Gridded Forecast Verification at WFO Phoenix

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Gridded forecast verification research has been ongoing at WFO Phoenix since summer 2006. BOIVerify, a gridded forecast verification program written by Tim Barker, SOO at Boise, Idaho, made it possible for each WFO to objectively measure the accuracy of its gridded forecasts, by comparing them to observed data as well as to MOS and explicit model guidance. Thus far, most of the BOIVerify-based research has focused on how to improve maximum temperature, minimum temperature and dew point grids.

The NWS WR QPF Verification Application website, created by WR SSD, has made it possible for operational meteorologists to quantitatively assess how well a precipitation event was forecast, in terms of areal coverage, precipitation amount, degree of collaboration, and event lead time.

Examination of local gridded forecasts has resulted in several key findings, which have been documented primarily via PowerPoint presentations (articulate and non-articulate) and Excel spreadsheets. Examples of findings that have been made available to the forecast staff include:

- Current 5-day and monthly MAE (mean absolute error) data for days 1-3-5-7 maximum and minimum temperature forecasts, made at both 0000 UTC and 1200 UTC, are accessible at each operational PC. These data reflect the average performance of all forecasts **verifying** over the given period. The top-performing forecast model for each verifying day has been identified and included at the bottom of each day’s column (Appendices A and B).

- Dew point forecasts from MOS and BC-MOS were shown to have a significant warm/high bias during and shortly after passage of a dry cold front. In these instances, model guidance such as GFS40 performed much better than GFS40BC or MOSGuideBC. Official dew point forecasts, while still too high in most instances, were closer to reality. Forecasters were encouraged to query forecast soundings, then nudge their first-guess dew point grid toward the GFS40 grids and GFS forecast soundings.

- Maximum temperature official forecasts for the day following a dry cold frontal passage were typically too warm, and less accurate than most MOS-based guidance, which also was too warm. This was true especially on days when maximum temperature was at least 10 degrees cooler than what had occurred the previous day. 1200 UTC MOS guidance performed more poorly than 0000 UTC guidance, which resulted in increased maximum temperature inconsistency between the midnight shift and day shift forecasts. Forecasters were encouraged to populate this grid via GFS40 and/or NAM12, or use the "nudge to model" tool to improve forecasts under this circumstance.

- Bias-corrected MOS grids perform better during periods with little day-to-day change; explicit model guidance performs better during significant weather changes. MOSGuideBC is typically difficult to beat during benign weather periods, especially in the short term (days 1-3). Use of the "serp" tool is not encouraged, though forecasters still feel the need to edit grids to reflect the minimum and/or maximum temperature expected at a given forecast point encompassed by a grid.

- In the extended range (beyond day 3), MOSGuideBC is not as difficult to beat, especially with regard to maximum temperature. During rather benign periods, the best approach often appeared to be: copy and paste day "n" forecast into day "n+1", then use the "nudge to model" tool to adjust forecast with the BC grid of choice (GFS40BC, MOSGuideBC, or ADJMEXBC).

- For large-scale wintertime precipitation events which impacted much of the southwest United States, WFO Phoenix, on average, began to hit the event hard 4-5 days in advance of its occurrence (PoP was increased noticeably, into the 'high chance' or 'likely' category). Its PoP forecasts tended to agree reasonably well with that of its principal neighbors, WFOs Tucson and Flagstaff, partially as a consequence of scheduled collaboration calls and office-to-office text messaging via 12Planet.

- Statistics generated by the NWS WR QPF Verification Application website reveal that use of the QPFHelper tool has greatly improved QPF accuracy. For potentially heavy precipitation events, WFO Phoenix forecasters collaborated with HPC, either by phone or by a 'gotomeeting' session; if forecasters agreed that HPC had a good handle on the event, they ran the QPFHelper tool with HPC QPF grids as input. Verification focal point Chris Breckenridge created an articulate PowerPoint presentation which highlighted how forecasters can access and interpret information posted on the NWS WR QPF Verification Application website (Chris is currently developing another articulate PowerPoint presentation which will explain and demonstrate how forecasters can use BOIVerify to help improve their gridded forecasts.)

Appendix A: Mean Absolute Error table for Forecast Days 1, 3, 5 and 7 verifying on 11-15 March 2008. This is only one-fourth of the 5-day monthly MAE table available to forecasters, since it shows only maximum temperature statistics generated for 0000 UTC cycle forecasts.

MAX T	**5 DAYS ENDING MAR 15**				**00Z**			
	DAY 1		DAY 3		DAY 5		DAY 7	
	MAE	AVG	MAE	AVG	MAE	AVG	MAE	AVG
OFFICIAL	2.28	1.1	2.23	-0.59	3.38	-2.57	3.87	0.21
ADJMAVBC	1.44	0.42	2.26	-1.19				
ADJMEXBC	1.42	0.25	2.29	-1.23	4.14	-3.48	4.67	-2.89
ADJMEX	2.56	1.87	2.68	1.62	3.17	0.49	4.2	1.22
GFS40BC	1.57	0.13	2.28	-1.04	4.6	-4	4.37	-1.74
MOSGuideBC	1.43	0	2.3	-1.56	3.68	-3	5.25	-2.56
MOSGuide	2.64	1.8	2.75	1.61	3.18	0.85	4.72	1.89
NAM12BC	1.70	-0.53	4.29	-4.06				
BEST MODEL	MOSGuideBC		ADJMAVBC		ADJMEX		ADJMEX	

Appendix B: February 2008 MAE table for maximum and minimum temperatures **verifying** on days 1, 3, 5 and 7, separated by forecast cycle (0000 UTC and 1200 UTC).

MAX/MIN TEMPERATURES - BC / RAW MODEL OUTPUT **00Z**

MAX T	**Month of February 2008**							
	DAY 1		DAY 3		DAY 5		DAY 7	
	MAE	AVG	MAE	AVG	MAE	AVG	MAE	AVG
OFFICIAL	2.6	0.3	3.22	0.79	4.35	1.09	5.25	1.59
ADJMAVBC	2.38	0.45	2.99	0.32				
ADJMEXBC	2.37	0.28	2.99	0.3	3.94	0.8	4.27	0.41
ADJMEX	3.33	2.29	4.09	3.25	5.19	4.05	5.53	4.42
GFS40BC	2.32	0.56	2.97	0.77	3.75	1.24	4.17	1.53
MOSGuideBC	2.33	0.31	2.96	0.59	4.03	0.98	4.63	0.97
MOSGuide	3.39	2.39	4.26	3.48	5.08	3.9	5.72	4.42
NAM12BC	2.05	0.29	2.7	0.14				
BEST MODEL	NAM12BC		NAM12BC		GFS40BC		GFS40BC	

MAX T	**Month of February 2008**					**12Z**		
	DAY 1		DAY 3		DAY 5		DAY 7	
	MAE	AVG	MAE	AVG	MAE	AVG	MAE	AVG
OFFICIAL	2.7	0.57	3.43	0.98	4.23	1.1	5.87	1.71
ADJMAVBC	2.57	0.3	3.24	0.25				
ADJMEXBC	2.64	-0.23	3.05	0.52	4.57	0.29	5.3	0.17
ADJMEX	2.89	0.83	3.7	2.37	4.55	2.18	5.5	2.69
GFS40BC	2.53	0.66	2.97	1.27	4.24	1.27	5.51	1.04
MOSGuideBC	2.5	0.3	3.09	0.9	4.2	1.06	5.06	0.75
MOSGuide	3.59	2.61	4.49	3.75	5.34	4.18	5.94	4.28
NAM12BC	2.4	0.11	2.92	0.47				
BEST MODEL	NAM12BC		NAM12BC		MOSGuideBC		MOSGuideBC	

MIN T	**Month of February 2008**					**00Z**		
	DAY 1		DAY 3		DAY 5		DAY 7	
	MAE	AVG	MAE	AVG	MAE	AVG	MAE	AVG
OFFICIAL	3.72	-2.37	4.32	-2.51	4.02	-1.54	4.37	-1.15
ADJMAVBC	2.72	0.3	3.21	0.73				
ADJMEXBC	2.73	0.33	3.1	0.54	3.61	0.59	3.88	0.47
ADJMEX	3.66	-1.04	4.04	-1.13	4.06	-0.76	4.19	-0.21
GFS40BC	2.85	0.18	3.13	-0.02	3.5	-0.06	4.24	-0.2
MOSGuideBC	2.71	0.48	3.17	0.43	3.45	1.13	3.92	1.33
MOSGuide	3.89	-1.82	4.11	-1.59	4	-1.16	4.2	-0.7
NAM12BC	3.35	-0.28	4.03	-0.96				
BEST MODEL	MOSGuideBC		GFS40BC		GFS40BC		ADJMEXBC	

MIN T	**Month of February 2008**					**12Z**		
	DAY 1		DAY 3		DAY 5		DAY 7	
	MAE	AVG	MAE	AVG	MAE	AVG	MAE	AVG
OFFICAL	3.65	-2.24	4.03	-2.07	3.91	-1.62	4.2	-0.7
ADJMAVBC	2.72	0.22	3.03	0.35				
ADJMEXBC	2.74	0.03	3.1	0.21	3.4	0.37	4.04	0.44
ADJMEX	3.47	0.31	3.85	0.75	4.27	1.98	4.76	2.42
GFS40BC	2.76	0.33	3.13	-0.24	3.51	0.14	4.49	-0.37
MOSGuideBC	2.62	0.43	3.05	0.52	3.49	1.08	3.7	1.15
MOSGuide	3.82	-1.86	4.18	-1.94	4.06	-1.23	4.13	-0.91
NAM12BC	3.29	-0.22	3.68	-0.85				
BEST MODEL	MOSGuideBC		ADJMAVBC		ADJMEXBC		MOSGuideBC	