

Monitoring system for Fisheries Research around Japan

**Fisheries Research Agency
National Research Institute of Fisheries Science
Takashi Setou**

Table of contents

■ Monitoring system by **J**apanese **F**isheries **I**nstitute

➤ History of the system

➤ Today's routine observations

- **J**apanese **F**isheries **I**nstitute (**JFI**) includes
 - 1) Fisheries Agency, 2) Fisheries Research Agency,
 - 3) **P**refectural Fisheries Institute ,and 4) National Fisheries University
- **J****P****F****I** means **J**apanese **P**refectural **F**isheries **I**nstitute.

■ Ocean forecast system – **FRA-JCOPE** --

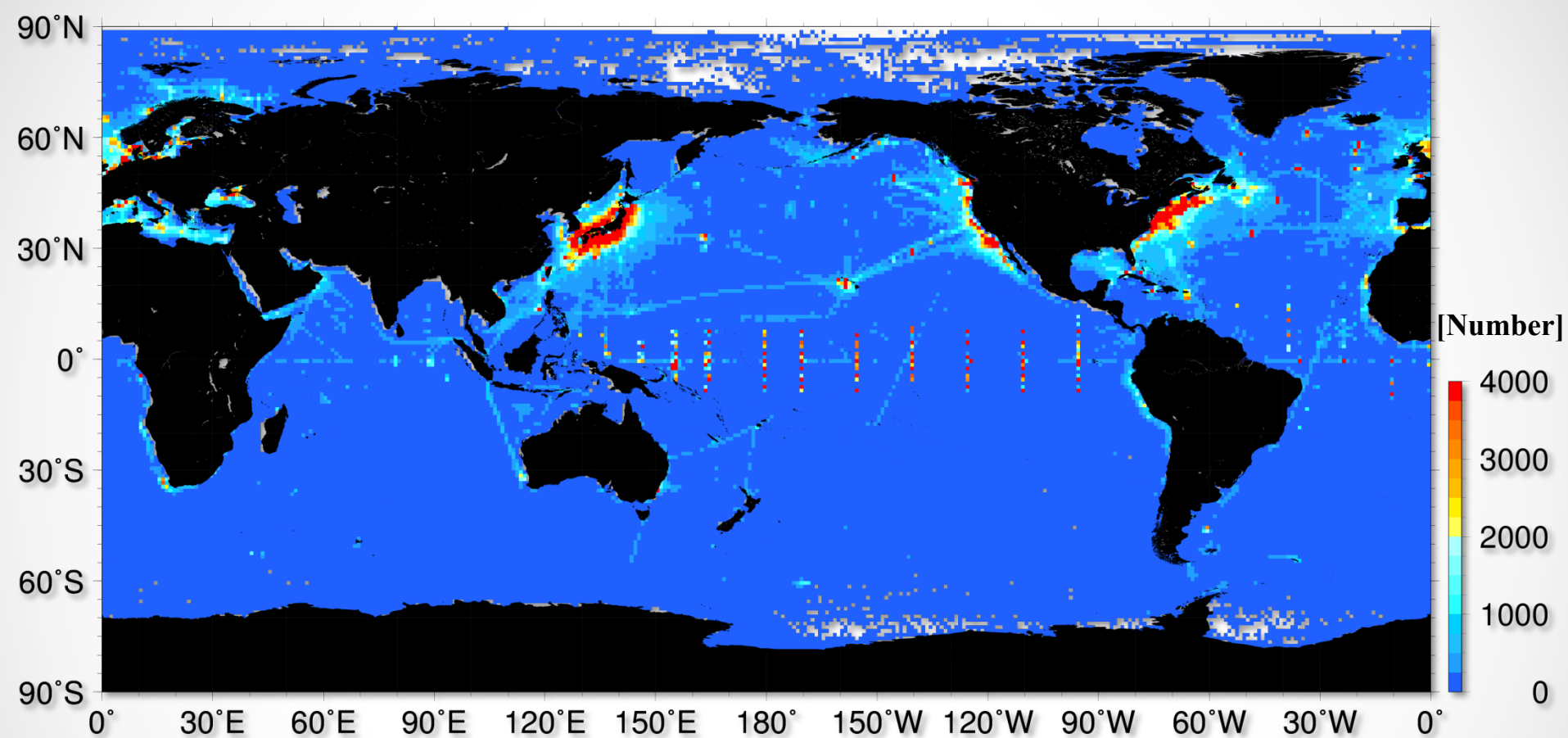
➤ The motivation of development of **FRA-JCOPE**

➤ The **J****P****F****I** data distribution system in near real time

➤ Two applications of **FRA-JCOPE**

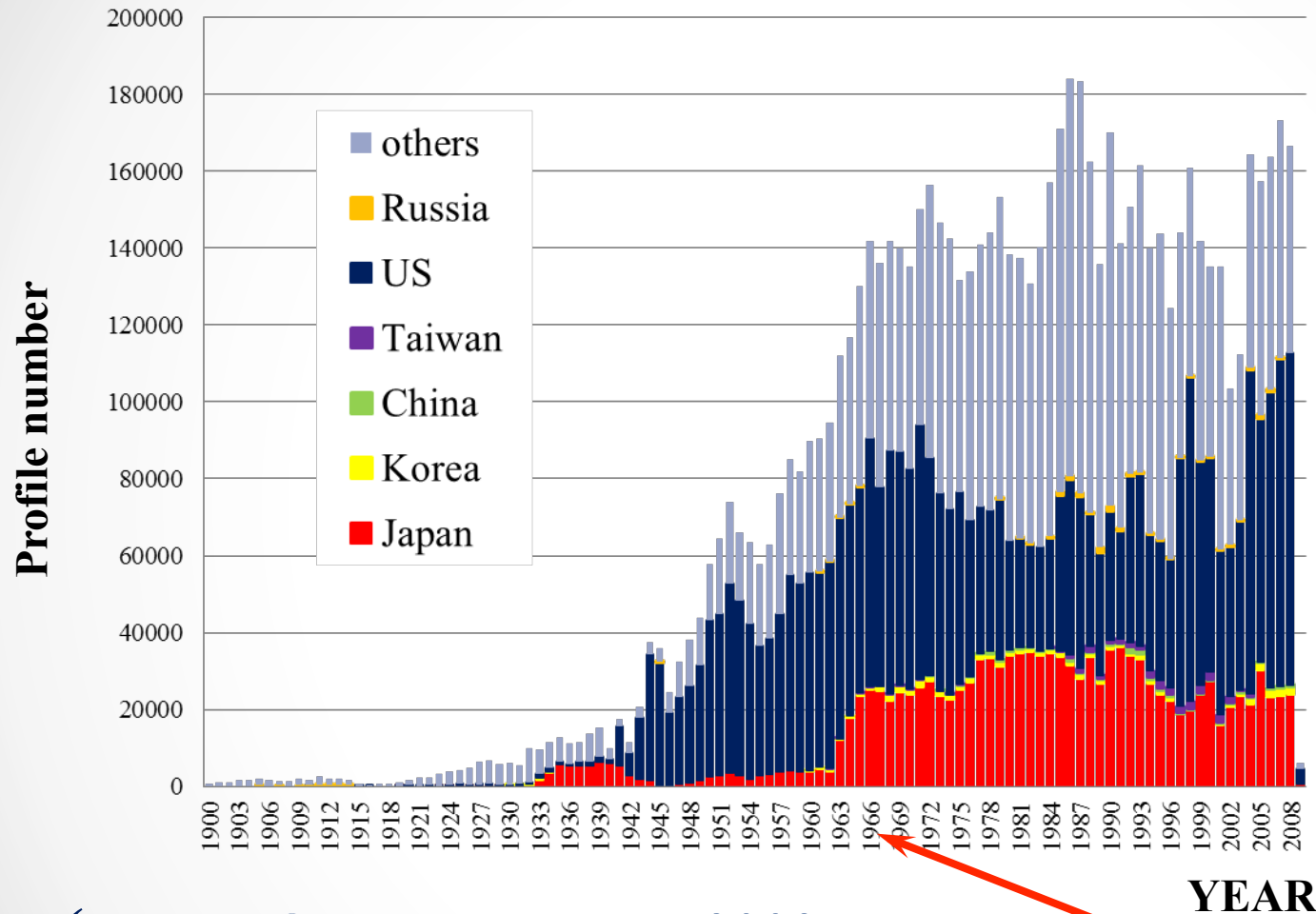
■ New monitoring system by **J**apanese **F**isheries **I**nstitute

Profile numbers from 1900 to 2009 - geophysical distribution



- ✓ World Ocean Data base 2009
- ✓ All type of data(OSD ,CTD, MBT,
- ✓ 1degree longitude by 1 degree latitude box

Profile numbers from 1900 to 2009 -- Time series --



- ✓ World Ocean Data base 2009
- ✓ All type of data(OSD ,CTD, MBT,)
- ✓ By Countrycode of WOD09

1963: Serious damage to Fishery due to Abnormal cooling around Japan.

Motivation of maintaining ocean monitoring by **J**apanese **F**isheries **I**nstitute.

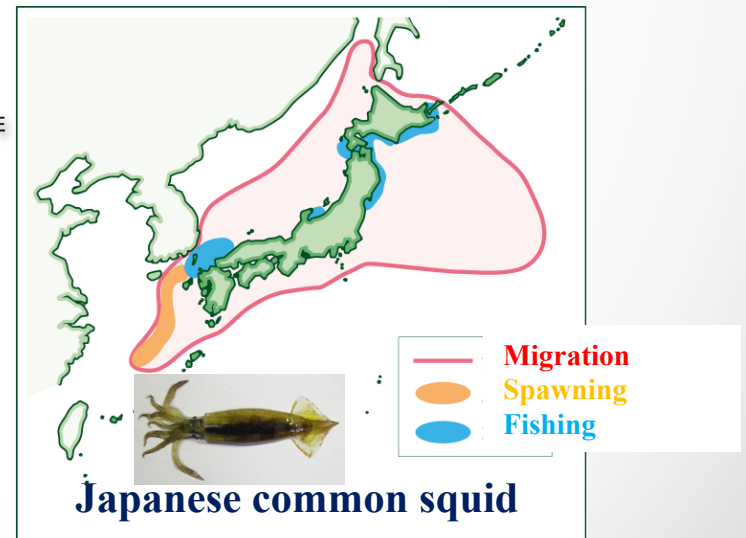
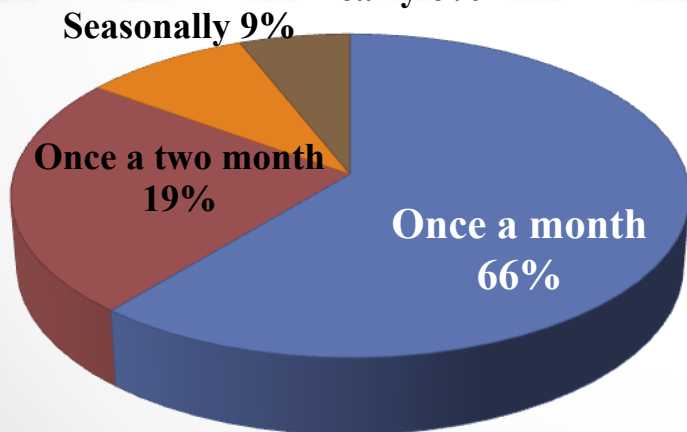
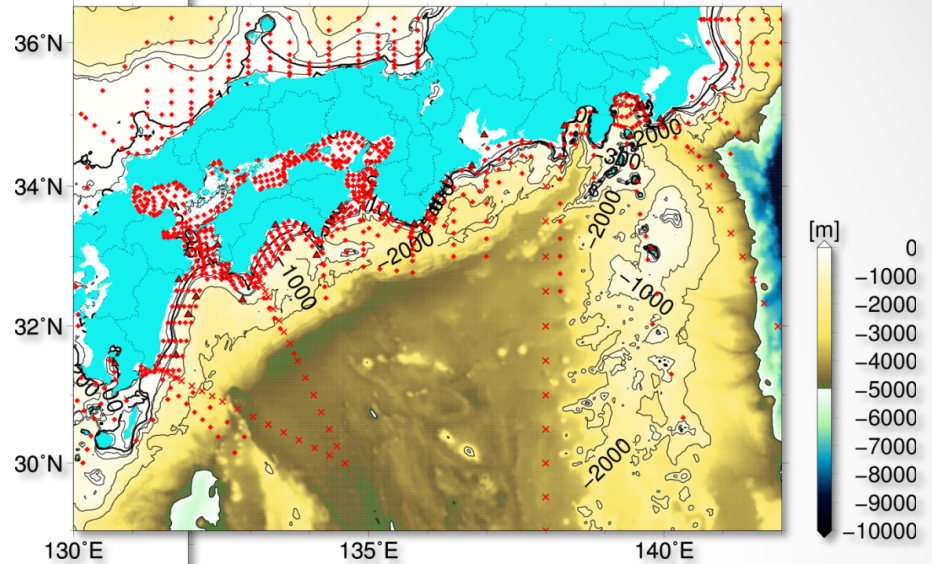
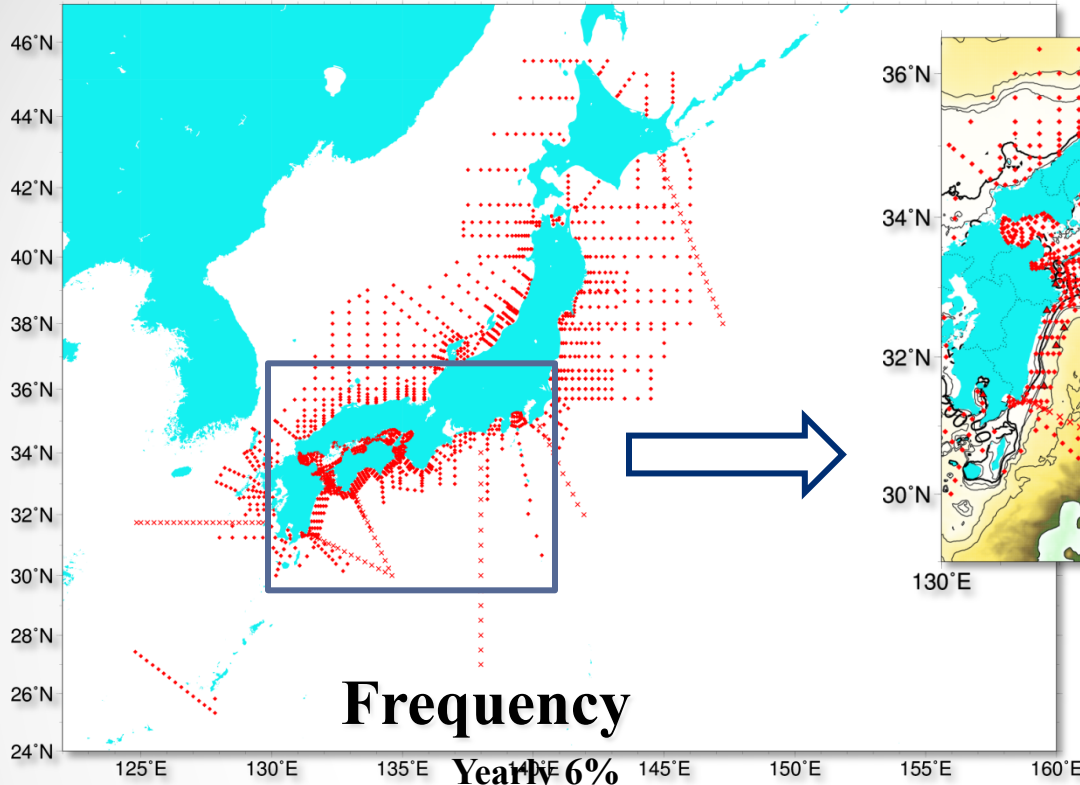


Civil Servants in Ministry of
Agricultural and Commerce
in Japan about 1910

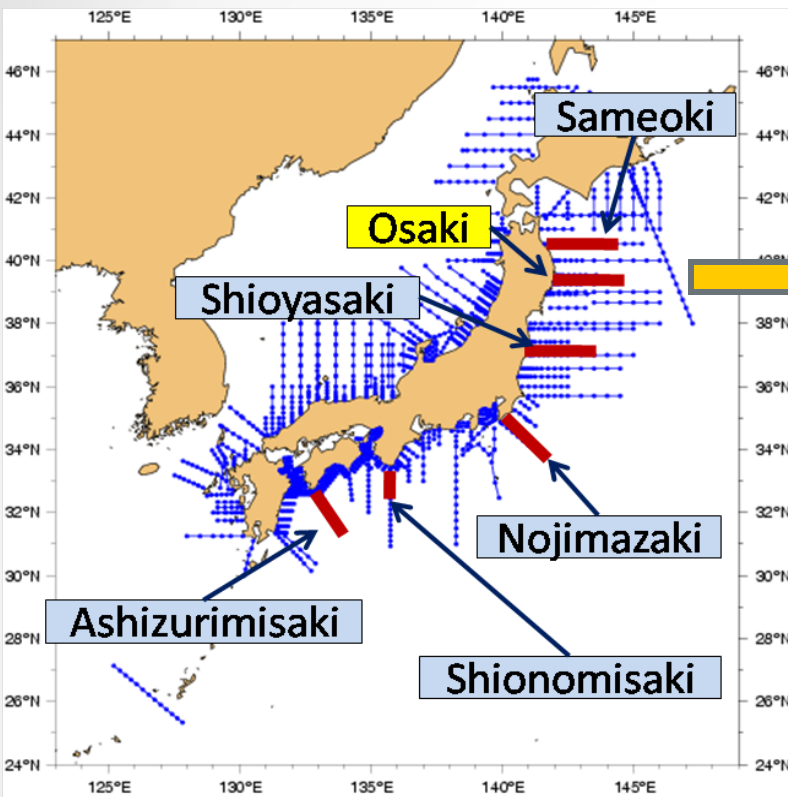
For sound development
of Fishery, we need to
clarify some relationship
between ocean and Fish.
For the purpose, we have
to maintain to observe
and investigate ecology,
fishing condition, and
some ocean condition.

About 100year history!!

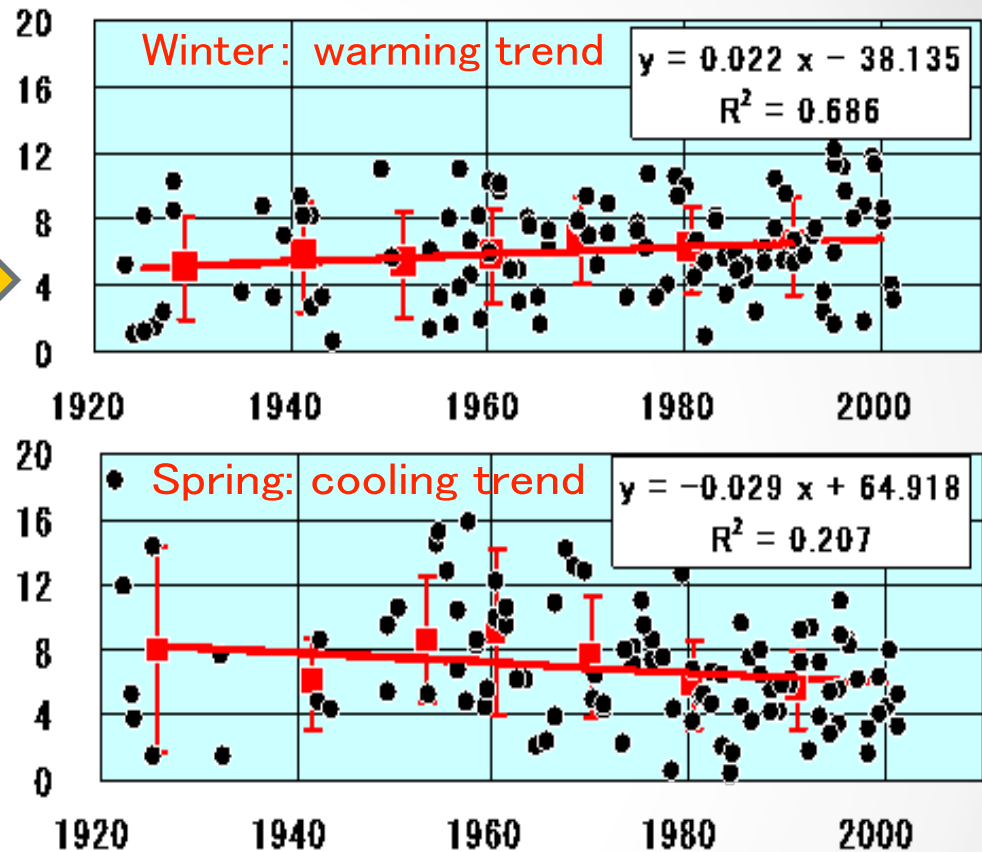
Today's routine observations by Japanese Fisheries Institutes



Other utilization of monitoring data



Observation lines where the long term time series are available.



Temperature trends at 100m at offshore point on Osaki-line in the Sanriku-area. The observation was done by the Iwate prefectural fisheries institute. Warming is observed in winter and cooling is observed in spring.

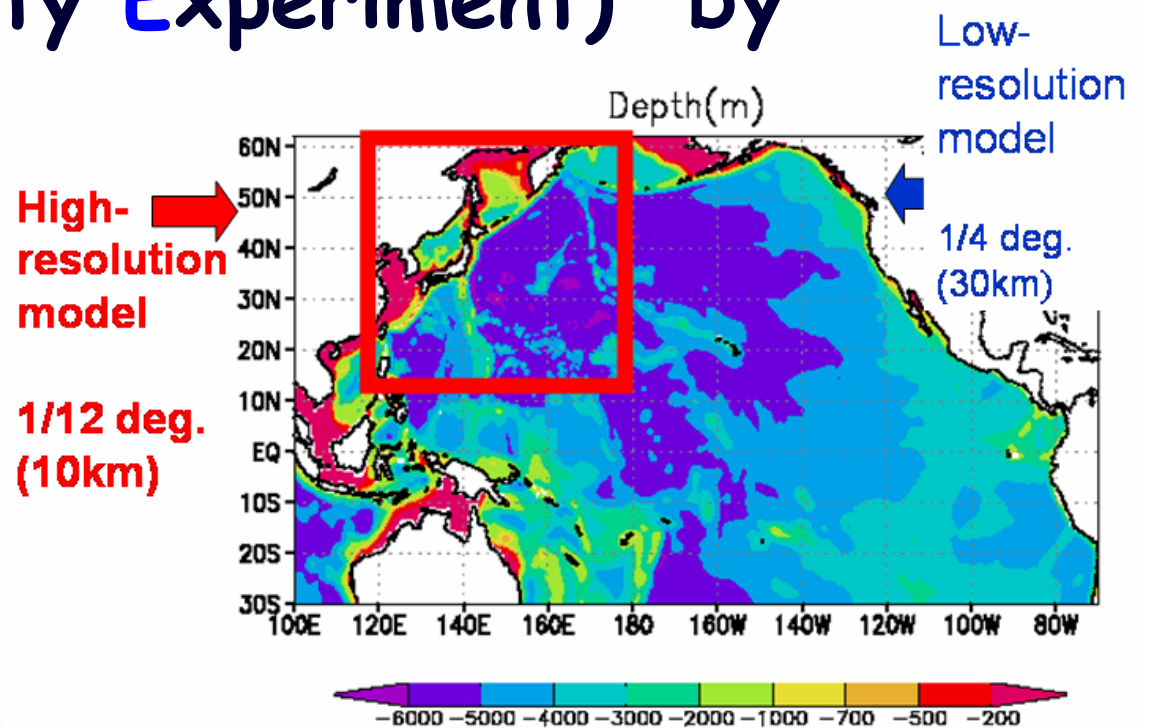
Summary of Monitoring system by Japanese Fisheries Institute

- Japanese waters are highly observed region.
- The routine observation network maintained by Japanese fisheries institutes has about 100 years history.
- In-situ observation by Japanese Prefectural fisheries institutes are carried out high frequency and densely.

Ocean forecast system

FRA-JCOPE from 2007

- FRA: Fisheries Research Agency
- JCOPE(Japan Coastal Ocean predictability Experiment) by JAMSTEC



Motivation of the development of FRA-JCOPE

- To improve the forecast predictability of Kuroshio current.
- To develop some application such as forecasting the migration of the giant jelly fish.
- • • • • •

For operating the ocean forecast system, many near real time data should be needed. But, until April of 2007 many of Prefectural NRT data were not distributed.

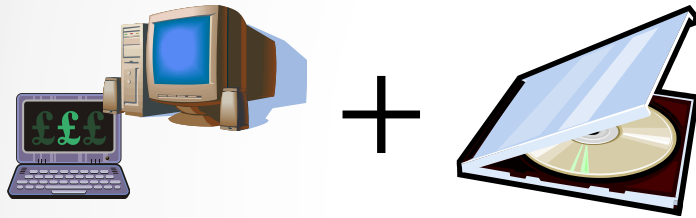
At the moment we begun to develop the **FRA-JCOPE** system, we started to develop the distribution system of Monitoring data for Prefectural Fisheries Institute in NRT (**FRA-uploader**).

Notice:

FRA-JCOPE: ocean forecast system

- **FRA-uploader:** monitoring data distribution system

Development of data distribution system: FRA-uploader



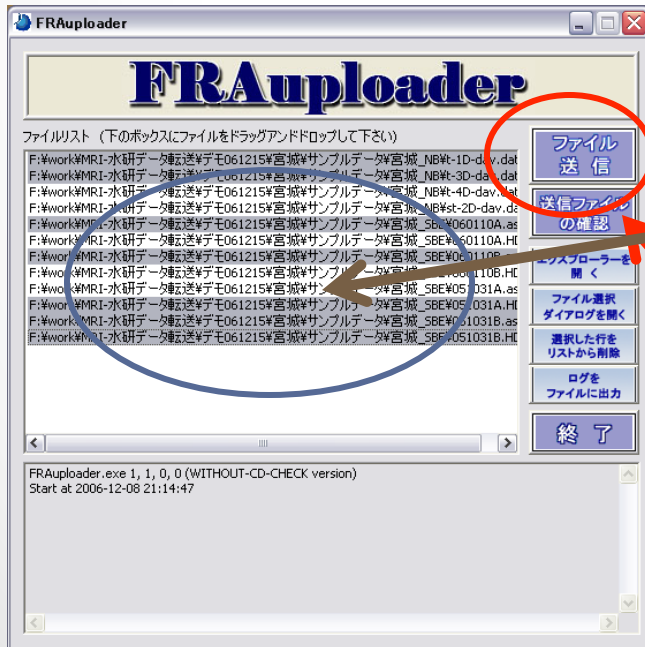
After Prefectural fisheries researchers get off R/V,

1. Set the FRA-uploader CD-R and execute FRA-uploader.

2. Set the digital data of observation data.

3. Select CTD data files and drag it to the box of FRA-uploader.

4. Push the sending button and the data send to FRA-JCOPE and GTS via internet.



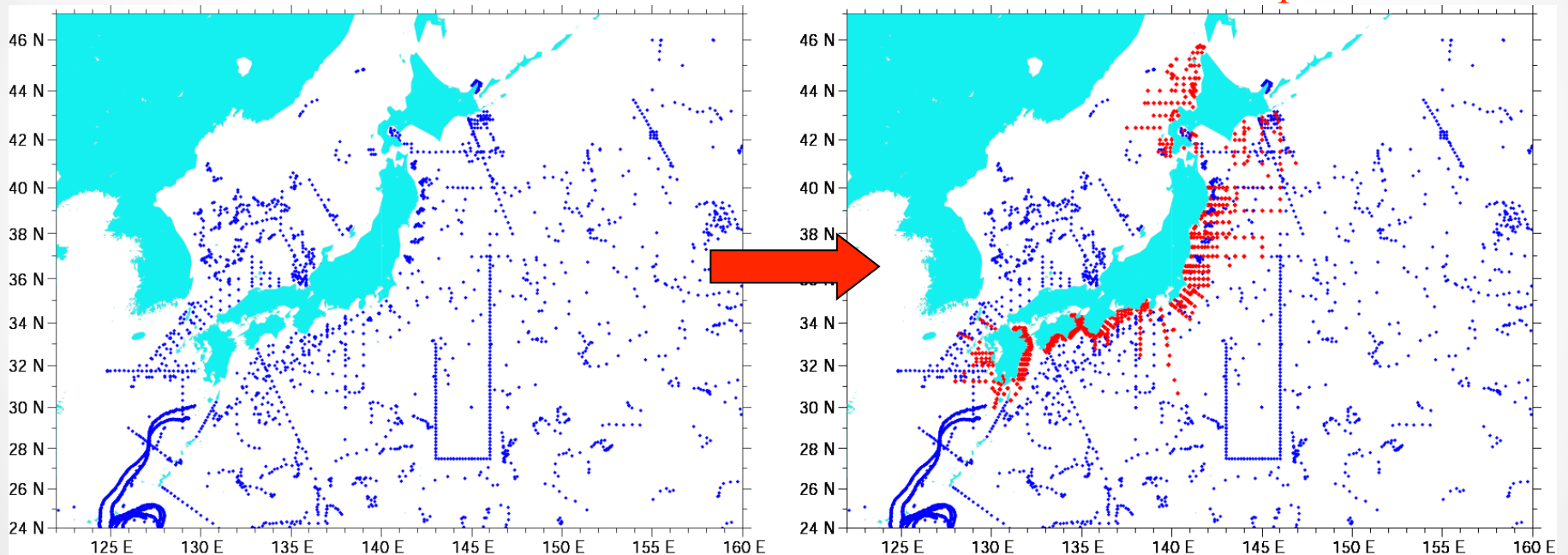
Only a few steps !!

Effect on introduction of FRA-uploader

Real Time GTSP data 2008.Aug-Sep

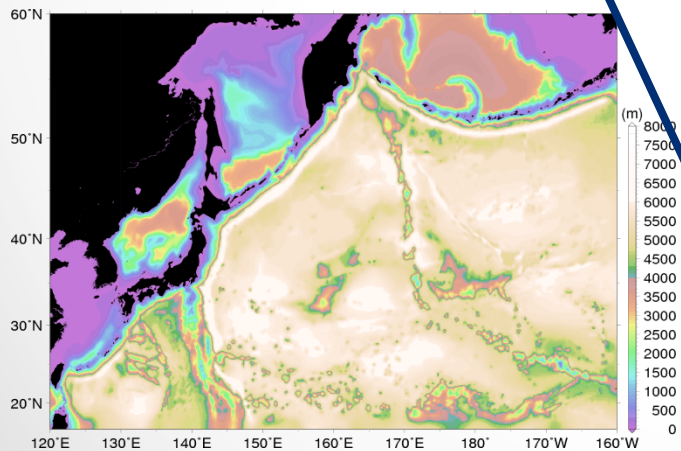
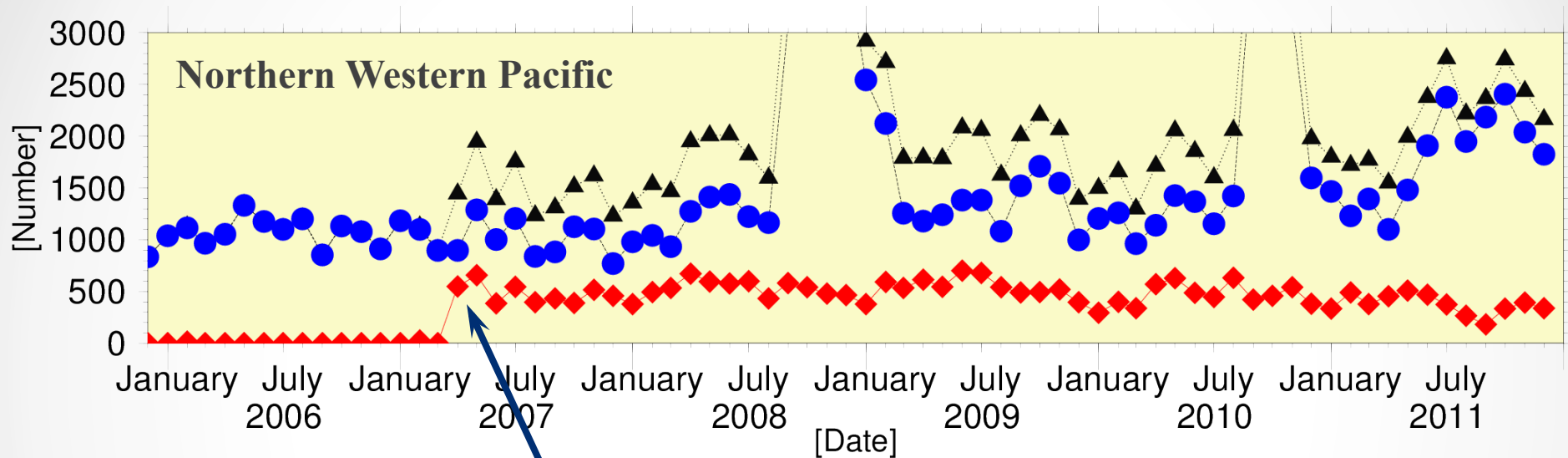
● GTSPP without Japanese
Prefectural Fisheries Institute

● + ◆ Prefectural Research
Institute via FRA-uploader



Contribution of **JPMI** and FRA-uploader to GTS

Real Time GTSPP data

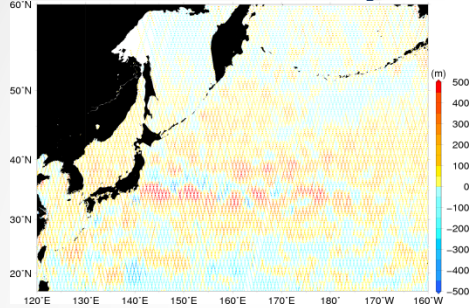


- ▲: Real Time GTSPP
- ◆: JF Prefectural inst. in ▲
- : ▲ — ◆

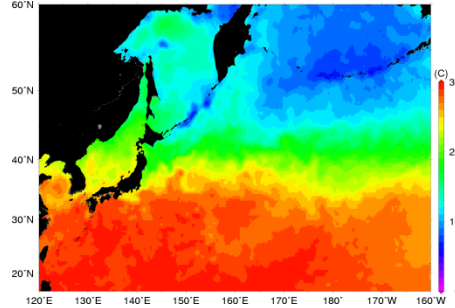
Start of Prefectural data Input by FRA-uploader !!

Description of the FRA-JCOPE system: Flow (1-cycle=1-week)

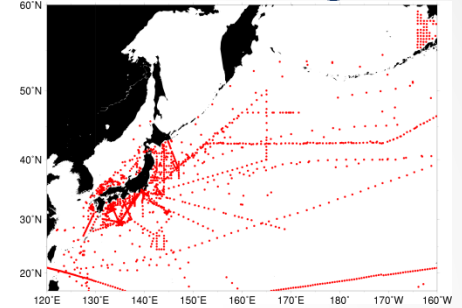
SSH anomaly



SST



In situ Temp. Sali.



x^o : observation

x^a : Analysis

x^b : Numerical model

3D-var assimilation

$S \leftarrow Z$

$S \rightarrow Z$

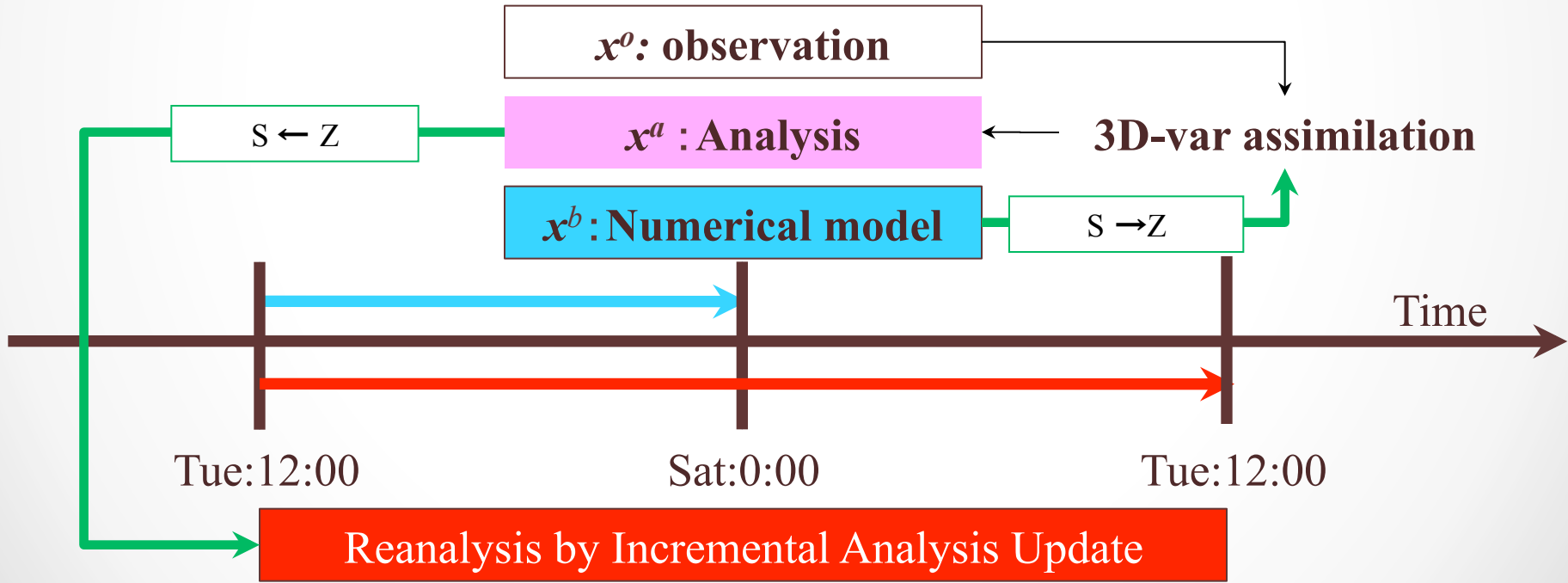
Tue:12:00

Sat:0:00

Tue:12:00

Time

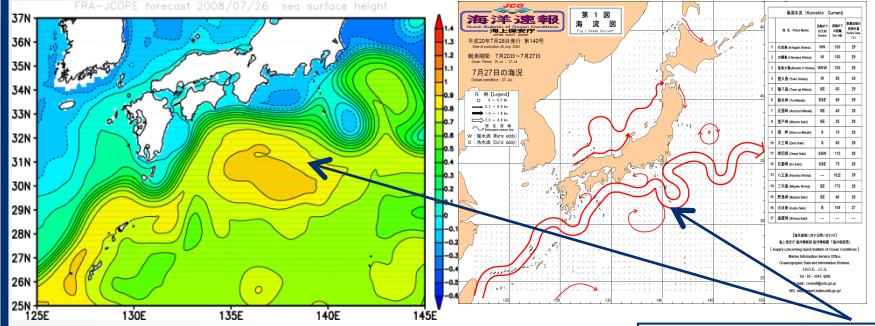
Reanalysis by Incremental Analysis Update



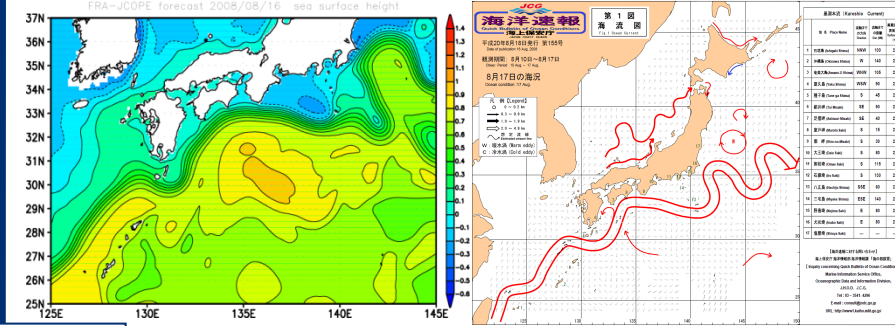
Application : Forecast of Kuroshio path

FRA-JCOPE forecast(start:2008.7.26) vs analyzed field by Hydrographic and Oceanographic Department

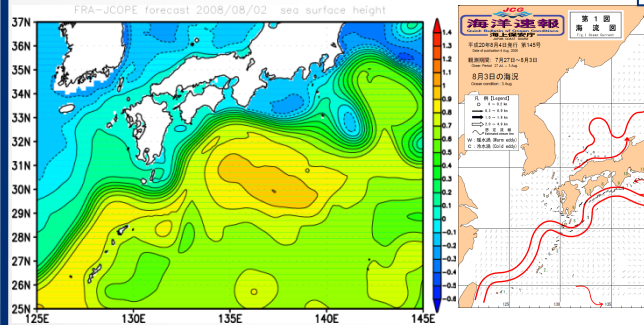
FRA-JCOPE 2008.7.26 JCG



FRA-JCOPE 2008.8.16 JCG

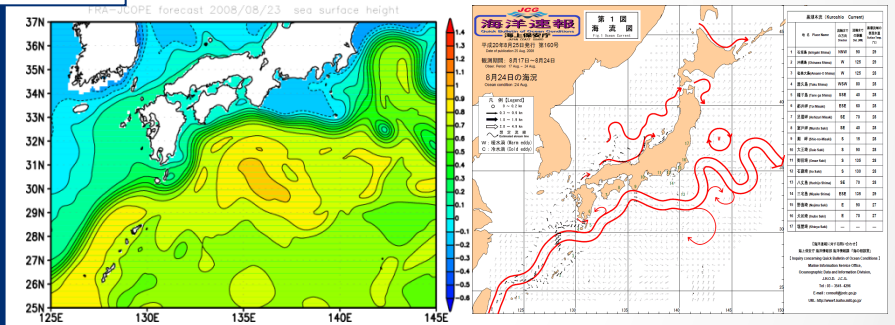


FRA-JCOPE 2008.8.2 JCG

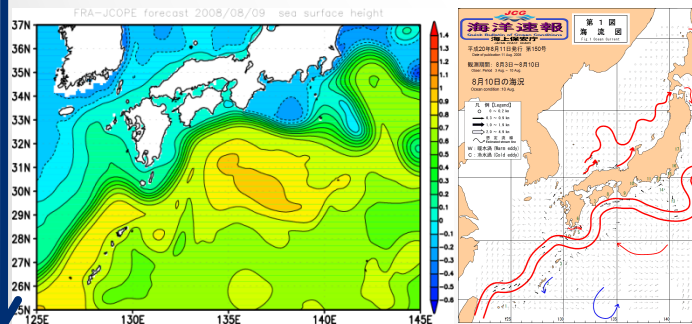


Kuroshio Current

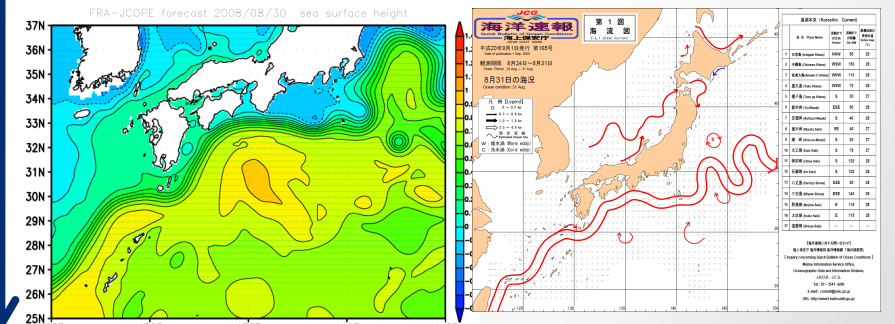
FRA-JCOPE 2008.8.23 JCG



FRA-JCOPE 2008.8.9 JCG



FRA-JCOPE 2008.8.30 JCG



Application : Appearance Forecast of the Giant Jellyfish

Since 2002, Surge of 'Giant Jellyfishes' brings serious damages to fisheries in the waters around Japan.

The forecast of the appearance of the Giant Jellyfish is needed for mitigation of damages.



photo by Mr.Honda (JSNFRI,FRA)

Giant Jellyfish
(*Nemopilema nomurai*)



(http://jsnfri.fra.affrc.go.jp/Kurage/kurage_top.html)

Information from sampling and sighting

Giant Jellyfishes entered in a fishing net.

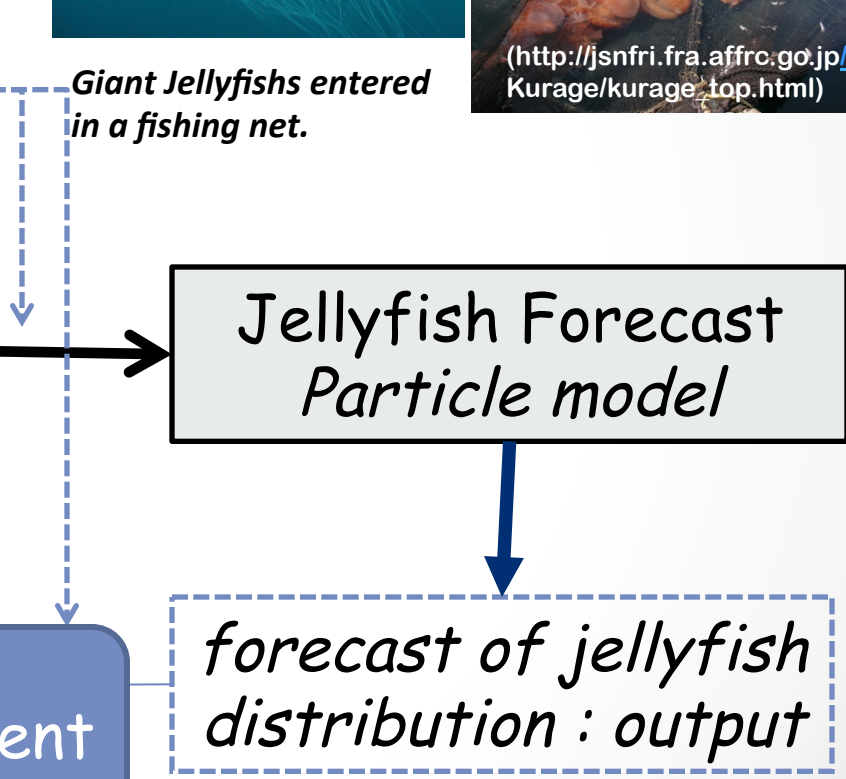
Ocean Forecast system of FRA
FRA-JCOPE, JADE

Jellyfish Forecast
Particle model

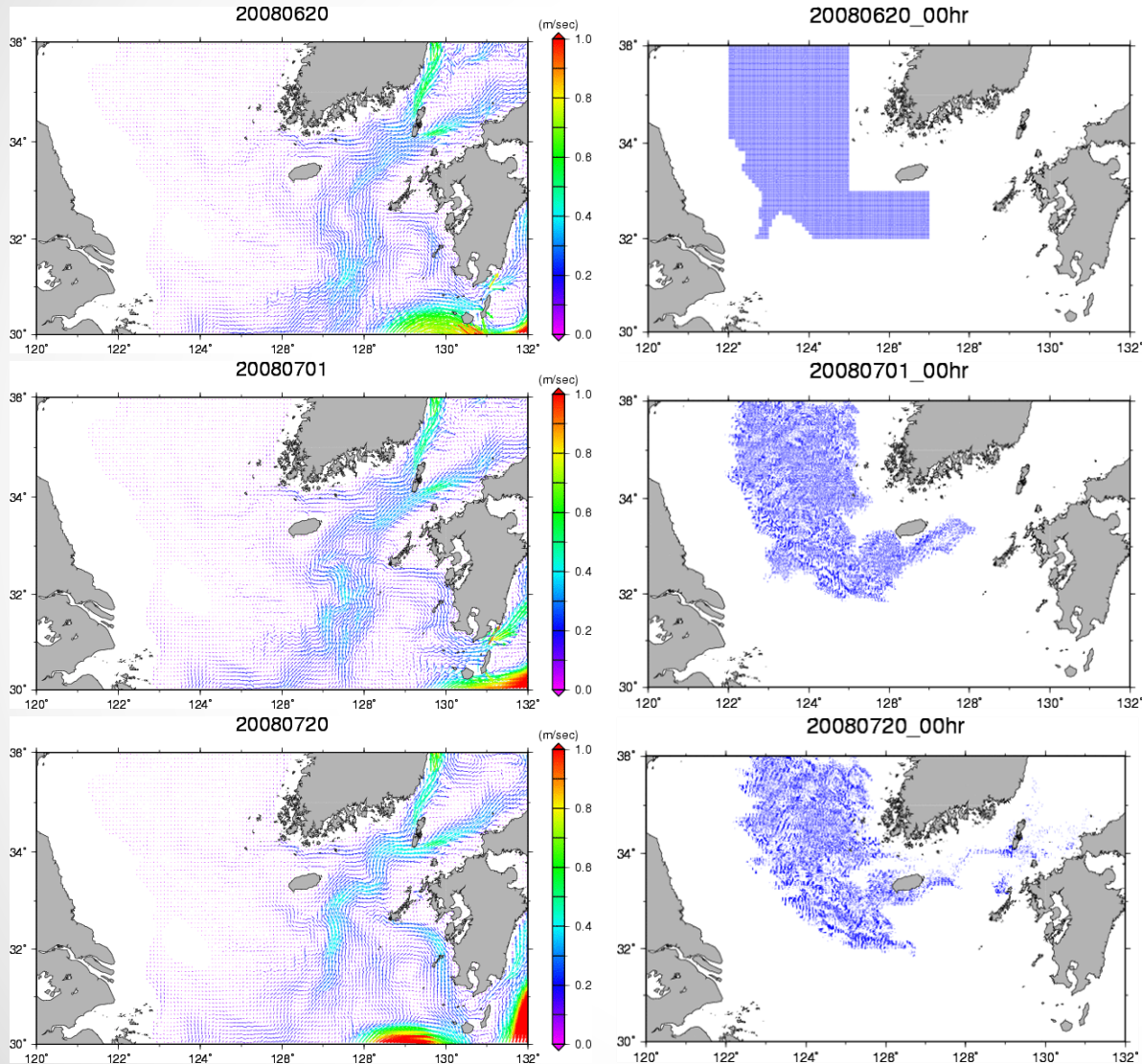
physical field : output

forecast of jellyfish distribution : output

Assessment



Application : Appearance Forecast of the Giant Jelly Fish



2008/6/20 initial
Current data on the FRA-
JCOPE 's 1/12 x1/12 grid
are interpolated to 1/120
x 1/120 grid.

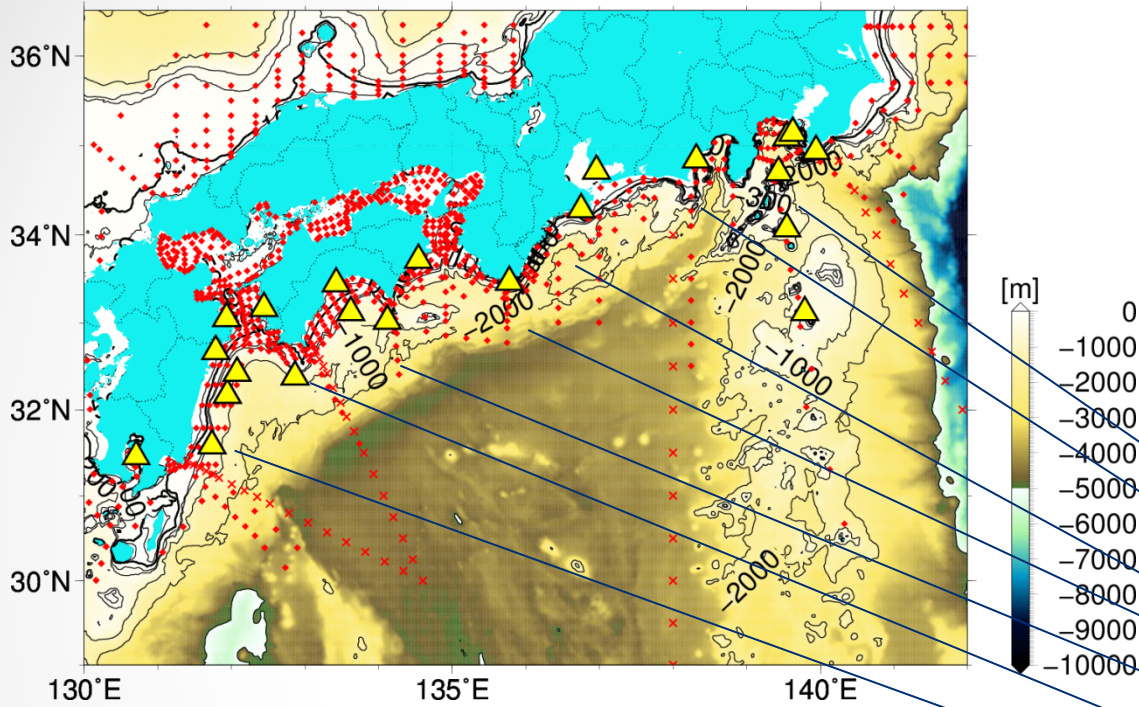
2008/7/01 11days

2008/7/20 30days

Summary of FRA-JCOPE and FRA-uploader

- We developed a software “FRA-uploader” to distribute **Japanese Prefectural Fisheries Institute data to not only FRA-JCOPE but also GTS.**
- Predictability of Ocean forecast system has been improved because of large input of data profile number due to FRA-uploader.
- As a result, Forecast of Kuroshio current south of Japan is well simulated.
- We started to predict the migration of Giant jelly fish using ocean forecast system, so we have a method to mitigate of damages by Giant jelly fish.

New monitoring system by Japanese Fisheries Institute



Moored type

Server and Website



With Fixed net type



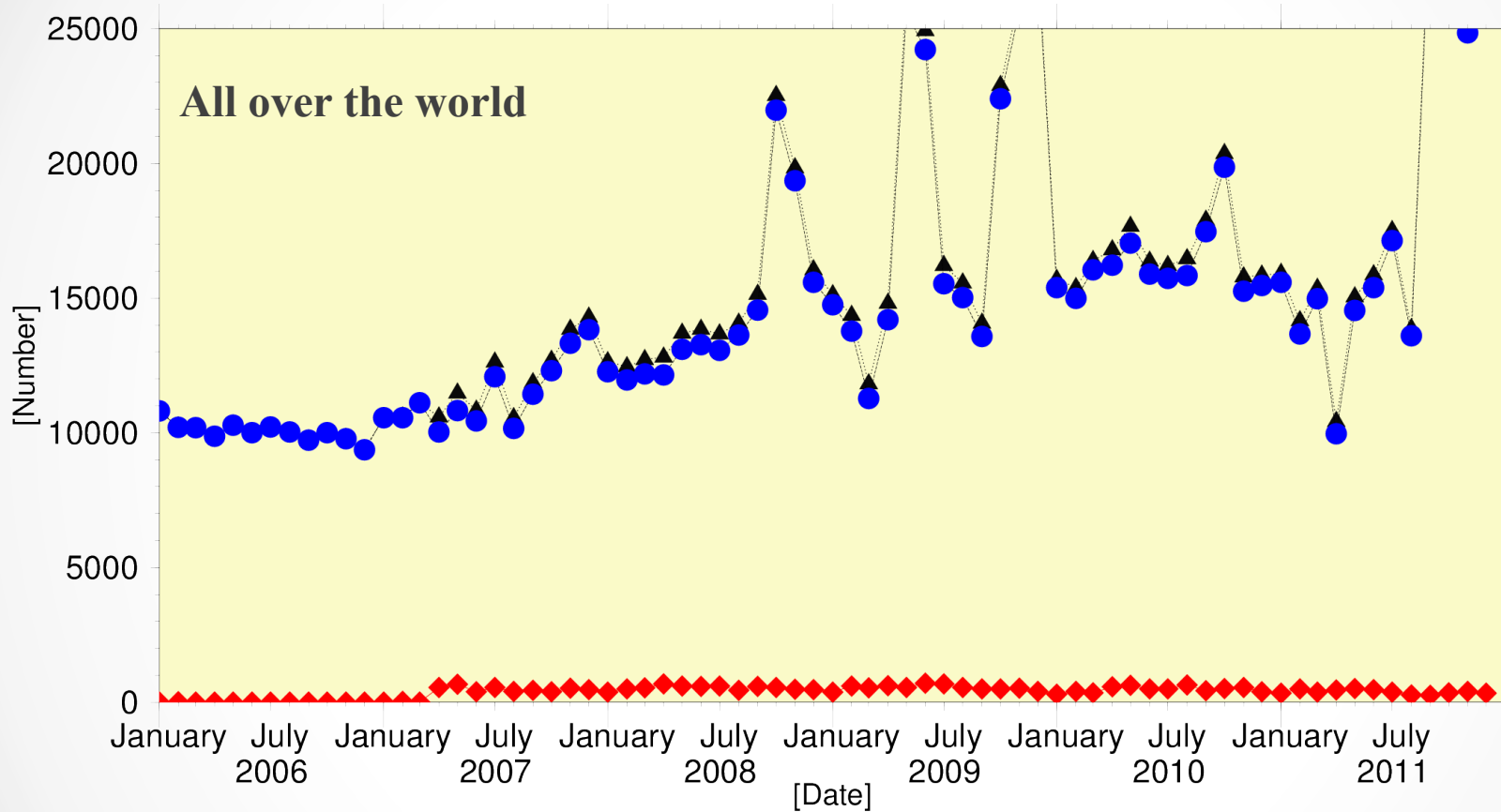
Profiling type





Effect on introduction of FRA-uploader

GTSPPP Near Real Time data



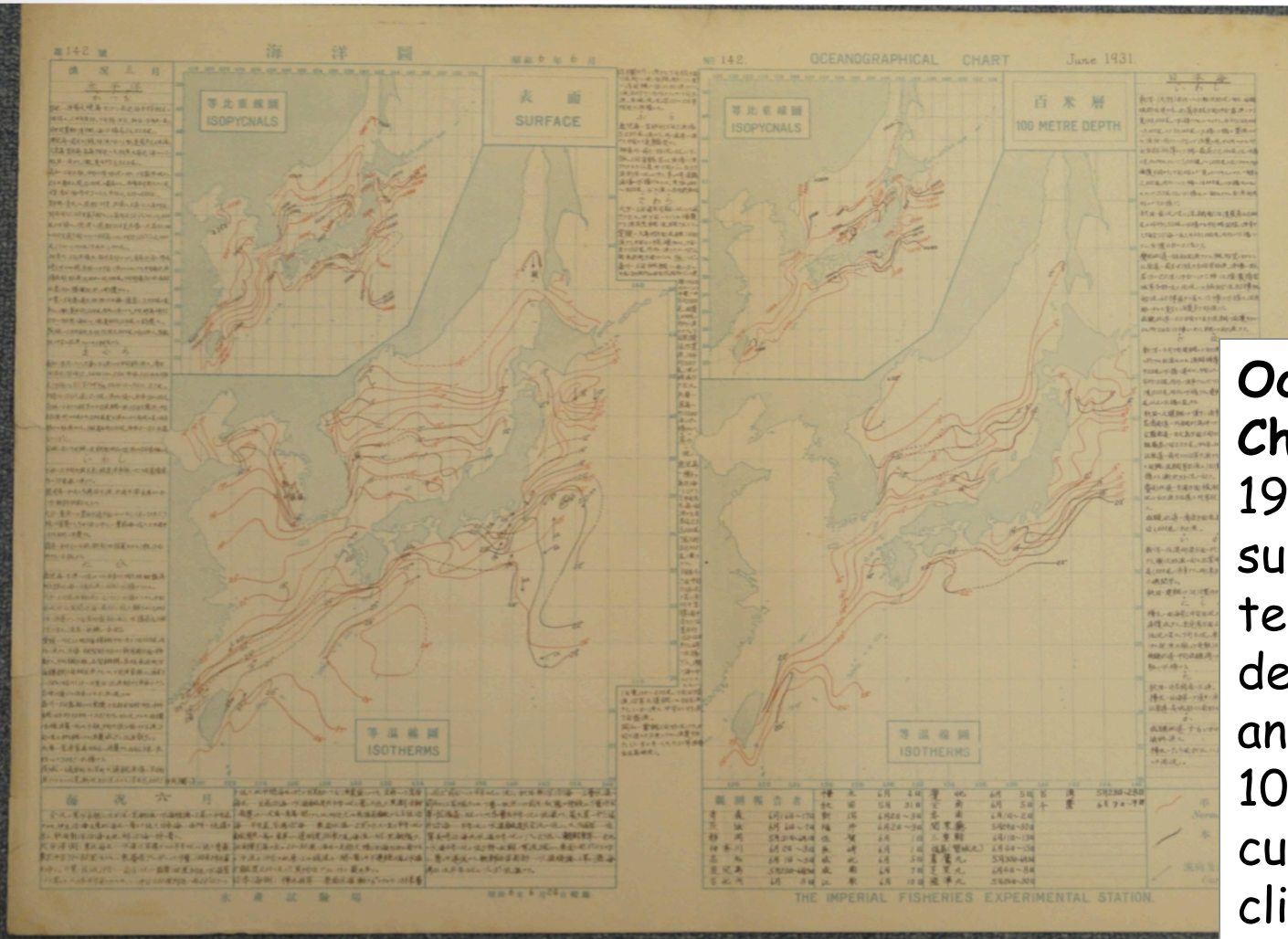
▲ : GTSPPP NRT TOAL

● : ▲ without JF Prefectural Inst.

◆ : JF Prefectural inst. in ▲

History of observation by JFI

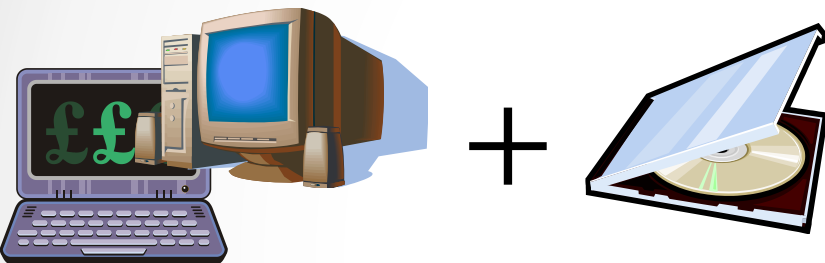
The most important objective of in-situ observation was to support fishery by providing information of oceanographic conditions.



Oceanographic Chart for June 1931. Left panel is surface temperature and density upper left) and Left panels for 100m depth. Red curves indicate climatology.

Development of Semi-automatic data distribution system: FRA-uploader

In the Prefectural institutes, researchers can send their observation data to FRA by only few steps.

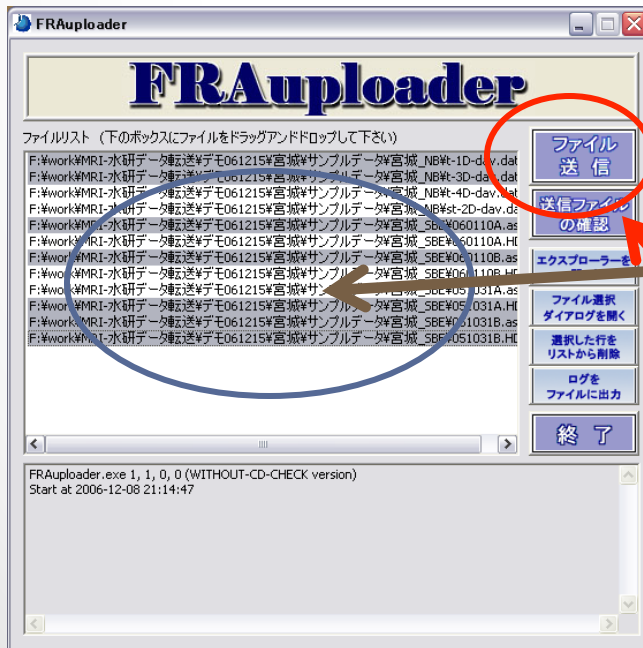


1. Set the FRA-uploader CD-R and execute FRA-uploader.

2. Set the digital data of observation data.

3. Select CTD data files and drag it to the box of FRA-uploader.

4. Push the sending button and the data send to FRA-JCOPE .server

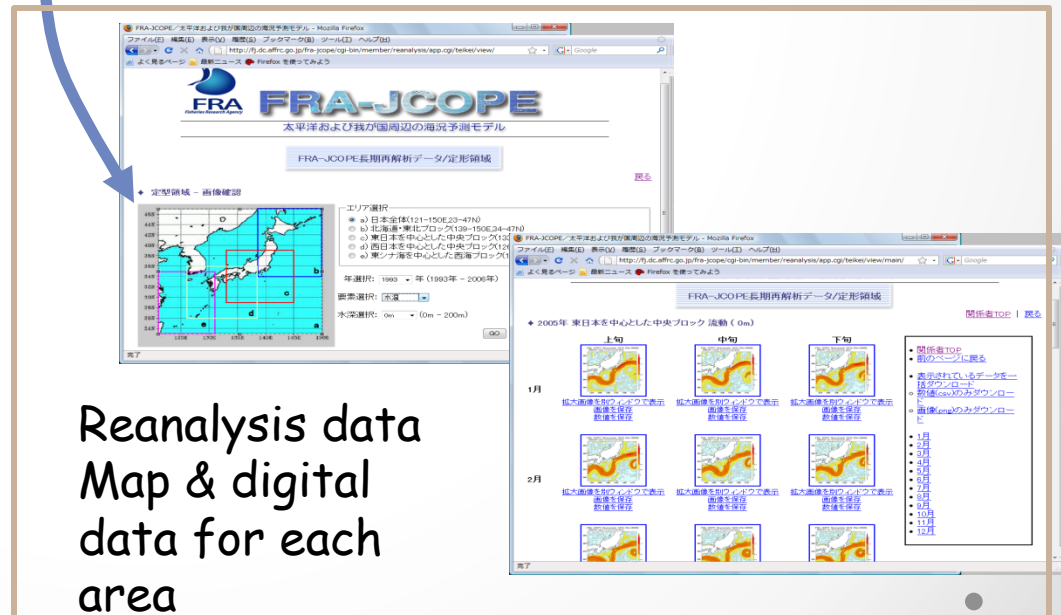
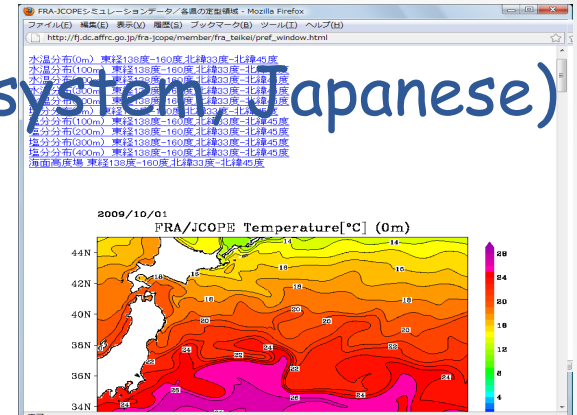
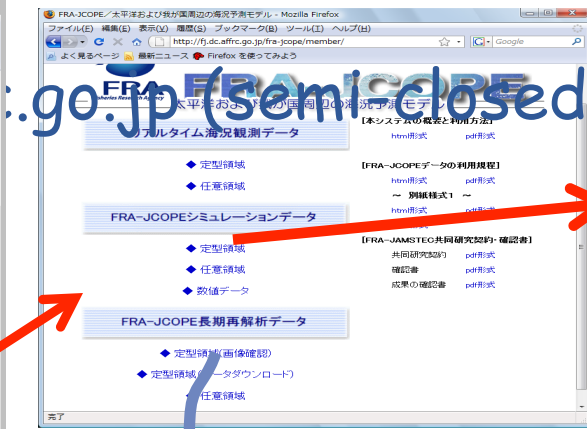


Distribution of simulated data via FRA-JCOPE HP



PUBLIC ACCESS Page

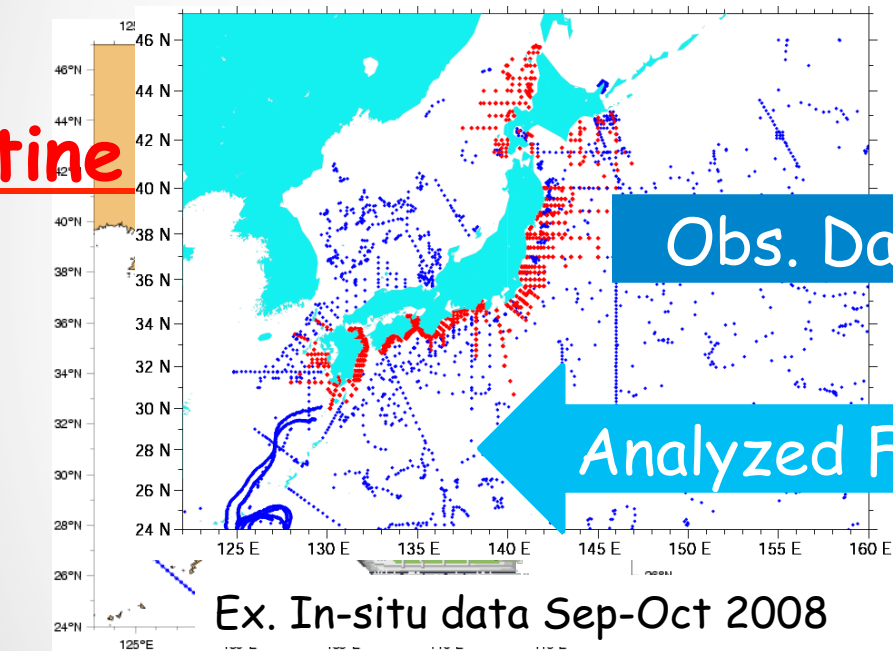
For member



Reanalysis data Map & digital data for each area

Application : Forecast of Kuroshio path

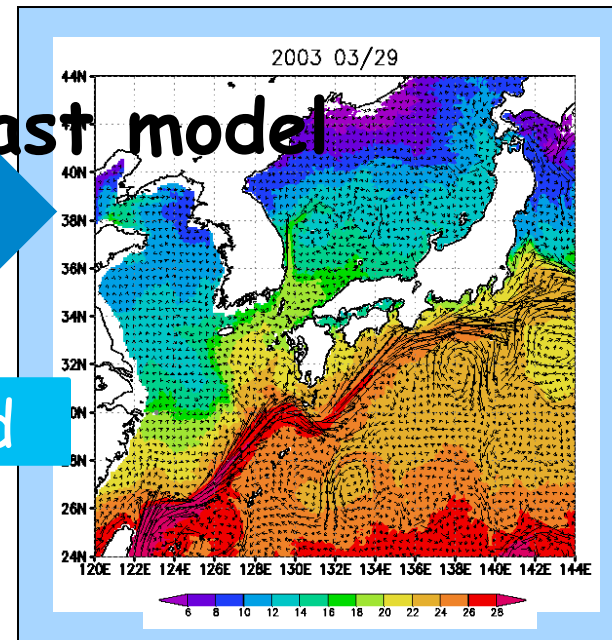
Cooperation between monitoring (local institutes) and forecast



Obs. Data

Analyzed Field

Forecast model



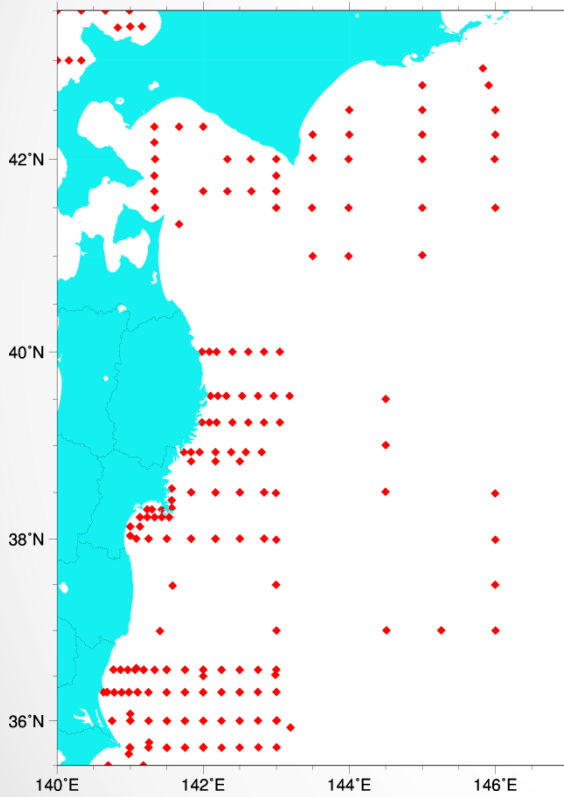
Incentive for monitoring

Improvement of forecast accuracy by using the observation network

Today's monitoring: **JFI** station only included in Prefectural Institute

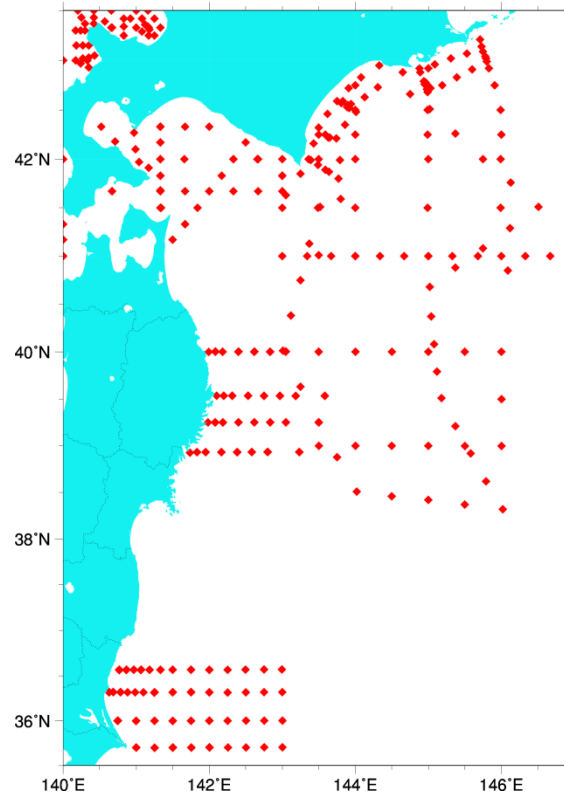
2011.Jan-Fwb

2011.1 – 2011.2



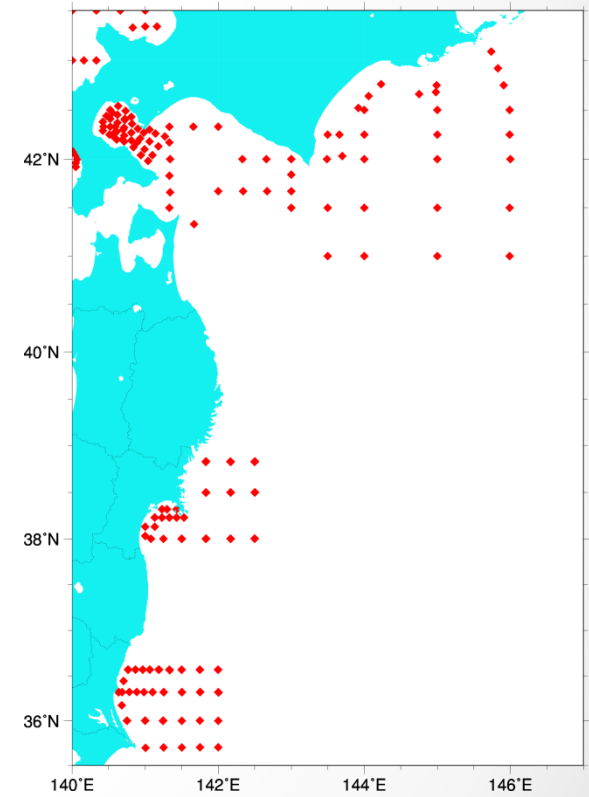
2011.May-Jun

2011.5 – 2011.6



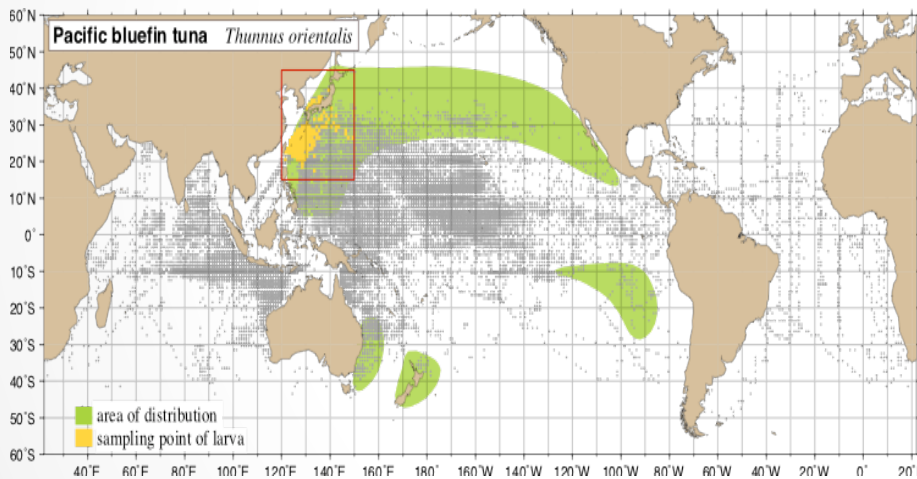
2012.Feb-Mar

2012.2 – 2012.3

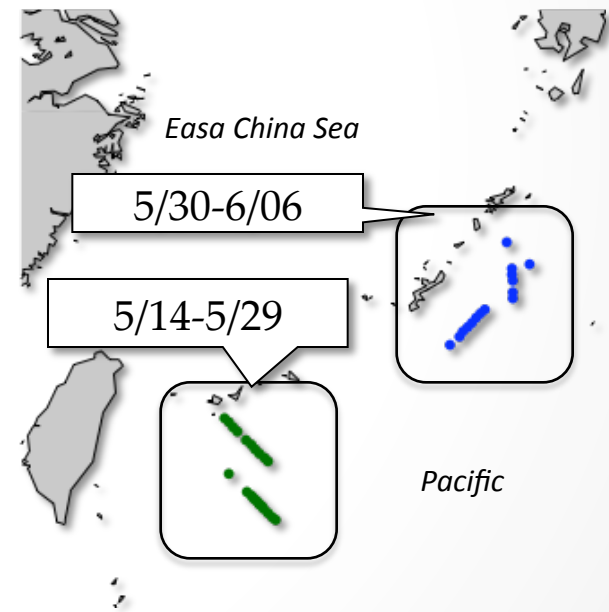


Application : Analysis of Environment the PBT spawning area

Pacific bluefin (PBF) tuna's spawning area is concentrated in a narrow area south of Japan. Recruitment process of the PBT young fish from the spawning area to the waters around southwestern part of Japan is important for the understanding of large year-to-year variability. To analyze the biological research in the spawning area, oceanographic data produced by FRA-JCOPE is used.

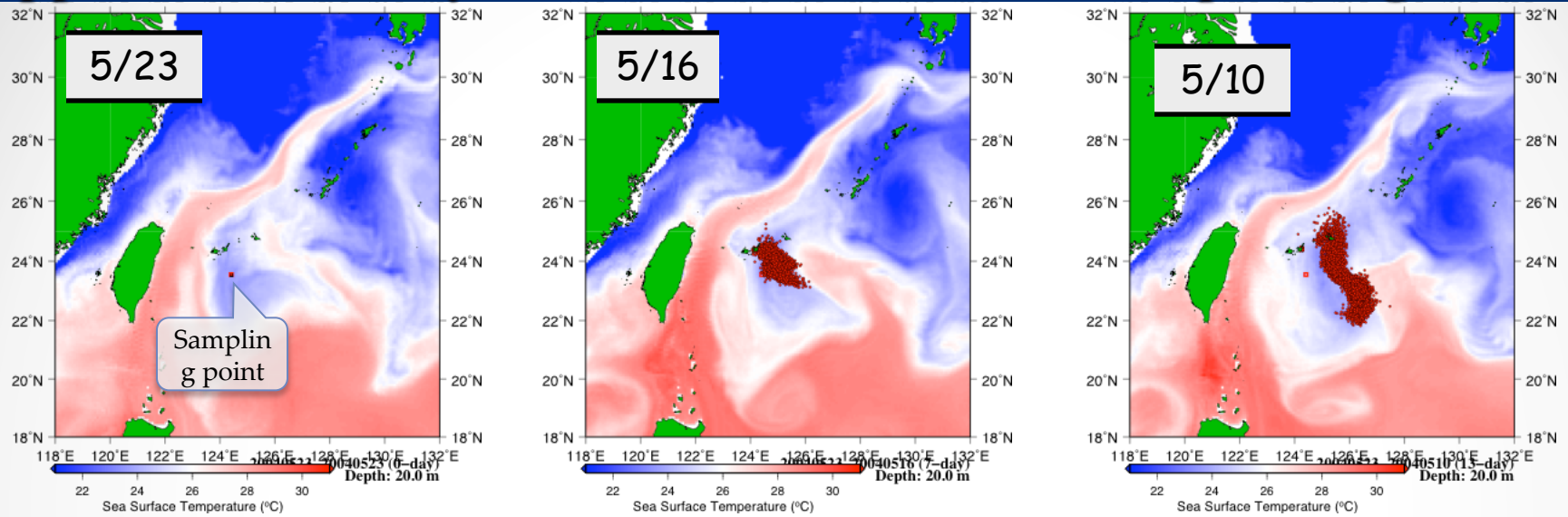


Habitat and spawning area of Pacific bluefin tuna. Spawning area, which are estimated by 63017-times larva net sampling 1956-89, is concentrated in a narrow area south of Japan.

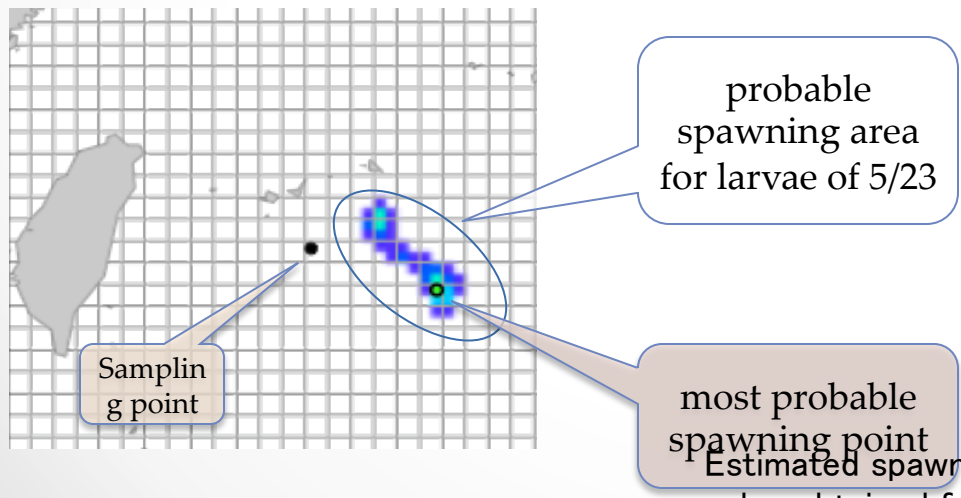


Sampling dates and positions of PBF larvae during a cruise of R/V Shunyo-maru (Japan Fisheries Research Agency) in May-June, 2004.

Application : Analysis of Environment the PBT spawning area



Particle tracking experiment to rewind to birth place. Velocity field at 10m depth of FRA-JCOPE is used. Number of particles flowing was 10,000, and random walk effect and horizontal diffusivity were taken into account

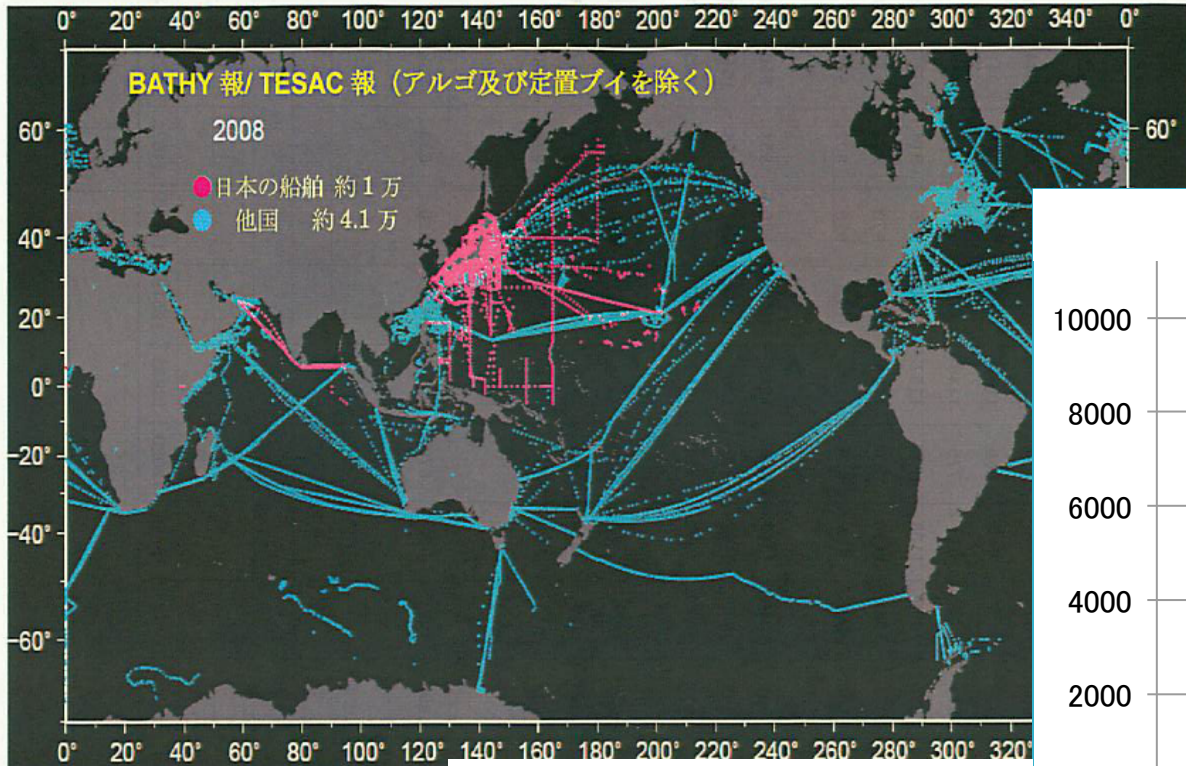


PARAMs	Most probable value
Temperature	25.4 degC
Vorticity	1.02e-05 s ⁻¹
Salinity	35.0 psu
Chl	0.41 mg/m ³

Estimated spawning area and the most probable environmental value obtained from particle tracking experiment.

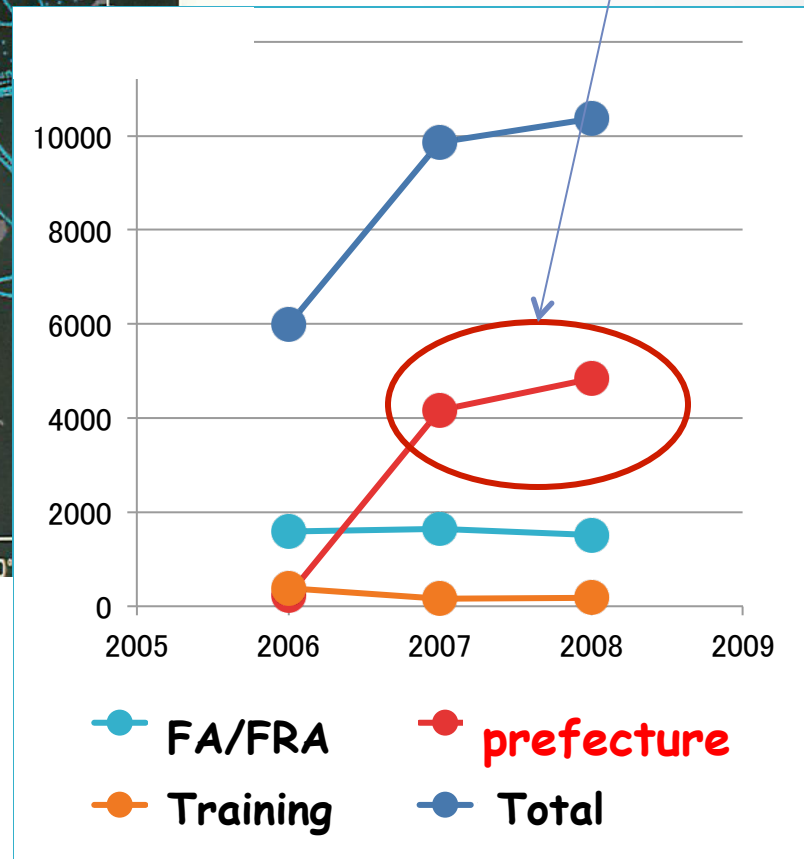
2. Introduction of Ocean Forecasting Model FRA-JCOPE

Contribution to the data exchange



Distribution of the BATHY and TESAC reports for 2008.

Drastic increase
2007-



3. Application : marine Information for fisheries

The image shows a web browser window displaying a list of fisheries reports. A blue arrow points from the list to a detailed view of a specific report. The detailed view shows a sea current prediction map for the period from August 5th to September 10th, 2009. The map displays current flow patterns with blue arrows and a thick black line indicating the Kuroshio current path. Two specific dates are highlighted: 9/5 予測 (Prediction for 9/5) and 9/10 予測 (Prediction for 9/10). Below the map, there is a caption and two explanatory notes.

イワシ類・シラス情報 | 愛知県 - Mozilla Firefox
http://www.pref.aichi.jp/0000009756.html

イワシ類・シラス情報

愛知県水産試験場イワシ類シラス情報

- イワシ類シラス漁況月報平成21年8月7日号 (ファイル名:090807geppou.pdf サイズ:820.02 KB)
- 月報平成21年8月7日号
- イワシ類シラス漁況月報平成21年7月8日号(ファイル名:070808geppou.pdf サイズ:820.02 KB)
- 月報平成21年7月8日号
- 速報7月6日号(ファイル名:sokuhou090706.pdf サイズ:310.02 KB)
- 速報7月6日号
- イワシ類シラス漁況月報平成21年6月5日号(ファイル名:060505geppou.pdf サイズ:820.02 KB)
- 月報平成21年6月5日号

PDFファイルの閲覧には Adobe Reader が必要で、
い場合には、[Adobe 社のサイトから Adobe Reader](#) をダウンロードしてください。

水産試験場のトップページへ戻る

イワシ類・シラス情報 | 愛知県 - Mozilla Firefox
http://www.pref.aichi.jp/cmsfiles/contents/0000009/9756/090807geppou.pdf

090807geppou.pdf (application/pdf)

93.9%

9/5 予測

9/10 予測

図 海況予測 2009年8月5日～9月10日 (矢印は黒潮流路と暖水流入)

※水温・海流予測図は、「FRA-JCOPE」システムによるものです。
FRA-JCOPEは、漁況予報の精度向上と資源変動要因解析のための海況情報の充実を図ることを目的に、水産総合研究センターと海洋研究開発機構の共同研究によって開発された海況予測システムです。
各県水試もデータを提供しています。

※ 漁獲量等の各数値は、水試調べのものです。また、集計は8月4日情報収集分までで、漁業種類は、しらす船びき網、ぱち網、まき網のみです。

Done

Motivation of the development the system.

“What is the FRA-ROMS system ?”

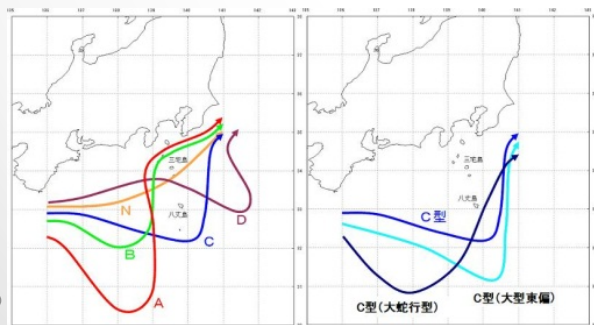
■ The FRA-ROMS is **the ocean data assimilation and Forecast system in the Northern-Western Pacific**, developed by the Fisheries Research Agency.

“Why do we need the system ?”

■ **In order to research some fisheries studies and subjects.**

- When do the giant-jellyfish appear near Japan island ?
- How type will Kuroshio current south of Japan take two months later ?
- etc.

✘ Although, until last fiscal year I used old data assimilation system to research above issues, at this fiscal year new system FRA-ROMS launched.



Description of the system: (2) Assimilation method

■ 3D-variational method

- ✓ Minimization of Cost function $J(x)$

$$J(x) = \frac{1}{2} (x - x^b)^T \mathbf{B}^{-1} (x - x^b) + \frac{1}{2} (H(x) - x^o)^T \mathbf{R}^{-1} (H(x) - x^o) + \frac{1}{2} (h(x) - h_{alt})^2$$

x : Temp. and Salinity Matrix which should be estimated

x^b : Temp. and Salinity Matrix of Numerical Model

x^o : Temp. and Salinity Matrix of observation data

\mathbf{B} : Background Covariance Matrix

\mathbf{R} : Observational Error covariance Matrix

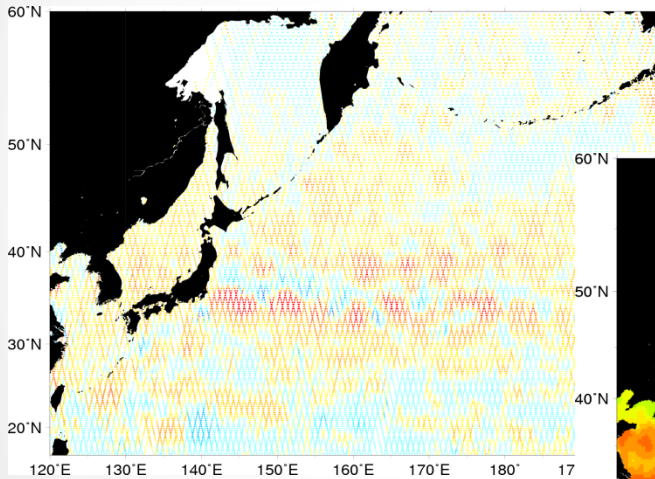
\mathbf{H} : Observational Matrix is used if the dimension of Model is different from the one of Obs.

✂ The 3D-var of FRA-ROMS is based on the Fujii and Kamachi (2003) in Meteorological Research Institute in Japan.

Description of the system: (3) Observation Data

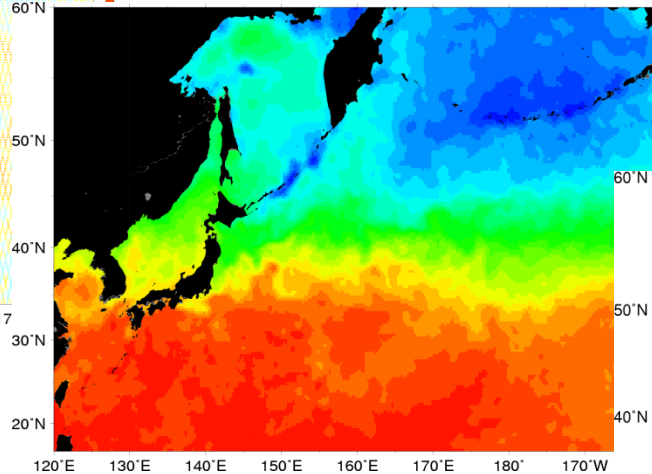
■ Sea Surface height

- alongtrack data of AVISO
- Ers1,2,Envisat
- Jason1,2



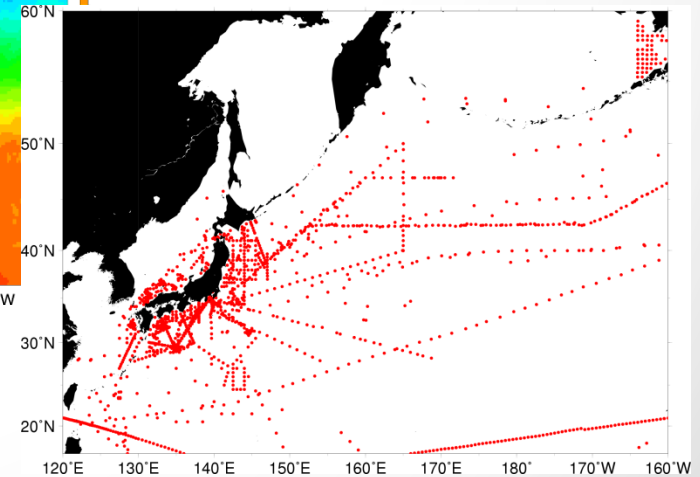
■ Sea Surface Temp.

- GHRSSST
- AVHRR_AMSR_OI
- 0.25×0.25deg



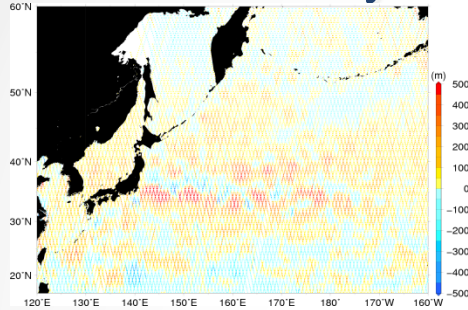
■ In situ data

- GTSP via GTS
- WOD
- Japanese Prefectural Fishery Institution

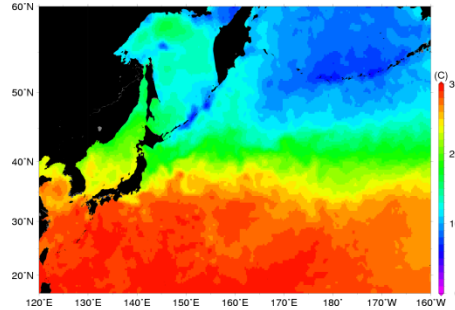


Description of the system: Flow (1-cycle=1-week)

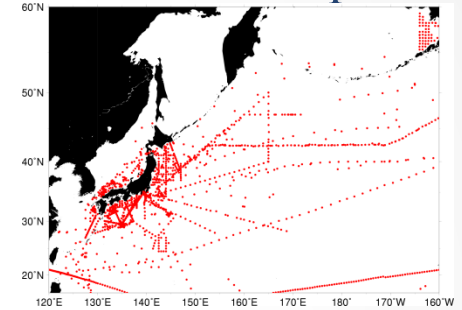
SSH anomaly



SST



In situ Temp. Sali.



x^o : observation

x^a : Analysis

x^b : Numerical model

3D-var assimilation

S ← Z

S → Z

Tue:12:00

Sat:0:00

Tue:12:00

Reanalysis by Incremental Analysis Update

Time