7.8 RESULTS FROM THE WINTER STORM RECONNAISSANCE PROGRAM 2002-2003

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1. INTRODUCTION

The Winter Storm Reconnaissance (WSR) program began in 1999 and has been operational since January 2000. Typically occurring January – March each year, the program has continued to improve forecasts in the 1-4 day lead-time range for high societal impact winter weather events over the continental U.S. (including Alaska) through the application of adaptive observation techniques in data sparse regions over the northeastern Pacific.

Past papers have documented forecast improvement during WSR 1999 (Szunyogh et al. 2000), WSR 2000 (Szunyogh et al. 2002), and WSR 2001 (Toth et al. 2002) using measures such as reduction in RMS error for winds and surface pressure over the selected verification regions. About 60-80% of the cases in which adaptive observations were used showed improvement during previous WSR field programs.

During 2002, the WSR program deployed additional dropwinsonde observations from the NOAA G-IV and the USAFR C-130 for a total of 20 cases. During 2003, between 18 January – 15 March 2003 observations for a total of 25 cases were collected.

This paper will examine the reduction in forecast RMS error due to the inclusion of targeted observations during WSR 2002 and 2003. It will also examine the Equitable Threat Score (ETS) for precipitation. The President's Day snowstorm of 2003 will also be examined as a case where adaptive observations were used to improve the forecast for a high societal impact weather event.

2. CHANGES IMPLEMENTED SINCE 2001

Since WSR 1999, the program has undergone a series of improvements to the targeting techniques employed. The changes to its operational implementation through 2001 are discussed in Majumdar (2002) while the theoretical aspects are discussed in Bishop (2002).

Changes thereafter are documented in Moskaitis (2002), and will be only summarized briefly in this paper.Majumdar (2002) describes the application of the ETKF in the WSR 2001 program. The method documented therein approximated the effect of the routine observational network on error covariance by rescaling the ensemble forecast perturbations in such a way that each perturbation has the same globally averaged magnitude. The new method, implemented in late 2002, accounts for the effect of routine observations at the targeting time, when adaptive observations are taken. It also assumes the routine observational network consists of rawinsonde temperatures and winds (850, 500, and 200 hPa) over specific locations in the northern hemisphere. It mimics the effect of satellite observations at 850, 500, and 200 hPa. A rescaling of the ensemble perturbations is also performed to eliminate the bias.

3. VERIFICATION

The verification statistics were evaluated using two versions of the GFS model at the same resolution as the ensemble used in the ETKF calculations. One version includes the dropwinsonde observations, as well as all other operationally available data collected over the Pacific (the operational run), while the other excludes the adaptive observations (the control run). The model forecasts are then verified against observational data. The total number of cases in which RMS error is reduced over the 1000 km radius verification region selected by forecasters is shown for surface pressure and winds between 1000-250 hPa.

3.1 *Surface Pressure, Wind and Precipitation forecasts*

Since there were no major changes between 2002 and 2003, the two years combined have a total of 45 cases in which targeted observations were used. Twenty-six cases showed improvement with the use of targeting techniques. In 14 cases, the forecasts were degraded, and 5 had neutral impact for surface pressure as measured by reduction in RMS error. Fig. 1 shows results from 2002-2003 for surface pressure. This improvement in surface pressure is significant at the 5% level.

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However, unlike previous years, there was no significant effect on wind forecasts.

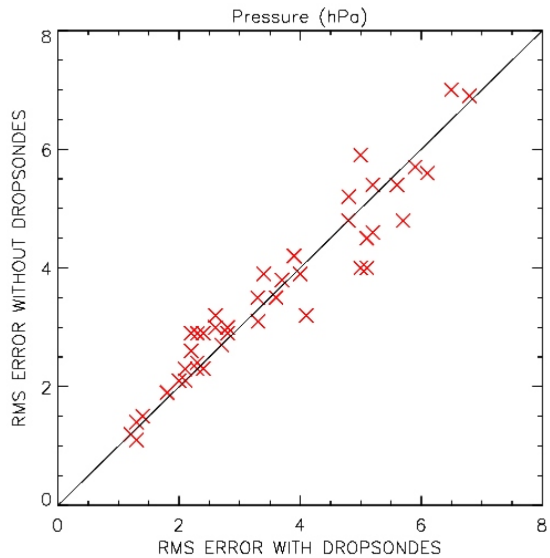

Fig. 1. RMSE with dropsonde observations versus RMSE without dropsonde observations over the verification regions for each WSR case 2002-2003.

A stringent method of subjectively analyzing the degree of improvement or degradation of precipitation forecasts due to the targeted observations was used to evaluate results in previous WSR field campaigns. These results were shown to be consistent with improvement in both the surface pressure and wind forecasts over the verification region. For the WSR cases between 2002-2003, the ETS was used as an objective method of measuring improvement or degradation in quantitative precipitation forecasts (QPF). These forecasts were divided into bins ranging from forecasts of 0.01 mm to 25 mm of liquid equivalent. While some thresholds showed improvement, unlike previous years by in large the results showed no significant impact in QPF.

3.2 *The President's Day Snowstorm*

One case during WSR 2003 with a high potential for societal impact was the President's Day snowstorm of 2003. The snowstorm broke records in many areas across the mid-Atlantic and closed down airports, and ruined travel plans for many.

For this case, both the NOAA G-IV and the USAFR C-130 were tasked for additional observations in the Pacific in support of WSR. These observations were taken on 14 February 2003 to decrease the forecast uncertainty for the potentially important forecast for 16 February at 12 UTC.

Fig. 2 shows the control forecast (contours, hPa) from 00 UTC on 14 February valid at 12 UTC on 16 February. The forecast improvement (red) and degradation (blue) are shown over the mid-Atlantic. The overall improvement in surface pressure forecast over the verification region was near 15%. Although little impact was shown in winds, the additional observations resulted in an improvement in ETS of 7.3% at precipitation amounts greater than 0.2mm.

In this case, the forecast was improved over a large portion of the eastern U.S -- the area most detrimentally affected by the snowstorm. In some areas, the numerical forecasts were improved by as much as 3 hPa.

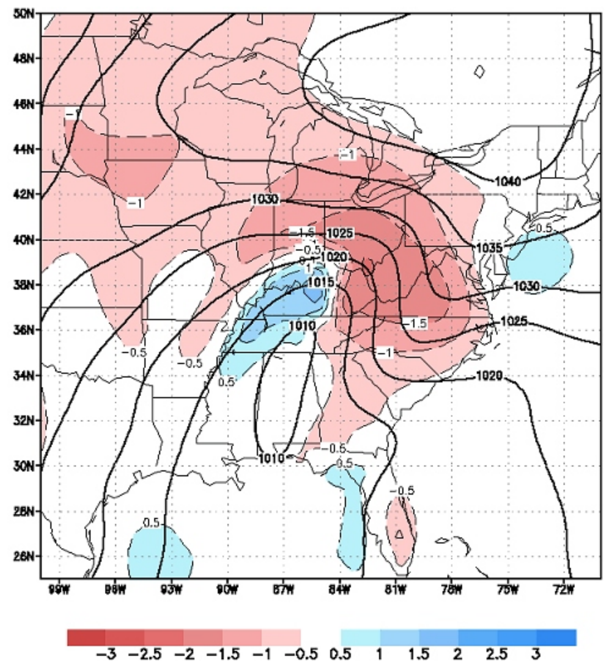

Fig 2. Forecast improvement (red) and degradation (blue) in surface pressure (hPa) over the area most impacted by the President's Day snowstorm of 2003. Solid contours show the surface pressure from the control forecast

5. CONCLUSIONS

Although past years of WSR have shown a greater degree of improvement for wind forecasts and precipitation, the improvement of surface pressure still remains consistently improved by targeted observations in WSR field programs. It is not clear why the forecast of winds between 1000-250 hPa was not improved by the additional dropwinsonde observations. Further investigation is currently being conducted to explore the lack of significant improvement in this forecast field.

The President's Day Snowstorm of 2003 was an example of how targeted observations were able to improve the forecast of a heavy snowstorm with large impact over a highly populated region of the U.S.

6. ACKNOWLEDGMENTS

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