GODAE Symposium on ocean data assimilation and prediction in Asia-Oceania, 16-18 October 2006, Beijing, China

Japan Coastal Ocean Predictability Experiment: Comprehensive Application of Ocean Forecasting

Yasumasa Miyazawa[1] Takashi Kagimoto[1] Xinyu Guo[1,2] Takuji Waseda[1,3] Kosei Komatsu[4]

[1] FRCGC-JAMSTEC [2] Ehime University [3] The University of Tokyo [4] NRIFS-FRA

Introduction

For better understanding of the Kuroshio variability and its predictability south of Japan, an eddy resolving ocean forecast system has been developed during the past few years, as a part of Japan Coastal Ocean Predictability Experiment (JCOPE) (Kagimoto et al., 2006). The JCOPE model component with 1/12 ° horizontal grid and 45 vertical levels is based on the Princeton Ocean Model. Most of available data (observed sea surface height anomaly, sea surface temperature and in-situ subsurface temperature/salinity) are assimilated into the model by using multi variate optimum interpolation. The JCOPE system has a forecasting skill of the Kuroshio path south of Japan for 1-2 months. In particular, the system has successfully predicted both the formation and decay of the Kuroshio large meander during the period from 2004 to 2005 (Fig.1).

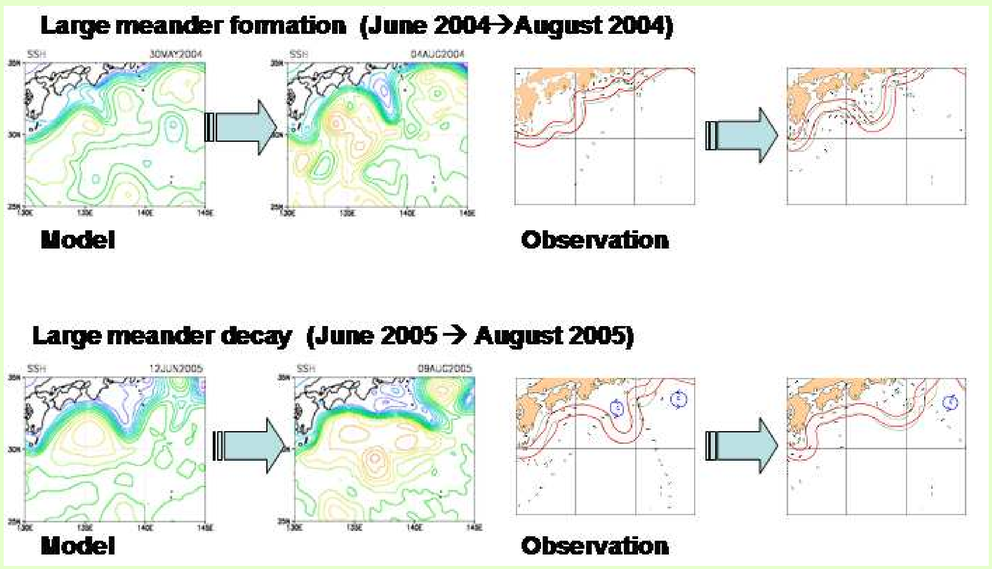

Fig.1 Comparison of the model snapshots and the observation by the Japan Coast Guard.

Forecast skill

We have validated the model products using many data sources including remote sensing data and in-situ data. For example, we compared the northern edge of the surface Kuroshio front, which is one of representations of the Kuroshio path, ,estimated from the model with that estimated from the high resolution sea surface temperature created by merging satellite-derived temperature data (NGSST) using the edge detection algorithm (Fig.2).

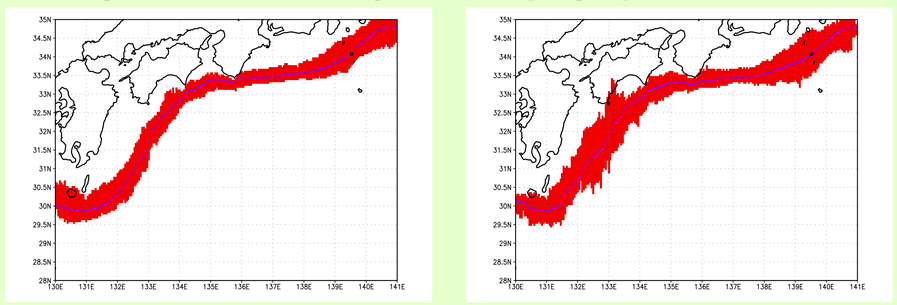

Fig.2 RMS errors of the Kuroshio northern edge positions for the NGSST(Feb.2003-Aug.2004). Left: Nowcast. Right: 2 months forecast.

Downscaling

The JCOPE system provides the lateral boundary conditions for regional modeling use. Okhotsk Sea and Okinawa models have been nested in the JCOPE model through cooperative studies with universities(Fig.3). We are now developing Tokyo bay, Sagami bay, and Suruga bay model with 1km grid(Fig.4).

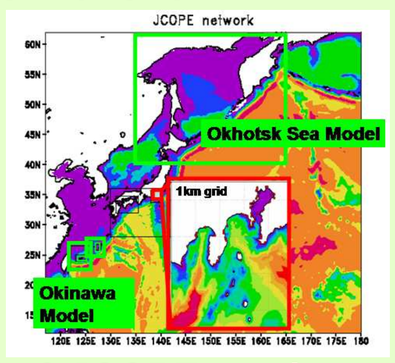

Fig.3 JCOPE nesting system.

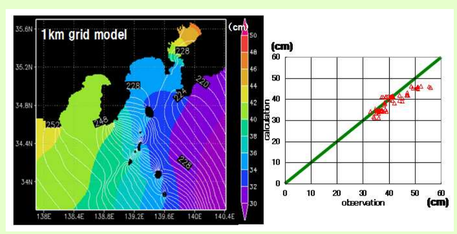

Fig.4 Harmonic analysis of M2 tidal simulation (left) and comparison of M2 amplitude between model and observation (right).

Inclusion of in-situ data obtained by fishery agencies

Cooperative study with the Fishery Research Agency, FRA-JCOPE, enabled us to incorporate large amount of in-situ data obtained by fishery agencies into the JCOPE system. A 3DVAR method is adopted to investigate impacts of in-situ temperature/salinity data on nowcasting oceanic conditions in the Kuroshio-Oyashio mixed water region, which has dense observation network owing to continuous efforts of various marine agencies for maintenance and strengthening (Fig.5). We compared the nowcast skill with and without the fishery research agencies data (FR-DATA), which has not been included in the original GTSPP archive. It is found that the inclusion of FR-DATA allows to represent detailed structure of water mass in the mixed water region (Fig.6).

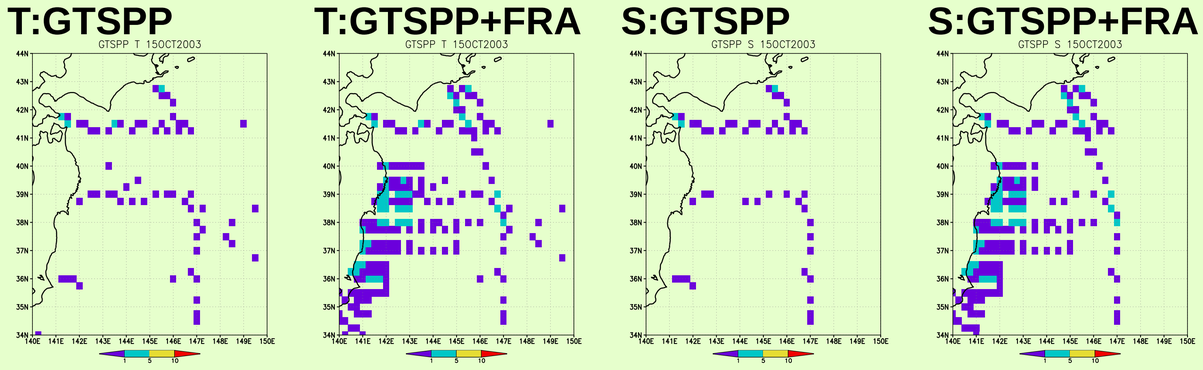

Fig.5 Data distributions of in-situ temperature/salinity profiles in Oct. 2003.

Fig.6 Analyses of temperature/salinity at 100m depth on 15 Oct. 2003 with 1/4° grid estimated by 3DVAR.

Wave current interaction

The interaction between ocean currents and wind waves is an important research subject for the safety of ocean routings. In order to pursue this direction of research, we started a new project called WAVE-JCOPE to develop a realistic high-resolution current and wind-wave coupled model covering a portion of the Kuroshio region south of Japan . Preliminary experimentsxs suggest that the effect of wave-current interaction is significant in the Kuroshio region, so the accurate information on the current field is essential for the high-resolution wave forecast (Fig.7).

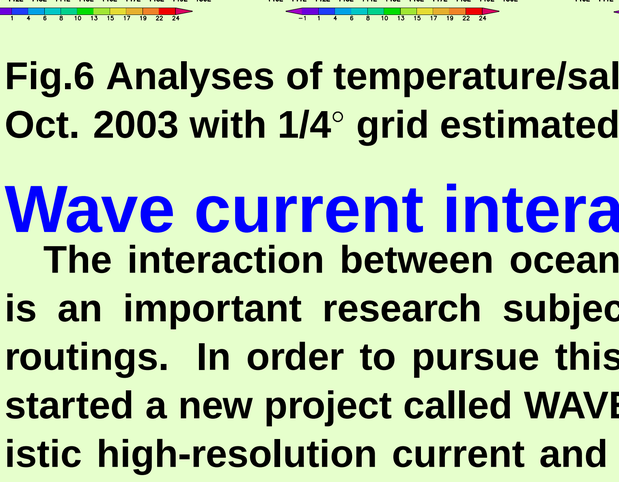

Fig.7 Significant wave height averaged in October 2004, calculated by a wind wave model, WAVE-WATCH III, with the JCOPE surface current. (b) Same as (a) except for without the JCOPE surface current. (a)-(b) Difference between (a) and (b).

References Kagimoto, T., Y. Miyazawa, X. Guo, and H. Kawajiri, 2006: High resolution Kuroshio forecast system -Description and its applications-, in High Resolution Numerical Modeling of the Atmosphere and Ocean, W. Ohfuchi and K. Hamilton (eds), Springer, New York,, in printing.