

March 2-4 2004 Winter Storm, Southeast Arizona – A WES Case

Jim Meyer, WFO Tucson, AZ

Introduction

One of the headlines in a local newspaper included "...a Storm that Delivers the Goods." We had just experienced a strong winter storm that had delivered widespread heavy snowfall to the mountains of Southeast Arizona. Our customers were happy with the fact that we had told them well in advance about a significant snow event. What they hadn't really noticed is that we had significant problems forecasting the track and timing of the storm coincident with the event itself, and for one brief time immediately before it hit we actually had no winter storm products out at all -- on purpose. This analysis will serve as much as a cautionary tale on a few forecasting trends and pitfalls as it will on a specific study of the event itself.

Summary

Late February had transitioned into a busy high energy northern hemisphere pattern after a fairly sedate 3 long wave pattern for most of the month. The initial lower latitude system in this new pattern brushed through Arizona on February 28th, bringing scattered light to moderate precipitation to the area. Medium range models had handled the timing on this transition fairly well, but model differences were apparent at the 3 to 5 day point ahead of the next system. The GFS was the most aggressive with a strong mean trough position through western states along and a strong southern split through Arizona by the 2nd of March. By late on the 28th and early on the 29th with the system of concern off the Pacific Coast near 46N 132W (Figure 1), model track differences were beginning to consolidate. They were now becoming more of a temporal issue rather than spatial. We ended up issuing an SPS early on the 29th advertising valley rain and mountain snow

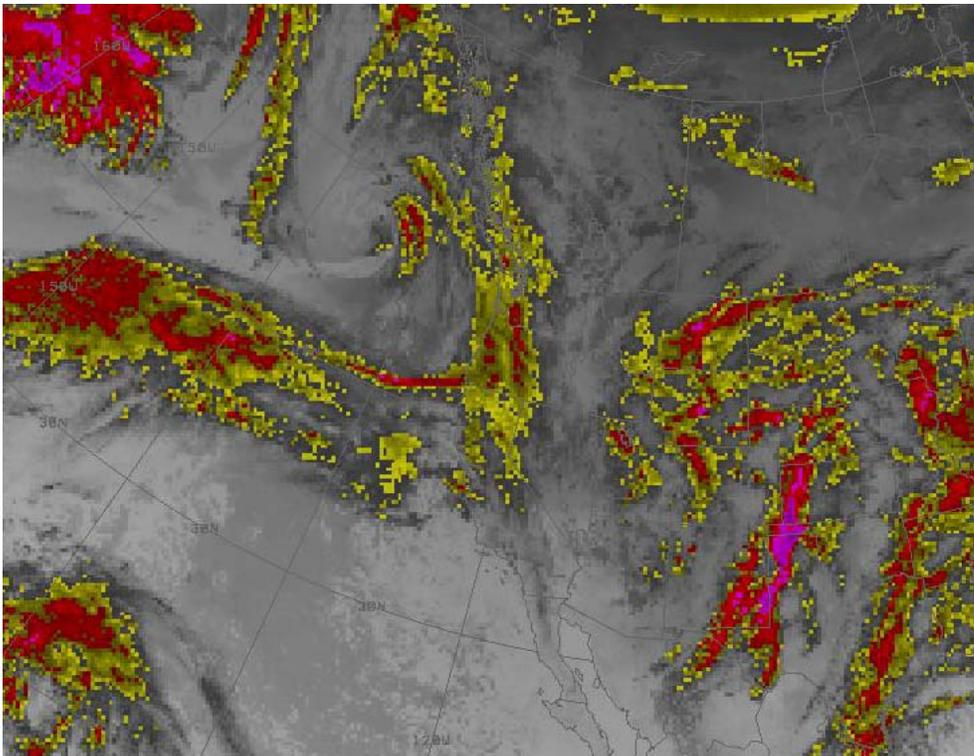


Figure 1: Incipient Gulf of Alaska low near Vancouver Island, 03Z February 29, 2004.

from Tuesday the 2nd through Wednesday the 3rd, with an emphasis on Tuesday night. It certainly had the right idea and was a nice heads-up for our customers, but would ultimately turn out to be about 24 hours early on the onset of heaviest precipitation.

By the morning of the 1st, model initialization of the system now near the Oregon coast was good, and, as even mentioned in a PMDHMD, model guidance was now in quite good agreement about moving the low along the U.S.-Mexico international border late on the 2nd into the 3rd (Figure 2). This agreed extremely well with the timing mentioned by our SPS, and with subsequent 12Z data falling into line, we issued a Winter Storm Watch with the afternoon package on the 1st. It was evident that the system was starting to lose expected higher latitude support early on the 2nd, so the Watch was extended through all day on the 3rd due to timing concerns as it became less progressive on its turn eastward. Short range model guidance was still in good agreement as all models showed likely precipitation overnight on the 2nd and into the 3rd.

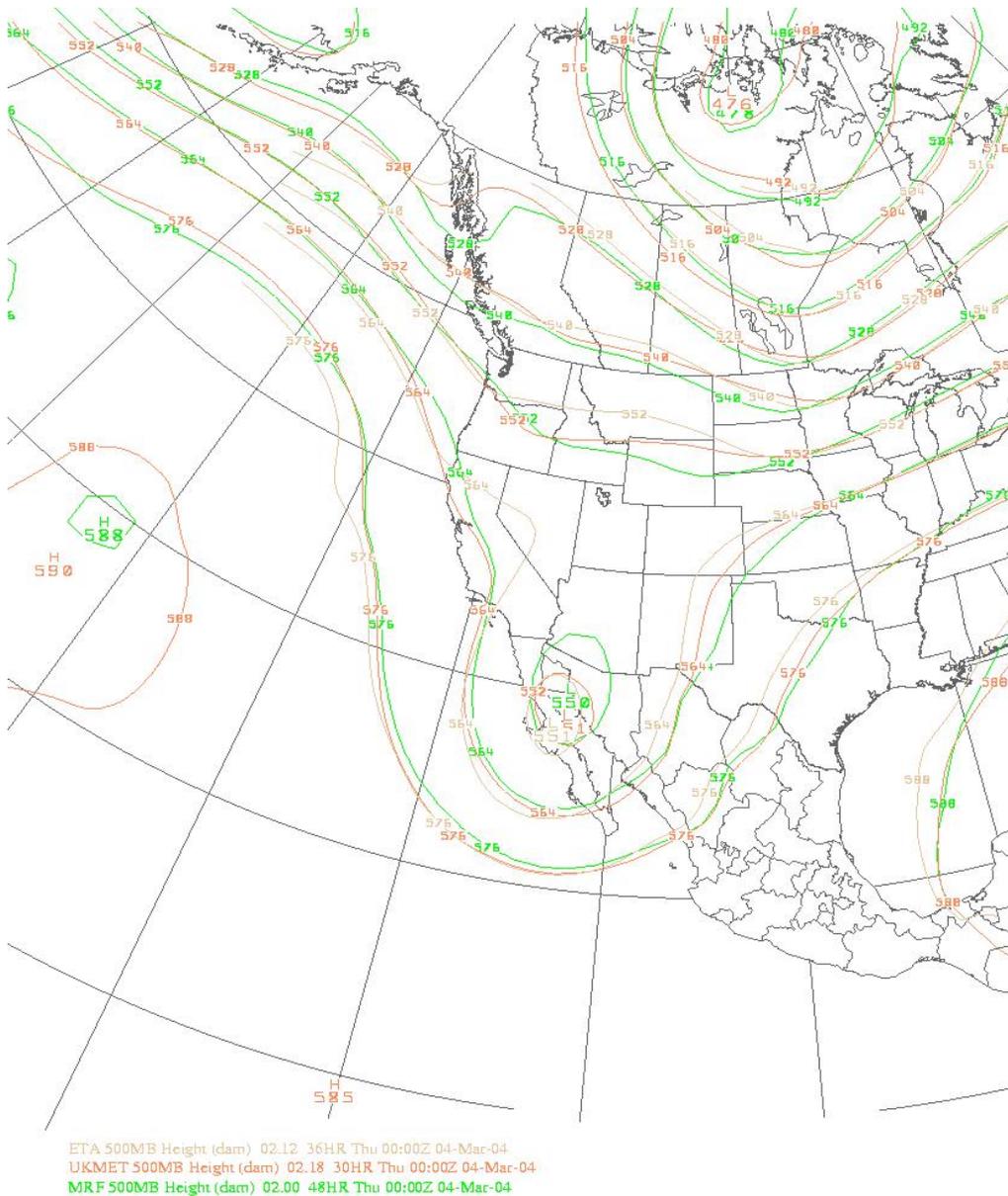


Figure 2: Eta, UKMET, and GFS 500mb height forecasts for 00Z March 4, 2004. Note excellent agreement between the models, possibly giving a "false sense" of security.

By the afternoon of the 2nd, the Lower Colorado River Valley was seeing heavy rain as the system continued to slowly fall behind initial timing expectations and our forecast crept along with it. With a slightly more southerly track expected and our forecast continuing to be too aggressive with the precipitation timing, the decision on the Watch was to go for advisory level snows in northern areas and Heavy Snow Warnings for southern areas for the first and second periods. By evening hours, it became clear that we were going to struggle further with timing as little first period precipitation was materializing. The low was showing further cutoff characteristics as it spun just west of the northern Baja coast, with another weak impulse carving into the backside showing the potential for more digging before an eventual turn eastward (Figure 3). From that point on we struggled along with the model data and MOS; limping along with minor forecast modifications and now-casting latest conditions into the first period of the forecast. All warnings were downgraded to advisories early on the 3rd, and even that seemed to be overdoing it a bit at that point.

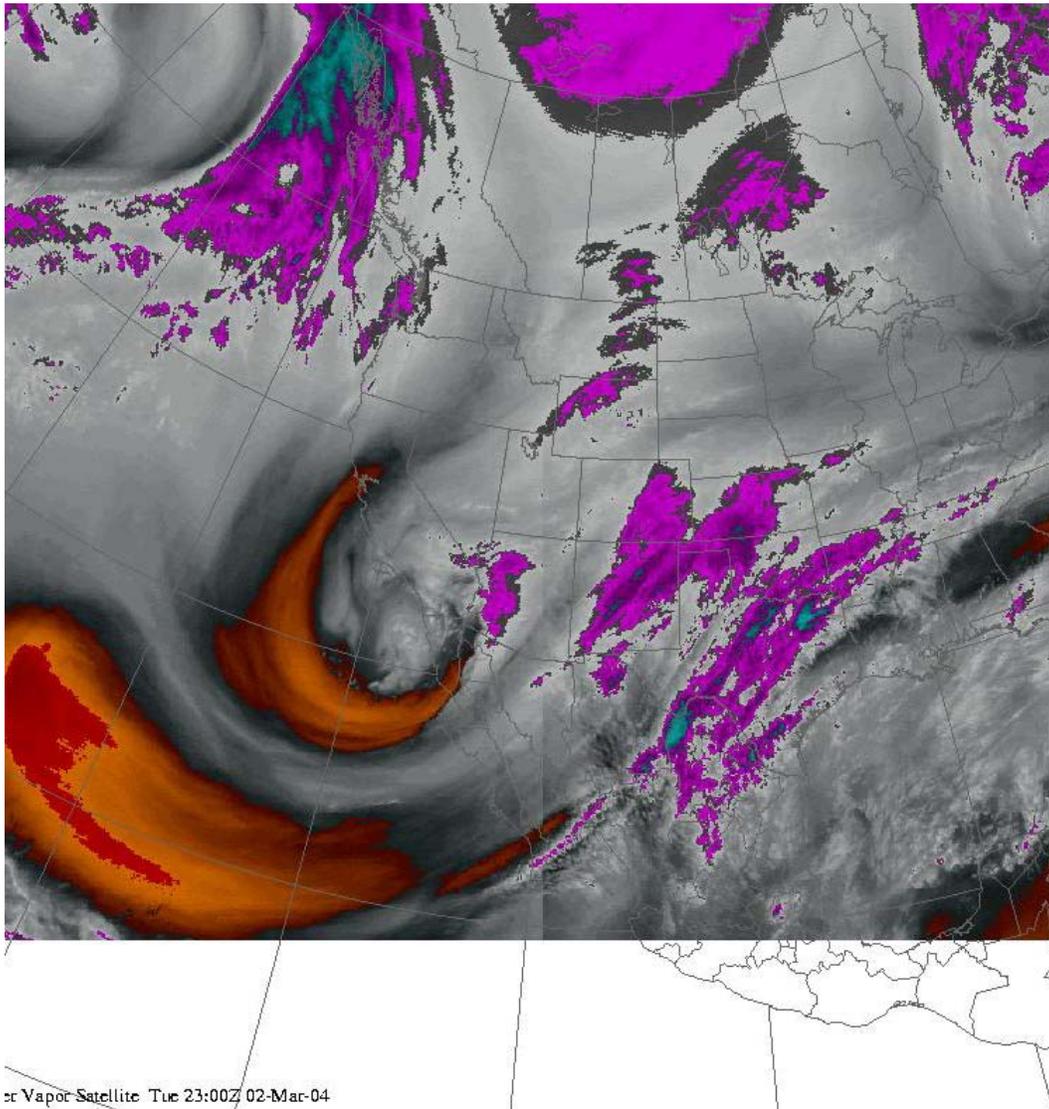


Figure 3: Water vapor satellite image, 23Z March 2, 2004. Note series of impulses rotating around the low, and additional weak upstream short waves over central California and southern Idaho. Both upstream disturbances will eventually be pulled into the cutoff low.

Verification and Conclusions

All the hastily resurrected winter storm products verified nicely, but with obviously less than desired lead time. The bottom line turned out to be that we were about 24 to 30 hours fast with the low, and allowed our winter storm script of Statement/Watch/Warning to be shot out of the water. Final storm totals included 22 inches at Mt Lemmon, 20 inches at Hannagan Meadow, 23 inches at Kitt Peak, and 8 to 12 inches above 5000 feet elsewhere. The forecast scenario changed from one where we had high confidence with good model agreement as the system neared, to one where we played catch-up along with the models as the low settled toward northern Baja. As irrational as it seems in hindsight, one actually started to wonder if you are going to get much precipitation at all when you swing and miss with likely POPs and warning level snows one or even two periods before the main event. This event highlighted the need for good satellite and upper level wind field analysis to support, or not support, model movement of the upper level low pressure system. This was a difficult case indeed!