WESTERN REGION TECHNICAL ATTACHMENT
NO. 88-24
July 12, 1988

QPF VERIFICATION IN THE PACIFIC NORTHWEST

Since the early 1960s, four WSFOs (Seattle, Portland, Boise, Great Falls) have been providing quantitative precipitation forecasts (QPF) to the Northwest RFC for several sites in the Pacific Northwest. The purpose of these forecasts is to provide input into the hydrologic models which predict runoff and stream flow. Typically, each of the WSFOs would begin sending daily QPFs at the beginning of the water year (October 1) and continue until runoff was over, about mid-July. In addition to the QPFs, forecasts of maximum temperature and freezing level heights were also sent to the NWRFC on a daily basis.

In an effort to determine the usefulness and accuracy of the forecasts, a verification program was agreed upon and implemented for the 1984-85 water year. There were some early problems with data collection, feedback to the forecasters, and software design. These were overcome, and a comprehensive QPF verification program was implemented last year, October 1, 1987. The program runs on the AOS system at WSFO Boise and is fully automated.

Three-day QPFs are issued by the WSFOs and verified by the AOS program. For the first two days, the QPFs are for 6-hour periods; on the third day, it's for the entire 24-hour period. Daily AFOS messages are generated by the verification software to each WSFO, detailing the previous day's forecast and verifying observations. In addition, a weekly AFOS message is produced which includes cumulative QPF statistics from the beginning of the water year. Table 1 represents the final summary for the 1987-88 season, which ran from October 1, 1987 through July 1, 1988. The four WSFOs are not identified except for their position relative to the Cascade Mountains (E1, E2 = east of Cascades, W1, W2 = west of Cascades).

First of all, the number of forecasts varies among the WSFOs because each office forecasts for a different number of sites (42 sites total in verification program). Not surprisingly, the precipitation frequency west of the Cascades was about 10-14% higher than the east side. The scores in the top half of the table reflect wet (.01 inches) vs. dry forecasts and observations. The False Alarm Ratio (FAR) and Probability of Detection (POD) scores are significantly better for the WSFOs west of the Cascades. This, too, is not surprising, since most weather systems move easterly. It's reasonable to expect more significant amounts and widespread precipitation west of the mountains than on the lee side. The scores for both offices east of the Cascades are evenly matched (still fairly good), indicating more of a general problem in predicting measurable precipitation in Idaho and western Montana rather than a forecast deficiency. The % Correct Values (wet vs. dry) were actually quite good and consistent among the offices. There was only a slight wet bias overall.

The second half of the table shows skill according to 7 precipitation categories. The WSFOs, as a whole, correctly forecast the right precipitation category about 60% of the time -- a good showing. However, the biases by category suggest that there is some room for improvement. WSFO E1 hardly ever forecast (when measurable precipitation was forecast) less than .10 inches at any of its sites. This tendency is also exhibited to much lesser extent at the other WSFOs. However, for the next precipitation category (.10-.25), WSFO E1 and the others display a strong wet bias. The conclusion is obvious. When a threat of measurable

precipitation existed, most forecasters rounded their estimates up to .10 inches or more. The wet bias carried over into Day 1 and Day 2 of the remaining precipitation categories, as well, but not Day 3. Again, this is not surprising since Days 1 and 2 QPFs are for 6-hour periods when Day 3 is for the 24-hour period. The primary problem is timing the precipitation event. In an effort to ensure the event is captured in the QPF, the forecaster will most often extend the event over 2 to 3 six-hour periods. Combine this with the aforementioned bias of over predicting the .10-.25 inch category, and this leads to a significant wet bias.

Even though this discussion has pointed out a few problems in the QPF forecasts, the WSFOs demonstrated significant skill in predicting rainfall events and amounts. There is a need to show better temporal resolution in forecasting amounts less than .25 inches, but that's a difficult task in the Pacific Northwest.

Reference:

Barker, Timothy B., 1987: AOS QPF Verification User's Guide. October, 26 pp.

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/ 20/ 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