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FORECASTING LARGE CHANGES IN SUMMERTIME SPOKANE, WASHINGTON MINIMUMS (CONTINUED)

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Introduction

Verification statistics were supplied by the Techniques Development Laboratory and Western Region SSD last August for the 1991 spring season. These showed that several forecast offices, including Seattle, had difficulty improving over the NGM big change minimum temperature forecasts. It was recommended that these offices explore the problem further using their local verification software.

The big temperature change statistic in question is a rather complex one. It includes all cases where the change is either (1) observed; (2) forecast by the staff; or (3) forecast by MOS. In addition the forecast changes are compared to the previous nighttime lows for the first two periods; the previous night's forecast low for periods three and four.

Unfortunately, the local verification software developed by Barker 1987 (Western Region Computer Programs and Problems #42) doesn't verify NGM guidance; only the LFM. Verification of the NGM awaits a final format for the AFOS "FWC" file. In the meantime a study of spring 1991 data was made using a nifty "JJVDATACHK" data display program developed by John Jannuzzi, DMIC Portland, plus old hard copies of the AFOS "FWC" data.

Locally this problem has been visited before. It was the subject of Western Region Technical Attachment #91-01 based on a similar loss to the LFM MOS in 1989. That study concluded that changes in cloud cover were the most important variable, more important than changes in air mass or wind speed. In some cases the change in surface temperature ran counter to the change in air mass aloft. The LFM MOS didn't do very well unless the change in surface temperature matched a large change in air mass.

Discussion

A study was made of large forecast and observed changes in minimums during the spring 1991 season. An attempt was made to determine why the staff lost to the NGM MOS and also if the conclusions of the previous study were still valid.

The National Verification Program sites for Washington are WSFO Seattle and WSO Spokane. There were no cases meeting the criteria at Seattle; the cases for Spokane are listed in Table 1.

No attempt was made to also verify the LFM MOS for all these cases since the LFM will soon be extinct. However, examination of some cases revealed a principal reason why the staff lost to the NGM MOS: they were deceived by the LFM MOS. In a number of cases the staff stuck close to the LFM MOS and the MOS struck out. A case in point:

DATE	LOW	1ST PERIOD			2ND PERIOD			3RD PERIOD			4TH PERIOD*		
		NGM	LFM	STAFF	NGM	LFM	STAFF	NGM	LFM	STAFF	NGM	LFM	STAFF
4/6/91	28	33	41	37	30	35	35	30	38	37	33	37	37**

This is not to say that the NGM guidance is automatically better than the LFM. In some cases the NGM MOS was worse, including a few mentioned below. A more comprehensive local verification conducted in 1989-90 found little difference in accuracy between the two.

Table 2 presents a subjective assessment of the factors which caused the observed large temperature changes. Once again cloud cover appeared the most important factor, although most cases in the early spring were accompanied by a similar change in air mass (e.g. less cloudiness/colder air mass). There were no cases where the change in minimum temperature ran counter to the change in cloud cover (e.g. warmer/less cloudiness).

The NGM MOS had problems when radiational cooling or the lack of it was the main factor causing the large temperature change. For example, on April 14th the low rose to 42 from 31 the previous day despite significant cold advection overnight. The main difference was the loss of good radiation conditions due to an increase in cloud cover and wind behind the cold front. The NGM MOS averaged a six degree error over the four forecast periods verifying April 14th, including an eight degree error in the first period.

Another case where the NGM MOS did poorly was in the period June 21 to 23. The early morning low plunged from 47 on the 21st to 37 on the 22nd, then rebounded to 47 on the 23rd. During this period there was a weak trough over the district with little change in air mass and light winds. The main change was temporary clearing early on the 22nd which allowed strong radiational cooling. The NGM MOS averaged a ten degree error on the 22nd, then recovered to a two degree error on the 23rd when the low again became consistent with the air mass.

Finally, the May 30 12Z NGM MOS forecast a spurious increase in low temperature from 42 on the 31st to 52 on June 1. The observed lows were 43 both nights. It appears that the guidance trended towards model output in the third period while good radiation conditions - clear skies and light wind - were the determining factor.

CONCLUSIONS

Studies conducted during the "Summer" verification season of 1989 and again during spring 1991 show that changes in cloud cover, not air mass, play the largest role in observed large changes in Spokane's minimums.

The staff has its best chance to beat the NGM MOS when it can identify cases where large changes in radiational cooling will accompany small changes in air mass. Usually this means large changes in cloud cover, especially in the late spring and (real) summer when winds are light and changes in air mass small.

OBSERVED CHANGE OF AT LEAST 10 DEGREES IN SPOKANE LOWS

DATE	LOW	1ST PERIOD		2ND PERIOD		3RD PERIOD		4TH PERIOD	
		NGM	LCL	NGM	LCL	NGM	LCL	NGM	LCL
4/06/91	28	33	37	30	35	30	37	33	37
4/10/91	26	29	34	26	28	24	28	27	32
4/14/91	42	34	33	38	36	37	36	34	35
4/25/91	33	34	34	31	36	31	37	33	34
5/05/91	44	41	38	39	37	40	37	42	37
5/09/91	33	37	36	35	35	35	36	35	35
5/11/91	48	41	40	40	42	42	42	(42)	na
5/13/91	39	40	46	43	43	44	43	43	43
5/16/91	47	45	41	45	45	43	41	44	40
5/20/91	37	45	46	44	45	48	50	49	48
5/21/91	47	47	44	48	44	50	46	49	47
6/05/91	50	41	40	39	38	43	37	42	38
6/11/91	56	53	50	55	50	54	50	55	50
6/12/91	41	42	41	43	45	45	45	48	44
6/22/91	37	47	48	49	45	50	49	49	47
6/23/91	47	48	47	49	47	51	50	51	50
AVERAGE	ERROR	4.1	6.0	3.9	5.0	4.8	6.2	4.7	5.9

NGM FORECAST CHANGE OF AT LEAST 10 DEGREES IN SPOKANE LOWS

4/06/91	28	33	37	30	35	30	37		
4/10/91	26			26	28	24	28		
4/25/91	33			31	36				
5/09/91	33	37	36	35	35			35	35
5/11/91	48	41	40						
5/21/91	47	47	44	48	44				
6/01/91	43					52	46		
6/06/91	47					51	47	50	44
6/12/91	41	42	41	43	45				
6/23/91	47	48	47	49	47				
AVERAGE	ERROR	3.0	3.8	1.6	3.0	4.3	3.5	2.5	2.5

LOCAL FORECAST CHANGE OF AT LEAST 10 DEGREES IN SPOKANE LOWS

4/06/91	28			30	35				
5/09/91	33	37	36	35	35	35	36		
6/04/91	35					38	37		
6/12/91	41	42	41	43	45				
6/19/91	47					50	54		
6/23/91	47	48	47	49	47				
AVERAGE	ERROR	2.0	1.0	2.0	3.3	2.7	4.0	NONE	

TABLE 1

PRIMARY FACTORS CAUSING OBSERVED LARGE TEMPERATURE CHANGES

DATE	LOW	FACTOR		
		CHANGE IN CLOUD COVER	AIR MASS ADVECTION	CHANGE IN WIND SPEED
4/06/91	28	X	X	
4/10/91	26	X	X	
4/14/91	42	X		X
4/25/91	33		X	
5/05/91	44	X	X	
5/09/91	33	X	X	
5/11/91	48	X	X	
5/13/91	39	X		
5/16/91	47	X	X	
5/20/91	37	X		X
5/21/91	47	X		X
6/05/91	50	X		X
6/11/91	56	X		
6/12/91	41	X	X	
6/22/91	37	X		
6/23/91	47	X		

NUMBER OF CASES THAT EACH FACTOR WAS SIGNIFICANT

CHANGE IN CLOUD COVER	15
AIR MASS ADVECTION	8
CHANGE IN WIND SPEED	4

TABLE 2