8.3 THE IMPACT OF ERS-1 WINDS ON NCEP OPERATIONAL NUMERICAL WEATHER ANALYSES AND FORECASTS

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1. INTRODUCTION

The backscatter measurements from the ERS-1 scatterometer have been processed at the National Centers for Environmental Prediction (NCEP) to produce ocean surface vector winds four times a day at every six hour intervals since the Summer 1994, using a procedure similar to that used operationally in the U.K Meteorological Office (Peters et al, 1994). The NCEP reprocessed ERS-1 wind data, after an extended period of investigation on their quality by comparing with collocated buoy reports, and several impact studies of the data on NCEP's analyses and forecasts (Yu and Derber, 1995, and Yu (1995)) were implemented in the NCEP's operational global data assimilation systems in October, 1995. For several weeks after the operational implementation, the quality of the ERS-1 vector winds were routinely monitored and their impact on the NCEP's numerical weather prediction systems were evaluated. It is the purpose of this paper to discuss results of this most recent ERS-1 wind data impact investigation. Section 2 briefly describes the experimental design associated with the NCEP global data assimilation system. The results of the assimilation and forecast experiments are discussed in Section 3.

2. THE NCEP ASSIMILATION SYSTEM

The NCEP T62 global data assimilation system (Kanamitsu et al ,1989), was used to assess the impact of the ERS-1 wind data. The forecast model is a global spectral forecast model of triangular truncation of 62 waves for the horizontal spectral resolution. It has 28 sigma layers for the vertical grid resolution. The spectral statistical interpolation scheme (Parrish and Derber, 1992) is used to update the first guess fields from the six hour spectral model forecasts and a six- hour time window for observations.

The impact of the ERS-1 winds is investigated by running two experiments in parallel -one without the inclusion of ERS-1 data (Exp. B), and one with the inclusion of the ERS-1 wind data (Exp.A) in the analyses, and comparing the results. The assimilation experiment covers a period of about two months from November 21, 1995 to January 20, 1996.

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3.RESULTS OF ASSIMILATION AND FORECASTS

3.1 Impact on the Analyses

Table 1 shows the RMS vector winds errors (m/sec) of the six hour forecast at 1000 mb with reference to various types of surface marine observations for Exp. A (with ERS-1 winds) and Exp. B (without ERS-1 winds) during the period between November 21, 1995 and December 31, 1995. Note that the number of observations represents the total numbers during the assimilation period. From Table 1, it can be seen that use of the ERS-1 winds in the assimilation improves the first guess fields, thereby suggesting the data have a positive impact on the wind analyses over the global oceans.

Table 1. Fit of first guess winds to various marine surface wind observations (in m/sec)

Ships and Buoy Winds	No. of Obs.	50507
	Exp.A (with)	5.14
	Exp.B (w/o)	5.16
TOGA Buoys	No. of Obs.	1388
	Exp.A (with)	3.30
	Exp. B (w/o)	3.36
SSM/I Winds	No. of Obs.	443453
	Exp.A (with)	2.82
	Exp.B (w/o)	2.86
ERS-1 Winds	No. of Obs.	1669244
	Exp.A (with)	4.19
	Exp.B (w/o)	4.25

Table 2 shows RMS vector wind and temperature errors at 1000 mb of the first guess with reference to radiosonde observations during the same period. Note that the majority of the radiosonde stations are over the land surfaces. It can be seen from Table 2 that similar to the results shown in Table 1 for over the oceans, the use of ERS-1 winds in the data assimilation also improves the first guess wind and temperature fields at 1000 mb over the land surfaces.

Table 2. Fit of first guess to radiosonde observations

1000 mb Winds (m/sec)	No. of Obs.	41433
	Exp.A (with)	5.10
	Exp.B (w/o)	5.11
1000 mb Temperature (° c)	No. of Obs.	44015
	Exp.A (with)	3.18
	Exp.B (w/o)	3.19

3.2 Impact on the Forecasts

During the assimilation period, a five-day forecast was initiated everyday at the 0000 UTC cycle, resulting in a total of 41 cases of forecasts (from 24 hours up to 120 hours) for the period from November 21, 1995 to December 31, 1995.

Table 3 shows the RMS vector wind errors (m/sec) of the model 10 meter wind forecasts with reference to mid-latitude buoy observations for parallel Exp.A (with ERS-1 winds) and Exp.B (without ERS-1 winds) during the same period. From Table 3, one can see that use of the ERS-1 winds leads to a small improvement in the ocean surface wind forecasts up to five days. Note that the buoy winds are all adjusted to the 10 meter level to insure a fair comparison with the 10 meter level model forecast winds.

Table 3. Forecast RMS vector wind errors (m/sec) of model 10 meter winds as compared to deep ocean mid-latitude buoys (25° N- 60° N)

Forecast Hours	No.of Buoys	Exp. A (with ERS-1 winds)	Exp. B (without ERS-1 winds)
24	3713	5.02	5.09
48	3754	6.04	6.16
72	3750	7.38	7.42
96	3750	8.00	7.97
120	3705	8.70	8.75

Similarly, when the model wind forecasts are compared to the land surface radiosonde observations, the statistics show that the ERS-1 winds have a positive impact on the 1000 mb and 500 mb wind forecasts for the five-day forecasts (see Table 4). It should be noted that results discussed thus far are based on the comparison of model forecasts form the two assimilation and forecast experiments with surface marine and radiosonde observations. Other statistics such as anomaly correlations and RMS forecast errors with respect to verifying analyses are also calculated, and they are in good agreement with the results discussed above.

Table 4. Five- day forecast wind errors at 1000 mb and 500 mb as compared to radiosonde observations

1000 mb winds (m/sec)	No. of Obs.	42131
	Exp.A (with)	7.39
	Exp.B (w/o)	7.40
500 mb winds (m/sec)	No. of Obs.	61950
	Exp.A (with)	12.55
	Exp.B (w/o)	12.60

4. SUMMARY AND CONCLUSIONS

The NCEP reprocessed ERS-1 vector winds have been used operationally in the NCEP numerical weather analyses and forecast systems since October 1995. The quality of the ERS-1 wind data and their impact on the NCEP numerical operations are routinely monitored since their implementation..

The paper discusses results of the most recent impact study of two month data assimilation and forecast experiments using ERS-1 vector winds data in NCEP numerical weather analysis and forecast systems. The results show that use of the ERS-1 wind data contributes to improvement of the low level wind fields in the initial analyses and the subsequent short range forecasts up to five days.

5. REFERENCES

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