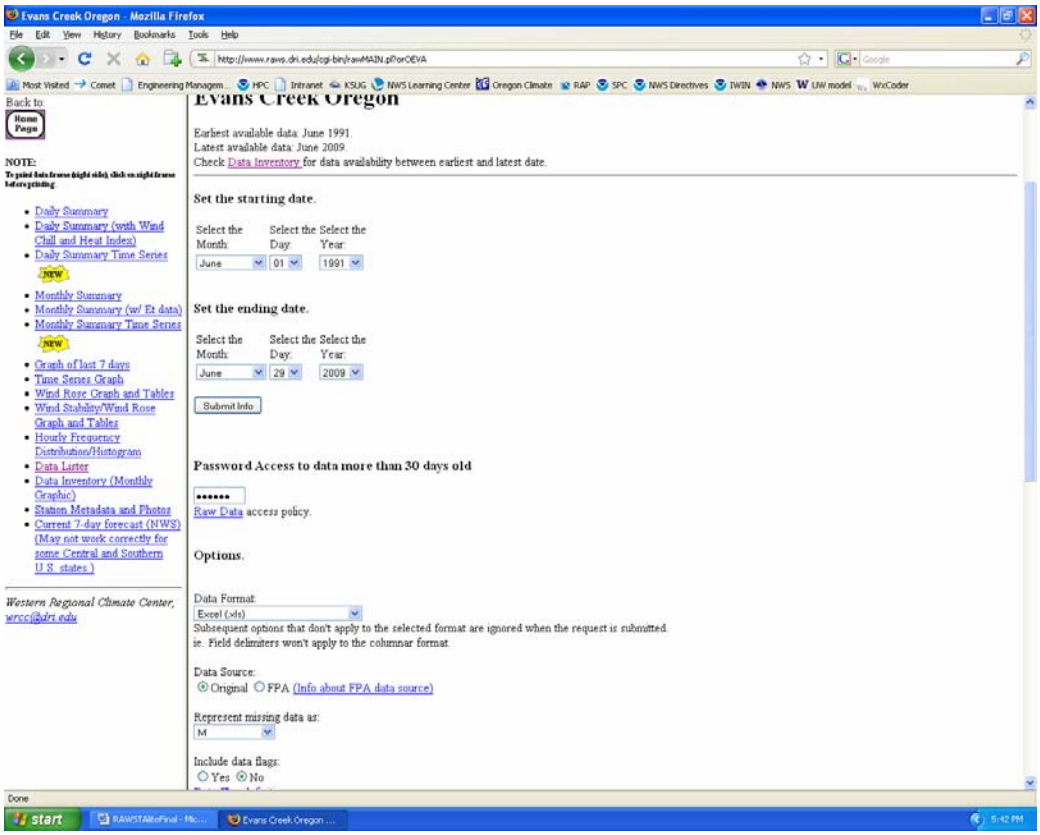


Figure 3. Data Lister webpage (top half).

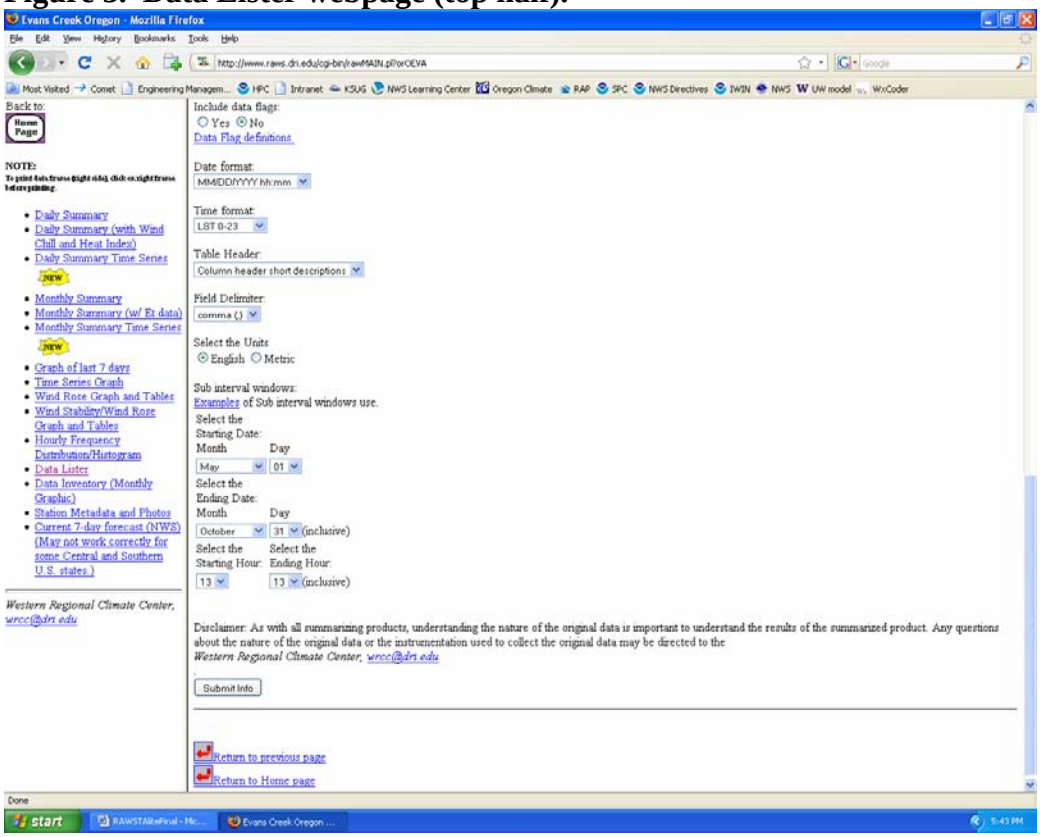
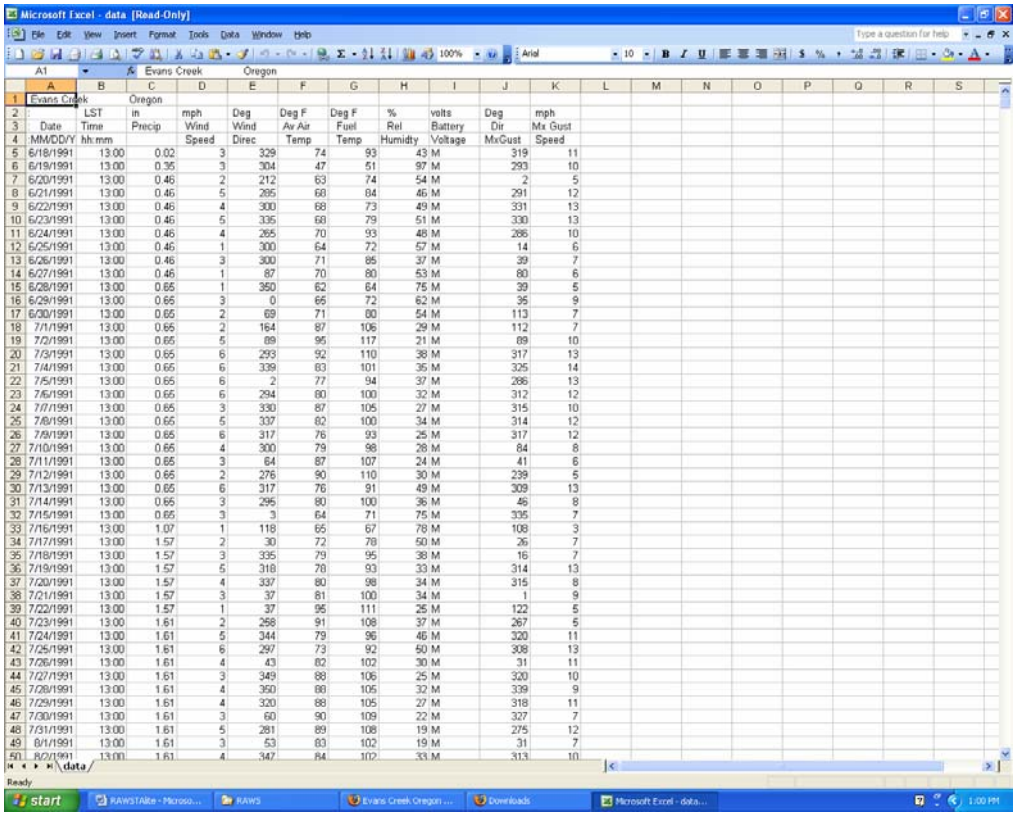


Figure 4. Data Lister webpage (bottom half).

Clicking “submit” will download the data into a Microsoft Excel spreadsheet. Figure 5 is an example of downloaded data. The download process was repeated for the 60+ RAWS sites that are located in the Medford fire weather district.



	A	B	C	D	E	F	G	H	I	J	K
1	Evans Creek		Oregon								
2		LST	in	mph	Deg	Deg F	Deg F	%	volts	Deg	mph
3	Date	Time	Precip	Wind	Wind	Av Air	Fuel	Rel	Battery	Dir	Mx Gust
4	MM/DD/Y	hh:mm		Speed	Direc	Temp	Temp	Humidty	Voltage	MxGust	Speed
5	6/18/1991	13:00	0.02	3	329	74	93	43	M	319	11
6	6/19/1991	13:00	0.35	3	304	47	51	97	M	293	10
7	6/20/1991	13:00	0.46	2	212	63	74	54	M	2	5
8	6/21/1991	13:00	0.46	5	285	68	84	46	M	291	12
9	6/22/1991	13:00	0.46	4	300	68	73	49	M	331	13
10	6/23/1991	13:00	0.46	5	335	68	79	51	M	330	13
11	6/24/1991	13:00	0.46	4	265	70	93	48	M	286	10
12	6/25/1991	13:00	0.46	1	300	64	72	57	M	14	6
13	6/26/1991	13:00	0.46	3	300	71	85	37	M	39	7
14	6/27/1991	13:00	0.46	1	87	70	80	53	M	80	6
15	6/28/1991	13:00	0.65	1	350	62	64	75	M	39	5
16	6/29/1991	13:00	0.65	3	0	66	72	62	M	35	9
17	6/30/1991	13:00	0.65	2	69	71	80	54	M	113	7
18	7/1/1991	13:00	0.65	2	164	87	106	29	M	112	7
19	7/2/1991	13:00	0.65	5	89	95	117	21	M	89	10
20	7/3/1991	13:00	0.65	6	293	92	110	38	M	317	13
21	7/4/1991	13:00	0.65	6	339	83	101	35	M	325	14
22	7/5/1991	13:00	0.65	6	2	77	94	37	M	286	13
23	7/6/1991	13:00	0.65	6	294	80	100	32	M	312	12
24	7/7/1991	13:00	0.65	3	330	87	105	27	M	315	10
25	7/8/1991	13:00	0.65	5	337	82	100	34	M	314	12
26	7/9/1991	13:00	0.65	6	317	76	93	25	M	317	12
27	7/10/1991	13:00	0.65	4	300	79	98	28	M	84	8
28	7/11/1991	13:00	0.65	3	64	87	107	24	M	41	6
29	7/12/1991	13:00	0.65	2	276	90	110	30	M	239	5
30	7/13/1991	13:00	0.65	6	317	76	91	49	M	309	13
31	7/14/1991	13:00	0.65	3	295	80	100	36	M	46	8
32	7/15/1991	13:00	0.65	3	3	64	71	75	M	335	7
33	7/16/1991	13:00	1.07	1	118	65	67	78	M	108	3
34	7/17/1991	13:00	1.57	2	30	72	78	50	M	26	7
35	7/18/1991	13:00	1.57	3	335	79	95	38	M	16	7
36	7/19/1991	13:00	1.57	5	318	78	93	33	M	314	13
37	7/20/1991	13:00	1.57	4	337	80	98	34	M	315	8
38	7/21/1991	13:00	1.57	3	37	81	100	34	M	1	9
39	7/22/1991	13:00	1.57	1	37	95	111	25	M	122	5
40	7/23/1991	13:00	1.61	2	268	91	108	37	M	267	6
41	7/24/1991	13:00	1.61	5	344	79	96	46	M	320	11
42	7/25/1991	13:00	1.61	6	297	73	92	50	M	308	13
43	7/26/1991	13:00	1.61	4	43	82	102	30	M	31	11
44	7/27/1991	13:00	1.61	3	349	88	106	25	M	320	10
45	7/28/1991	13:00	1.61	4	350	88	105	32	M	339	9
46	7/29/1991	13:00	1.61	4	320	88	105	27	M	318	11
47	7/30/1991	13:00	1.61	3	60	90	109	22	M	327	7
48	7/31/1991	13:00	1.61	5	281	89	108	19	M	275	12
49	8/1/1991	13:00	1.61	3	53	83	102	19	M	31	7
50	8/2/1991	13:00	1.61	4	347	84	102	33	M	313	10

Figure 5. Downloaded RAWS data.

Step 2. Created the statistics for each RAWS site

Step 2a. Cleaned up and quality controlled the data

Once the data was downloaded, a little cleaning up and data quality control was needed. For the verification project, the only columns in the spreadsheet that were used were date, wind speed, air temperature, and relative humidity. All the other columns were deleted (wind direction, fuel temperature, voltage, etc.). We encountered a few days where daily parameters were missing (see “M” in Table 1). In order to have daily averages and standard deviations for all dates, we had to interpolate missing values for each parameter from the most recent day having data. Although this method introduced a potential source of error in our computations, it occurred so seldom that it was found to be statistically insignificant. Extra parameter labels occurring across the columns were also deleted. Figure 6 shows the result of these actions.

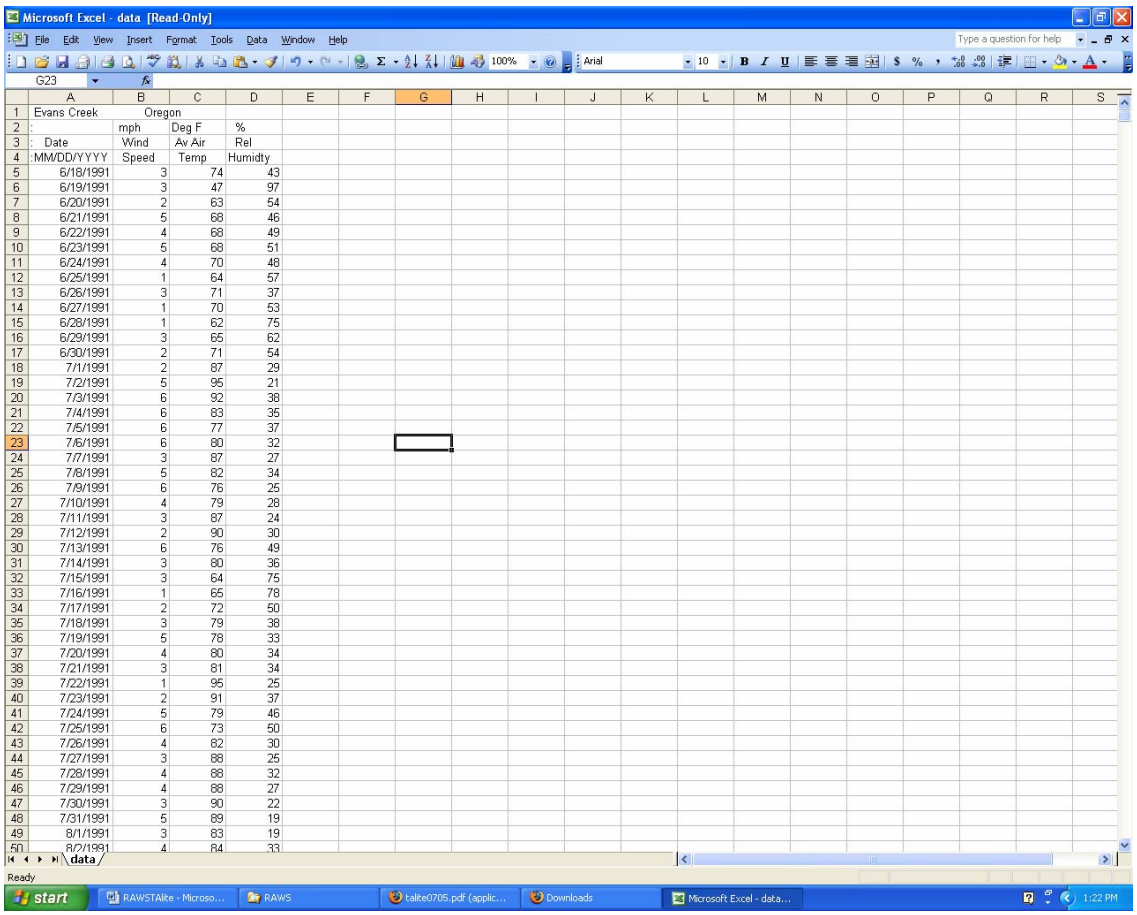


Figure 6. Data that was cleaned up and quality controlled (extra data columns deleted and any missing daily data interpolated).

Step 2b. Created trend values and statistics using the PivotTable function in Excel

Not only did we want to know the average wind speed, air temperature and relative humidity by date for each of our RAWS sites, we also wanted to know the average daily change of those variables. This allowed us to check the forecasted values and the 24 hour trends forecasted against "normal" in the FWM product. This was easily achieved by using the subtraction formula in Excel for each meteorological parameter (notice the ws diff, t diff, rh diff columns in Figure 7). Also notice the "MONTH" and "DAY" columns in the spreadsheet. The month and day columns use the month() and day() functions in Excel. These two functions were necessary for the next step. Next, the actual statistics were calculated using the PivotTable function in Excel. The PivotTable function allows for a quick calculation of data regardless of the amount of data used. Using PivotTables saved time in the long run since doing manual calculations in Excel would have required individual adjustments in column length, depending on how much data each RAWS site had in its inventory. Creating a PivotTable is simple processes of highlighting all necessary data, navigating to the "Data" pull down menu in Excel and choosing the "PivotTable and PivotChart Report" option. This process will bring up a wizard. The "layout" button in the wizard was used to produce the desired layout (month in columns, day in rows, with data intersecting the month and day – see Figure 7). Within the

PivotTable, averages of wind speed, air temperature, relative humidity, the averages of the daily differences or trends for each parameter, and standard deviations were calculated.

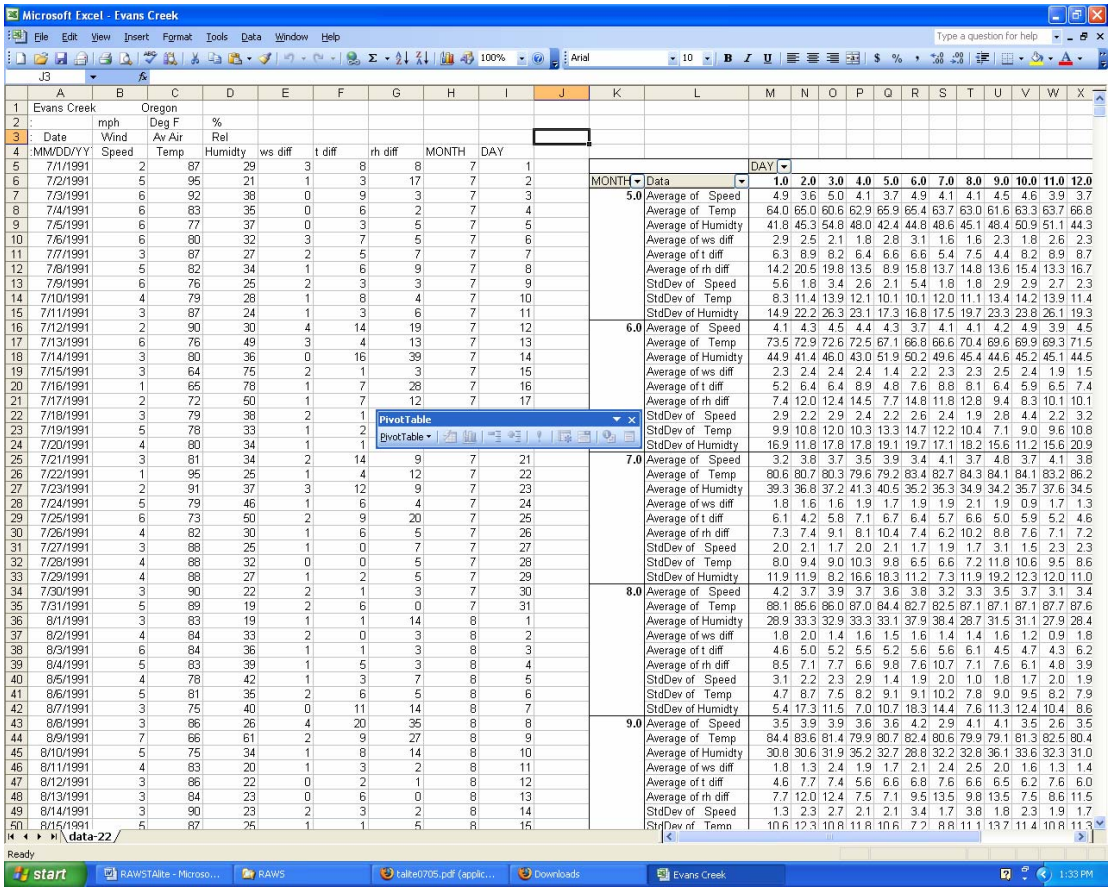


Figure 7. Difference, month, and day columns added and PivotTable created.

Step 3. Exported statistics to a text (.txt) format

The calculated data was exported as a text (.txt) formatted file so it could be uploaded and read in the AWIPS environment. This conversion was a straight forward process of selecting the PivotTable, copying it to a new spreadsheet, and then using "save as" to write the contents of the new spreadsheet to a text file. Figure 8 shows an example of an output file. The text files were then copied to the mass storages drives in AWIPS. For our purposes the data was written to the **/data/fxa/LOCAL/guidance/FWMStations** directory to make it available to each of the AWIPS workstations.

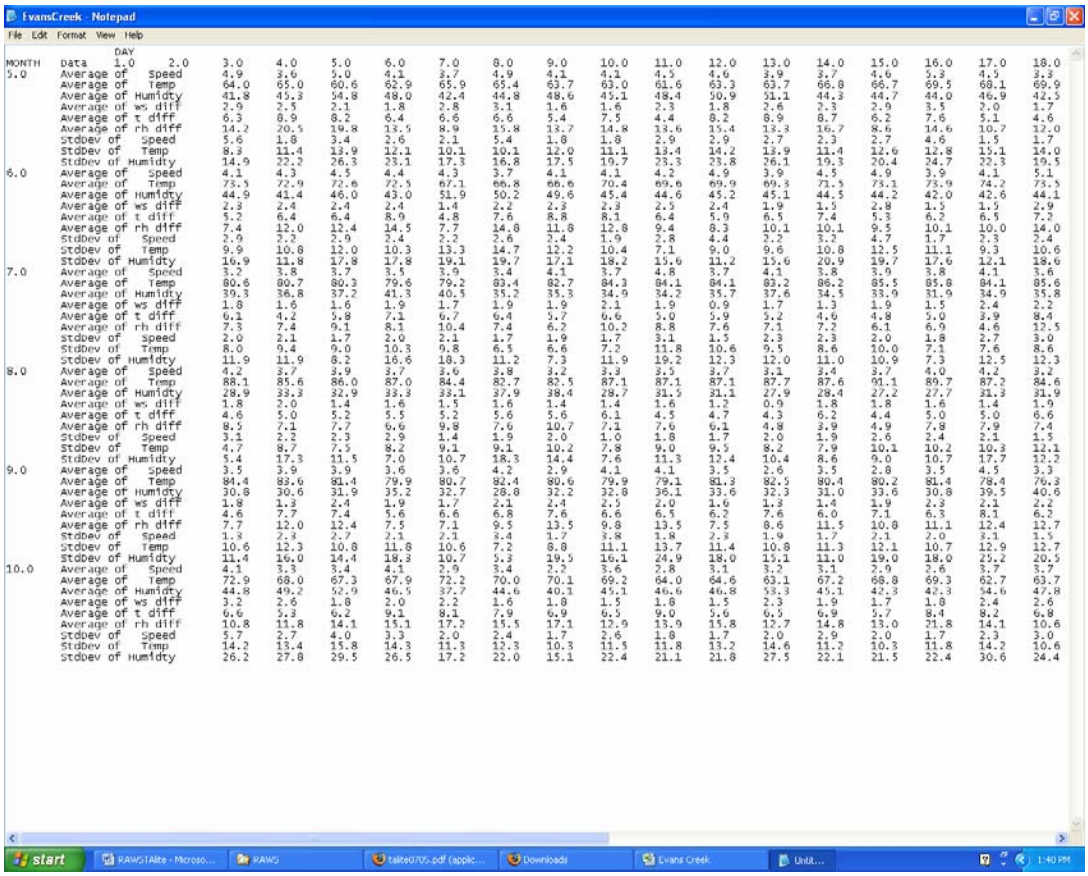


Figure 8. PivotTable exported to a text file.

Step 4. Coded the FWM_MFR_Overrides Python file to use the data

This step required knowledge of the Python programming language to modify the FWM_MFR_Overrides file to read in and use the statistical data. For anyone interested in seeing how this was done locally, this file can be obtained from WFO Medford. Essentially, the statistics for the date were read from the file and compared with the forecast for 2100Z tomorrow as well as the trend this forecast represented from the current 2100Z NFDRS observation. If the average difference or standard deviation thresholds were exceeded, a remark was added to the bottom of the FWM product. Figure 9 shows output from the FWM program. Notice the remarks at the bottom of the FWM product. This output tells the forecaster that they may want to recheck the grids as the forecasted data falls outside of the threshold set for this variable and may be inaccurate.

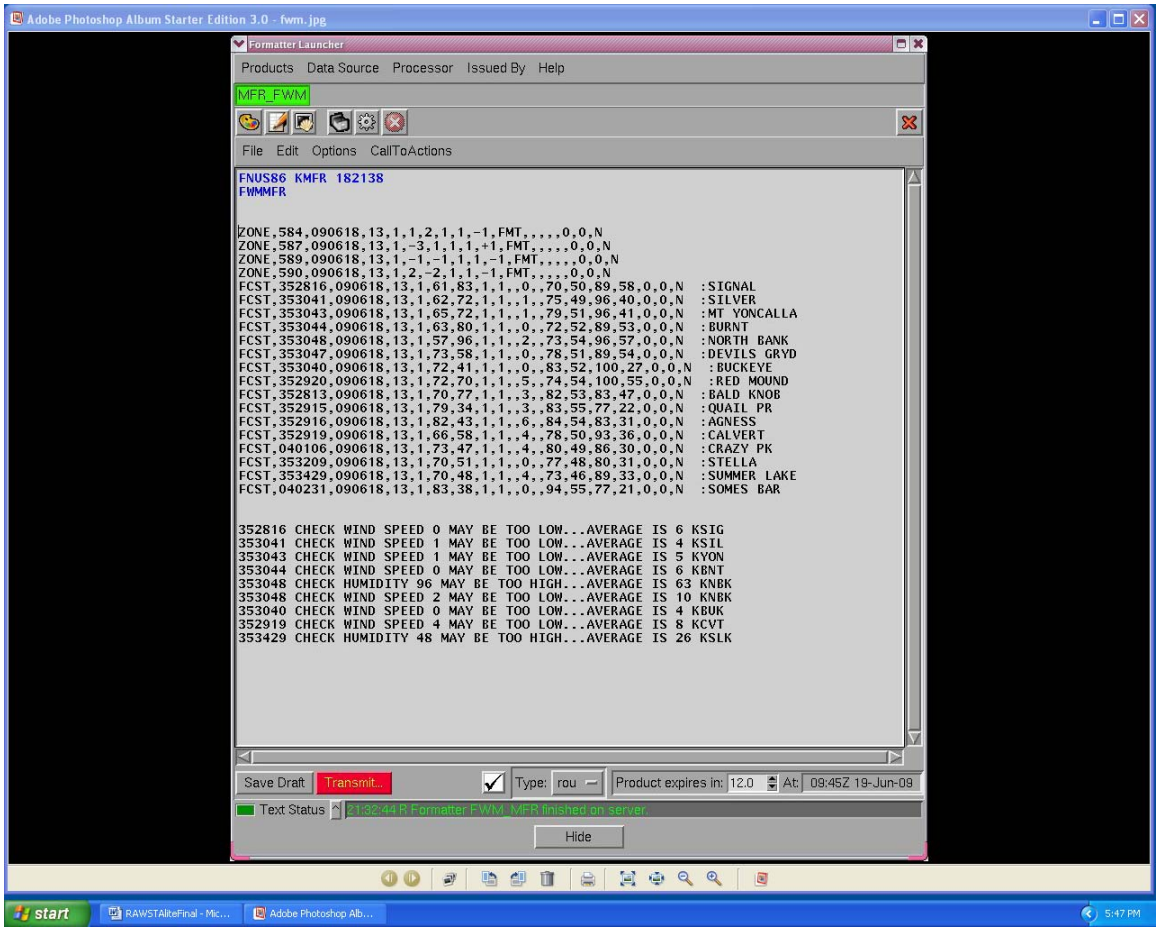


Figure 9. FWM output with qualifier remarks using statistics from each RAWS.

Conclusion

The ultimate goal of this project was to improve verification scores of our NFDRS forecast. We have already seen many cases where our forecasts were changed and improved because of the qualifier remarks or "flags" at the end of the FWM product. We intend to compare the verification scores of the NFDRS forecast at the end of this season with previous seasons to determine the full extent of the improvement made by using these statistics.

Acknowledgements

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References

Western Region Climate Center – RAWS USA Climate Archive. http://raws.dri.edu. Accessed numerous times 2008/2009.