JP 4.7 OPERATIONAL USE OF QuikSCAT WINDS IN NCEP GDAS

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1. INTRODUCTION

The U.S. NASA QuikSCAT satellite was launched on June 19,1999. Onborad the satellite is a scatterormeter SeaWinds instrument which can measure near surface wind speed and direction over the global oceans under all weather and cloud conditions. The QuikSCAT wind data, featuring a 25 km horizontal resolution and a 1800 km wide swath, amount to a total of more than 150,000 data points for every six-hourly synoptic cycle.

Since its launch, a considerable numbers of global data assimilation experiments have been conducted to test the impact of QuikSCAT wind data for possible implementation. On January 15, 2002, QuikSCAT wind data of one degree longitude-latitude superobs were finally implemented in the operational Global Data Assimilation System (GDAS) of the National Center for Environmental Prediction (NCEP). This paper discusses results of a pre-implementation test, and those of a more recent experiment using QuikSCAT wind data in NCEP numerical weather prediction systems.

2. PRE-IMPLEMENTATION TEST RESULTS

In pre-implementation testing with its operational resolution (75 km horizontally) data assimilation system, NCEP conducted a parallel 45 days of global data assimilation and forecast experiment, starting on the 0000 UTC cycle of September 27, 2001, and ending on the 0000 UTC cycle of November 10, 2001. In a +/- 3 hours window of a synoptic cycle, the total number of one-degree superobed resolution QuikSCAT wind data is about 10,000 with an effective resolution of about 100 km. This resolution is comparable to that of the currently operational GDAS at NCEP.

Based on time-series and average scores of 1000 mb and 500 mb anomaly correlations, and those of tropical wind RMS errors at 850 mb and 250 mb, from a total of 40 forecast cases of this parallel experiment, NCEP obtained a positive impact of QuikSCAT data from day 1 up to day 5 forecasts. The impact is most seen in the low level ocean surface 10 meter wind and sea level pressure forecasts. These positive impacts result from the development of refined quality control techniques which took more than a year to develop, test and implement.

The maximum impact of QuikSCAT data is on oceanic surface fields, the 10 meter wind and mean sea level pressure. Summary tables of QuikSCAT data impacts show 3-8% improvement in 24-96 hour forecasts of 10 meter wind in the midlatitudes (Table 1), 2-17% in midlatitude sea level pressure (Table 2), and 2-7% in tropical surface wind forecasts (Table 3). These improvements are consistently seen from the RMS errors of first guess (FG), and day 1 (F24) to day 5 forecasts (F120) in the mid-latitudes as well as in the tropics, when QuikSCAT wind data were used in the GDAS. It should be emphasized that surface winds are an important component for ocean forcing, wave generation and sea state conditions globally.

3. RECENT EXPERIMENT USING HIGHER RESOLUTION QUIKSCAT WINDS

Recently a parallel data assimilation experiment was conducted for a 35 days period using a half-degree longitude-latitude superobed QuikSCAT wind data in the NCEP operational GDAS. The main purpose for this experiment is that NCEP is implementing a new higher resolution GDAS with a forecast model of about 50 km horizontal resolution in the fall of 2002, and this new GDAS should be capable of using “mesoscale” features contained in the higher resolution QuikSCAT wind data.

The assimilation experiment was initiated on 0000 UTC cycle of June 12, 2002, and ended on 0000 UTC cycle of July 17, 2002 for a total of 35 days. In a +/- 3 hours window of a synoptic cycle, the total umber of half-degree superobed resolution QuikSCAT wind data is about 40,000 with an effective resolution of about 50 km. This resolution is again quite compatible with that of the new high resolution GDAS soon to be implemented operationally at NCEP.

Results of this experiment show that use of half-degree superobed QuikSCAT winds leads to a small improvement in both Northern and Southern Hemisphere geopotential height forecasts, but a very large improvement in the tropics wind forecasts, when

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compared to results from the use of currently operational one-degree superobed resolution of QuikSCAT wind data in GDAS. The improvements are seen in both the zonal and meridional wind components from day 3 to day 5 forecasts, with the most significantly large improvement being in the meridional component of the tropical winds (Fig. 1).

Table 1. RMS vector wind forecast errors (m/sec) with reference to mid-latitude deep ocean buoys for the forecast period from October 2, 2001 to November 10, 2001, based on 40 forecasts from a 45 days of GDAS (T170, L42) experiment.

Forecast Hours	No. of Buoys	OPNL (w/o)	QSCAT (With)
FG	1487	3.10	3.08
F24	1479	3.94	3.63
F48	1480	4.44	4.29
F72	1477	5.46	5.08
F96	1449	6.16	5.99
F120	1450	6.96	6.94

Table 2. RMS mean sea level pressures forecast errors (mb) with reference to mid-latitude deep ocean buoys for the forecast period from October 2, 2001 to November 10, 2001, based on 40 forecasts from a 45 days of GDAS (T170,L42) experiment.

Forecast Hours	No. of Buoys	OPNL (w/o)	QSCAT (With)
FG	1830	1.15	1.13
F24	1816	1.91	1.59
F48	1821	2.43	2.19
F72	1818	3.07	2.87
F96	1800	3.71	3.63
F120	1763	4.18	4.18

Table 3. RMS vector wind forecast errors (m/sec) with reference to TOGA deep ocean buoys for the forecast period from October 2, 2001 to November 10, 2001, based on 40 forecasts from a 45 days of GDAS (T170, L42) experiment.

Forecast Hours	No. of Buoys	OPNL (w/o)	QSCAT (With)
FG	510	3.04	3.02
F24	494	3.35	3.26
F48	492	3.81	3.55
F72	493	4.37	4.15
F96	483	4.58	4.61
F120	489	5.33	5.22

4. SUMMARY AND FUTURE PLANS

This paper summaries results of a pre-implementation impact test as well as those of the most recent experiment using QuikSCAT wind data in the NCEP global data assimilation systems.

Results from the pre-implementation test shows that use of one-degree longitude-latitude superobed QuikSCAT wind data (at 100 km resolution) improves NCEP short range weather forecasts, with the maximum impact being on the wind and pressure fields near the ocean surface. Results from the most recent experiment with the use of half- degree longitude-latitude superobed (at a 50 km resolution) QuikSCAT wind data in the currently operational GDAS show that the impact of the data is more positive and further enhanced,with the maximum improvement being in the tropical wind forecasts.

One of the very important issues concerning the operational use of QuikSCAT wind data in NCEP GDAS is that QuikSCAT winds suffer from a serious rain contamination problem. To improve the effective use of the data, the quality control aspect of the QuikSCAT winds has to be further investigated. NCEP is implementing a high resolution GDAS in the fall 2002, and this new system is capable of resolving mesoscale features of QuikSCAT wind data. Future work plans call for new data assimilation experiments to test new quality control procedures using higher resolution QuikSCAT winds in the new NCEP GDAS.

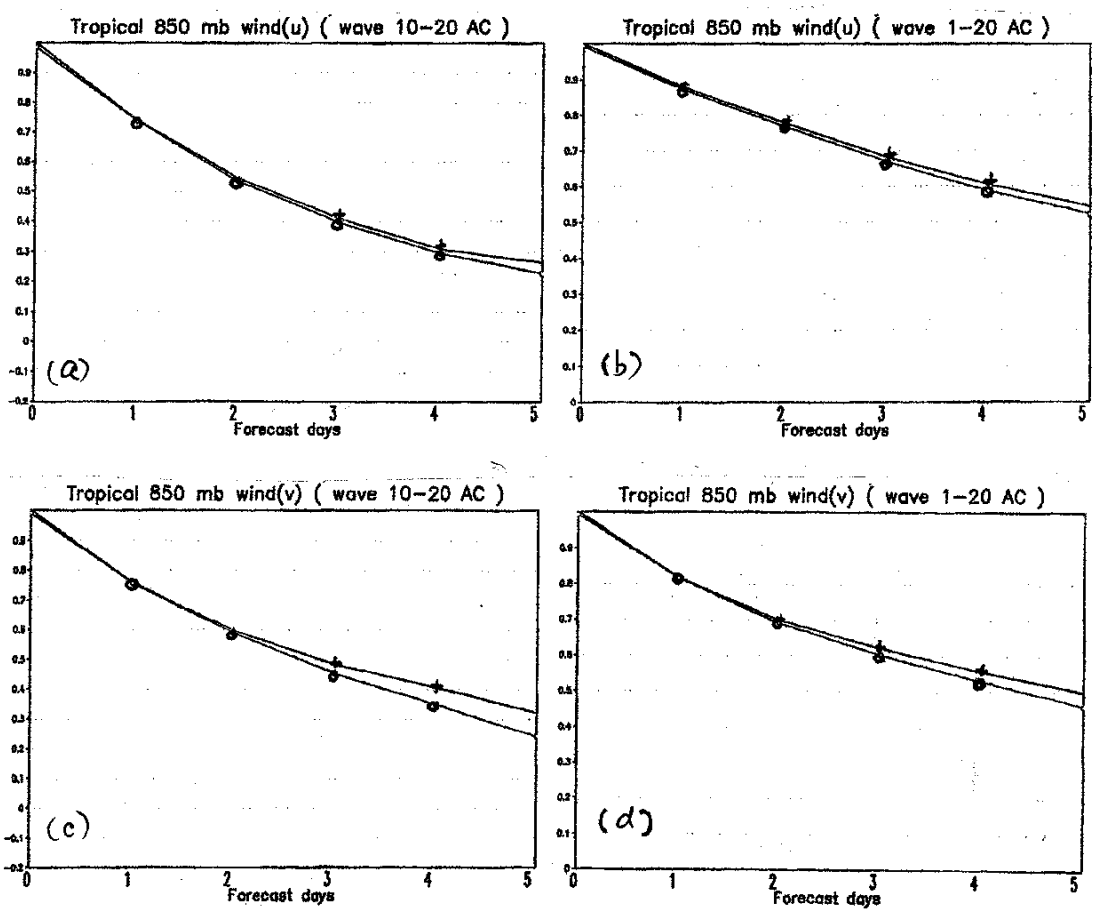

Fig.1 Mean anomaly correlations calculated for (a) zonal wind of waves 10-20, (b) zonal wind of waves 1-20, (c) meridional wind of waves 10-20, and (d) meridional wind of waves 1-20, from 00 UTC June 18, 2002 to 00 UTC, 17 July, 2002 at tropical region. —— o ——Operational Run; ——— + ——— Parallel Run