

Review of the Well-Collaborated but Poorly-Forecasted Weather Event of Late January 2009

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WFO Phoenix Arizona

INTRODUCTION

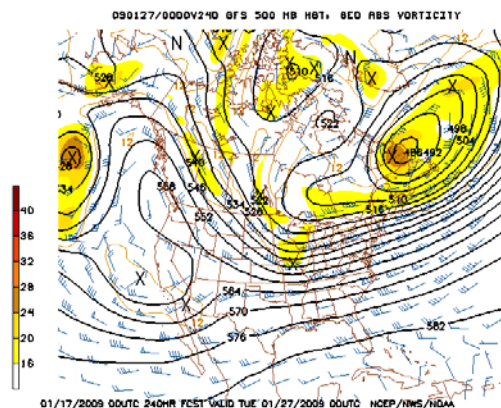
A high-impact hydrometeorological event was forecast to affect portions of Arizona during the last week of January 2009. The GFS and ECMWF indicated that as much as 2-4" of rain would fall over the higher terrain of central and eastern Arizona, including the Salt and Verde watersheds. Since the Salt River watershed was at near-capacity storage levels prior to the onset of this forecasted event, SRP would be forced to release heavy flows through the Salt River if the rainfall event occurred as forecast. This paper details the forecasts provided by the principal numerical model guidance, highlights how that model data was interpreted by national centers and WFOs, depicts WFO PoP forecasts, and concludes by describing what transpired.

DISCUSSION

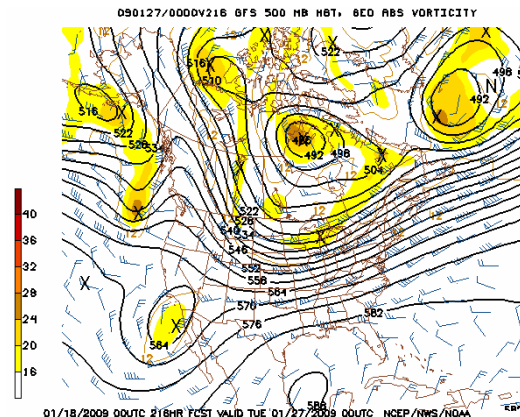
As early as 17 January 2009, numerical models began to advertise the potential for a significant precipitation event during the last week of January, especially over and near the Salt and Verde River watersheds of central Arizona. Forecast uncertainty was relatively high, given poor run-to-run consistency and less-than-stellar agreement amongst models. However, for 6 successive 0000 UTC operational runs, the GFS forecast a weather disturbance near the central California coast, with a moist southwest flow across far southern California and Arizona (Figures 1a-f).

Figure 1. Successive 0000 UTC GFS 500 hPa forecasts, all valid 0000 UTC 27 January 2009, with lead times ranging from 240 hours to 120 hours.

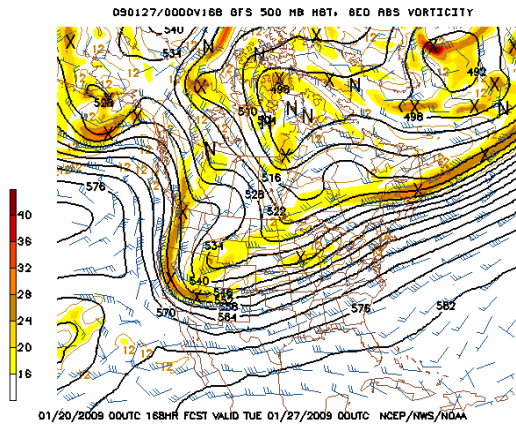
a) 240 hour (10 day) forecast



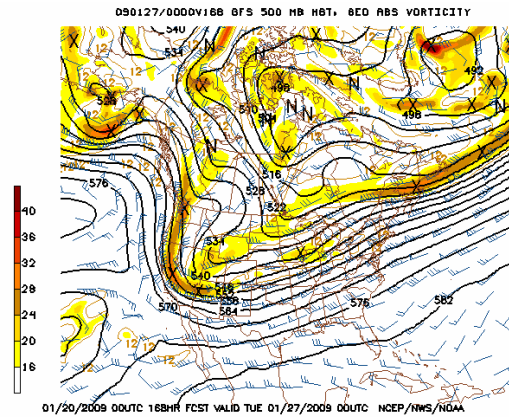
b) 216 hour (9 day) forecast



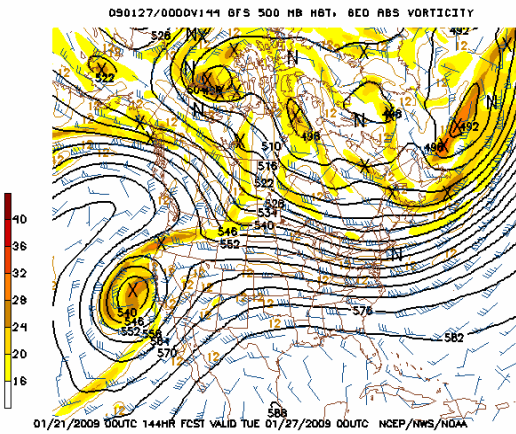
c) 192 hr (8 day) forecast



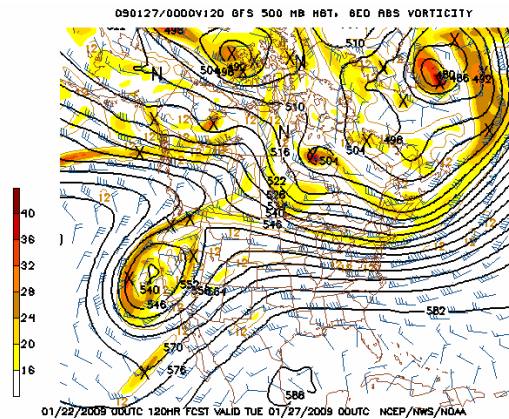
d) 168 hr (7 day) forecast



e) 144 hr (6 day) forecast



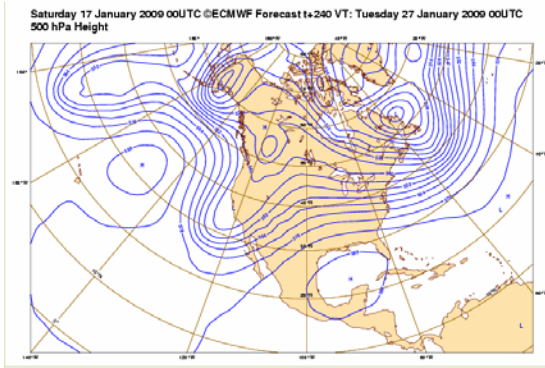
f) 120 hr (5 day) forecast



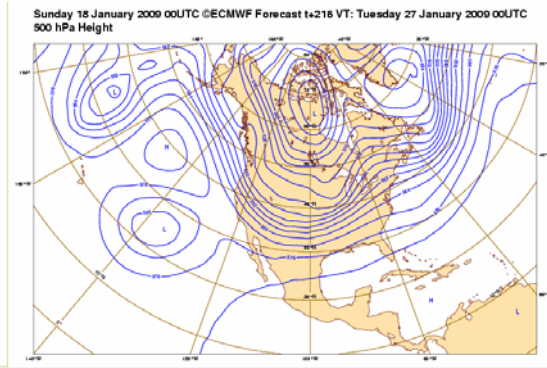
The ECMWF, which outperformed the GFS in the extended forecast range during much of the period October-December 2008, provided mixed signals with this event. At a lead time of 10 days, the ECMWF was bullish regarding precipitation potential over Arizona during the last week of January. But, a major long wave adjustment occurred in the ECMWF between lead times of 10 and 9 days, with dry northwest flow forecast over Arizona during the 7-9 day lead time period. Then, the ECMWF shifted gears again at a lead time of 6 days, forecasting an upper low along the south-central California coast by 0000 UTC 27 January 2009 (Figures 2a-f).

Figure 2. Successive 0000 UTC ECMWF 500 hPa forecasts, all valid 0000 UTC 27 January 2009, with lead times ranging from 240 hours to 120 hours (see page 3).

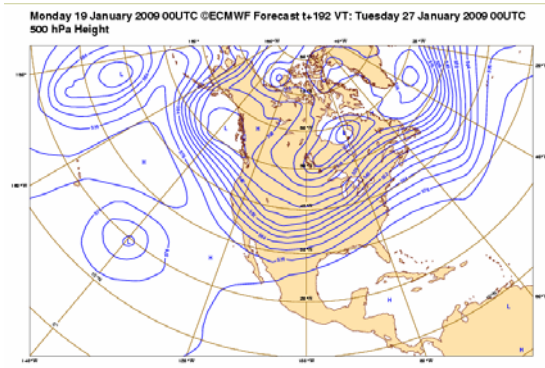
a) 240 hour (10 day) forecast



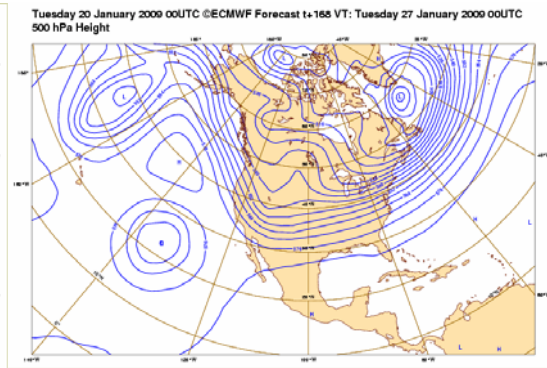
b) 215 hour (9 day) forecast



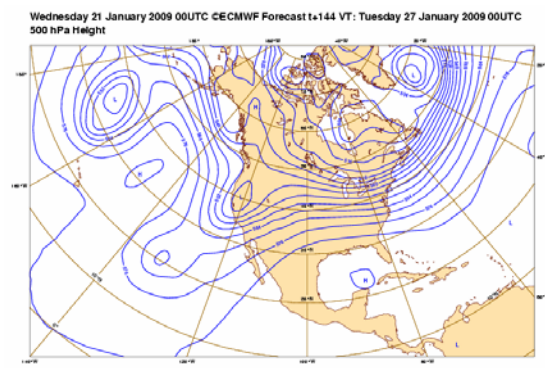
c) 192 hour (8 day) forecast



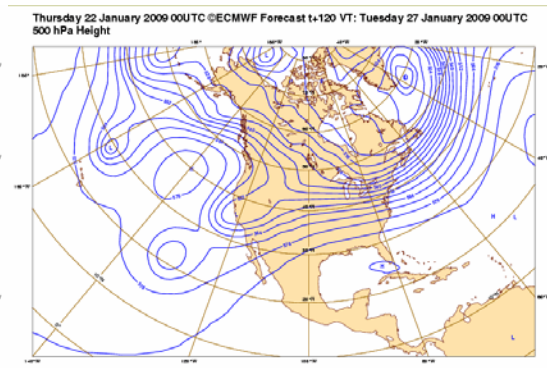
d) 168 hour (7 day) forecast



e) 144 hour (6 day) forecast



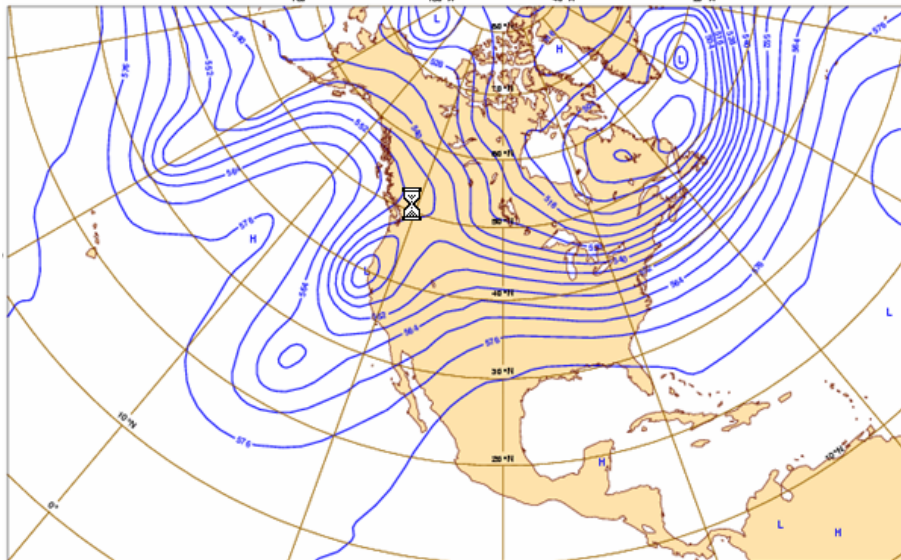
f) 120 hour (5 day) forecast



Excellent ECMWF-GFS operational model agreement occurred with the 1200 UTC 21 January runs (Figure 3); both models forecast a strong upper low just off the central or northern California coast, with a weaker subtropical low to its south and west. Interaction of subtropical moisture with the strong upper low resulted in impressive QPFs from both models; the GFS indicated central Arizona would receive 2-4" of rain as the event unfolded, mainly during the period 1200 UTC 26 January-1200 UTC 28 January (Figure 4). The Hydrometeorological Prediction Center (HPC) forecast a significant precipitation event, though not as much rain as what the GFS indicated (Figure 5).

Figure 3. ECMWF (top panel) and GFS (bottom panel) operational 500 hPa 120-hr forecasts valid 1200 UTC 28 January 2009.

Wednesday 21 January 2009 12UTC ©ECMWF Forecast t+120 VT: Monday 26 January 2009 12UTC
500 hPa Height



D90126/1200V120 GFS 500 MB HGT, 6ED ABS VORTICITY

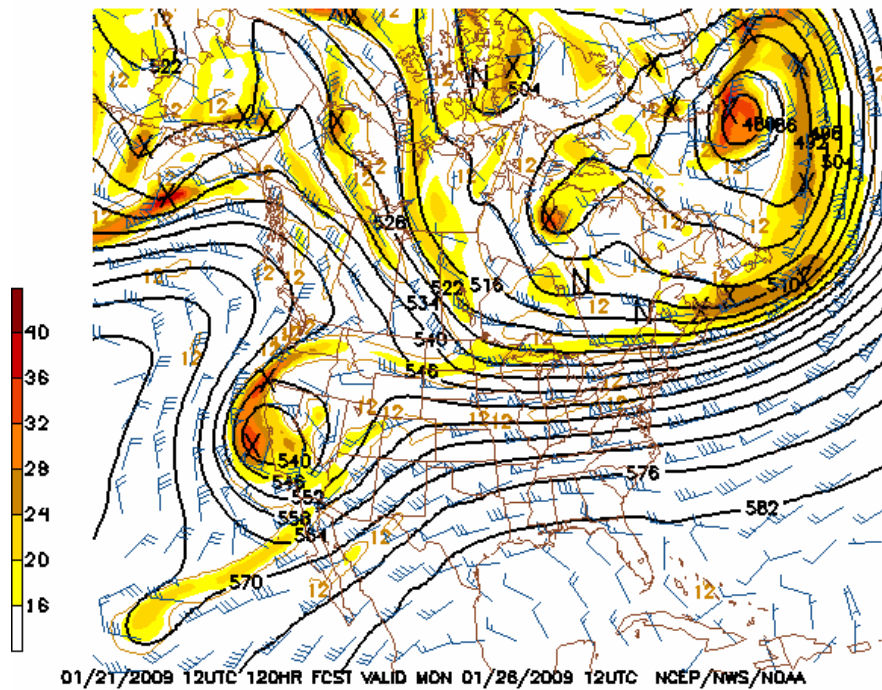


Figure 4. GFS storm total precipitation for the period 5 am 22 January-5 pm 30 January, from the 1200 UTC 22 January operational run. Note the subtropical QPF plume southwest of Baja California, and the rather large area of 3-4 inch precipitation amounts forecast across central Arizona. Nearly all the precipitation depicted to fall over Arizona occurred during the period 1200 UTC 26 January to 1200 UTC 28 January (about 10% of the precipitation total over Arizona was associated with a weak storm on 22-23 January). Figure available courtesy of SRP.

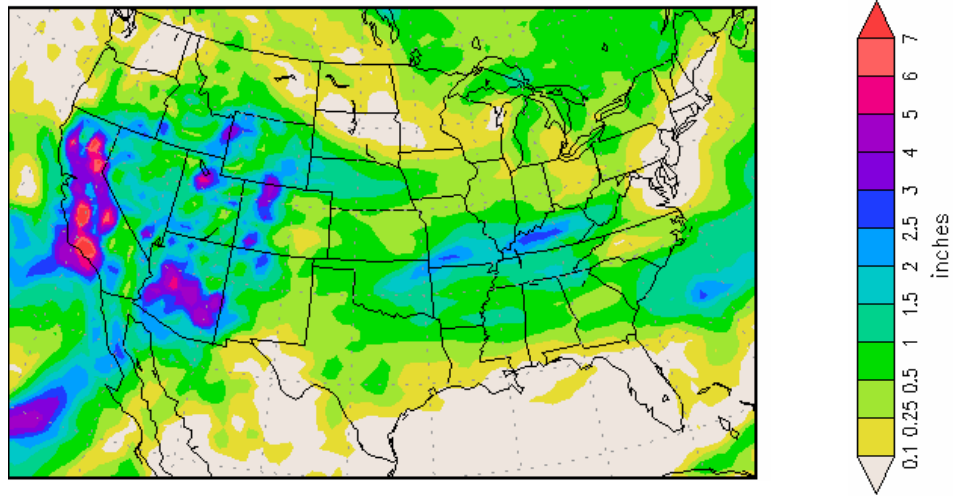
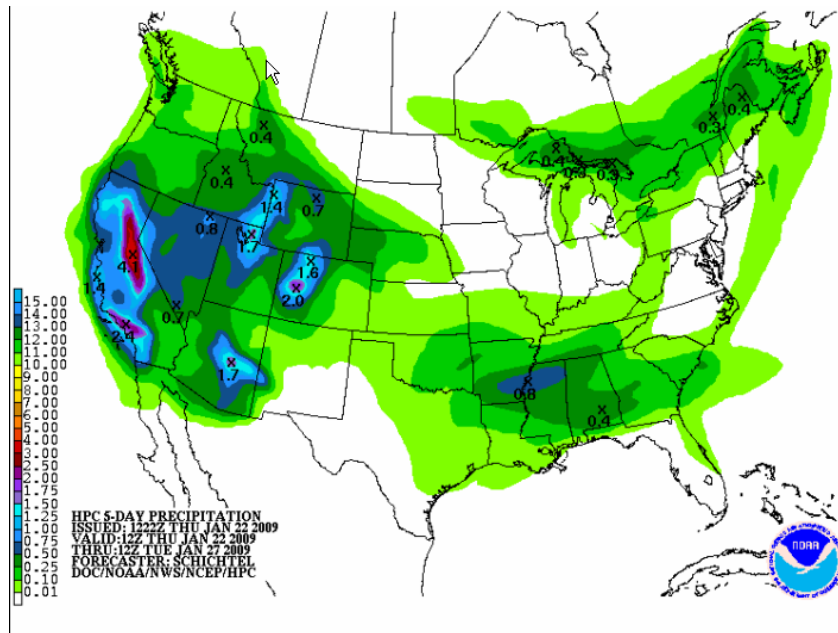


Figure 5. HPC 5-day precipitation, valid 1200 UTC 22 January 2009 to 1200 UTC 27 January 2009 (precipitation was expected to continue beyond 1200 27 January 2009).



HPC's extended forecast discussion issued at 1846 UTC 22 January highlighted the challenges faced by extended range forecasters for this event:

EXTENDED FORECAST DISCUSSION

NWS HYDROMETEOROLOGICAL PREDICTION CENTER CAMP SPRINGS MD

146 PM EST THU JAN 22 2009

VALID 12Z SUN JAN 25 2009 - 12Z THU JAN 29 2009

THE PRELIMINARY FRONTS AND PRESSURES FOR DAYS 3 THROUGH 7 WERE CONSTRUCTED BASED ON A PROGRESSIVE BLEND FROM THE 00Z/22 ECMWF TOWARD THE MOST RECENT EC ENSEMBLE MEAN FROM 12Z/21 WITH UPDATED INCORPORATION OF THE 00Z ECMWF ENS MEAN FOR DAYS 6 AND 7 WED/THU. THE ECMWF SEEMS TO HAVE RECOVERED FROM ITS RATHER EXTREME SPLIT OF THE WESTERLIES OFF THE CALIFORNIA COAST INDICATED BY ITS 12Z/21 RUN WITH A VERY DEEP CUTOFF LOW OFF THE CA COAST. THE 00Z/22 GFS STILL SHOWS MORE PROGRESSION OF THE OFFSHORE CLOSED LOW WELL INLAND INTO THE LOWER GREAT BASIN AS DOES THE CMC. THE GFS ENS MEAN SUGGEST KEEPING A MORE INTACT CLOSED LOW WELL WWD JUST ALONG THE SOCAL COAST AS DOES ENS MEANS OF ECMWF FROM BOTH 12Z AND 00Z RUNS AND EXPERIMENTAL PARALLEL RUNS OF THE 00Z GFS. RECENT VERIFICATION OF SYSTEMS IN THE SOUTHWEST HAVE SEEN A PROGRESSIVE OP GFS BIAS OF EJECTING SHORTWAVES TOO FAST OUT OF THIS REGION WITH BETTER VERIFICATION TIMING OF THE ECMWF.

TODAYS 0Z/22 ECMWF SEEMS TO VERY POSSIBLY HAVE THE OPPOSITE PROBLEM OF HOLDING BACK A CUTOFF LOW OFF THE SOCAL COAST A DAY LONGER BEFORE BRINGING IT INLAND TO NEAR THE NRN GLFCA LATE DAY 7 THURS. BOTH GFS AND 12Z/00Z ECMWF ENS MEANS ARE SIMILAR IN LOCATION OF THE SWRN CONUS TROF AND CLOSED LOW AND ITS INTERACTION WITH A DOMINANT NRN STREAM FLOW. THIS PROVIDES A BOTH A COMPROMISE AND BETTER AGREED UPON SOLUTION RESOLVING AMPLITUDE AND TIMING FOR THE LATE PERIOD OF THE FORECAST [DAYS 6 AND 7 WED/THURS].

12Z CMC AND UKMET HAVE BACKED OFF ON THE AMPLITUDE OF THE SHORTWAVE DROPPING DOWN THRU THE WEST WITH A CONTD INSIDE SLIDER IDEA OF CMC WHILE UKMET HAS MADE A RADICAL CONTINUITY CHANGE FROM AN OUTSIDE SLIDER/CUTOFF LOW OFF THE SOCAL COAST TO A WEAKER INSIDE SLIDER/PROGRESSIVE TROF IDEA. GFS MAINTAINS RELATIVE CONTINUITY TO ITS PRIOR RUNS WITH THE 12Z GFS ENS MEAN LOOKING MUCH LIKE PRIOR MEANS OF GFS AND ECMWF.

12Z ECMWF ALSO WEAKER AND A MORE INSIDE TRACK OF THE SHORTWAVE DROPPING THRU CA AND INTO THE GREAT BASIN INSTEAD OF ITS CUTOFF LOW OFF THE SOCAL COAST AT DAY 6.

LACK OF CONTINUITY EVEN IF ALL MODELS GO WITH A CHANGE DOES NOT YIELD CONFIDENCE IN ANY ONE SOLUTION. THIS LEADS US TO A LARGE USAGE OF THE ENS MEANS ON NIGHT AND MORNING ISSUANCES. UPDATED HPC MORNING PROGS USED PRIOR MORNING PRELIMS THRU DAY 5 WHICH WERE BASED ON OP 00Z ECMWF AND YESTERDAYS 12Z ECMWF ENS MEAN. THIS REMAINS THE SAME FOR UPDATED MORNING PRELIMS AND AFTN FINALS. DAYS 6 AND 7 INCORPORATE MORE OF THE 00Z ECMWF ENS MEAN.

AMPLIFYING DEEP COLD MID LEVEL CLOSED LOW DROPPING DOWN THE WEST COAST AS AN OUTSIDE SLIDER WILL BRING ADDITIONAL HVY PCPN...MAINLY SNOW TO THE CA SIERRA DAYS 3-5. WHILE THE GFS SEEMS TOO FAST AND THE OP ECMWF SEEMS TOO SLOW WITH INLAND EJECTION OF THE CUTOFF LOW BOTH MODELS QPF GUIDANCE SHOWS A SIGNIFICANT TAP OF SUBTROPICAL MOISTURE STREAMING NEWD INTO LOWER SOCAL/BAJA/AZ AND POSSIBLY NWD INTO SRN NV/UT AND CO WED/THURS WITH HVY PCPN POTENTIAL.

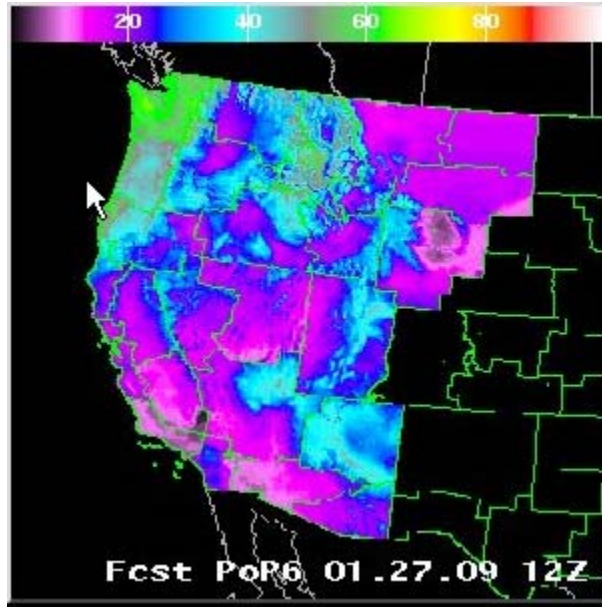
WFO Phoenix's area forecast discussions (AFDs) began to highlight the potential for a significant precipitation event as early as Wednesday afternoon, 21 January. An excerpt from the Thursday afternoon, 22 January AFD is provided below (slightly edited for clarity):

COOLER AND UNSETTLED WEATHER APPEARS LIKELY EARLY NEXT WEEK AS A STRONGER AND COLDER LOW PRESSURE SYSTEM TAKES SHAPE NEAR THE CALIFORNIA COAST. ECMWF AND GFS...ALONG WITH A NUMBER OF ENSEMBLE MEMBERS...AGREE THAT UPPER LOW WILL TRACK SOUTH FROM THE WASHINGTON COAST SUNDAY MORNING...TO THE NORTHERN CALIFORNIA COAST BY MONDAY MORNING. THEN...SOLUTIONS DIVERGE...THOUGH BOTH THE [1200 UTC 22 JANUARY] GFS AND 0000 UTC [22 JANUARY] ECMWF MODELS MOVE CENTER OF LOW PRESSURE OVER THE SOUTHWESTERN UNITED STATES BY LATE WEDNESDAY. HAVE INCREASED POP INTO CHANCE CATEGORY OVER MUCH OF THE CWA MONDAY NIGHT...WITH CHANCE POP EVERYWHERE ON TUESDAY...AND CONTINUED CHANCE POPS IN SOUTH-CENTRAL ARIZONA WEDNESDAY. THE SYSTEM COULD BE A GENEROUS PRECIPITATION PRODUCER BY THE MIDDLE OF NEXT WEEK. THIS WILL HAVE TO BE WATCHED CLOSELY DUE TO HIGH SNOW LEVELS WITH SIGNIFICANT RAIN POSSIBLE ON TOP OF SNOW PACK ABOVE 6 THOUSAND FEET.

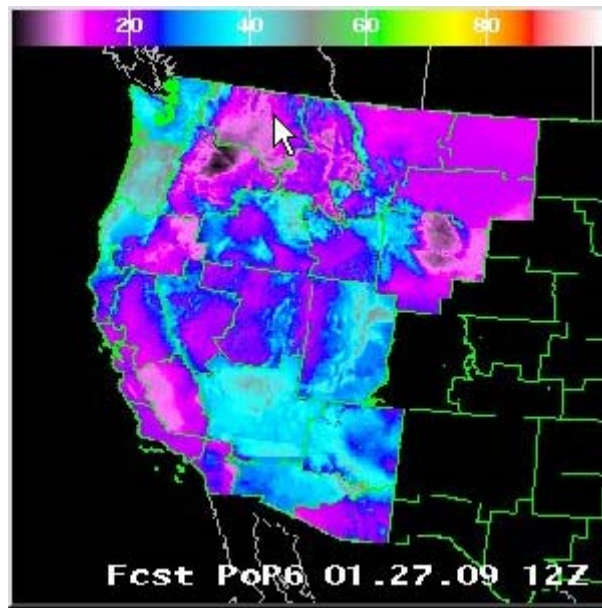
QPF grids are not generated beyond Day 3 of the forecast, so another way to objectively track how WR WFOs handled this event in the extended range (beyond Day 3) is via probability of measurable precipitation (PoP) forecasts. Forecasters at southwest United States WFOs generally agreed that potential for a precipitation event existed; however, much uncertainty remained. Consequently, PoP forecasts, while well above climatology at most locales, were mainly in the "chance" category (30-40%), even over the higher terrain (see Figures 6a-d).

Figure 6. Six-hour PoP forecasts valid 1200-1800 UTC Tuesday, 27 January 2009, commencing with the 156-162 hour forecast and ending with the 120-126 hour forecast (forecast generation occurred on the shift identified in parentheses).

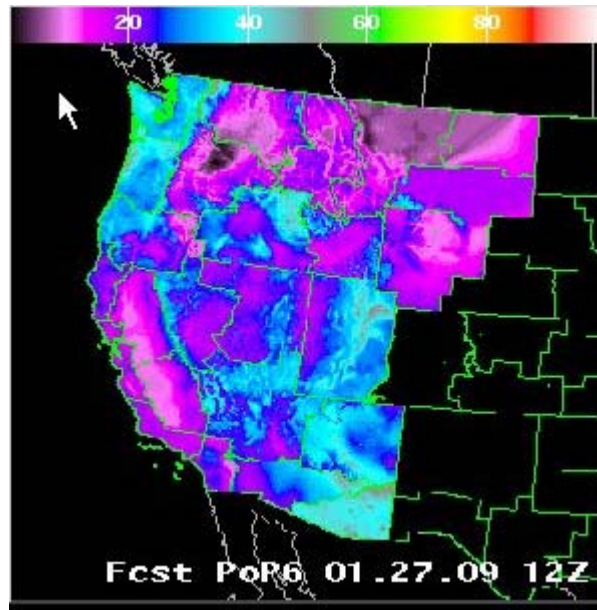
- a) 156-162 hour PoP forecast, issued by the 21 January mid-shift.



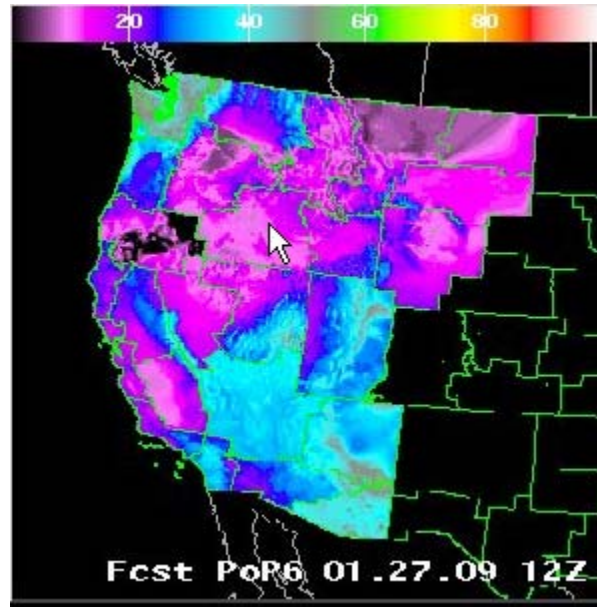
- b) 144-150 hour PoP forecast, issued by the 21 January day shift.



c) 132-138 hour PoP forecast, issued by the 22 January mid-shift.



d) 120-126 hour PoP forecast, issued by the 22 January day shift.



The 0000 UTC 23 January GFS operational solution regarding expected sensible weather over Arizona was wildly different from its predecessors; it indicated that little if any precipitation would occur over or near the Phoenix CWA during the upcoming week (Figure 7). The associated MEX MOS PoP guidance for Phoenix forecast single digit values for each forecast period in the extended portion of the forecast. Two key factors led to this major shift: 1) the subtropical system that had been expected to provide abundant moisture to the atmosphere was weaker and further southwest than earlier indicated, and 2) the strong upper low was forecast to track further east, over land (“inside slider”), and be weaker than earlier model forecasts had indicated. Interestingly, the 0000 UTC 23 January ECMWF remained quite bullish regarding precipitation chances for the upcoming week (Figure 7). The Arizona WFOs and their neighbors opted to lower PoP slightly, but keep it above climatology (Figure 8).

Figure 7. ECMWF and GFS 500 hPa forecast from 0000 UTC 23 January, valid 0000 UTC 27 January 2009.

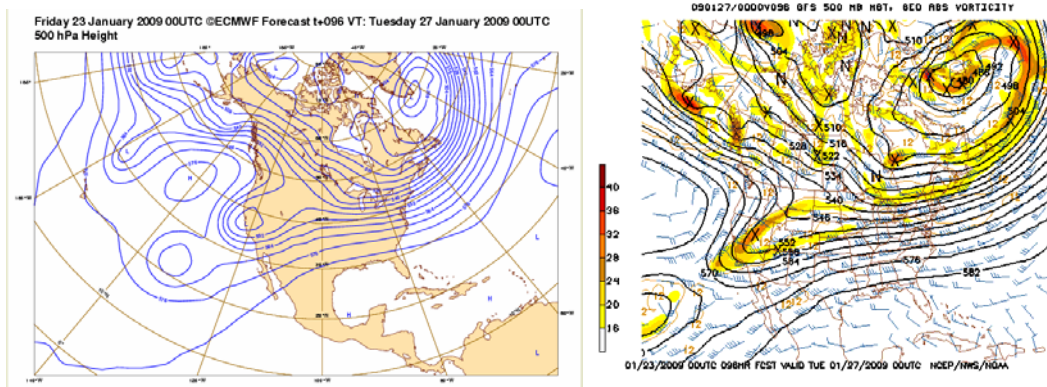
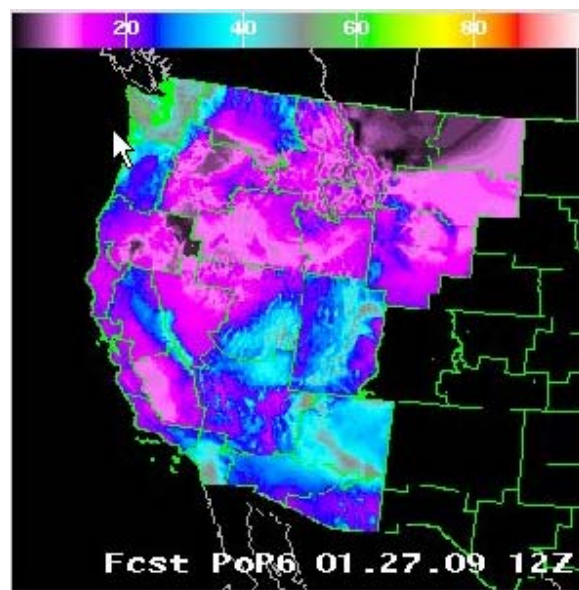


Figure 8. 108-114 hour PoP forecast, issued by the 23 January mid-shift, valid 1200-1800 UTC Tuesday, 27 January 2009.



Model discrepancies and run-to-run changes were mentioned in the early Friday morning, 23 January, WFO Phoenix AFD:

SIGNIFICANT INTER-MODEL AND INTRA-MODEL (22/12Z VS 23/00Z ECMWF) DISCONTINUITIES REMAIN FOR NEXT WEEK. BOTTOM LINE IS THAT A STRONG TROUGH/VORTEX IS LIKELY TO DEVELOP ACROSS THE WEST...ULTIMATELY TAPPING INTO TROPICAL MOISTURE AND AFFECTING THE REGION IN SOME SHAPE OR FORM. SUGGESTED BLEND BETWEEN THE TEMPERED 00Z GFS AND ECMWF ESSENTIALLY YIELDS POPS IN THE 20-40 PERCENT RANGE THROUGH MUCH OF THE WEEK. HOWEVER...SIGNIFICANT PRECIPITATION WOULD BE A POSSIBILITY IF THE LATEST ECMWF PANS OUT.

HPC also noted how the numerical guidance was struggling with this scenario:

PRELIMINARY EXTENDED FORECAST DISCUSSION
NWS HYDROMETEOROLOGICAL PREDICTION CENTER CAMP SPRINGS MD
901 AM EST FRI JAN 23 2009

VALID 12Z TUE JAN 27 2009 - 12Z FRI JAN 30 2009

MODELS HAVE HAD SERIOUS CONTINUTY DIFFERENCES OVER THE PAST COUPLE OF RUNS AND HAVE TRADED PLACES WITH SOLUTION EVOLUTION IN RUN TO RUNS. ECMWF HAS REVERTED TO PRIOR 00Z/22 CONTINUITY AFTER A RADICAL CHANGE IN ITS 12 RUN YTDA AND THE GFS HAS DONE THE SAME BUT WITH AN OPPOSITE RESULT. EARLIER USE OF ENS MEANS OF BOTH GFS AND ECMWF AGAIN SEEMS HIGHLY PRUDENT AS MEANS WERE BOTH REASONABLE IN AGREEMENT AND CONSISTENCY.

PREFERENCE TODAY FOR DAYS 3-5 MON-WED IS DOMINATED BY OP 00Z/23 ECMWF WITH SOME MODERATION ADDED IN WITH THE ECMWF 0Z ENS MEAN. THIS ALLOWS FOR A NON-PROGRESSIVE SOLUTION COMPARED TO GFS OF A CLOSED MID LEVEL LOW DROPPING DOWN AS AN OUTSIDE SLIDER ALONG THE CA COAST CUTTING OFF BEFORE EJECTING INLAND INTO SWRN CONUS LATE PERIOD. ECMWF ENS MEANS OFFER A WEAKER CONCURRENCE OF THIS SOLUTION...WHICH IS TYPICAL OF AN ENS AVERAGE. A LARGE AMOUNT OF UNCERTAINTY IN THIS EVOLUTION REMAINS AS ECMWF AND ITS ENS MEAN ARE OUTLIERS COMPARED TO GFS/UKMET AND CMC WHICH ARE VERY PROGRESSIVE AND DO NOT CLOSE OFF NOR CUT OFF THE DIGGING SHORTWAVE AND COME DOWN INLAND AS AN INSIDE SLIDER SHORTWAVE. RECENT GFS VERIFICATION HAS SHOWN A BIAS OF PROGRESSION TOWARD EJECTION OF SHORTWAVES AND CLOSED SYSTEMS OUT OF THE SOUTHWEST OR COASTAL EPAC.

The 1200 UTC 23 January 2009 GFS and ECMWF 500 hPa forecasts, valid at 1200 UTC 26 January 2009, are shown in Figure 9. Both models forecast a positively-tilted trough to be west of Arizona, with a decent precipitation event a distinct possibility. However, storm total QPFs from both operational models had lowered to 1-2", and the HPC 5-day precipitation forecast (Figure 11) also indicated lower precipitation amounts were likely, with average basin rainfalls only on the order of one quarter to three quarters inch. WFO Phoenix lowered PoP slightly (Figure 10), but still had enough confidence to issue a SPS headlined 'Significant Precipitation Event Possible Next Week'.

Figure 9. ECMWF and GFS 500 hPa forecast from 1200 UTC 23 January valid 1200 UTC 26 January 2009.

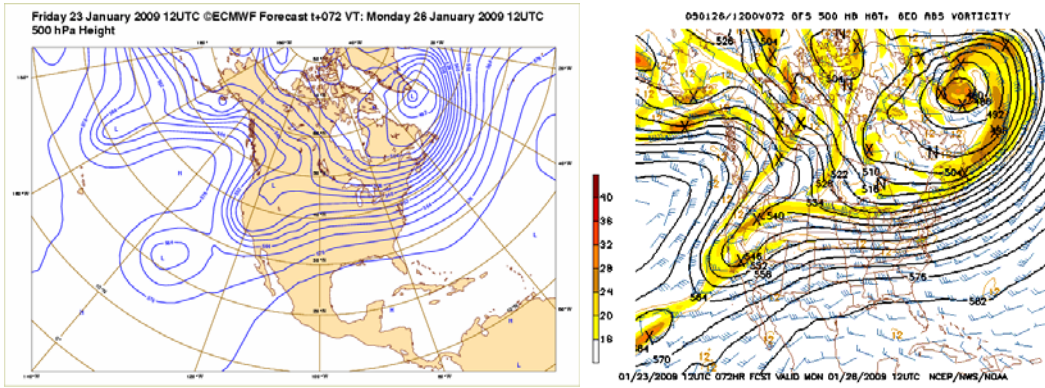


Figure 10. 96-102 hour PoP forecast, issued by the 23 January day shift, valid 1200-1800 UTC Tuesday, 27 January 2009.

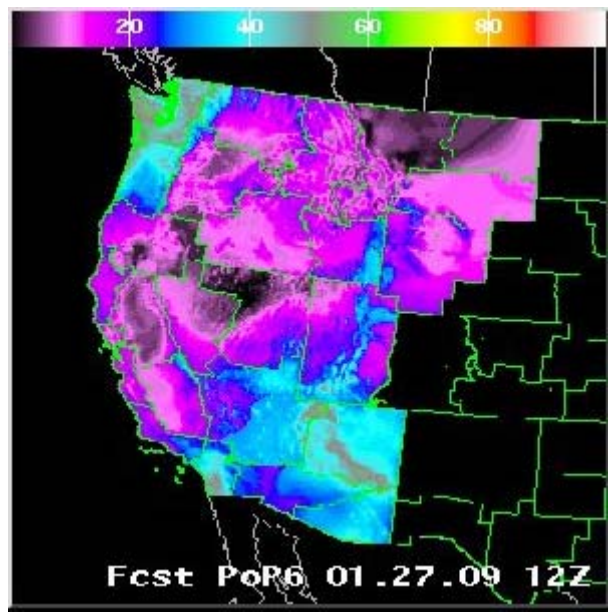
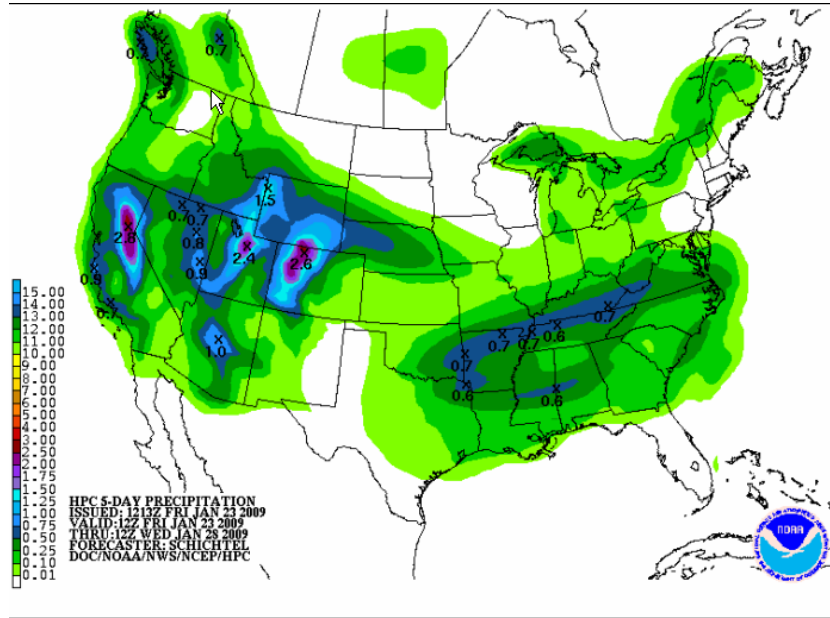


Figure 11. HPC 5-day precipitation, valid 1200 UTC 22 January 2009 to 1200 UTC 27 January 2009 (precipitation was expected to continue beyond 1200 27 January 2009).



Forecaster confidence that a precipitation event would occur over the Phoenix CWA remained fairly high with receipt of the Friday night operational models, but the potential for a significant precipitation event decreased. The ECMWF 0000 UTC 24 January operational run (Figure 12) forecast the storm system approaching from the northwest would 1) take more of an overland trajectory and 2) not tap into quite as much subtropical moisture. Consequently, ECMWF storm total QPF was much lower than what previous model runs indicated. The GFS solution was slightly drier, but overall very similar to the 1200 UTC 23 January run, with the best chance for rain Tuesday night and Wednesday. The WFO PoP forecast (Figure 13) was little-changed from the previous shift; however, HPC’s precipitation forecast called for lower rainfall totals (Figure 14).

Figure 12. ECMWF and GFS 500 hPa forecast from 0000 UTC 24 January valid 0000 UTC 27 January 2009.

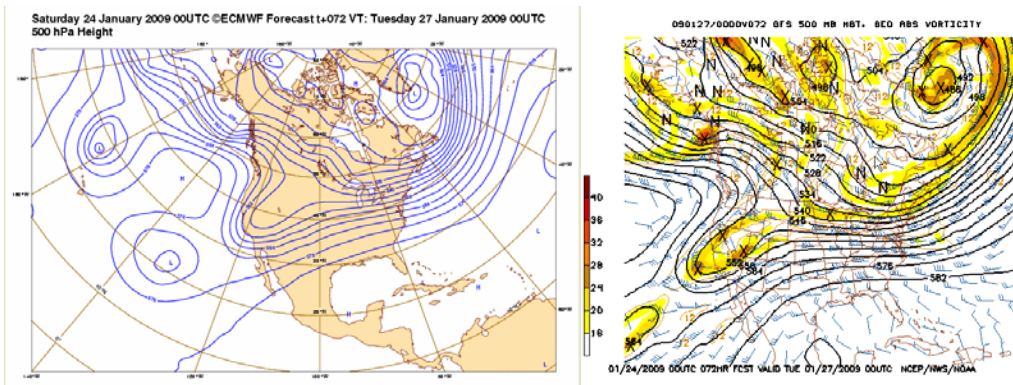


Figure 13. 84-90 hour PoP forecast, issued by the 24 January mid-shift, valid 1200-1800 UTC 27 January 2009.

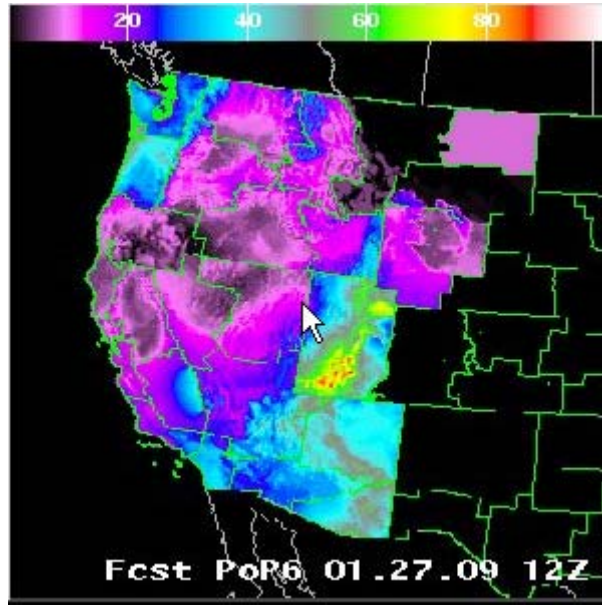
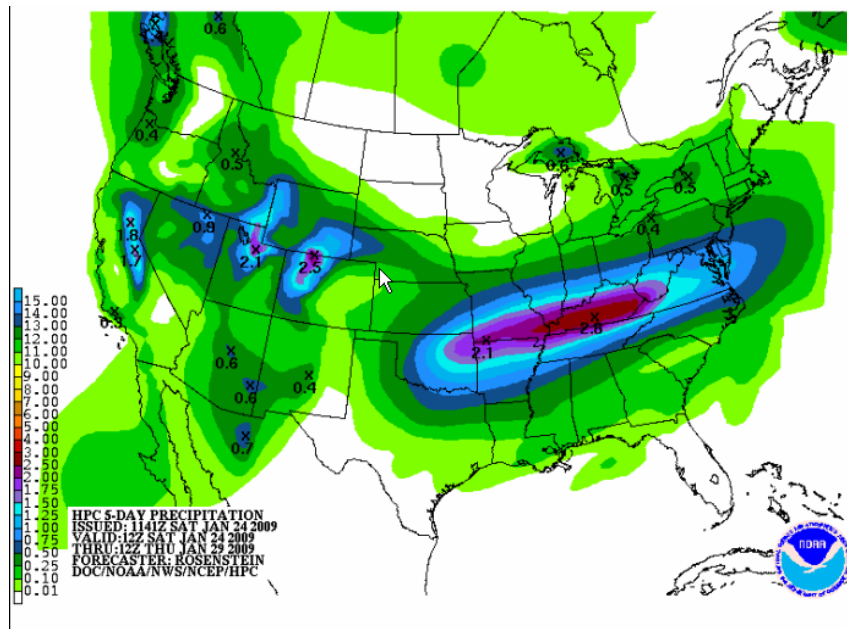


Figure 14. HPC 5-day precipitation, valid 1200 UTC 24 January 2009 to 1200 UTC 29 January 2009.

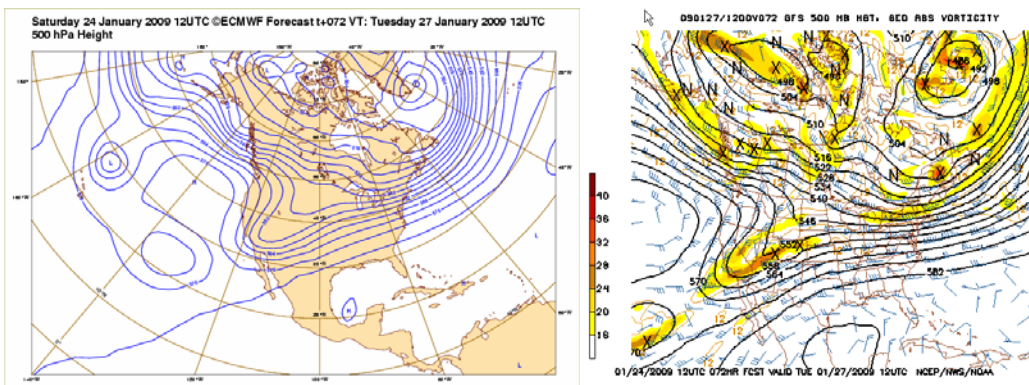


The late Friday night/Saturday morning AFD from WFO Phoenix noted the ECMWF changes:

THINGS GET INTERESTING BY TUESDAY...AS LATEST GFS CARVES OUT A CLOSED LOW JUST WEST OF LOS ANGELES AND CONTINUES A LONG FETCH OF SUBTROPICAL MOISTURE INTO OUR AREA. LATEST EURO BACKS OFF QUITE A BIT ON PRECIP CHANCES...AND BRINGS AN OPEN TROUGH THROUGH THE STATE MUCH EARLIER. WITH SO MUCH MODEL UNCERTAINTY...FEEL THAT A COMPROMISE SOLUTION IS IN ORDER...WHILE KEEPING POPS ELEVATED INTO THE MIDDLE OF THE WEEK AS INDICATED BY PREVIOUS FORECASTS. TOO EARLY TO TELL MUCH ABOUT THE DETAILS OF TIMING AND THE AMOUNT OF RAIN...EXCEPT THAT THE PATTERN THAT IS UNFOLDING BY WEDNESDAY SUGGESTS THAT A SIGNIFICANT RAIN EVENT MAY OCCUR.

The 1200 UTC 24 January GFS forecast a **much drier** scenario over the southwest United States, including Arizona; in essence, it 'caught up' with the more progressive and decidedly drier 0000 UTC 24 January ECMWF solution (Figure 15). The GFS-based MAV MOS PoP values 'nosedived', with single digit PoP forecast for Phoenix Tuesday night and Wednesday, versus 40-60% PoP for those two 12-hour periods produced by the 1200 23 January and 0000 UTC 24 January GFS-based MAV MOS. Not surprisingly, HPC dramatically lowered its 5-day precipitation outlook (Figure 16), with little or no precipitation forecast for the Phoenix CWA. The official PoP forecast was lowered only slightly (Figure 17), with forecasters reluctant to trim back precipitation chances as much as model guidance indicated.

Figure 15. ECMWF and GFS 500 hPa forecast from 1200 UTC 24 January valid 1200 UTC 27 January 2009.



The Saturday afternoon 24 January 2009 AFD from WFO Phoenix stated:

MODELS HAVE CONTINUED TO FLIP FLOP...NOTABLY THE GFS...AND IT NOW APPEARS THAT THERE WILL BE A POSITIVE TILT TROUGH MOVING THROUGH WITH AN OVERLAND TRAJECTORY. THERE APPEAR TO BE ABOUT THREE SPLITS IN THE WESTERLIES OVER NORTH AMERICA AND THE EASTERN PACIFIC AND THE MODELS HAVE BEEN HAVING DIFFICULTY ROUTING THE ENERGY CONSISTENTLY.

PARED BACK POPS FOR TUESDAY NIGHT THROUGH THURSDAY IN LIGHT OF MODEL TRENDS AND HPC GUIDANCE. PER COORDINATION WITH ADJACENT OFFICES...HELD OFF ON CUTTING BACK POPS TO WHAT THE LATEST MODELS WOULD SUGGEST. GIVEN THE COMPLEX FLOW PATTERN...THINGS COULD CHANGE AGAIN BUT WITH THREE RUNS IN A ROW FROM THE ECMWF SHOWING A PROGRESSIVE SOLUTION...THINGS ARE BEGINNING TO LOOK DECIDEDLY DRIER. REISSUED A SPECIAL WEATHER STATEMENT FOR CONTINUITY BUT TRIED TO INDICATE THAT THINGS ARE NOT LOOKING AS WET AS PREVIOUSLY THOUGHT.

Figure 16. HPC 5-day precipitation, valid 0000 UTC 25-29 January 2009.

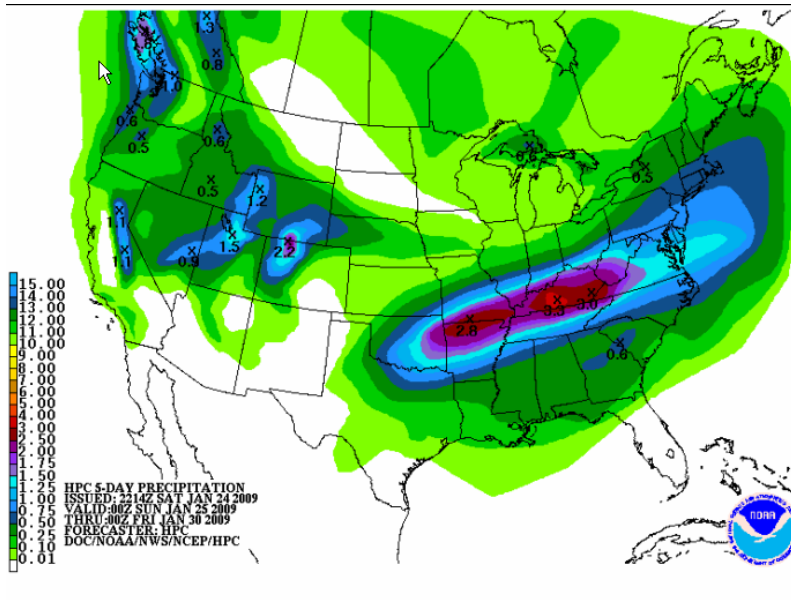
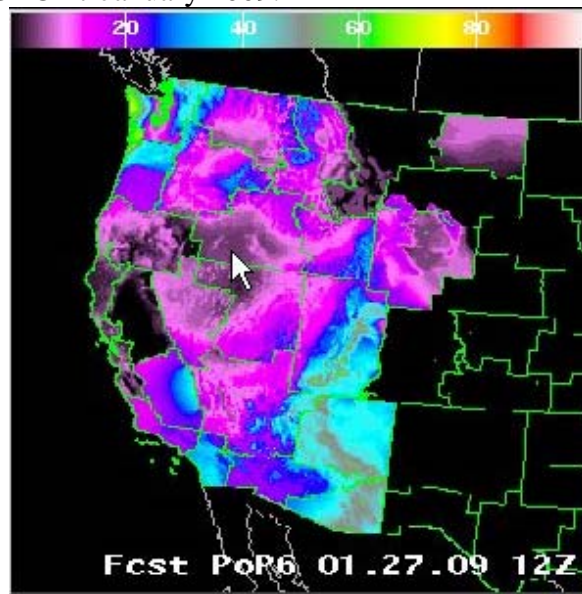
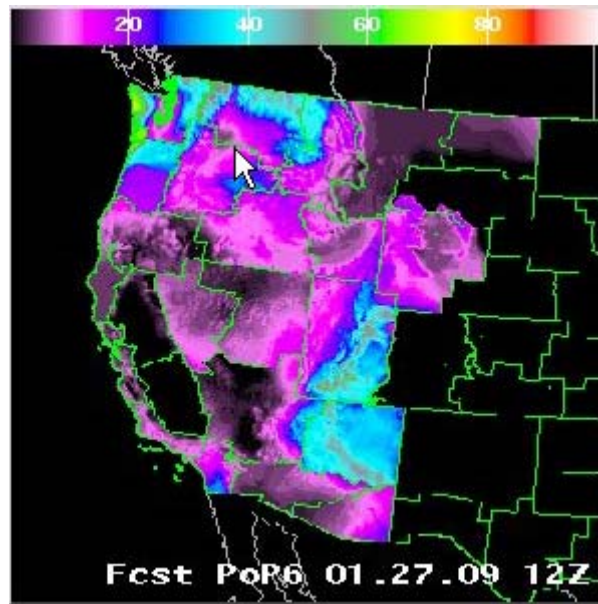


Figure 17. 72-78 hour PoP forecast, issued by the 24 January day shift, valid 1200-1800 UTC 27 January 2009.



The 0000 UTC 25 January ECMWF and GFS operational model runs were similar to the 1200 UTC 24 January runs; they continued to depict a more progressive solution regarding the positively tilted trough, and no subtropical connection for it to work with; consequently, PoP for measurable precipitation during all 12-hour periods in the upcoming 7 days was reduced dramatically, enough to remove mention of precipitation from most lower desert zones (Figure 18).

Figure 18. 60-66 hour PoP forecast, issued by the 25 January mid-shift, valid 1200-1800 UTC Tuesday, 27 January 2009.



The excerpt from the Saturday night/Sunday morning WFO Phoenix AFD essentially reflected what transpired:

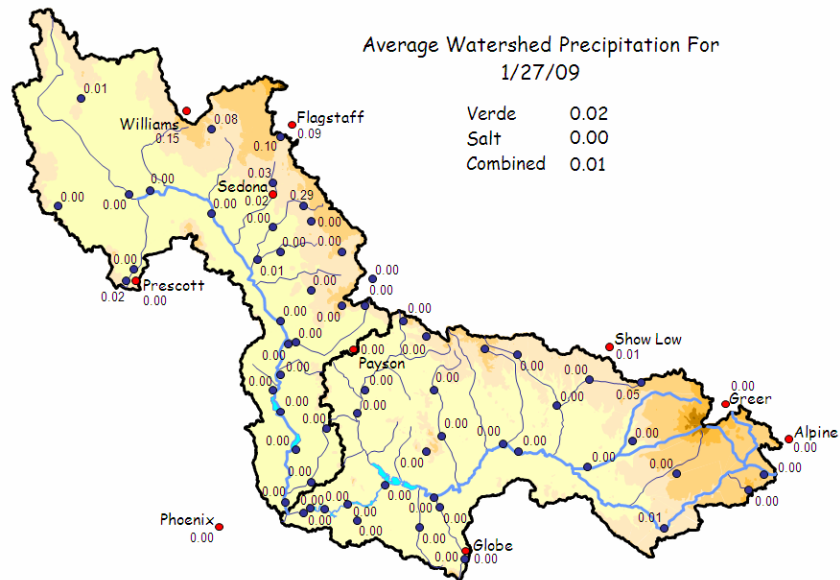
FOR MONDAY AND TUESDAY...MODELS NOW HAVE COME INTO BETTER AGREEMENT WITH THE STRONGER TROUGH ALONG THE WEST COAST BEING PROGRESSIVE AND BRUSHING BY TO THE NORTH. AT THE SAME TIME...THE CLOSED LOW THAT WAS ADVERTISED BY SOME MODELS TO SIT OFF THE BAJA COAST AND INJECT A LOT OF SUBTROPICAL MOISTURE OUR WAY...IS PRETTY MUCH HISTORY AND LITTLE IF ANY DEEP LAYERED RH WILL COME INTO PLAY.

FOR THE EXTENDED PERIOD...GFS AND ECMWF AGREE IN PUMPING UP THE EASTERN PAC RIDGE...WITH LARGE HEIGHT RISES OVER ALL THE SOUTHWESTERN STATES BY THURSDAY. AT THE SAME TIME...THEY KICK OUT THE POSITIVE TILT TROUGH AND OFFERS US LITTLE IF ANY CHANCE OF RAIN BEYOND TUESDAY NIGHT.

EVENT SUMMARY

Little if any precipitation fell over the Phoenix CWA during the last week of January 2009. No precipitation occurred over the greater Phoenix area. A few hundredths of an inch of rain fell over the SRP watersheds on 26-27 January (Figure 19); no precipitation occurred the remainder of the week. During the latter part of the previous week, WFO Phoenix asked HPC forecasters to participate in its statewide collaboration calls; however, HPC participation was cancelled once the threat for rainfall had decreased. SRP scheduled an agency briefing for its key customers for 27 January, ostensibly to explain how expected heavy rainfall and snowmelt would affect projected releases/flows through the Salt River; the briefing took place as scheduled, though releases/flows were sharply reduced. A key SRP hydrologist cancelled a trip to Canada, where he had been scheduled to give a conference keynote address, in anticipation of the potential precipitation event (Ester, personal communication).

Figure 19. 24-hr precipitation over the Salt-Verde watershed, 6 am MST 26 January to 6 am MST 27 January 2009 (figure courtesy of SRP).



Tables 1 and 2 depict MAV MOS and official PoP forecasts for Phoenix Sky Harbor Airport for seven consecutive 12-hour periods. Note the dramatic lowering of PoP commencing with the 1200 UTC 24 January model run.

Table 1. 12-hour MAV MOS PoP forecasts (%) at Phoenix Sky Harbor ASOS, for 7 consecutive forecast periods (beginning time of forecast period at top of columns 2-8), issued over a period of 6 days commencing with 1200 UTC 19 January 2009 (first entry in column 1). Phoenix Sky Harbor climatological 12-hour PoP is slightly below 10 percent.

	26/1200	27/0000	27/1200	28/0000	28/1200	29/0000	29/1200
19/1200	15	09					
20/0000	13	16	10				
20/1200	17	27	18	17			
21/0000	23	32	34	30	16		
21/1200	25	23	18	26	19	14	
22/0000	25	40	43	34	20	09	06
22/1200	49	65	40	11	18	29	17
23/0000	04	04	07	05	04	04	04
23/1200	11	21	33	58	54	30	14
24/0000	14	07	24	40	57	37	21
24/1200	08	13	07	02	02	03	04
25/0000	10	04	01	01	03	02	03

Table 2. 12-hour official PoP forecasts (% , rounded) at Phoenix Sky Harbor ASOS, for 7 consecutive forecast periods (beginning time of forecast period at top of columns 2-8), issued over a period of 6.5 days commencing with 1200 UTC 19 January 2009 (first entry in column 1).

	26/1200	27/0000	27/1200	28/0000	28/1200	29/0000	29/1200
19/1200	10	--	--	--	--	--	--
20/0000	05	--	--	--	--	--	--
20/1200	05	05	05	--	--	--	--
21/0000	20	20	20	--	--	--	--
21/1200	20	20	20	05	05	--	--
22/0000	20	30	40	20	20	--	--
22/1200	30	30	30	30	30	30	20
23/0000	10	30	30	30	30	30	20
23/1200	10	20	30	30	40	40	30
24/0000	10	20	30	40	50	40	30
24/1200	10	20	30	30	30	30	20
25/0000	05	05	10	05	05	05	05
25/1200	05	05	05	05	05	00	00

Interestingly, even though this potential high-impact event turned out to be a non-event, key customers, including emergency managers and SRP scientists, were pleased with WFO Phoenix's outreach efforts, several individuals felt the actions they took in response to our forecast served as an excellent "dry run" for their respective agencies. The general consensus was: given the state of the Salt reservoir system (near capacity), we'd rather be forewarned about the potential for a significant event rather than have it downplayed.

From a meteorological perspective, it was apparent that the principal numerical operational models, including the GFS, and their ensemble members had great difficulty dealing with this weather situation. Considering the fact that little if any precipitation occurred, with zero precipitation reported during most of the 12-hour periods in question, an argument could be made that most WFOs, including WFO Phoenix, hit the event too hard in the extended range of the forecast, and held onto inflated PoPs too long. However, most offices, acknowledging forecast uncertainty, kept forecast PoPs at or below MOS-based guidance for the majority of the forecast packages leading up to the event. Another factor that may have influenced WFOs to hang onto somewhat higher PoPs than they might otherwise have done for this potential event centered on the fact that several periods of light precipitation occurred during the period 21-24 January, the time period when the wettest forecasts for the potential event were made, as a weak southern branch storm tracked east across the southwest United States (sidenote: timing periods of measurable precipitation with this system were extremely challenging).

WFO Phoenix, noting the lack of GFS forecast model consistency, especially regarding the degree and location of the upstream eastern Pacific Ocean ridge, placed a flight request with the Winter Storm Reconnaissance (WSR) program at 0045 UTC 23 January. In response, dropsonde flights occurred over the north Pacific Ocean near 38N 120W, in time for dropsonde-derived data to be ingested into the 1200 UTC 24 January numerical model runs. Although the impact of the dropsonde information on model initialization and resultant forecasts is not known, GFS model-forecasted sensible weather over the Phoenix CWA during the week of 26-30 January 2009 markedly improved commencing with the 1200 UTC 24 January GFS operational model run.

ACKNOWLEDGMENTS

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