MULTIVARIATE ASSIMILATION OF SEA LEVEL, SST, AND CURRENTS FOR THE TROPICAL PACIFIC

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INTRODUCTION

Over the past number of years, observations have been made in the field of ocean data assimilation. New data types such as those provided by the extended altimetry missions (T/P, Geosat, and Envisat) provide ocean scientists with much higher quality data to allow data assimilation on basin-wide scales. In the current study, a Regional Ocean Modeling System (ROMS) approach is used to assimilate various data types into a general circulation model of the tropical Pacific Ocean. The ocean model is a single-column, single-temperature model that uses observed temperature and currents. Assimilation experiments are conducted with and without bias correction. In all experiments, SL, SST, and U+V are assimilated individual and combined. The assimilation methodology is based on assimilation of the ocean surface height (SL) from TOPEX/Poseidon altimetry and sea surface temperature (SST) from various satellite and in situ observations. In addition, this study incorporates surface current (U+V) derived from SL and SST assimilation. Compared to previous research using the same methodology (Cotton et al., 1999), assimilation results are evaluated using RMS data of observed quantities (SST, TOPEX/Poseidon, and U+V) and model variables. The impact of single- and multivariate assimilation is evaluated to determine if significant improvements are achieved.

RMS Expressions

The root mean square error (RMSE) and bias error (Bias) are calculated from the model to allow the assimilation. Assimilation experiments with and without bias correction are used in the analysis. The bias error is calculated as the difference between the observed and simulated data. The RMSE is calculated as the square root of the average of the squared differences between the observed and simulated data. Bias is calculated as the difference between the observed and simulated data. The RMSE is calculated as the square root of the average of the squared differences between the observed and simulated data.

Model Description

The model is an extended altimetry model (Cotton and Chen 1996) with bias correction (Cotton et al., 1999). The model is a single-column, single-temperature model that uses observed temperature and currents. Assimilation experiments are conducted with and without bias correction. In all experiments, SL, SST, and U+V are assimilated individual and combined. The assimilation methodology is based on assimilation of the ocean surface height (SL) from TOPEX/Poseidon altimetry and sea surface temperature (SST) from various satellite and in situ observations. In addition, this study incorporates surface current (U+V) derived from SL and SST assimilation. Compared to previous research using the same methodology (Cotton et al., 1999), assimilation results are evaluated using RMS data of observed quantities (SST, TOPEX/Poseidon, and U+V) and model variables. The impact of single- and multivariate assimilation is evaluated to determine if significant improvements are achieved.

SUMMARY

Negative, but significant, differences between observed SL and SST (a) in the eastern Pacific, SPC and NCC regions are not reproduced by the model (b). This leads to an unrealistic model performance over the tropical Pacific Ocean. However, the assimilation of SST (c) degrades the results significantly. The assimilation of both SL (b) and especially U+V (d) improves simulation of zonal currents. Assimilation of SST (c) degrades results significantly. The assimilation of both SL (b) and especially U+V (d) improves simulation of zonal currents. Assimilation of SST (c) degrades results significantly.

Conclusions

• Assimilation experiments show that the direct application of the technique is expected to improve model results. However, assimilation of SST degrades the simulation.

• Assimilation of SST and U+V improves the model results, whereas assimilation of SL degrades the simulation.

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