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PACIFIC NORTHWEST QPF VERIFICATION PROGRAM

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The primary purpose of any verification program should be to improve the forecasts in question. If at all possible, the verification program should be automated. To encourage use, the program should also be user-friendly.

As noted in WRTA 88-24, a program to verify QPFs supplied to the NWRFC was implemented in 1984 with the above specifications in mind. This program runs on the AOS computer at WSFO Boise. It is fully automated, even to the extent that forecasters at the participating WSFOs (Seattle, Portland, Great Falls, and Boise) receive AFOS messages indicating whether or not their products are properly coded. The user-friendly aspect of the program has been well-documented by Hill and Mathewson (1986). Forecaster input resulted in some minor changes to the program in 1987.

Since the 1987-88 water year was characterized as drier than normal with drought or near-drought conditions over much of the western U.S., it might be of interest to compare QPF verification scores to those for the more normal 1988-89 period.

Table 1 represents the summary for the 1987-88 season. WSFOs are identified only with regard to their location in relation to the Cascade Mountains; e.g., E1, E2 = east of the Cascades, W1, W2 = west of Cascades. As noted in WRTA 88-24, the number of forecasts vary among the WSFOs in Table 1 since each office forecasts for a different number of sites.

Table 2 is the final summary for the 1988-89 season. As expected, the precipitation frequency was higher than 1987-88 for all areas this past season, especially for the east side stations where about a 40 percent increase occurred. Threat scores were very similar to the 1987-88 drought year except at W2 and E2 where a significant improvement can be seen. The same is true for False Alarm Rates (FAR). Probability of Detection (POD), Percent Correct (PC), and Wet Bias scores were all very similar to the previous year except for a significantly drier day 3 Bias at east side stations. W2 scored an improvement in every category for every forecast period. In fact, W2 day 2 scores were as good as their previous year's day 1 scores!

The lower half of Table 2 indicates that the very significant dry bias displayed by E1 for the .01-.09 inch category in 1987-88 continued, and seems to have spread to W1 and E2 in 1988-89! At the same time, these three offices increased their tendency to overforecast the .10-.25 and .26-.50 inch categories.

WRTA 83-4 illustrated how Signal Detection Theory (SDT) can be applied to QPF verification scores to gain further insight into forecaster performance. Table 3, from WRTA 83-4, provides standard verification scores for 3 sites (BOI, PIH, S06) for the 1981-82 season. Also included in Table 3 are the discrimination index (D) and likelihood ratio (L) from SDT. Table 4 gives corresponding scores for the 1988-89 season.

In comparing Table 3 with Table 4, it is interesting to note that the Frequency of Precipitation Events (S), the Threat Scores (TS), and PC are very similar. The FAR for 1988-89 showed a great improvement over the 1981-82 season, but the POD scores were significantly poorer. Also, while the 1981-82 scores showed a wet bias for day 1 and day 2 forecasts, the 1988-89 forecasts moved towards a significantly drier bias. The corresponding SDT scores provide some insight into these somewhat conflicting results. Note that for day 1, the discrimination function D, which is regarded as a measure of the forecaster's ability to discriminate between the meteorological conditions that precede occurrence and those which precede non-occurrence, showed a 25 percent decrease for the 1988-89 season. This could be due to changes in the forecaster staff, more difficult forecast situations, or possibly forecaster "rustiness" following two consecutive drought years. The corresponding likelihood ratios suggest that forecasters had changed their decision criterion significantly. In 1988-89, forecasters generally required a 50 percent POP, compared to 40 percent POP in 1981-82.

It is encouraging to note that D doubled for day 3. This is likely due to considerably more NWP guidance for the 48 to 72 hour period now being provided to forecasters compared to 1981-82. However, the only standard verification score which improved for day 3 was the FAR, while the Bias became drier and POD decreased significantly. From L for day 3, it can be seen that this may have been due to forecasters moving from a 50 percent POP in 1981-82 to a nearly 60 percent POP in 1988-89.

The above discussion illustrates a few ways that verification scores can be used to gain insights into QPFs. For 1988-89, it appears that forecasters may have still been operating in a "drought-mode." The result was an increase in the dry bias. At the same time, when precipitation was forecast, forecasters generally overforecast amounts. The dry bias in forecasting occurrence was also evident in the comparison of scores for three forecast points in the Boise QPF to corresponding scores from several years ago.

The verification system for the Pacific Northwest QPFs is fully automated, user-friendly, and very flexible. In addition to the composite scores presented here, the system also easily produces individual forecaster and individual

forecast point scores for in-depth studies. The program is accessible to all forecasters via a dial-in port on the Boise AOS computer.

Reference:

Hill, C. D. and M. A. Mathewson, 1986. An Automated QPF Verification Program Which Provides Both Real-time and Long-term Statistical Scores in a User-Friendly Environment. NOAA Technical Memorandum NWS SR-117. 13-19

Hill, C. D., 1983. Signal Detection Theory Applied to QPF Verification. Western Region Technical Attachment 83-4.

QPF Verification in the Pacific Northwest. Western Region Technical Attachment 88-24.

VERIFICATION FOR OCTOBER 1, 1987 THROUGH JULY 1, 1988
 24-Hour Statistics Calculated Each Day for All Sites and All Forecasters
 Output Format for Each WSFO: Day 1/Day 2/Day 3

WET/DRY STATS	E1	W1	W2	E2
* FCSTS.....	608/ 576/ 572	1344/1306/1295	1517/1504/1478	1565/1552/1552
* PCPN EVNTS	203/ 197/ 192	538/ 524/ 517	621/ 600/ 585	418/ 408/ 404
* THREATS...	287/ 298/ 284	641/ 654/ 635	859/ 797/ 778	637/ 645/ 593
* WET FCSTS.	218/ 219/ 169	539/ 543/ 437	777/ 666/ 565	497/ 474/ 350
PCPN FREQ...	33/ 34/ 34	40/ 40/ 40	41/ 40/ 40	27/ 26/ 26
THREAT SCORE	47/ 40/ 27	68/ 63/ 50	63/ 59/ 48	44/ 37/ 27
F.A.R.....	39/ 46/ 54	19/ 24/ 27	31/ 30/ 34	44/ 50/ 54
P.O.D.....	66/ 60/ 40	81/ 79/ 62	87/ 78/ 64	67/ 58/ 40
% CORRECT...	75/ 69/ 64	85/ 82/ 76	79/ 78/ 73	77/ 74/ 72
WET BIAS....	107/ 111/ 88	100/ 104/ 85	125/ 111/ 97	119/ 116/ 87
7-CAT STATS				
% CORRECT...	62/ 56/ 56	64/ 59/ 59	58/ 58/ 55	67/ 64/ 66
SKILL SCORE.	29/ 28/ 12	40/ 33/ 28	37/ 32/ 23	30/ 22/ 16
BIAS BY CAT				
DRY	96/ 94/ 106	100/ 98/ 110	83/ 93/ 102	93/ 94/ 105
0.01--0.09	4/ 5/ 0	58/ 71/ 54	108/ 71/ 91	102/ 101/ 89
0.10--0.25	174/ 198/ 194	142/ 131/ 132	159/ 169/ 141	163/ 175/ 123
0.26--0.50	184/ 137/ 42	86/ 104/ 81	124/ 118/ 97	128/ 89/ 18
0.51--1.00	120/ 160/ 20	119/ 112/ 81	118/ 115/ 69	53/ 16/ 5
1.01--2.49	0/ 0/ 0	170/ 133/ 19	91/ 58/ 15	0/ 0/ 0
2.50--	0/ 0/ 0	0/ 20/ 0	100/ 10/ 0	0/ 0/ 0
END				

TABLE 1

VERIFICATION FOR OCT 1 1988 THRU JUL 31 1989

24 HOUR STATISTICS CALCULATED EACH DAY FOR ALL SITES AND ALL FORECASTERS
 OUTPUT FORMAT FOR EACH WSFO: DAY 1/DAY 2/DAY 3

WET/DRY STATS	E1	W1	W2	E2
# FCSTS.....	530/ 524/ 517	1323/1307/1272	1286/1291/1260	1601/1582/1572
# PCPN EVNTS	236/ 234/ 228	603/ 614/ 595	608/ 613/ 605	604/ 606/ 598
# THREATS...	308/ 331/ 309	747/ 789/ 747	786/ 814/ 778	832/ 815/ 737
# WET FCSTS.	215/ 250/ 178	600/ 616/ 503	730/ 731/ 625	647/ 559/ 368
PCPN FREQ...	45/ 45/ 44	46/ 47/ 47	47/ 47/ 48	38/ 38/ 38
THREAT SCORE	46/ 46/ 31	61/ 56/ 47	70/ 65/ 58	50/ 43/ 31
F.A.R.....	33/ 39/ 46	24/ 28/ 30	24/ 27/ 28	35/ 37/ 38
P.O.D.....	61/ 65/ 43	76/ 72/ 59	91/ 86/ 75	69/ 58/ 38
% CORRECT...	69/ 66/ 59	78/ 73/ 69	82/ 78/ 74	74/ 71/ 68
WET BIAS....	91/ 107/ 78	100/ 100/ 85	120/ 119/ 103	107/ 92/ 62
7-CAT STATS				
% CORRECT...	49/ 45/ 47	57/ 49/ 50	55/ 50/ 48	58/ 56/ 59
SKILL SCORE.	19/ 16/ 9	34/ 24/ 21	36/ 29/ 23	27/ 21/ 15
BIAS BY CAT				
DRY	107/ 94/ 117	100/ 100/ 114	82/ 83/ 97	96/ 105/ 124
0.01--0.09	0/ 0/ 0	49/ 40/ 37	95/ 79/ 63	55/ 59/ 57
0.10--0.25	185/ 225/ 205	135/ 139/ 136	171/ 177/ 194	179/ 155/ 92
0.26--0.50	181/ 236/ 58	123/ 109/ 86	136/ 152/ 130	156/ 84/ 34
0.51--1.00	175/ 163/ 44	110/ 146/ 101	86/ 114/ 41	65/ 67/ 4
1.01--2.49	50/ 0/ 0	132/ 150/ 60	94/ 33/ 2	33/ 0/ 0
2.50--	0/ 0/ 14	0/ 50/ 0	0/ 0/ 0	0/ 0/ 0
END				

TABLE 2

Table 3

1981-82 Verification of Precipitation versus No Precipitation Forecasts

DAY	S	POD	TS	FAR	PC	BIAS	D	L
1	.43	.85	.61	.31	77	1.25	1.6	.67
2	.43	.74	.53	.35	74	1.15	1.0	.90
3	.43	.49	.37	.42	64	.86	0.2	1.05

Table 4

1988-89 Verification of Precipitation versus No Precipitation Forecasts

DAY	S	POD	TS	FAR	PC	BIAS	D	L
1	.46	.72	.58	.26	76	.99	1.2	1.03
2	.46	.61	.51	.25	72	.84	1.0	1.25
3	.46	.38	.33	.25	65	.52	0.4	1.30