November 1, 2018

HOKKAIDO UNIVERSITY

PICES-2018 Annual Meeting:

Toward integrated understanding of ecosystem variability in the North Pacific

Oct 25 – Nov 4, 2018
Yokohama, Japan

Practical procedure for potential fishing zone prediction of neon flying squid (*Ommastrephes bartramii*) in the north western North Pacific

Sei-Ichi Saitoh[1], Irene Alabia[1], Hiromichi Igarashi[2], Yoichi Ishikawa[2], Masafumi Kamachi[2] and Yutaka Imamura[3]

[1]Arctic Research Center, Hokkaido University (ARC-HU)
[2]Japan Agency for Marine Earth-Science and Technology (JAMSTEC
[3]Aomori Prefectural Industrial Technology Research Center
ssaitoh@arc.hokudai.ac.jp

Hokkaido University Arctic Research Center

JAMSTEC

AITC Aomori Prefectural Industrial Technology Research Center
地方独立行政法人 青森県産業技術センター

Outline

Introduction

    Eddy year – Non-eddy year

Data and method

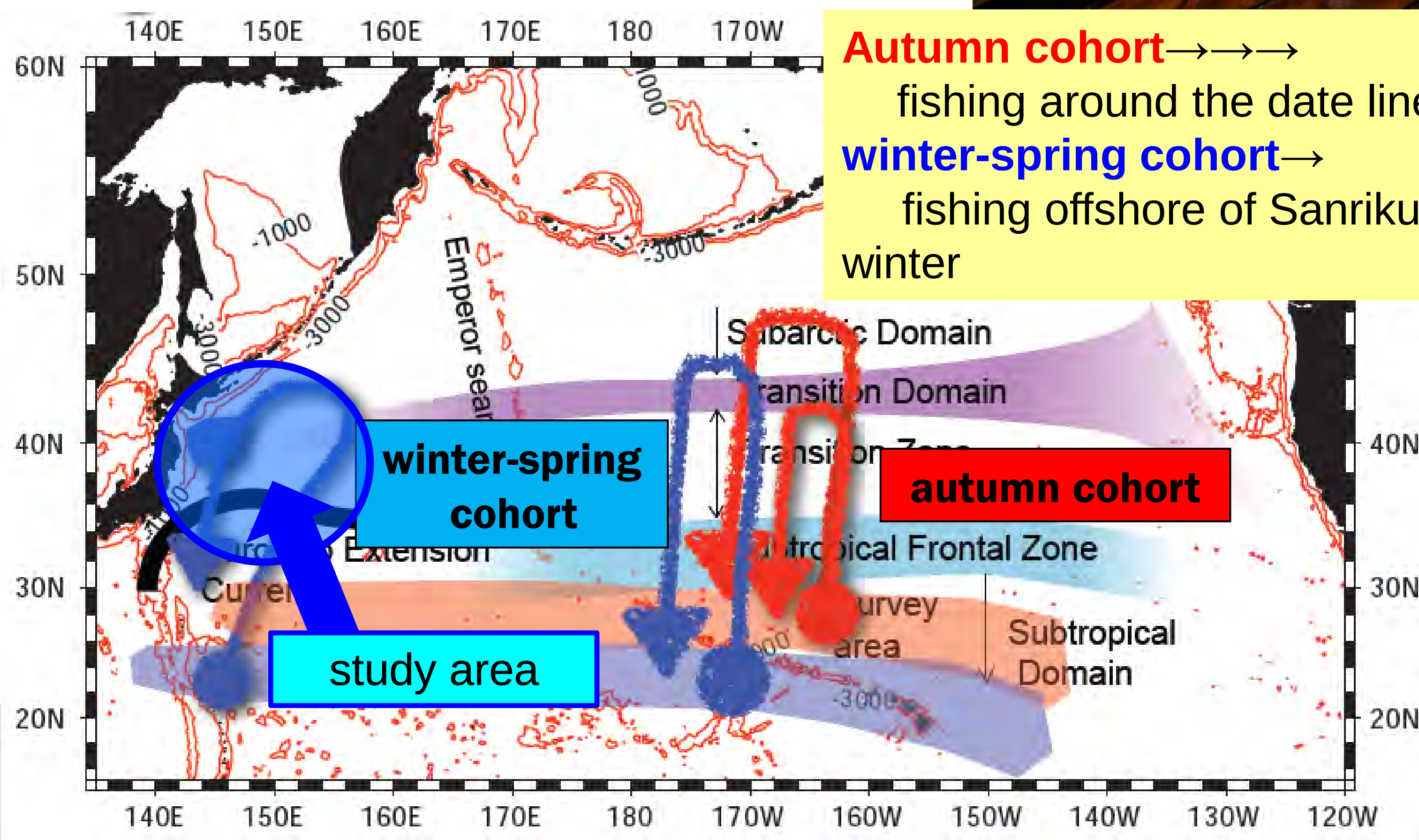
Result and discussion

    Model validation

Concluding remarks

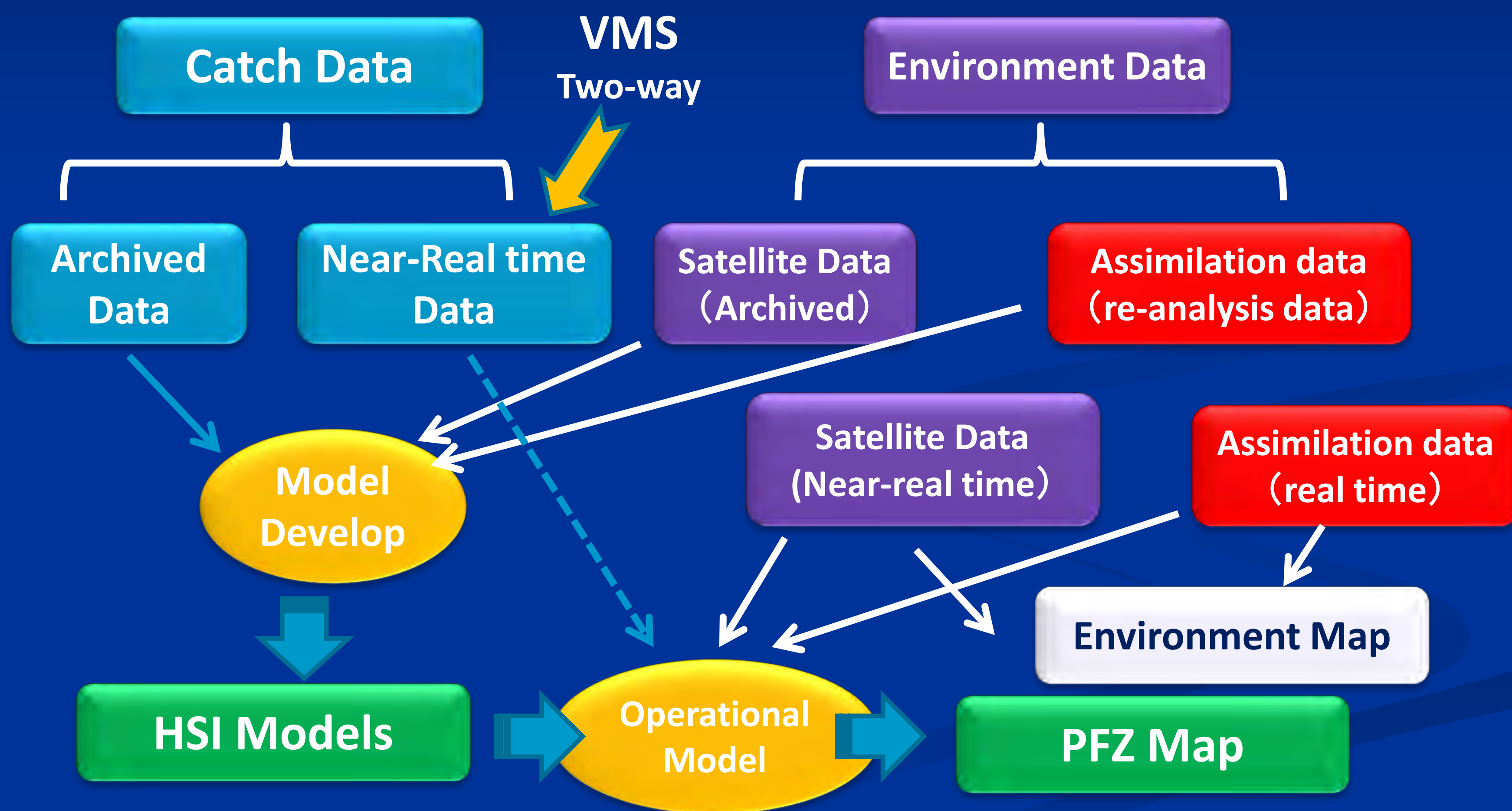
Neon flying squid (*Ommastrephes bartramii*)

- widely distributed in the north Pacific
- 1-year lifespan and seasonal migration
- important for pelagic ecosystem and Japanese fisheries



Autumn cohort→→→
fishing around the date line in summer
winter-spring cohort→
fishing offshore of Sanriku in the next winter

Pin-point PFZ prediction

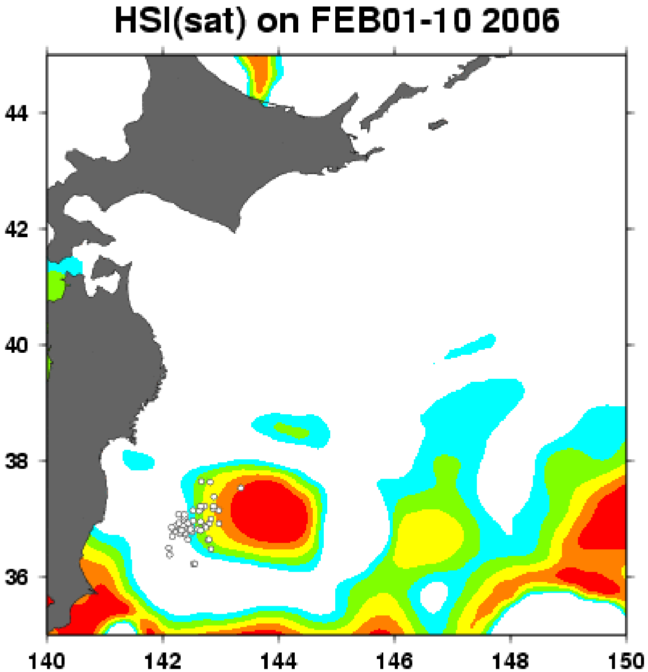


Fisheries Information Service

Improving HSI model

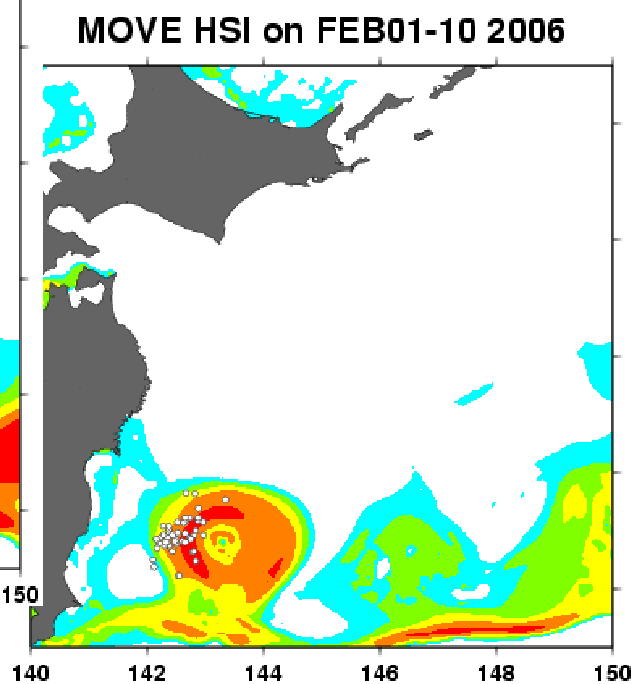
(composite HSI map on 1-10Feb.2006)

Satellite-based model
(SST,SSH,∇SSH)

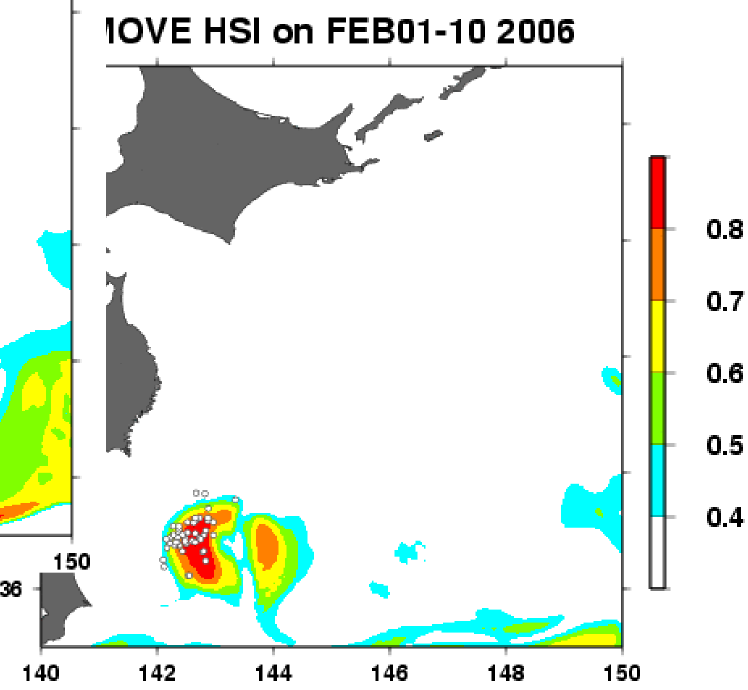


white dots: fishing points
by commercial vessels

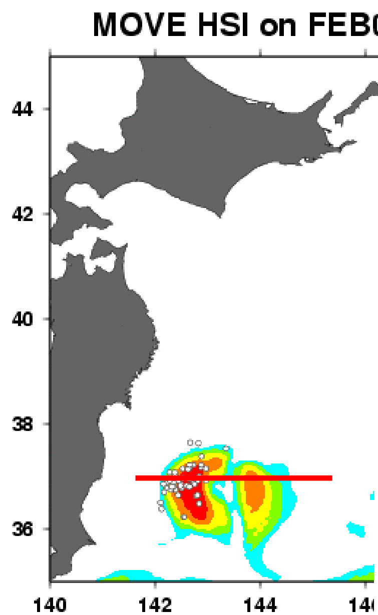
MOVE-2D model
(SST,SSH,∇SSH)

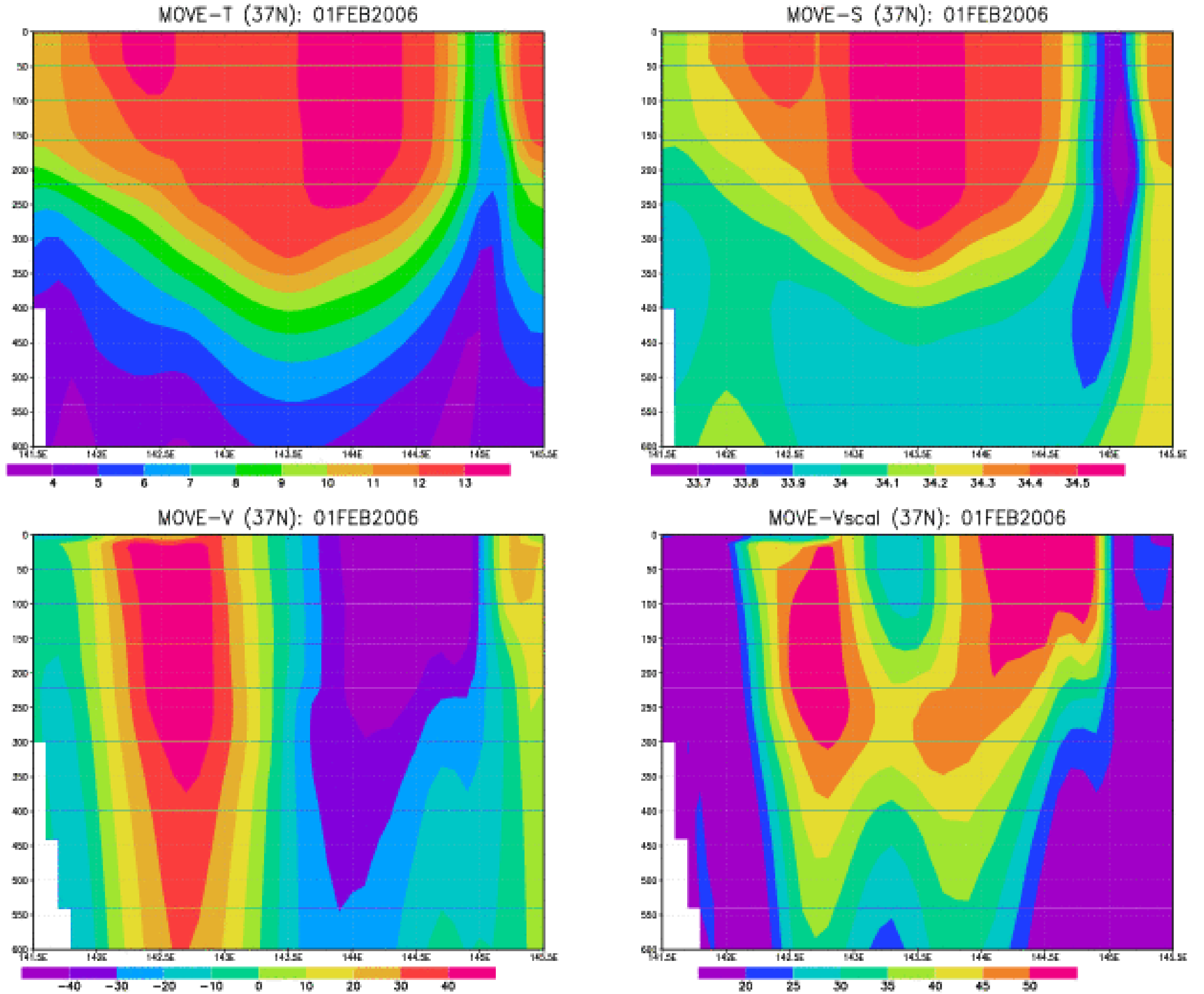


MOVE-3D model
(SST,SSH,∇SSH,
MLD,S330,Vscal480,
V138)



WCR（Jan.-Feb.2006）



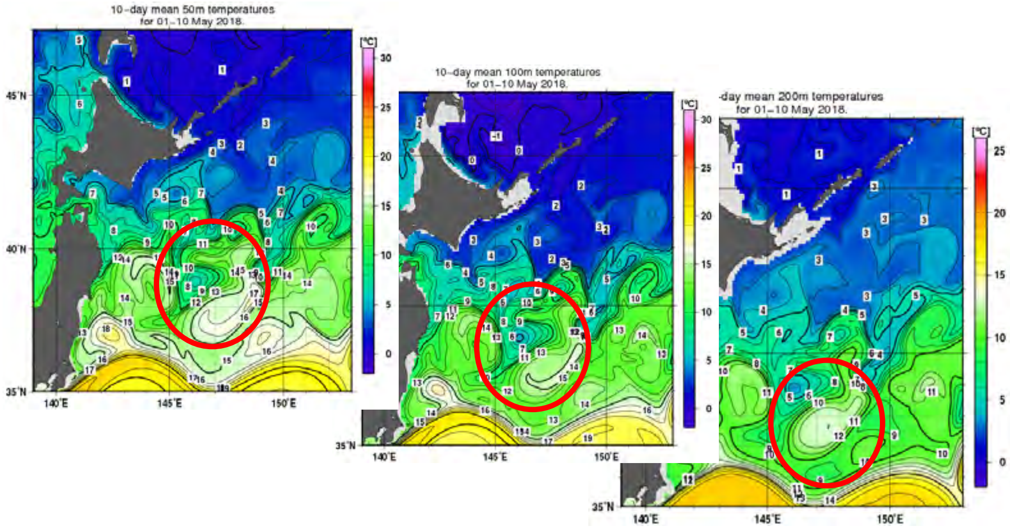


HSI model Parameters

SST
S330
V138
Vscal480

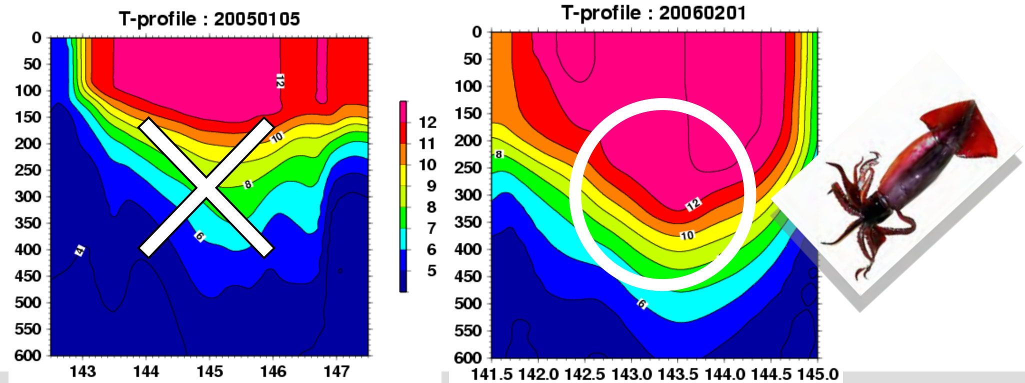
Subsurface Structure

50m,100m,200m Temp.： JMR HP



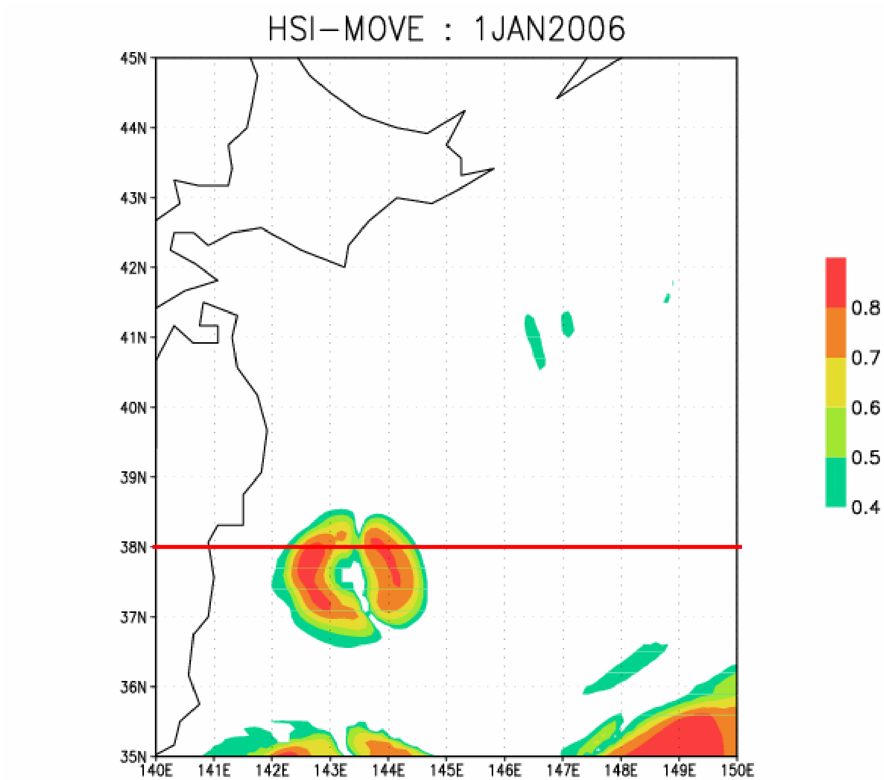
Subsurface structure

Thin or Thick Structure

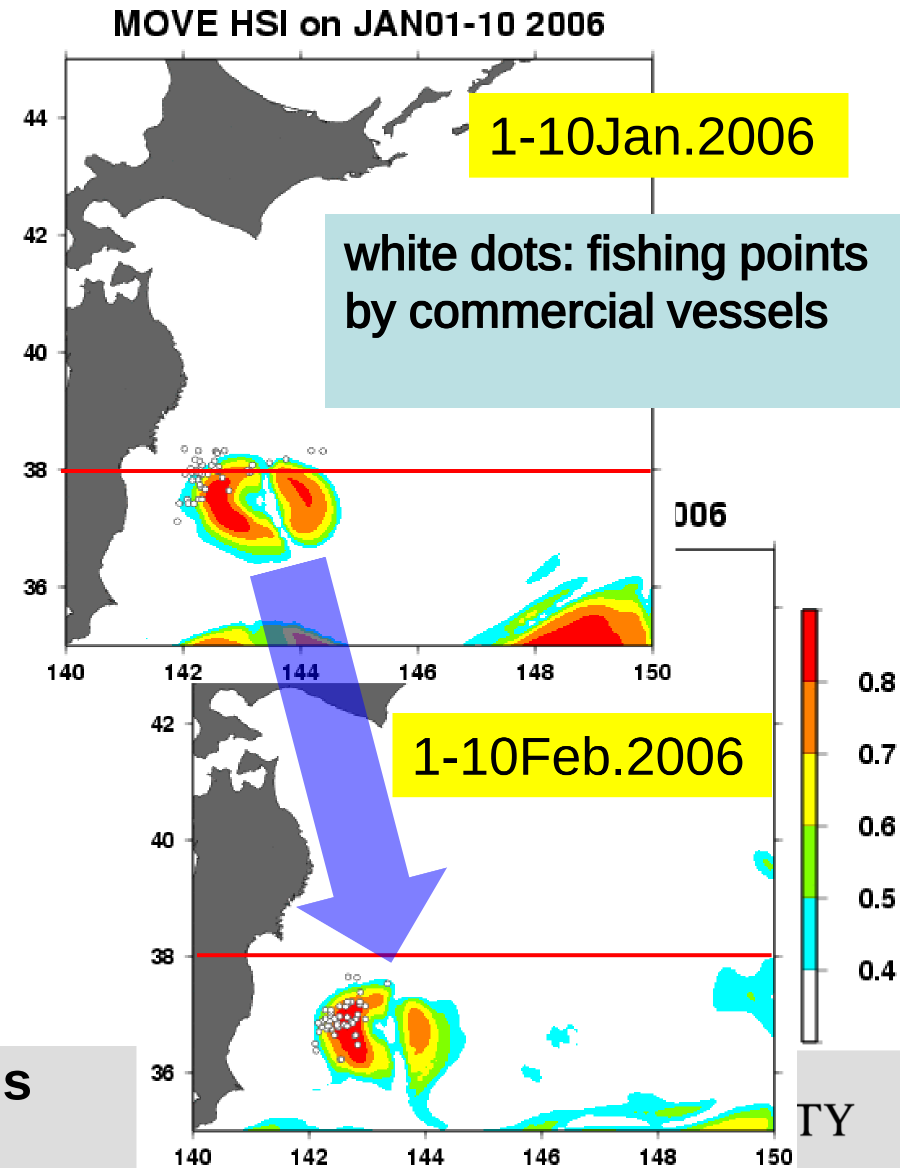


HSI model (MOVE-3D)

SST,SSH,∇SSH,MLD,
S330,Vscal480,V138

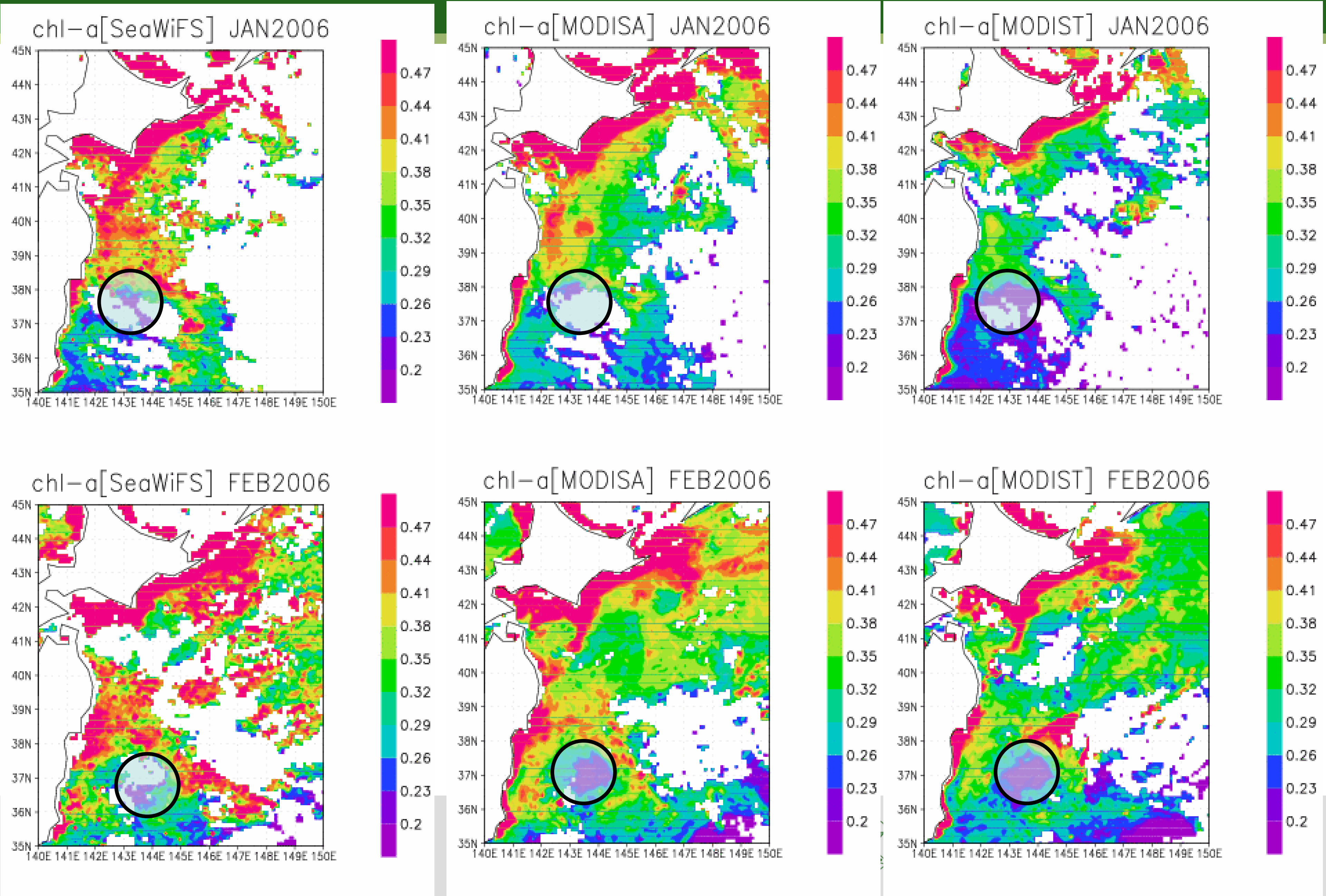


daily HSI map 1Jan.-28Feb.2006



Southward transition of the actual fishing ground corresponding to the movement of the anti-cyclonic eddy is well-reproduced.

WCR chl-a（Jan.-Feb.2006）



Why eddy is important for neon flying squid

High chl concentration around WCR

- **good feeding environment**

Thick structure of WCR

- **avoiding from predators**
- **adaptation to warm environment for southward migration**

Objectives

- Propose a practical procedure to use synchronize the model for eddy year or non-eddy year.

- Apply results to operational use

Date and Method

Fishery data

Commercial fisheries data of neon flying squid from January to February during 2001-2011

(by Aomori Prefectural Industrial Technology Research Center)

the dates of fishing, fishing locations, CPUE(No./hour/machine)

3D-VAR data assimilation product

MOVE(MRI Multivariate Ocean Variational Estimation)

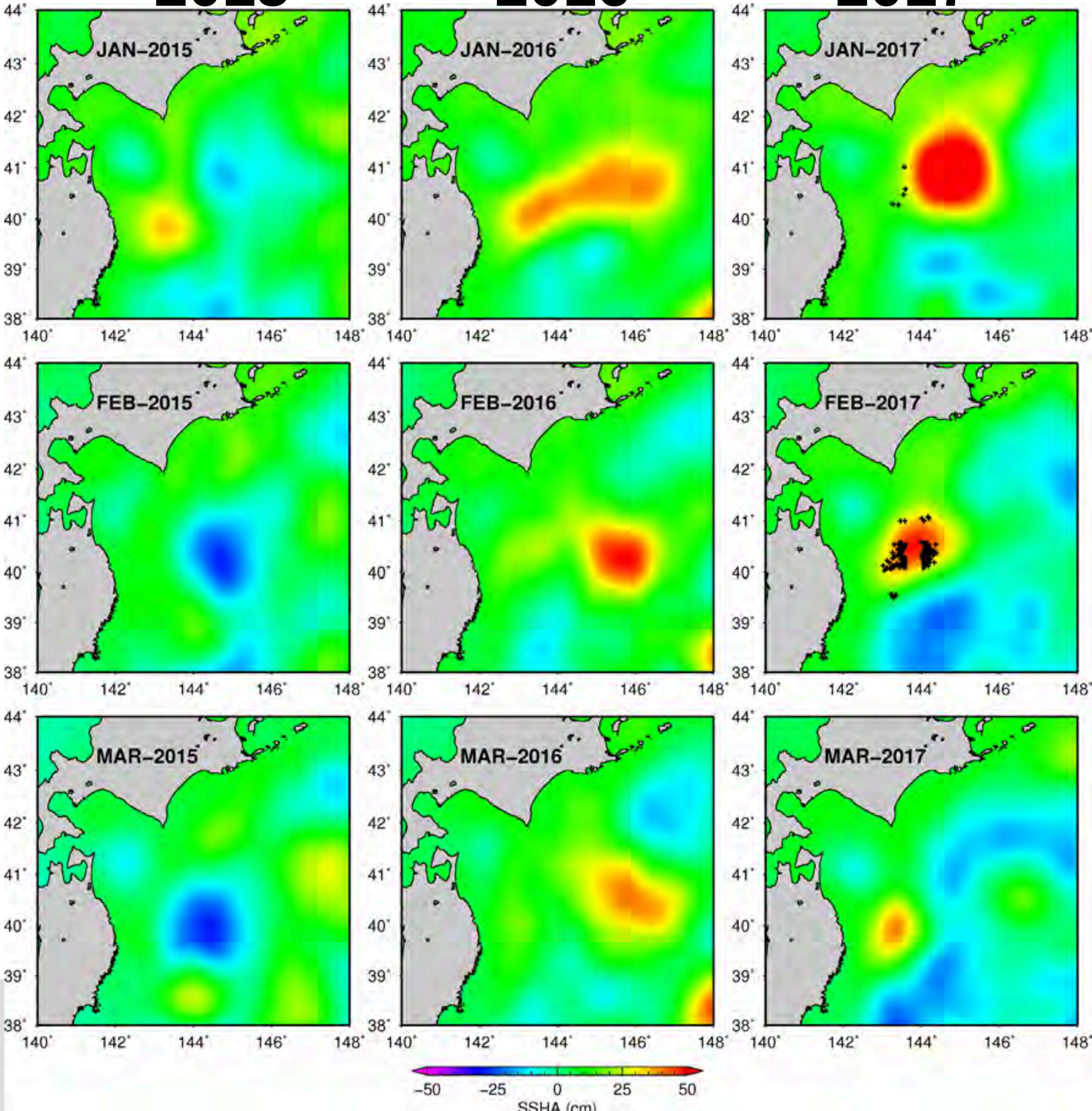
Temperature, Salinity, Current velocity(U,V,W),SSH

(0.1deg, vertical 54 levels, 5-days → daily interpolated)

HSI model : MaxEnt (Machine learnig model)

No fishing activities: 2015 and 2016

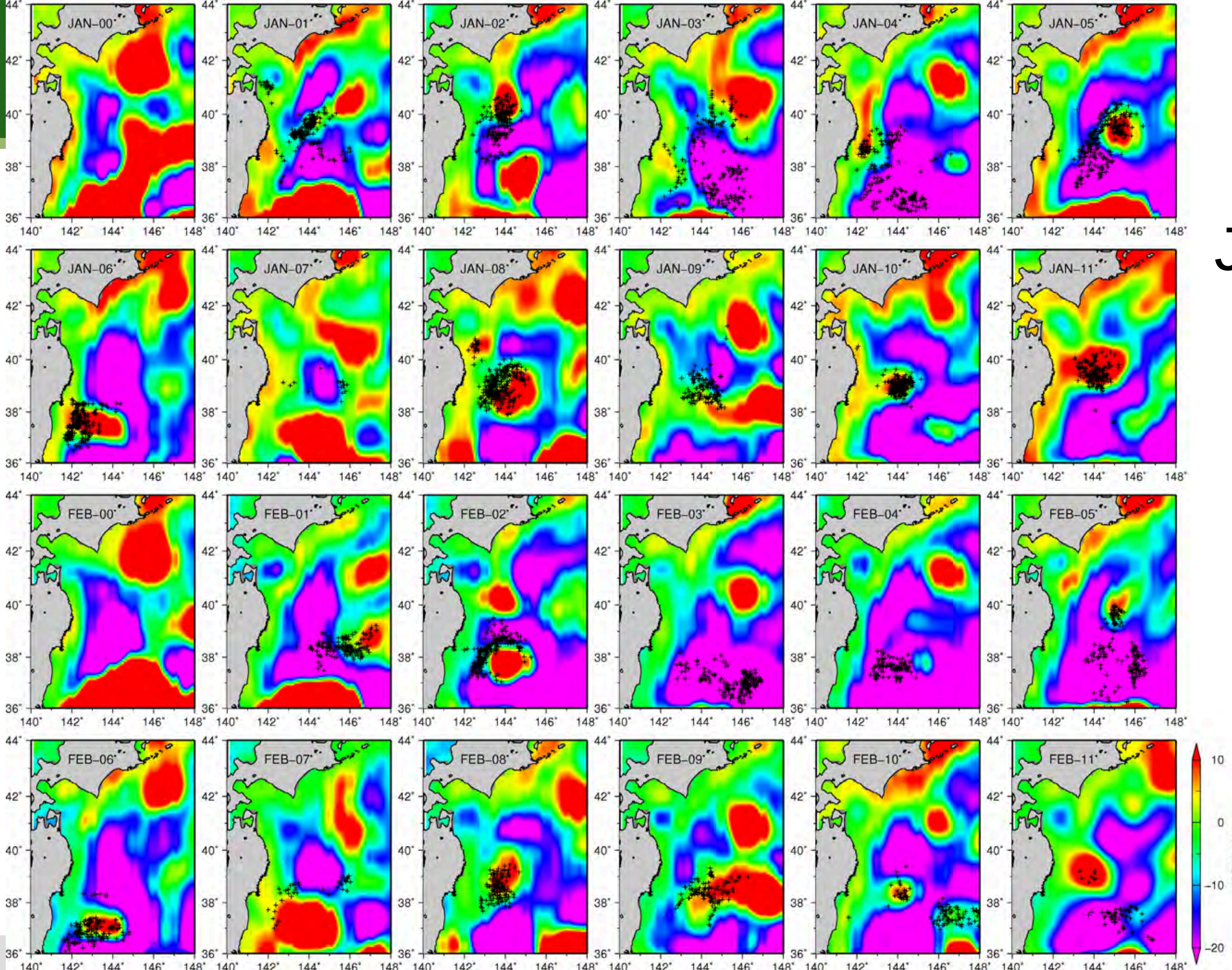
2015 **2016** **2017**



January

February

March


JAN–00
JAN–01
JAN–02
JAN–03
JAN–04
JAN–05
JAN–06
JAN–07
JAN–08
JAN–09
JAN–10
JAN–11
FEB–00
FEB–01
FEB–02
FEB–03
FEB–04
FEB–05
FEB–06
FEB–07
FEB–08
FEB–09
FEB–10
FEB–11
44°
42°
40°
38°
36°
140°
142°
144°
146°
148°
10
0
−10
−20
SSHA (cm)

Jan.

Feb.

Classification of eddy and non-eddy model

Data preparation

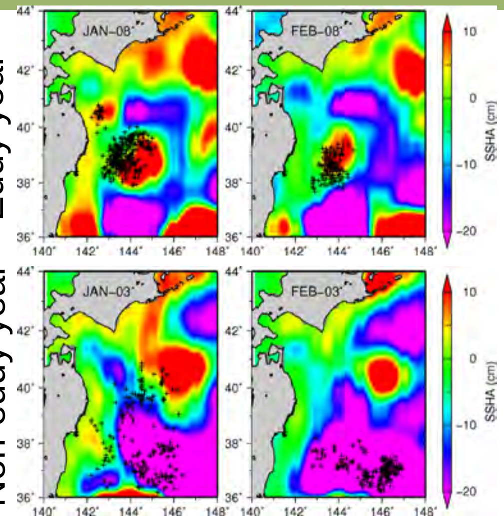
Classification of years based on presence of warm-core eddies

MaxEnt models for specific period (eddy vs non-eddy years)

Model predictions

Eddy year

Non-eddy year

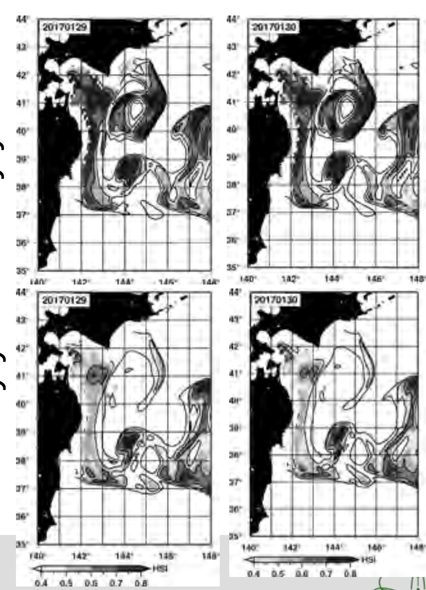


Eddy year
(2002, 2005-06, 2008, 2010-11)

Non-eddy year
(2001, 2003-04, 2007, 2009)

Eddy year

Non-eddy year

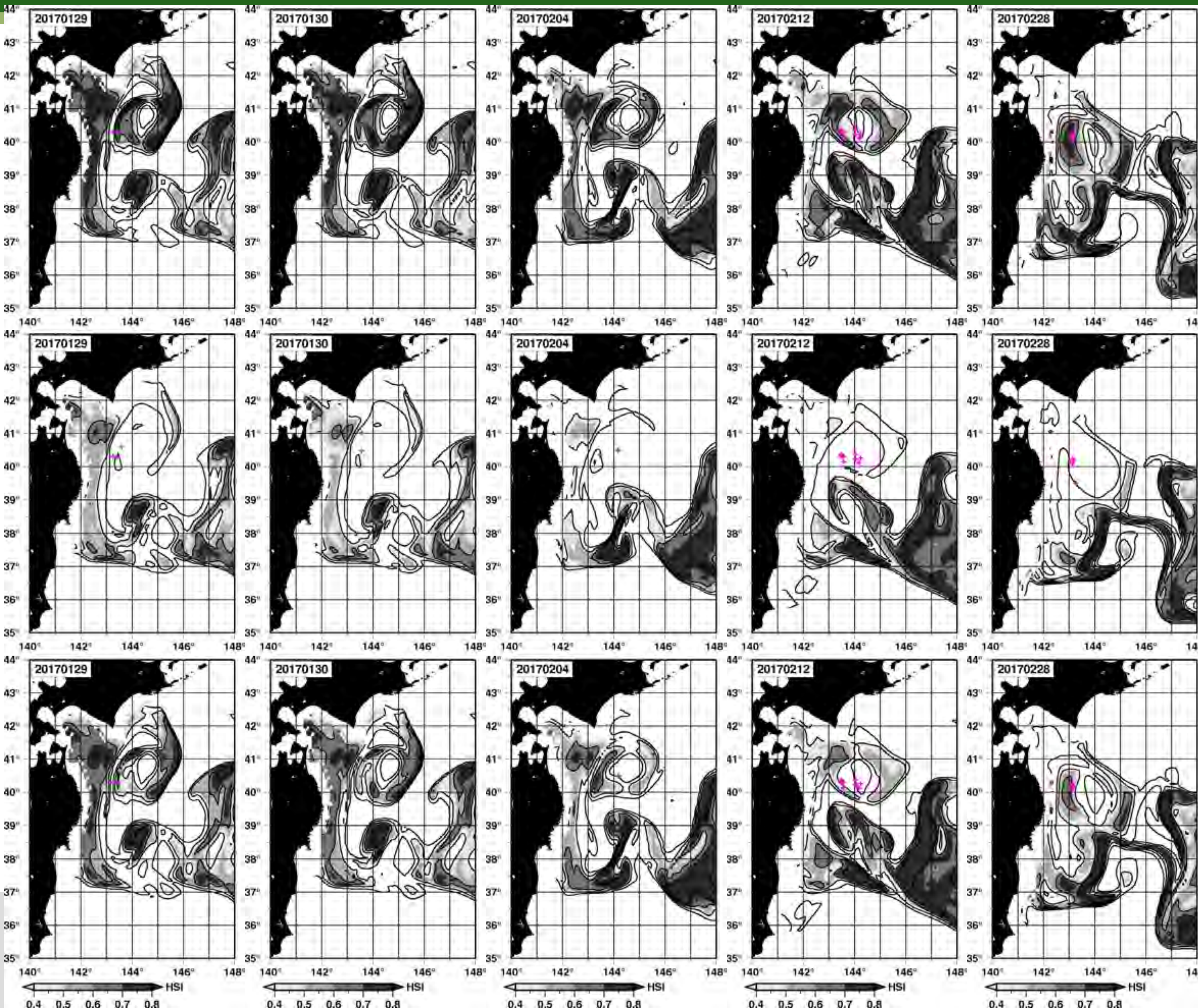


Classification of eddy and non-eddy model

Eddy year
(2002, 2005-06,
2008, 2010-11)

Non-eddy year
(2001, 2003-04,
2007, 2009)

All year model
(2001-2011)



AUC : Training and Testing

Winter (Jan-Feb) MaxEnt models	Temporal coverage	Training AUC (70%)	Testing AUC (30%)
Eddy-year model	**2002,2005-2006, 2008, 2010-11**	**0.919**	**0.918 ±0.004**
Non-eddy-year model	**2001, 2003-04, 2007, 2009**	**0.953**	**0.953 ±0.003**
All-year model	**2001-2011**	**0.925**	**0.932 ±0.003**

Prediction performance when applied to year with characteristic mesoscale conditions (eddy year: Jan-Feb 2017 daily predictions)

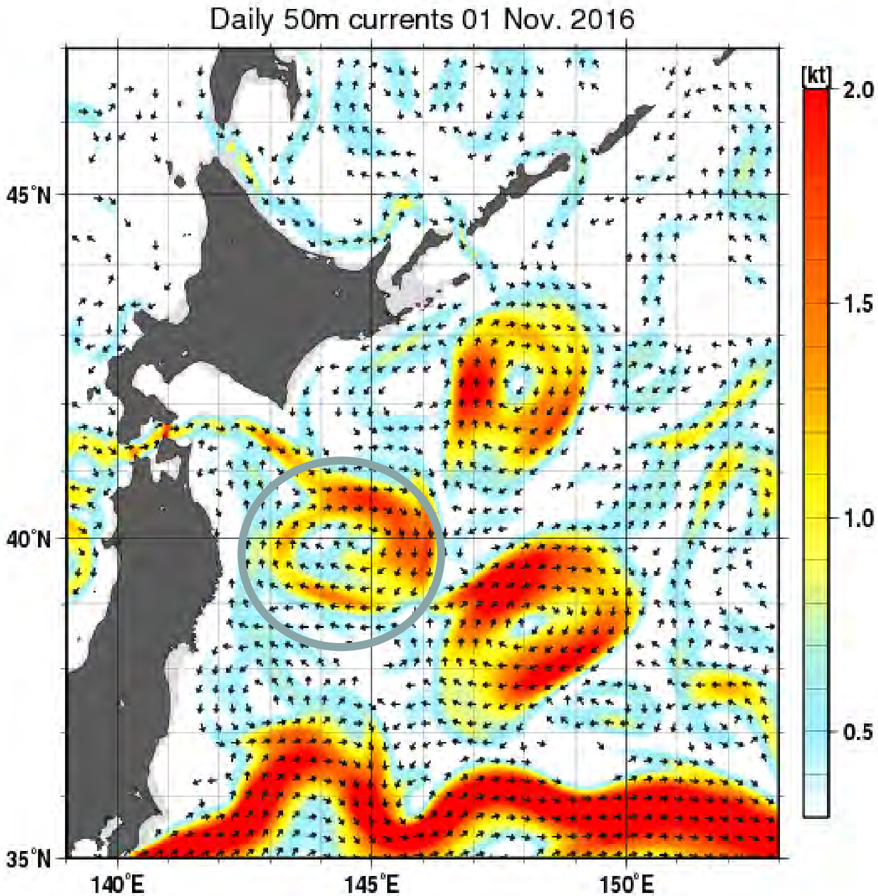
AUC : Eddy-year – Non-eddy year

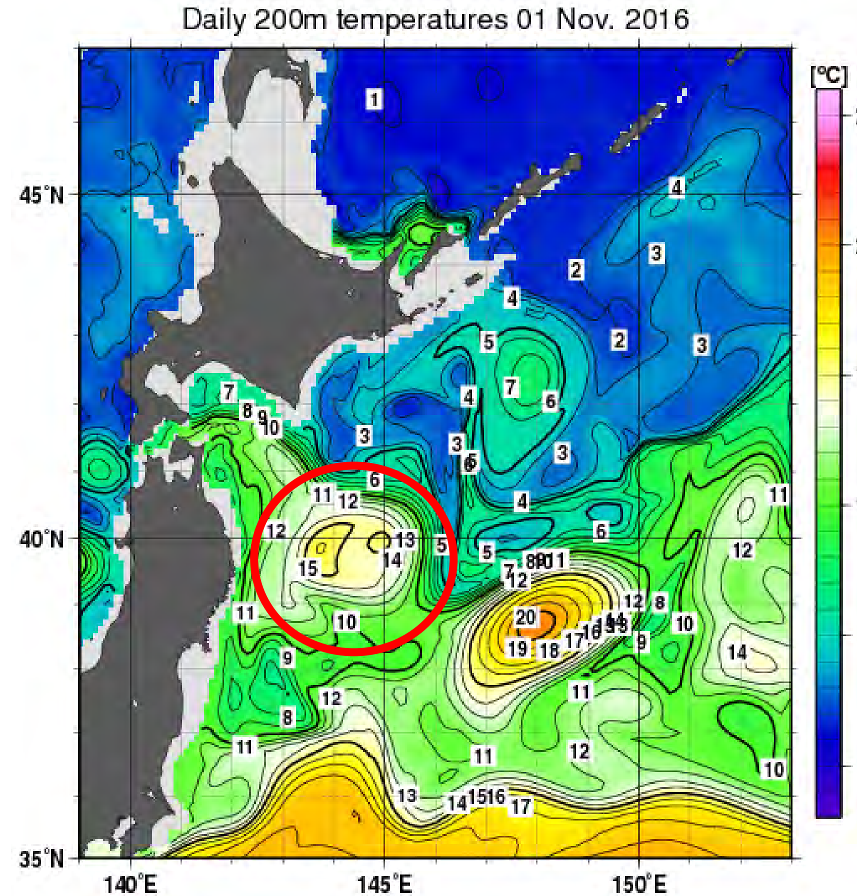
Winter (Jan-Feb) MaxEnt models	AUC	TSS	POD
Eddy-year model	0.903	0.589	1.000
Non-eddy-year model	0.722	-0.026	0.898
All-year model	0.844	0.429	1.000

Model variables: T01 (surface temp: 0.5*-1m), S22 (salinity 330m), SSH, V14 (N-S velocity component 138m) *used for model building (move data); 1m-prediction (JMA data)

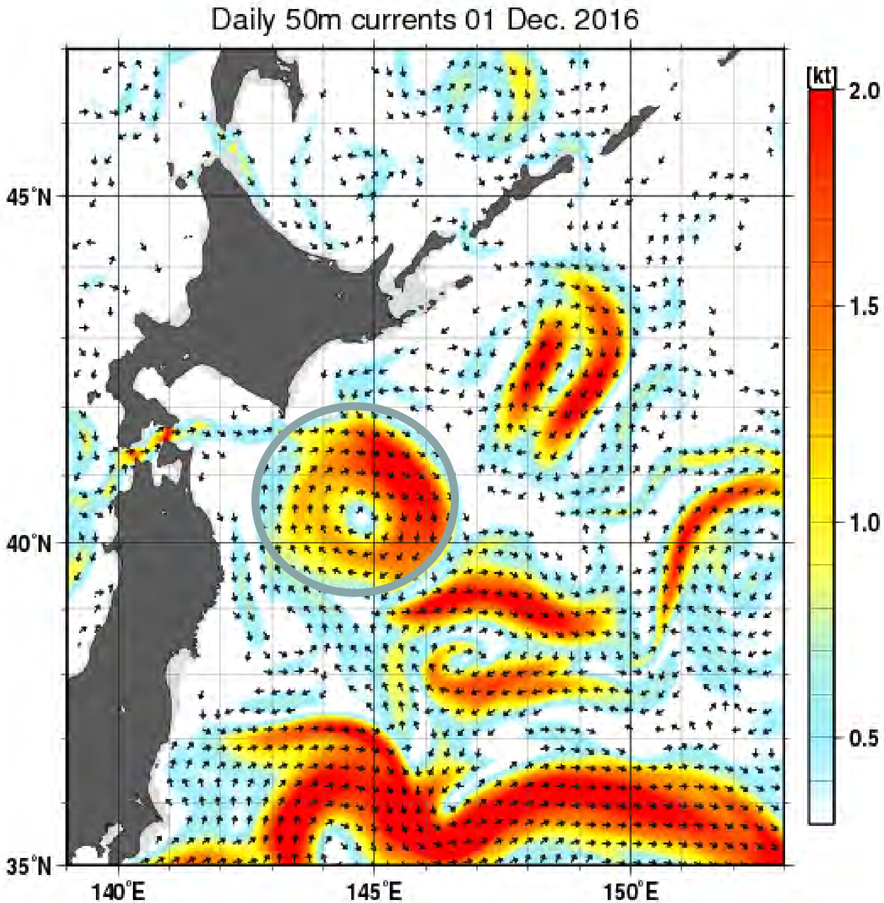
TSS(True Skill Statistic): to evaluate the predictive accuracy of a given species distribution model.

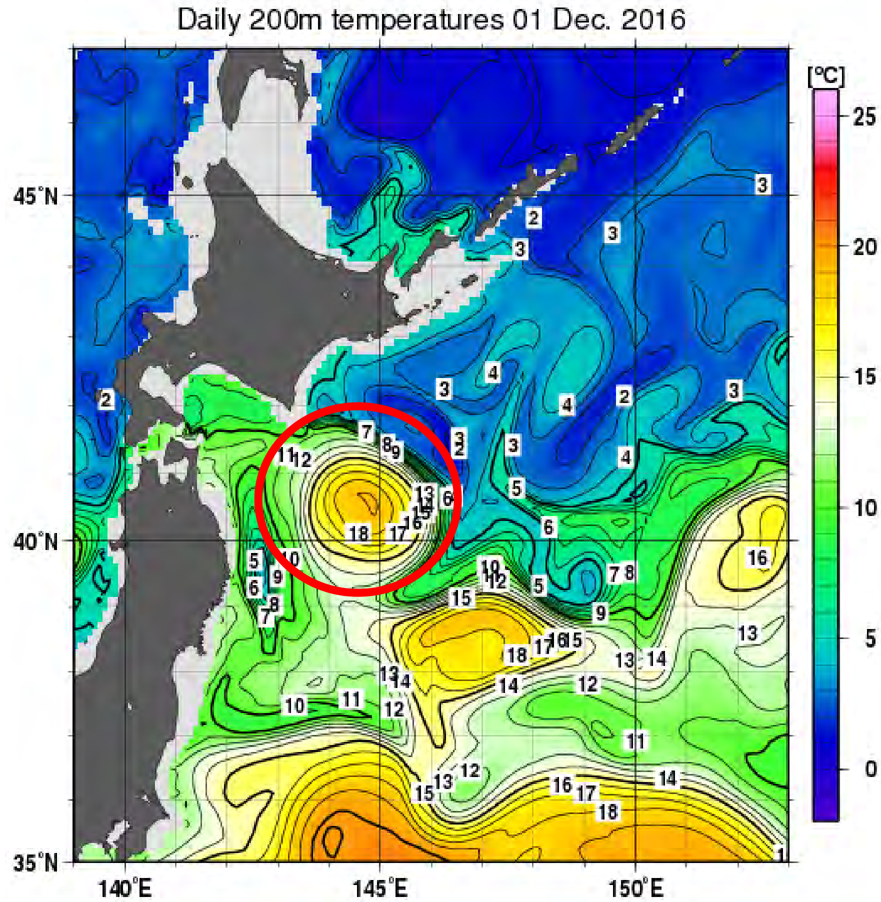
1 NOV. 2016


Daily 50m currents 01 Nov. 2016
[kt]
2.0
1.5
1.0
0.5
45°N
40°N
35°N
140°E
145°E
150°E

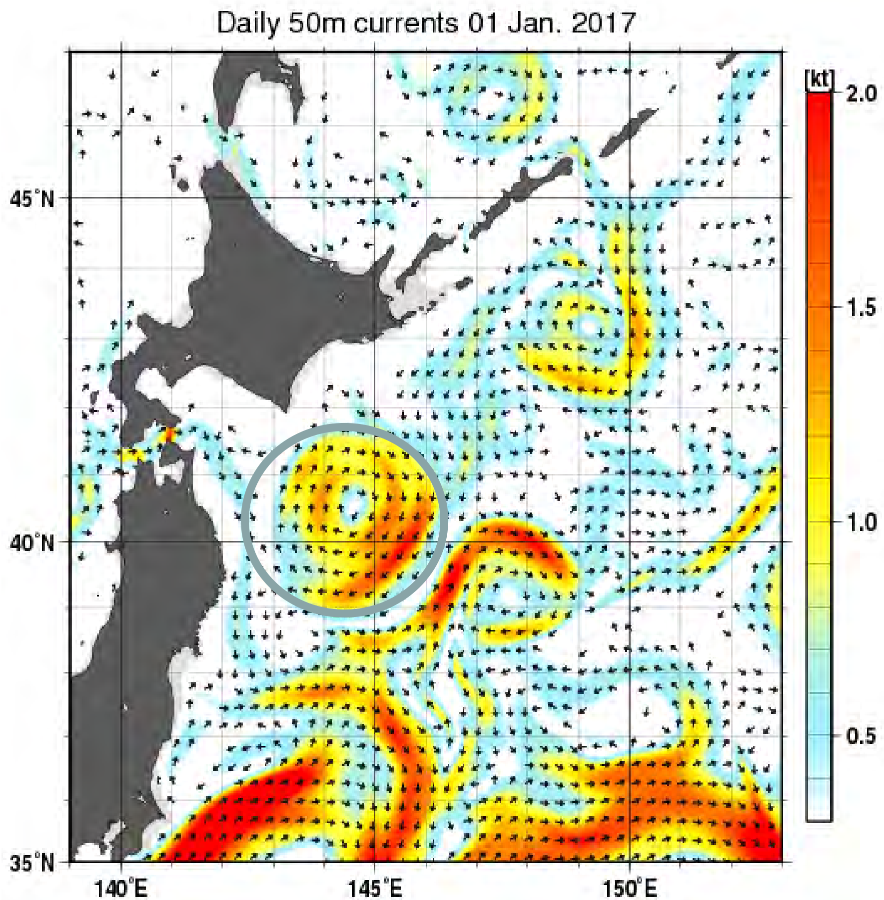

Daily 200m temperatures 01 Nov. 2016
[°C]
25
20
15
10
5
0
45°N
40°N
35°N
140°E
145°E
150°E

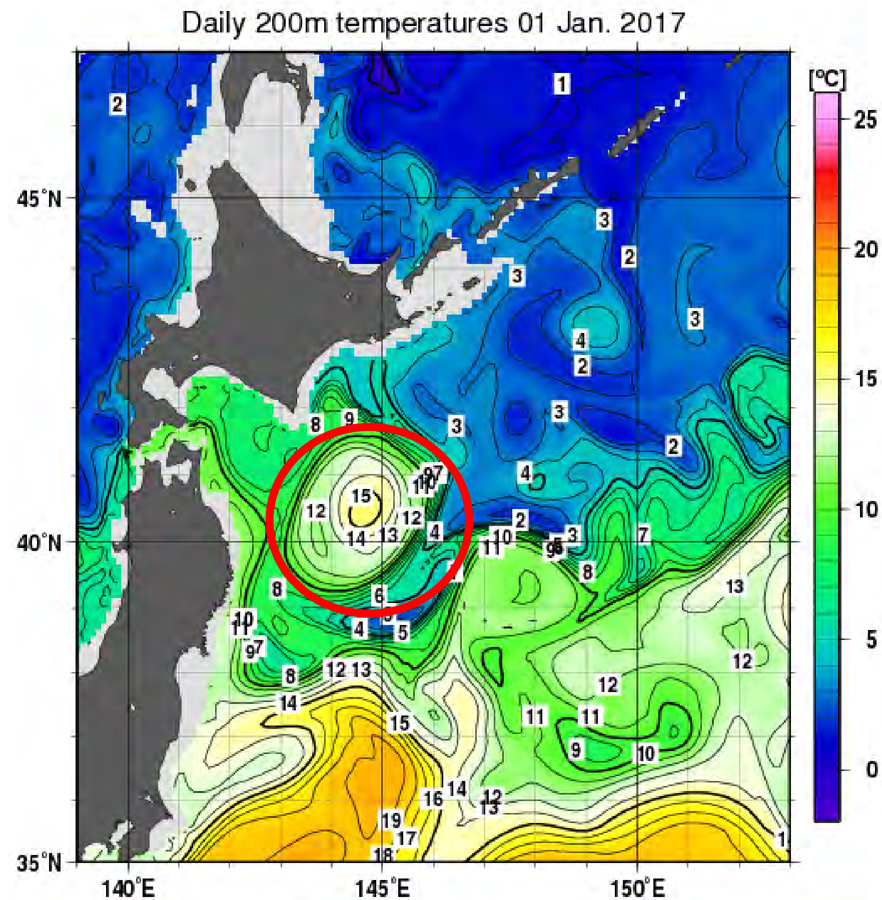
1 DEC. 2016


Daily 50m currents 01 Dec. 2016
[kt]
2.0
1.5
1.0
0.5
45°N
40°N
35°N
140°E
145°E
150°E

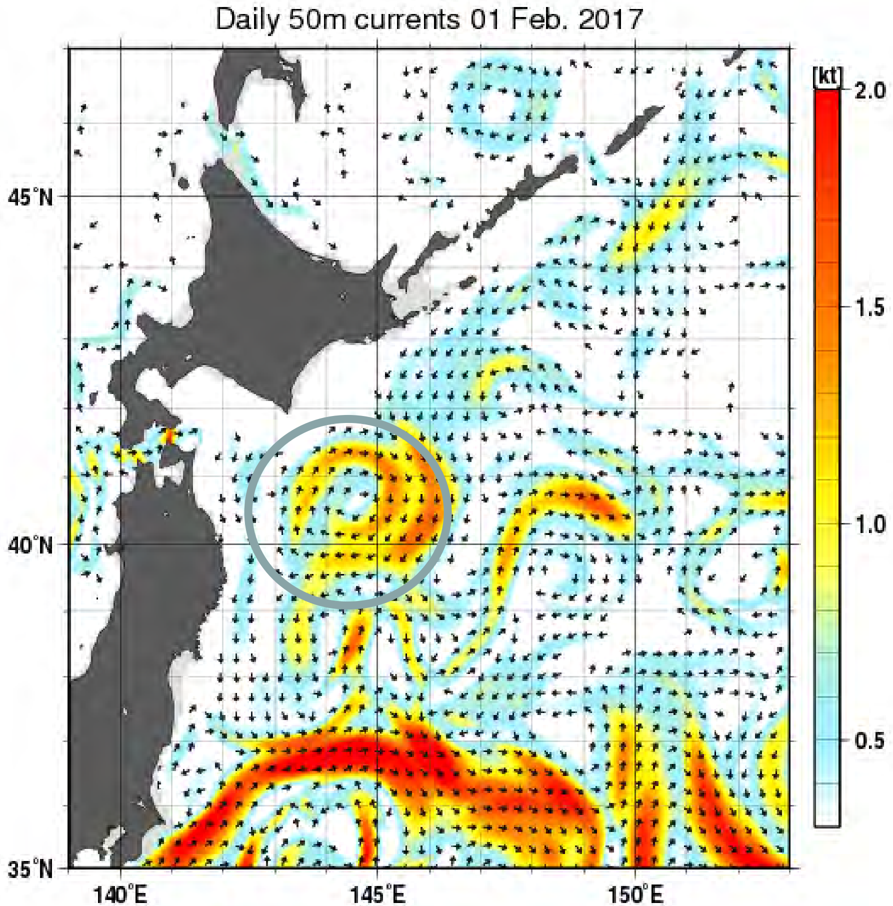

Daily 200m temperatures 01 Dec. 2016
[°C]
25
20
15
10
5
0
45°N
40°N
35°N
140°E
145°E
150°E

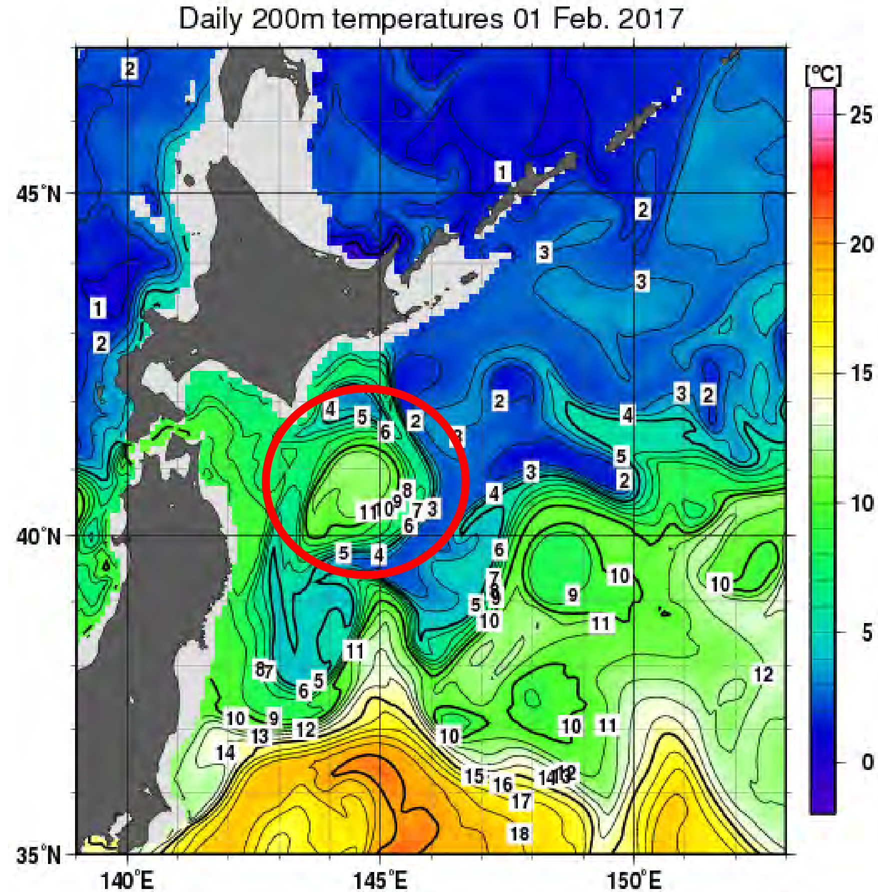
1 JAN. 2017


Daily 50m currents 01 Jan. 2017
[kt]
2.0
1.5
1.0
0.5
45°N
40°N
35°N
140°E
145°E
150°E

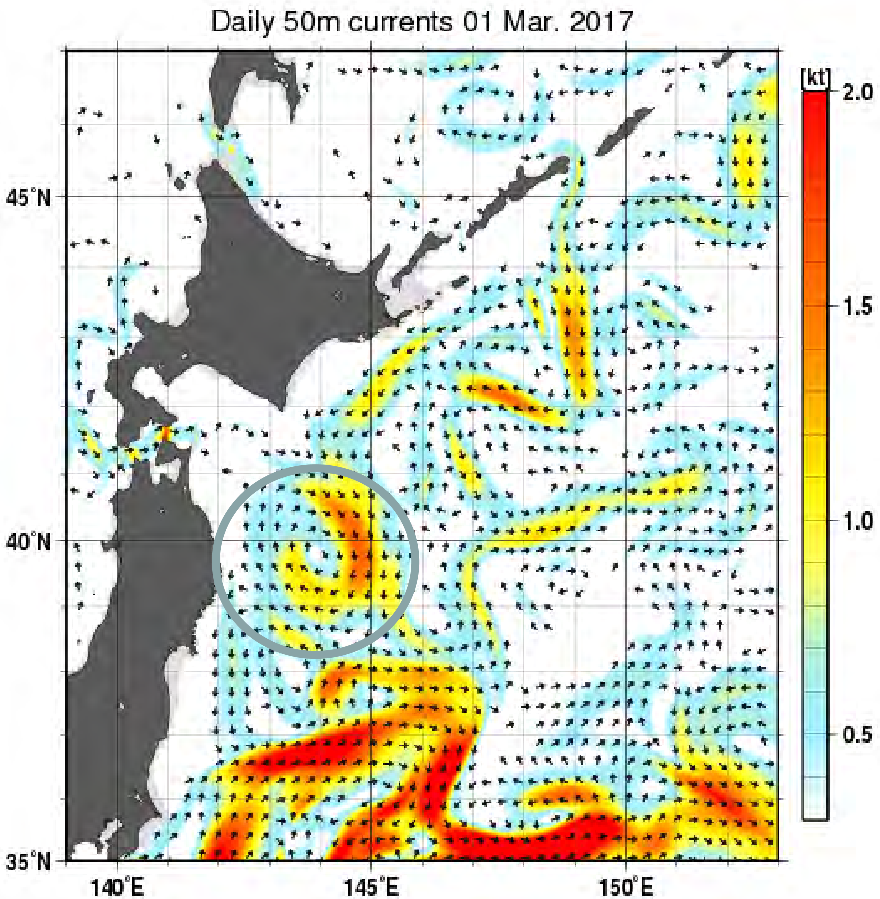

Daily 200m temperatures 01 Jan. 2017
[°C]
25
20
15
10
5
0
45°N
40°N
35°N
140°E
145°E
150°E

1 FEB. 2017

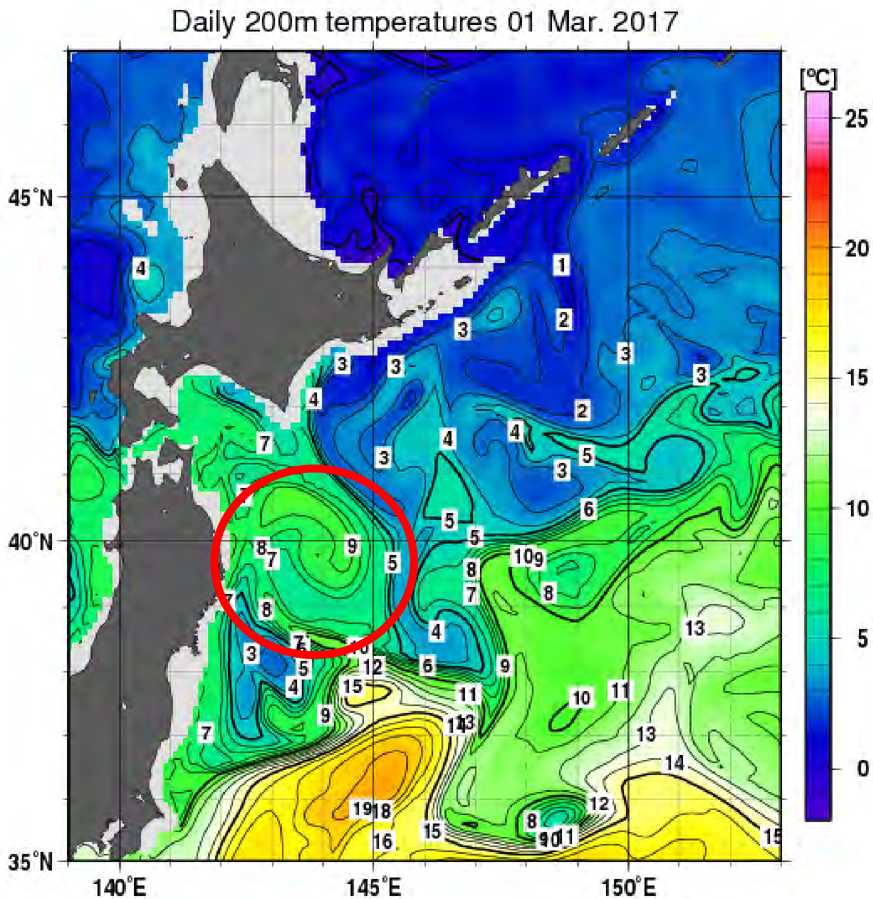

Daily 50m currents 01 Feb. 2017
[kt]
2.0
1.5
1.0
0.5
45°N
40°N
35°N
140°E
145°E
150°E


Daily 200m temperatures 01 Feb. 2017
[°C]
25
20
15
10
5
0
45°N
40°N
35°N
140°E
145°E
150°E

1 MAR. 2017

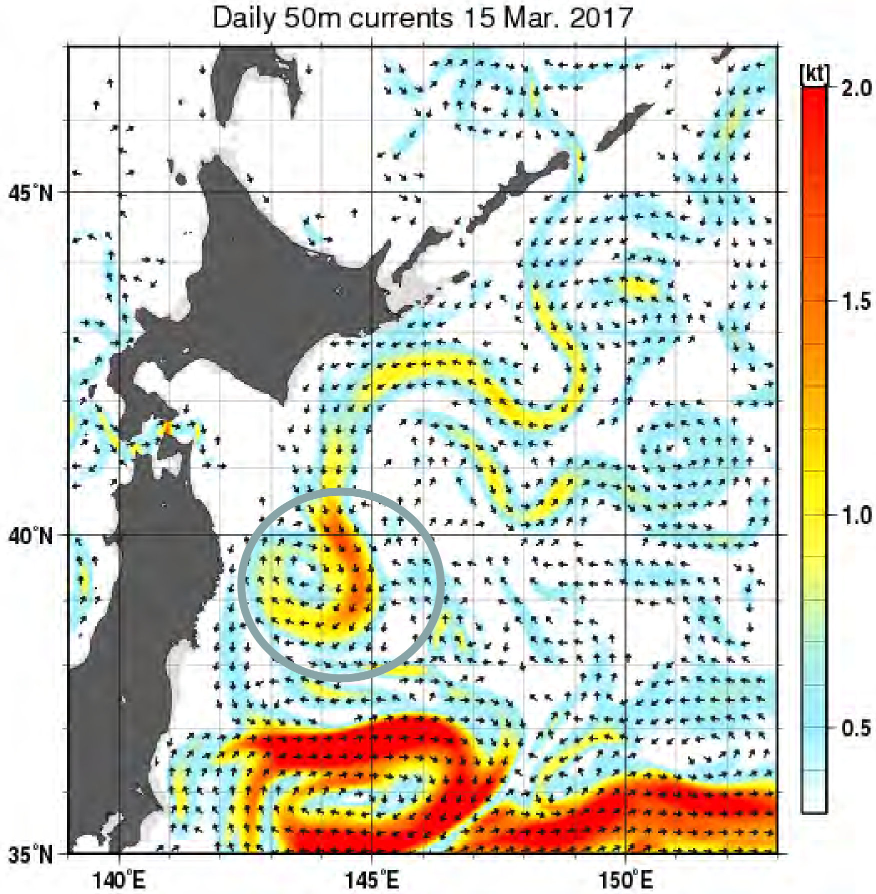


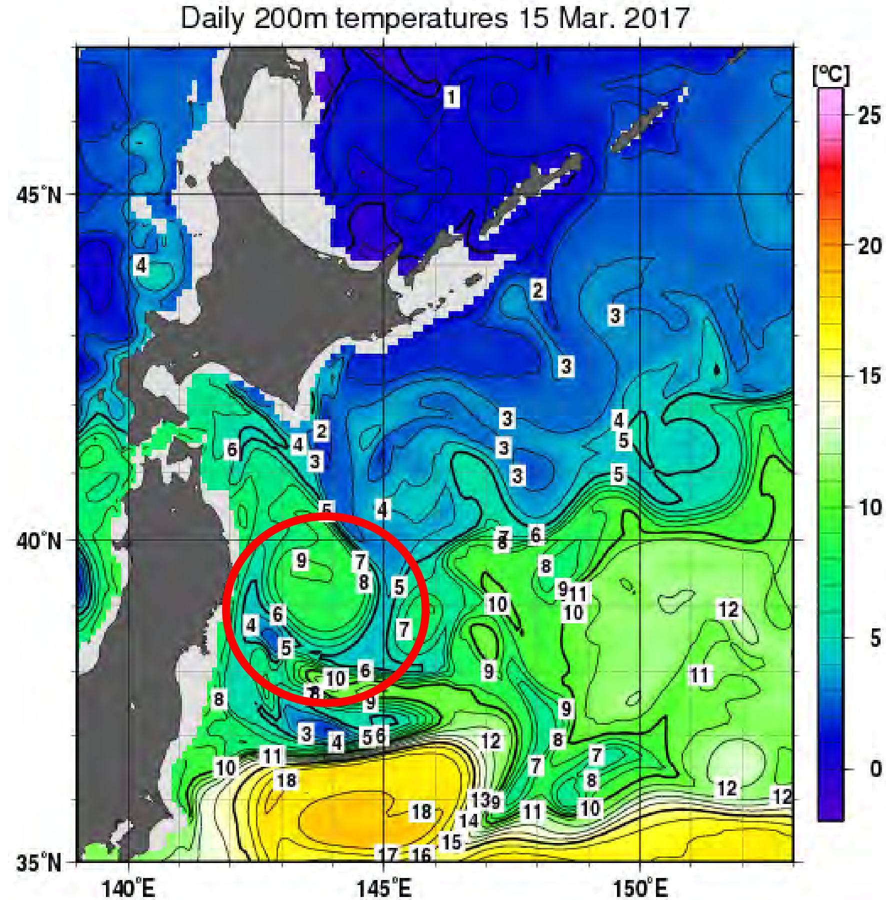
Daily 50m currents 01 Mar. 2017
[kt]
2.0
1.5
1.0
0.5
45°N
40°N
35°N
140°E
145°E
150°E



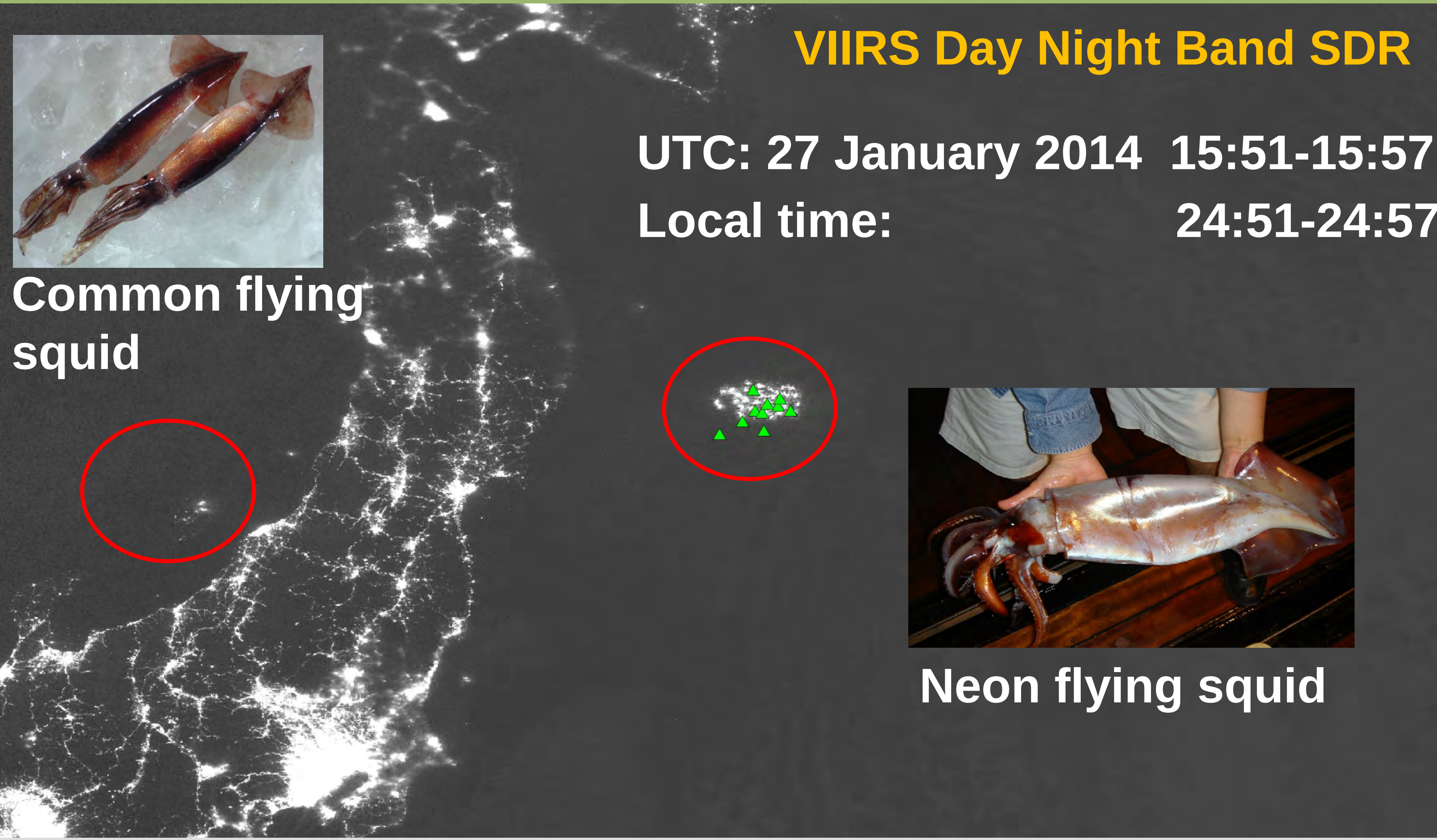
Daily 200m temperatures 01 Mar. 2017
[°C]
25
20
15
10
5
0
45°N
40°N
35°N
140°E
145°E
150°E

15MAR. 2017


Daily 50m currents 15 Mar. 2017
[kt]
2.0
1.5
1.0
0.5
45°N
40°N
35°N
140°E
145°E
150°E

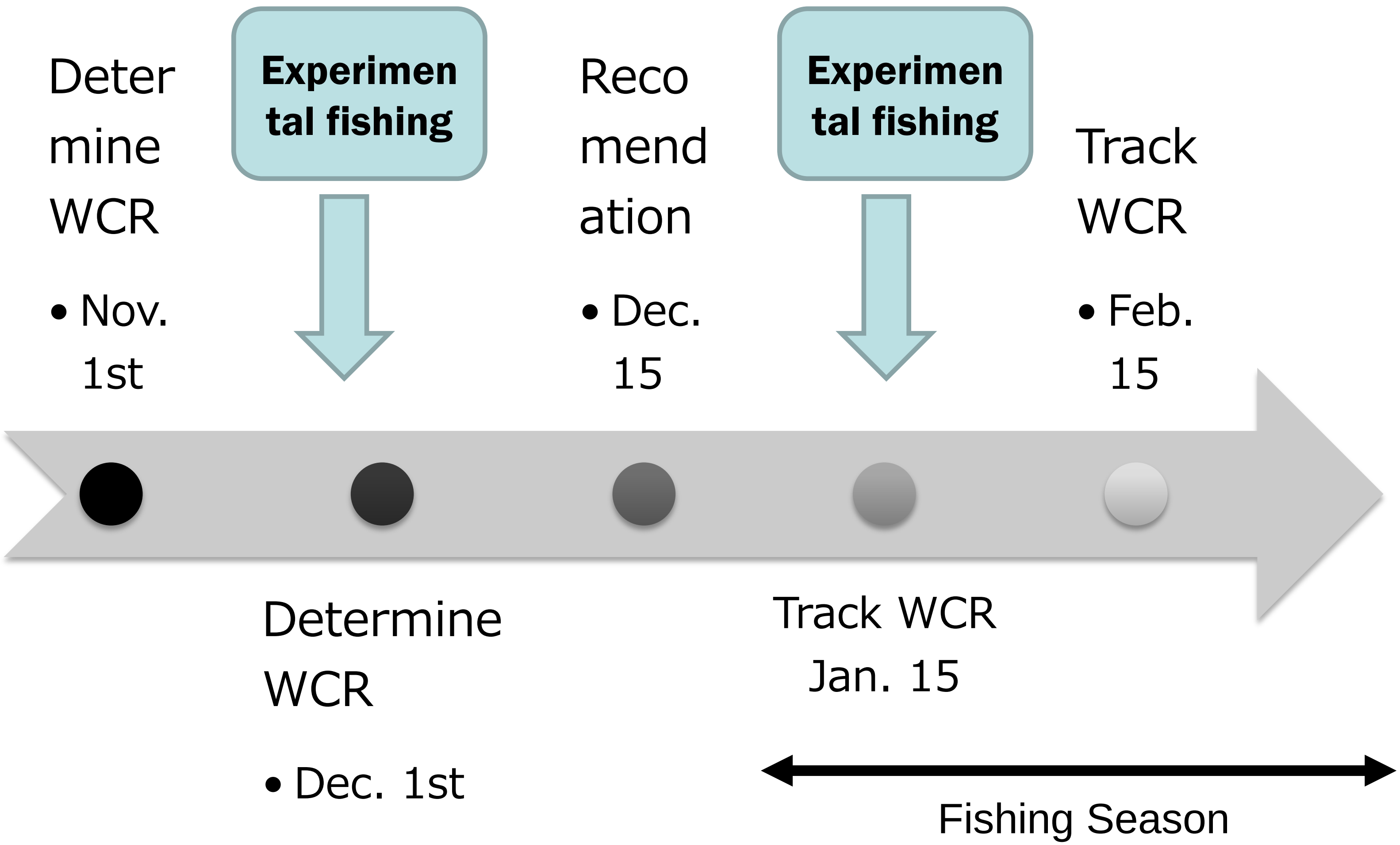

Daily 200m temperatures 15 Mar. 2017
[°C]
25
20
15
10
5
0
45°N
40°N
35°N
140°E
145°E
150°E

Decision making : To go or not to go



▲ Reported location of fishing vessel for Neon flying squid

Practical procedure for potential fishing zone prediction



Concluding remarks

- **We propose a practical procedure to use synchronize the model for eddy year or non-eddy year.**
- **In the case of 2017, eddy year, in advance two months before fishing season, we can identify eddy develop or eddy non-develop.**
- **We can advise fisher to decide to go to off Sanriku to catch neon flying squid, not to go to Japan Sea to catch common flying squid as fishing strategy.**
- **This practical procedure could be useful for economic catch planning and tactical fisheries activities management.**

Thank you for your attention!