

Activities on coastal forecasts for using COMPIRA



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Introduction

Japan Aerospace Exploration Agency (JAXA) is working on a conceptual study of altimeter mission named Coastal and Ocean measurement Mission with Precise and Innovative Radar Altimeter (COMPIRA). A framework called "Coastal forecast core team" has started to aim at developing framework and system for coastal forecast through pre-launch activities toward COMPIRA. As one of the activities, several ocean data assimilation products and their multi-ensemble product were assessed by comparing with satellite and in-situ data.

Data and Method

Table 1 shows an overview of the several ocean data assimilation products we used. MOVE-WNP and JCOPE2 were provided based on the activities of "Coastal forecast core team" by JMA and JAMSTEC. HYCOM data was downloaded from HYCOM.org. Multi-model Ensemble (MME) product is created by a simple average with an equal weight.

Table 1. Model specification used for analysis.

Institute	Model	Area		Grid	Vertical levels	Time int.	Time
		NW	SE				
JMA	MOVE-WNP	65N	15N	1/10°	673×442×54	1 day	2011
JAMSTEC	JCOPE2	117E	160W				
		62.16N	10.5N	1/12°	866×620×46	1 day	2011
NRL	HYCOM	108.00E	180.01E				
		60.0N	20.0S	1/12°	626×501×40	1day	2011
		120.E	170.0E				

Comparison of Kuroshio Axis

Kuroshio that is the western boundary current of Subtropical gyre in North Pacific has a significant impact not only on **social activities**, such as fishery and ship routing, but also on **local weather**.

Marine Information Research Center (MIRC) routinely produces **Kuroshio Axis data** by comprehensively analyzing satellite-SST, SSH, and in-situ observations. Fig.1 shows example of Kuroshio axis detection on January 6, 2011. **Kuroshio axes (blue line)** are estimated from surface currents of the assimilated products based on Ambe et al. (2004) method. They are compared with **Kuroshio Axis data (red line)** produced by MIRC.

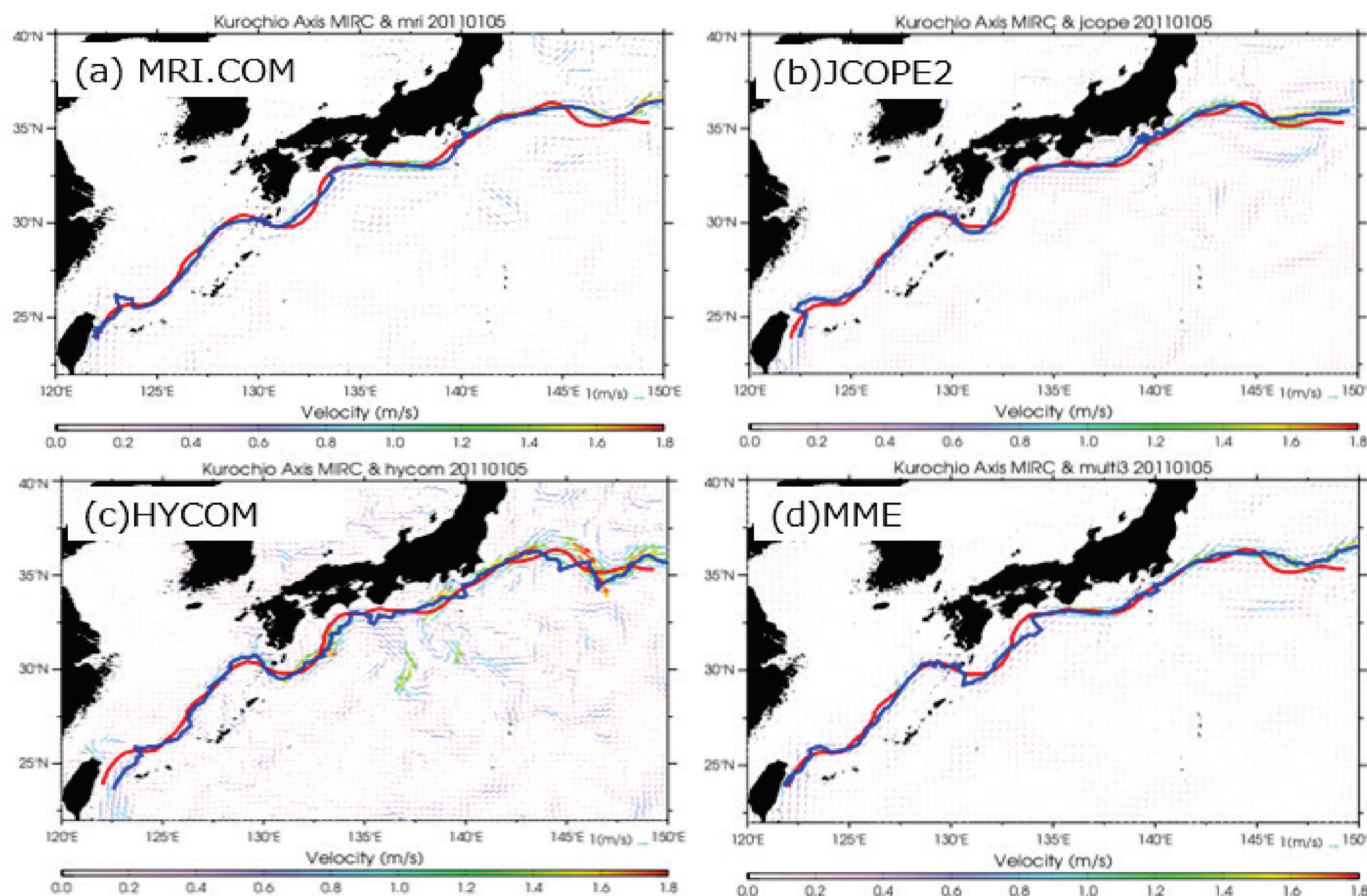


Fig. 1. Example of detection of the Kuroshio Axis on January 6, 2011.

The flow axis error was calculated as an index of evaluation. The Kuroshio axis error is defined as a value obtained as follows (Fig.2):

$$\text{Axis error} = \text{area surrounded by model and truth axis}/\text{axis length}$$

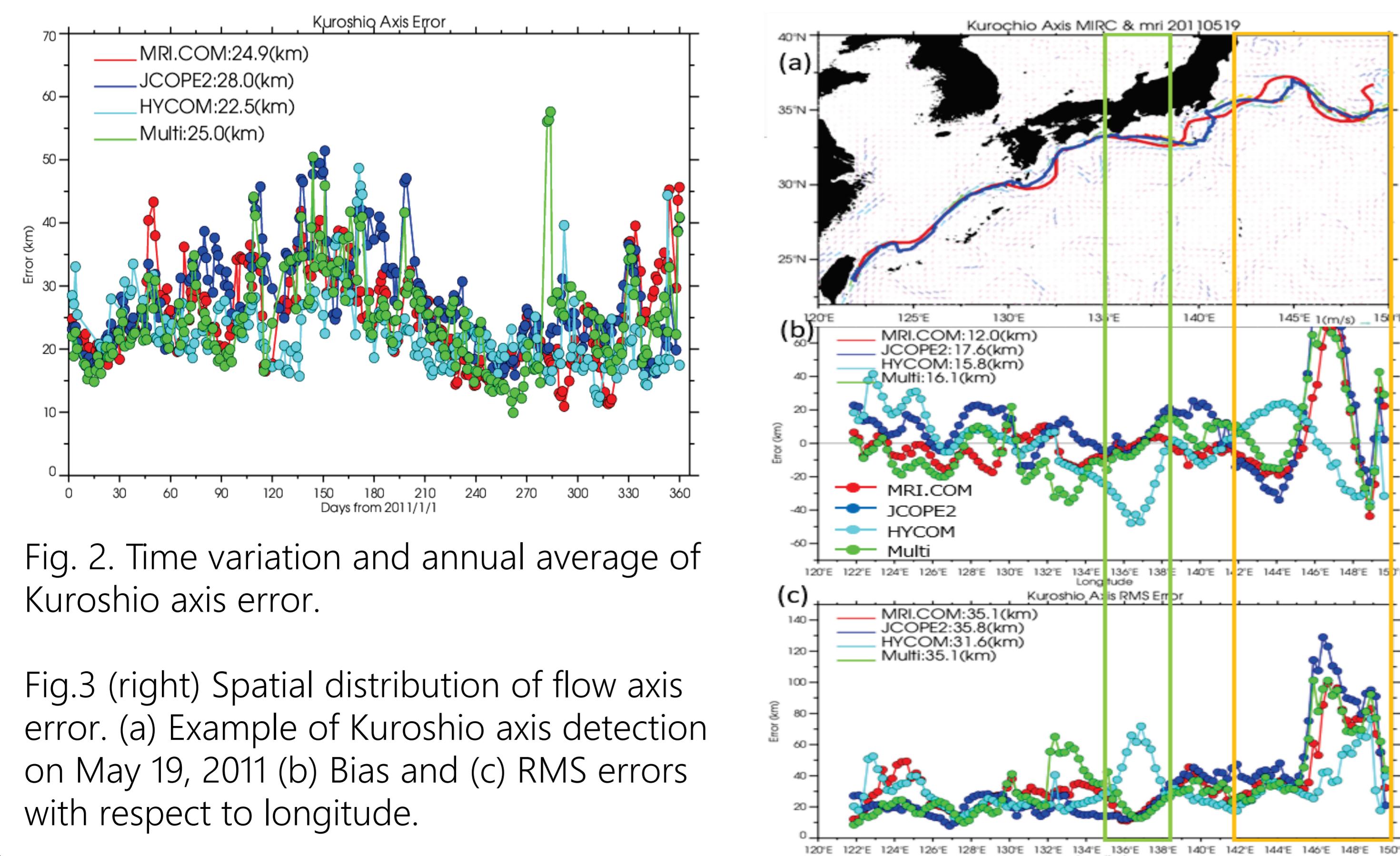


Fig. 2. Time variation and annual average of Kuroshio axis error.

Fig.3 (right) Spatial distribution of flow axis error. (a) Example of Kuroshio axis detection on May 19, 2011 (b) Bias and (c) RMS errors with respect to longitude.

We calculated mean value and standard deviation of flow axis error with respect to longitude (Fig.3). HYCOM has a smaller error than the other models in the Kuroshio Extension, shown in the orange frame, but tends to have a large error in off Kii Peninsula, shown in the green frame.

In order to investigate the systematic shift of the flow axis and the factor of the difference between models, comparison with altimeter-derived SSH was carried out (Fig.4). In MRI.COM and JCOPE, the bias is large between the first and second ridges of the quasi-steady meander of the Kuroshio Extension, and the RMS error is large downstream of the second ridge. On the other hand, HYCOM has a large bias in the first peak, but in the downstream, both the bias and the RMS error are smaller.

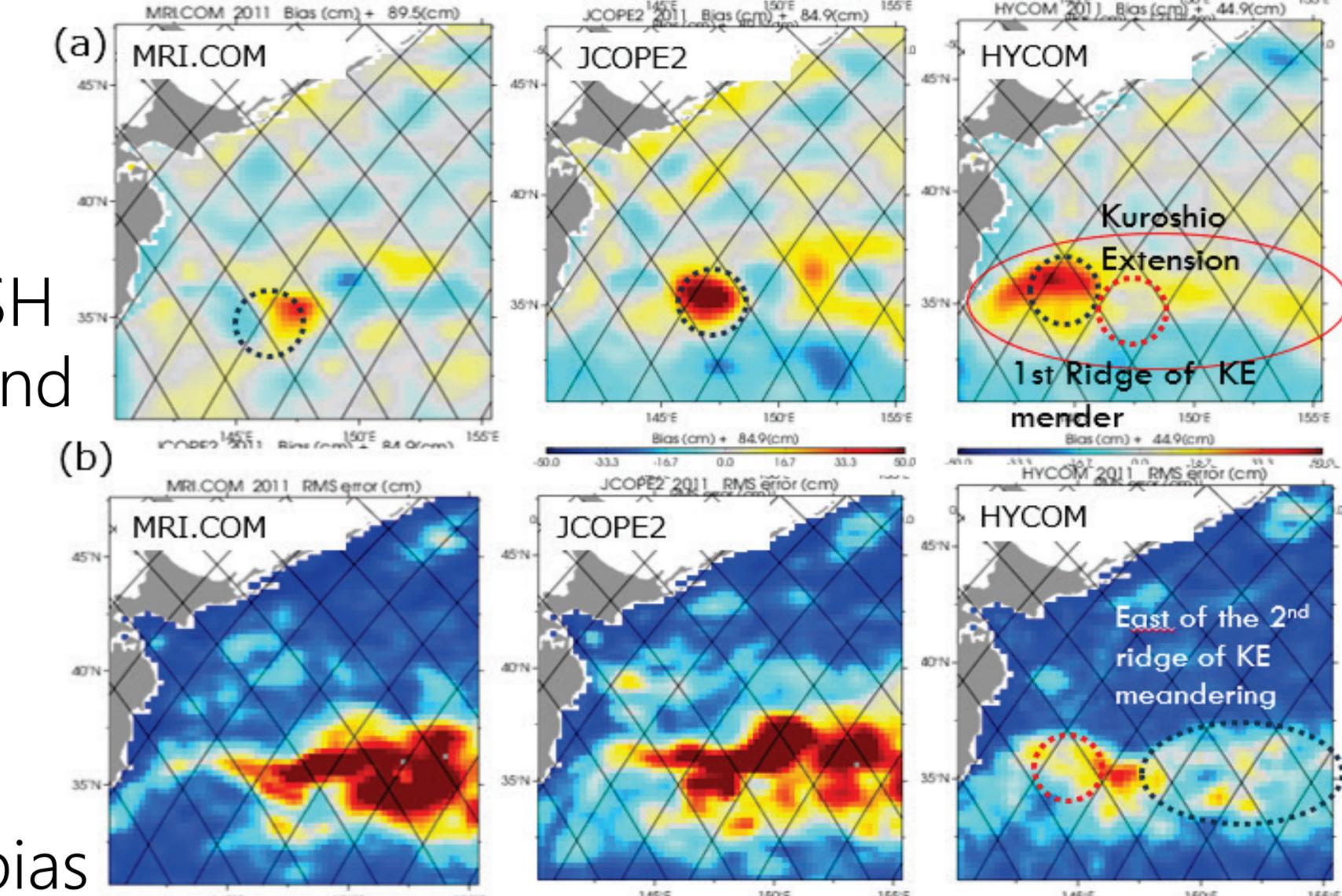


Fig. 4. Comparison of SSH with ocean model and altimeter in the Kuroshio Extension.

Comparison of mixed layer depth

Comparisons were made by calculating the mixed layer depth (MLD) from ARGO profiling float and ocean model. MLD was defined as the depth which is 0.5 °C lower than the sea surface water temperature.

Fig. 5 shows the detection results of MLD in February and August 2011, and Fig. 6 shows the spatial distribution of the difference between ocean model and the ARGO float.

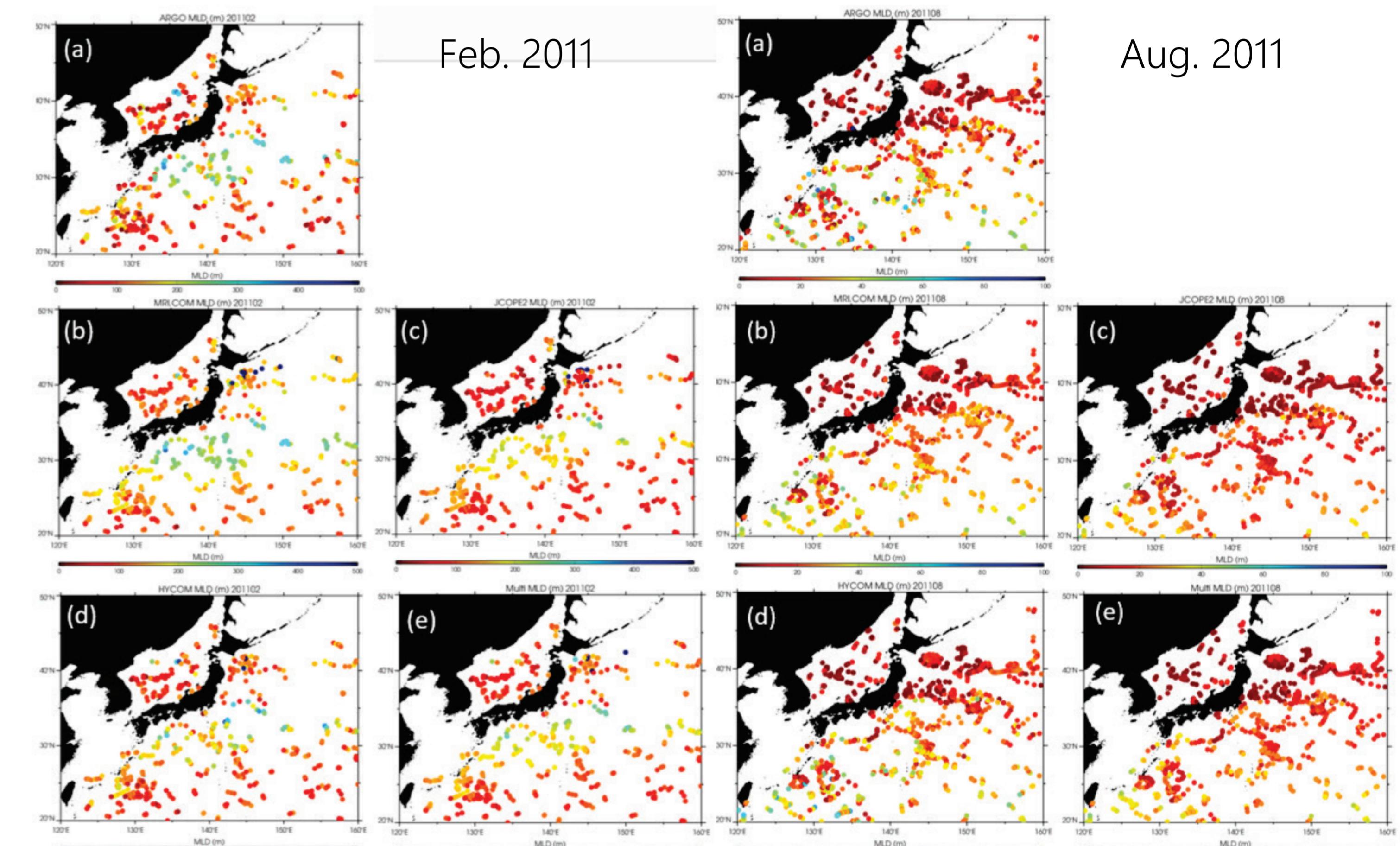


Fig. 5. Detection result of MLD in (left) February and (right) August 2011. The MLDs by (a) ARGO float, (b) MRI. COM, (c) JCOPE2, (d) HYCOM, (e) MME is shown.

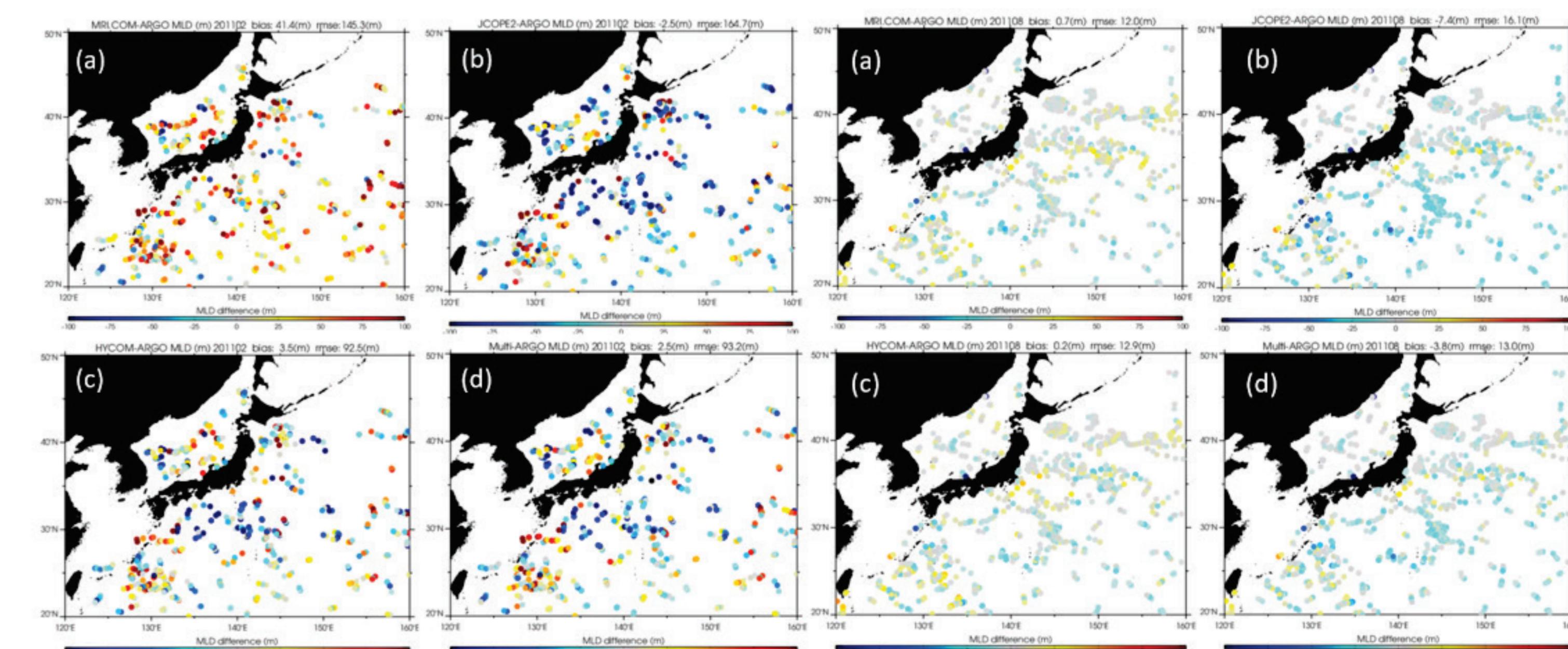


Fig. 6. Spatial distribution of the difference of MLD between ARGO float and the ocean models of (left) February and (right) August 2011. Those from (a) MRI.COM, (b) JCOPE2, (c) HYCOM, (d) MME are shown.

As a result of evaluation using MLD, a systematic tendency to be estimated shallow or deep appeared for each model.

Toward wide swath altimeters

The spatial resolution of the present assimilation products we used is NOT fine especially for submesoscale processes including coastal predictions.

The following items are required to be developed/prepared.

- ✓ a coastal model and an assimilation method for wide-swath SSH,
- ✓ infrastructures, such as bathymetry, atmospheric fields, and river runoff,
- ✓ in-situ observation systems applied for shallow waters, which are used for assimilation/validation.