October 23, 11:20–11:40

Simulated primary production in the **Kuroshio Extension** under the influence of the **global warming**

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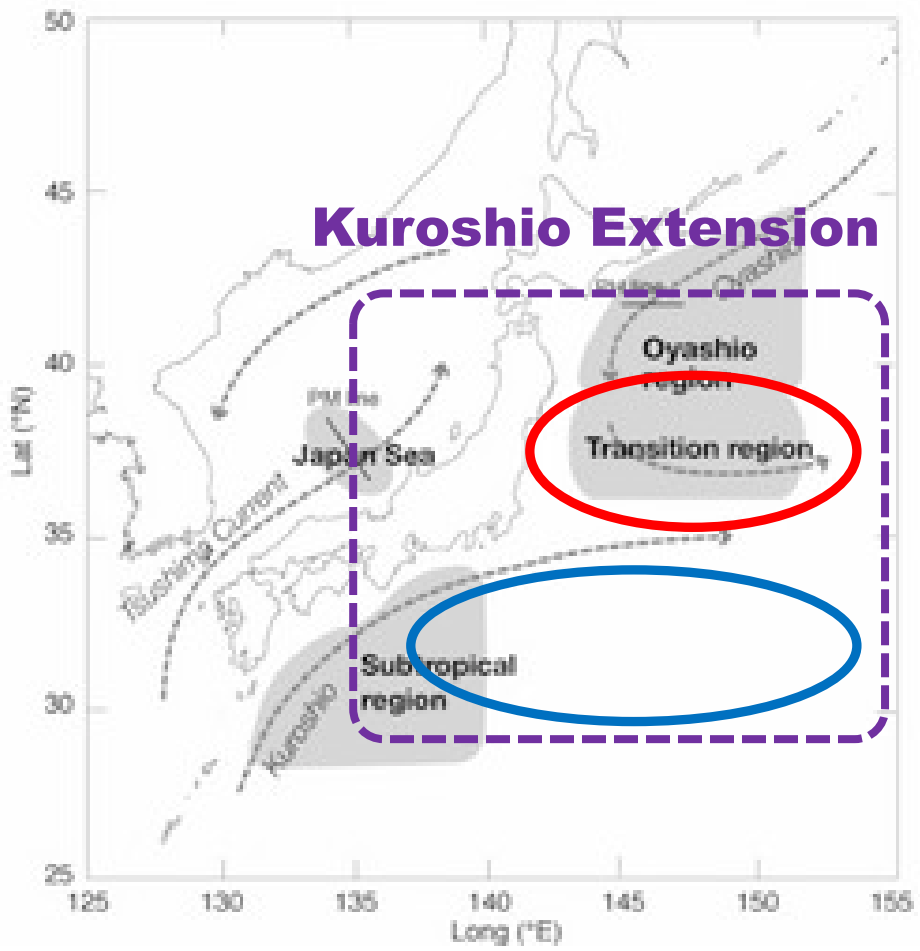
Introduction



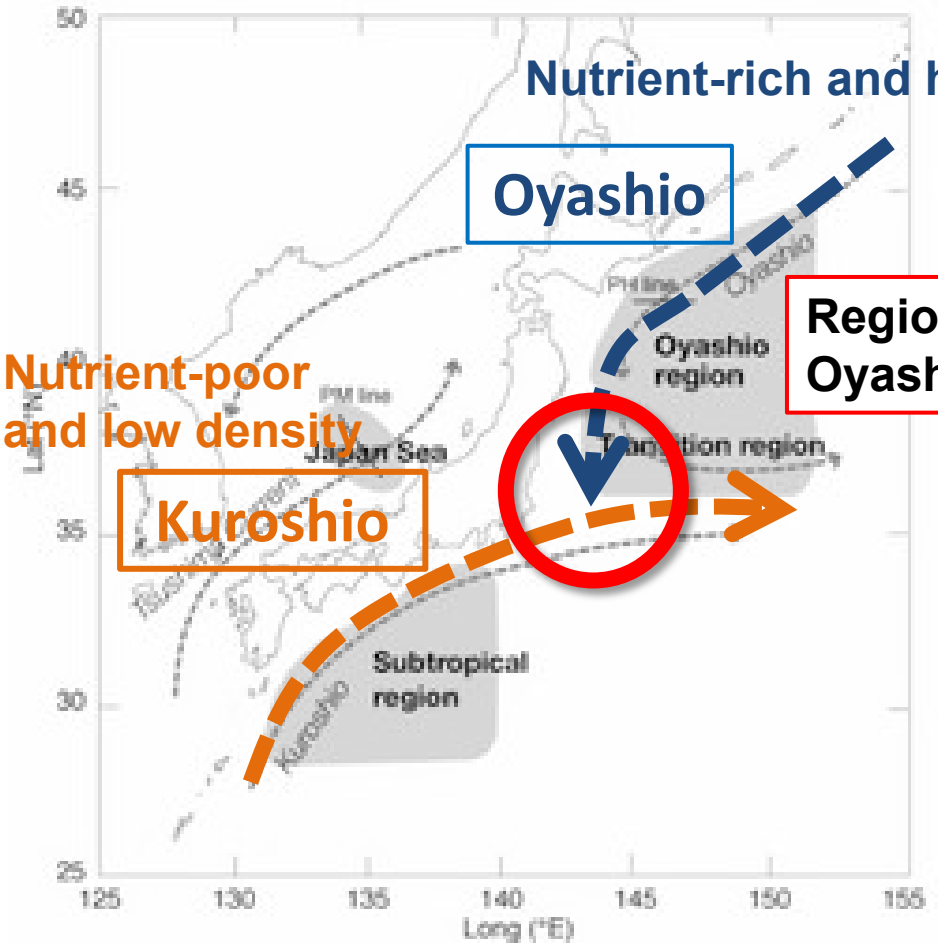
Kuroshio-Oyashio transition region

Between the Kuroshio front and the Oyashio front

Kuroshio recirculation region

South the Kuroshio front

Introduction



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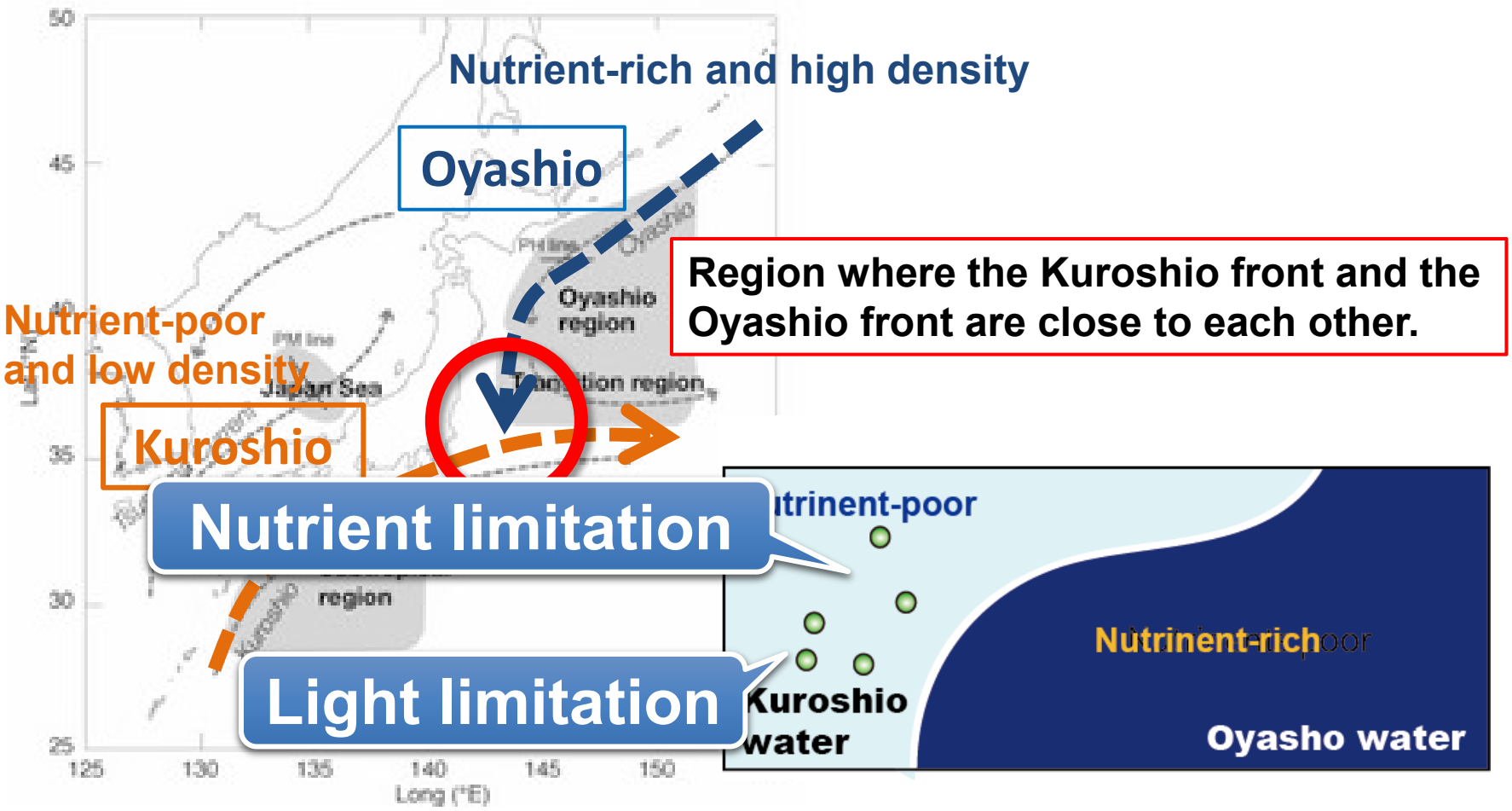

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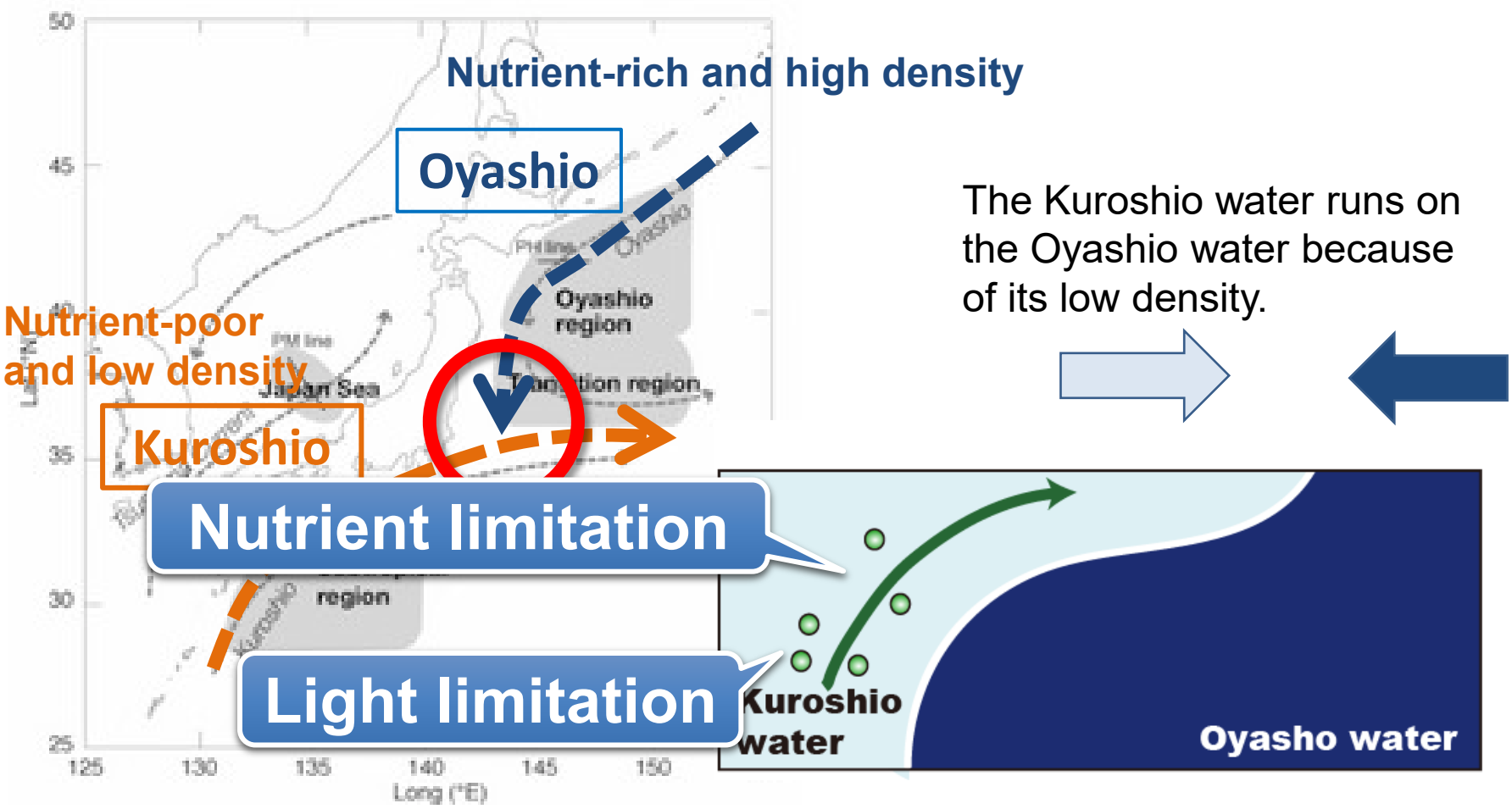

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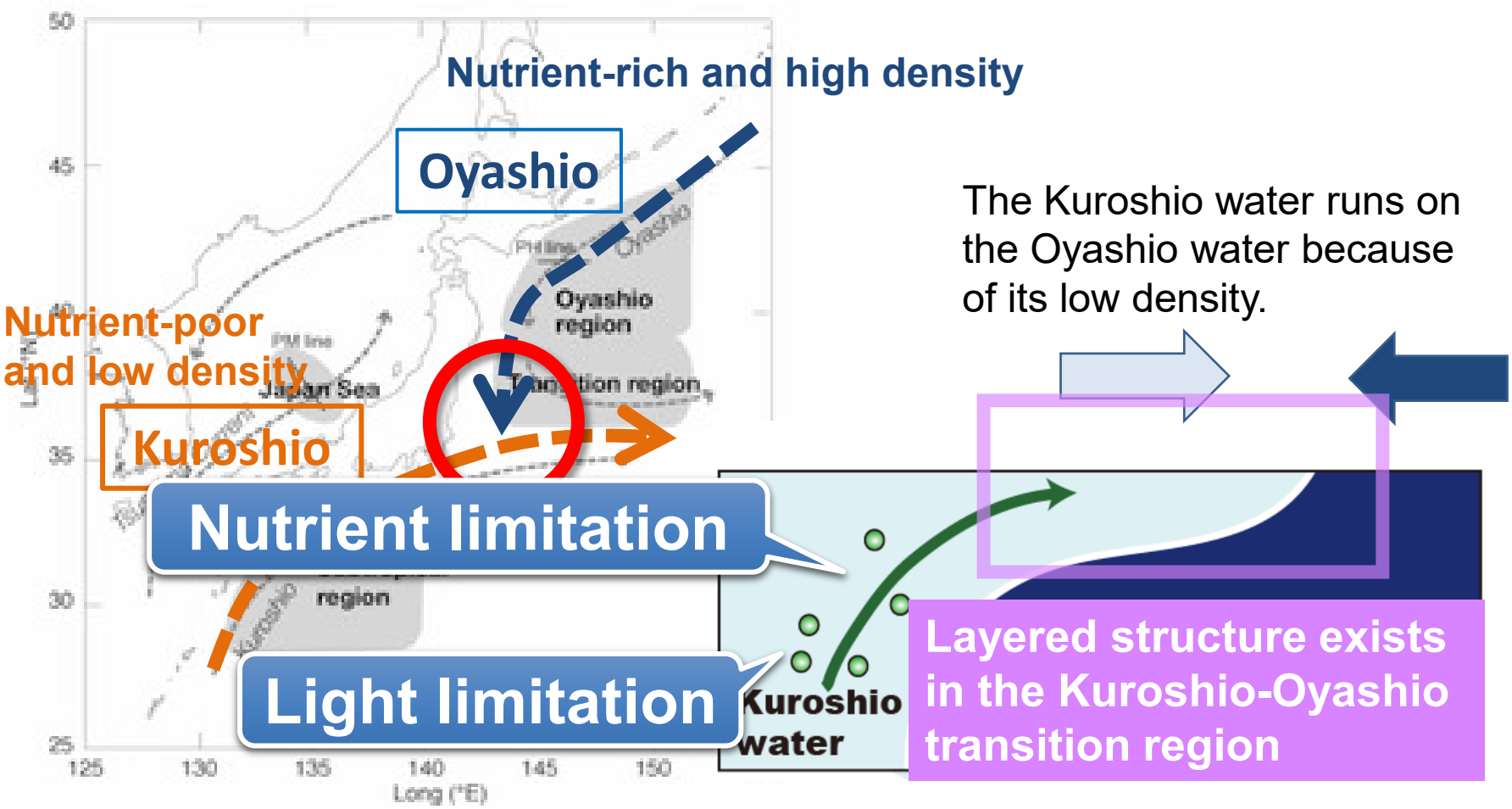
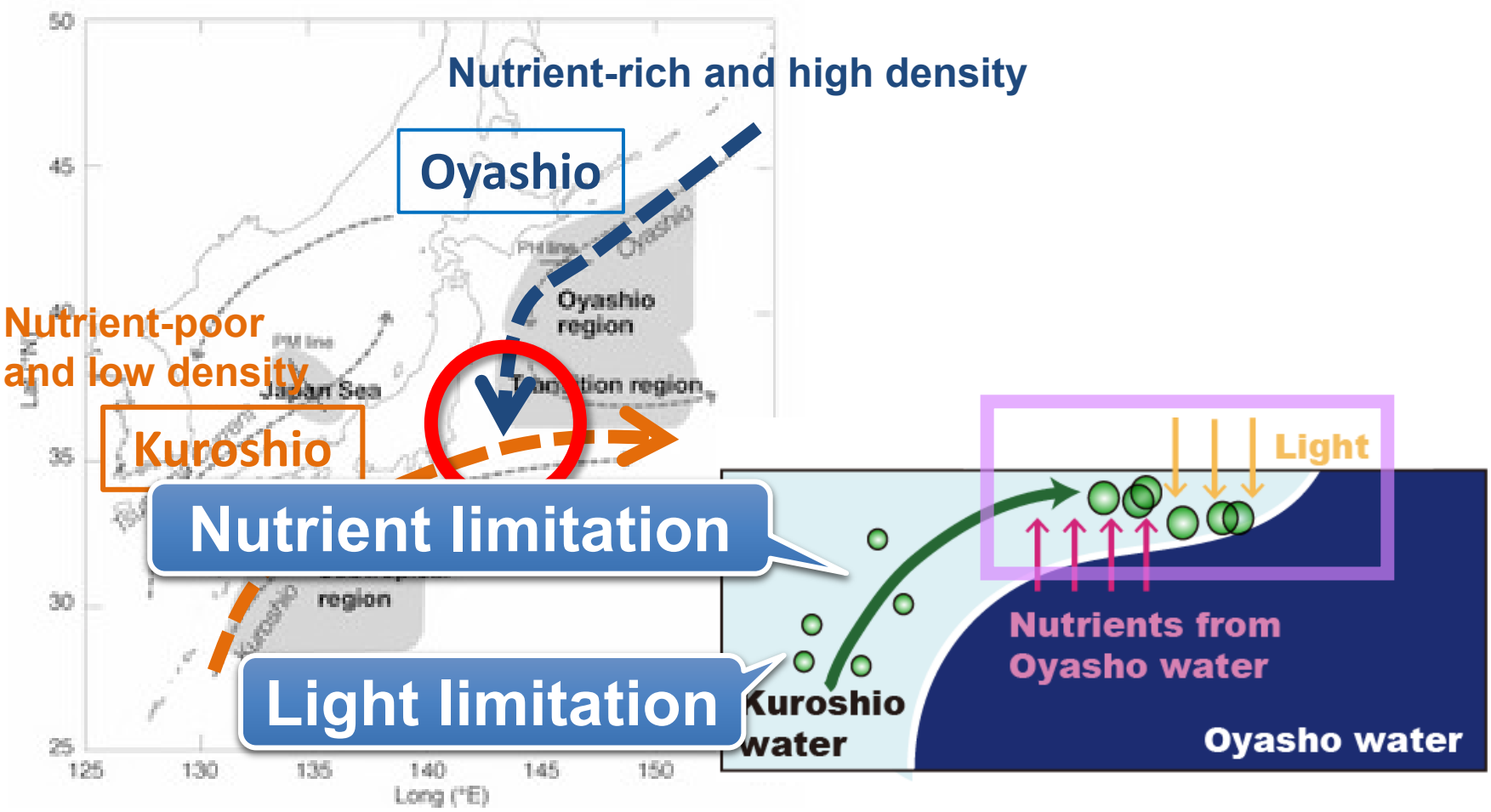


The Kuroshio water runs on the Oyashio water because of its low density.

Layered structure exists in the Kuroshio-Oyashio transition region

Introduction



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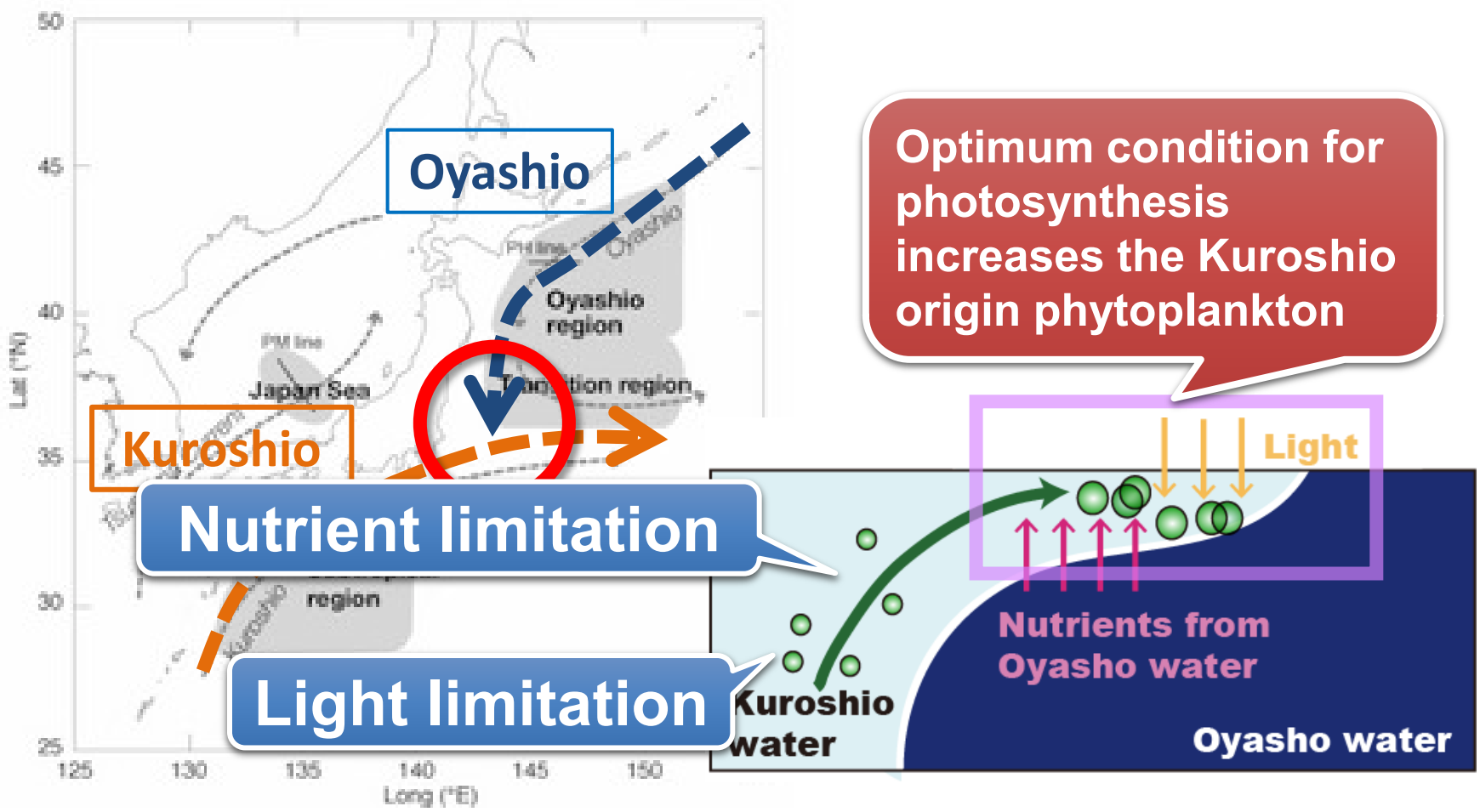
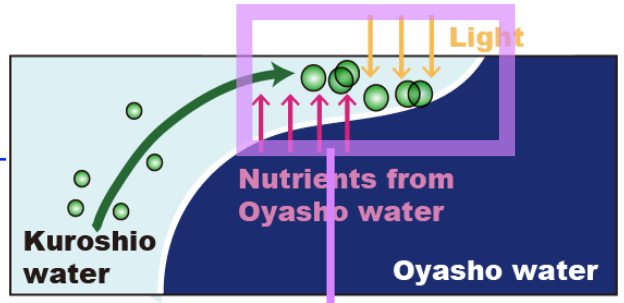
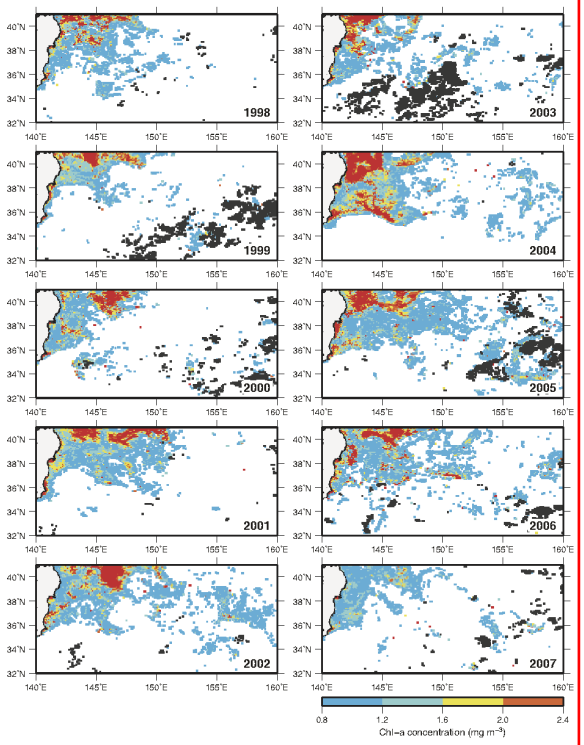


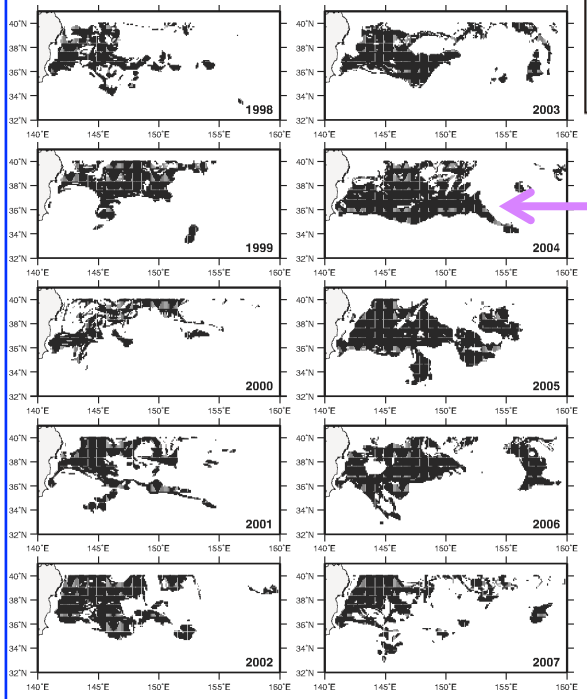
Relationship between the layered structure and the primary production in the KOTR



April–May



Distribution of **high chlorophyll-a density** (< 0.8 mg/m^3) area from 1998 to 2007



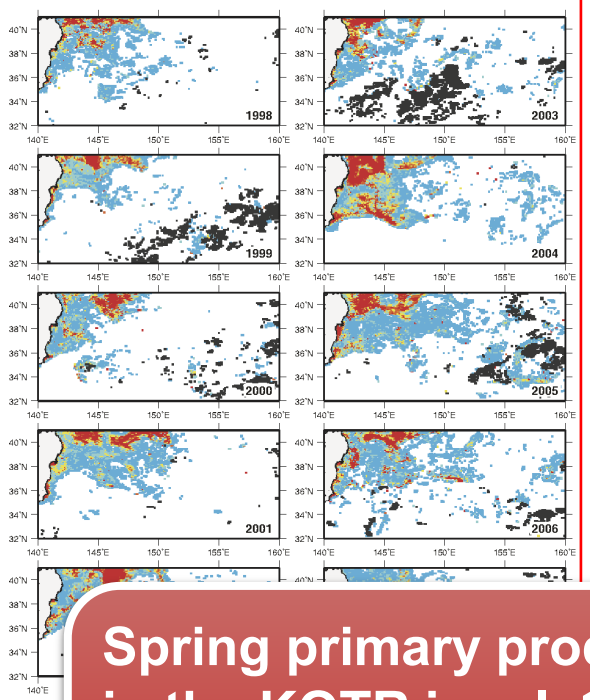
Distribution of **layered structure** from 1998 to 2007

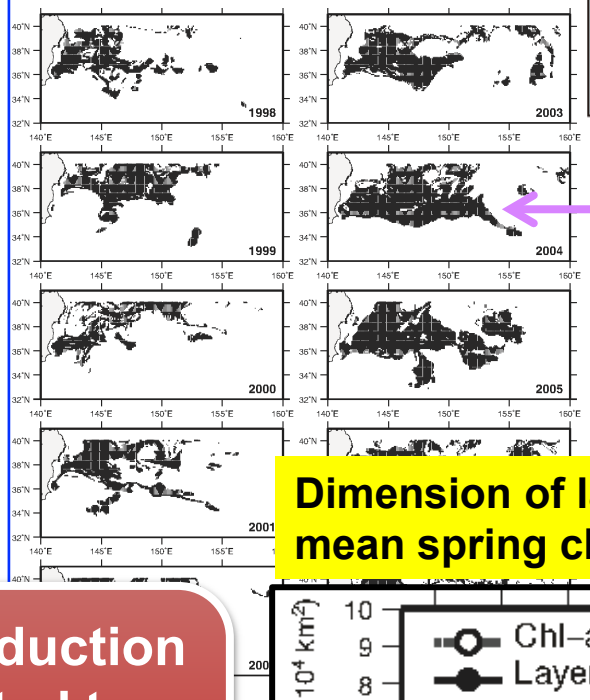
Each distribution resembles each other

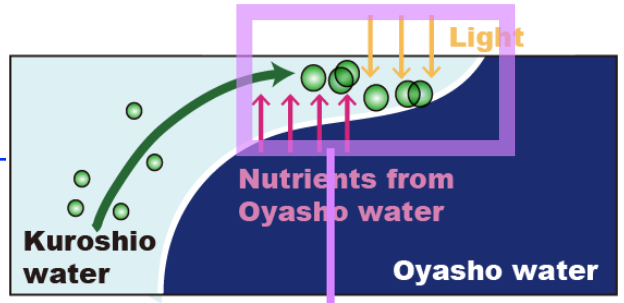
Nishikawa et al. (2016)

Relationship between the layered structure and the primary production in the KOTR

April–May





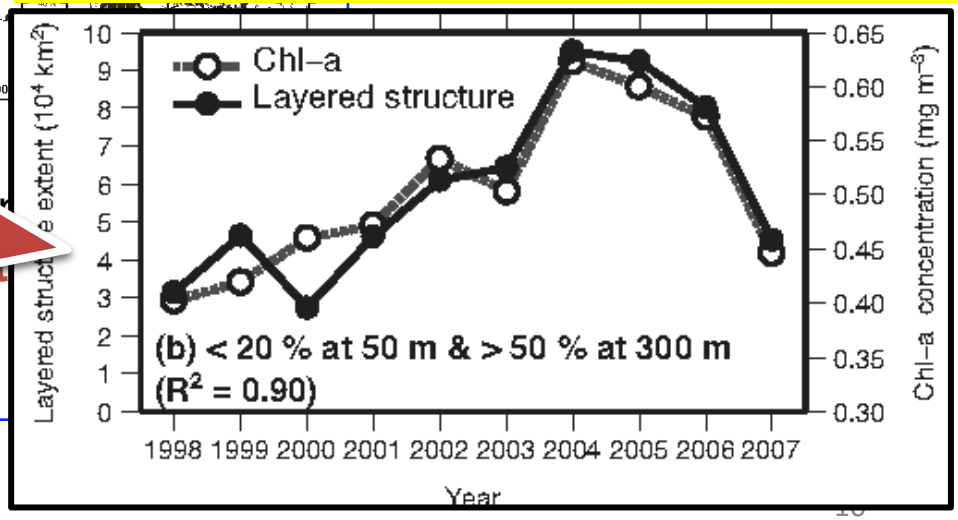


Dimension of layered structure and the box mean spring chlorophyll-a density in the KOTR.

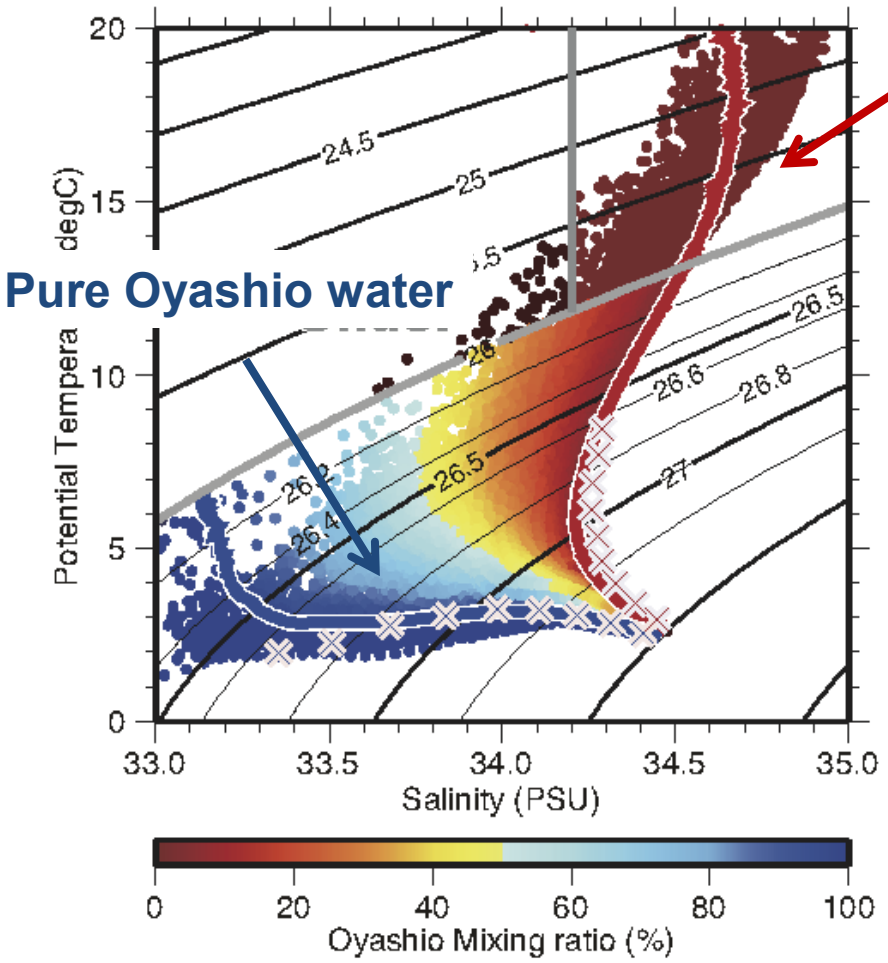
Spring primary production in the KOTR is related to the distribution of the layered structure.

D
c
(< 0.8 mg/m^3) area
from 1998 to 2007

from 1998



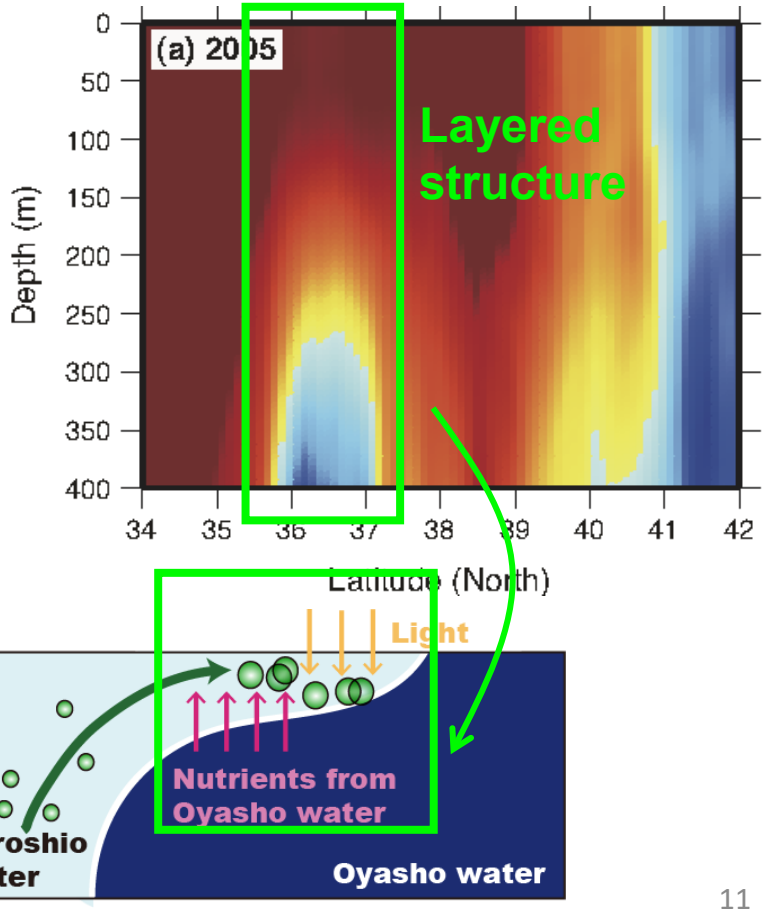
How to detect the layered structure



Definition of layered structure

Oyashio mixing ratio < 20% at 50m

Oyashio mixing ratio > 50% at 300m



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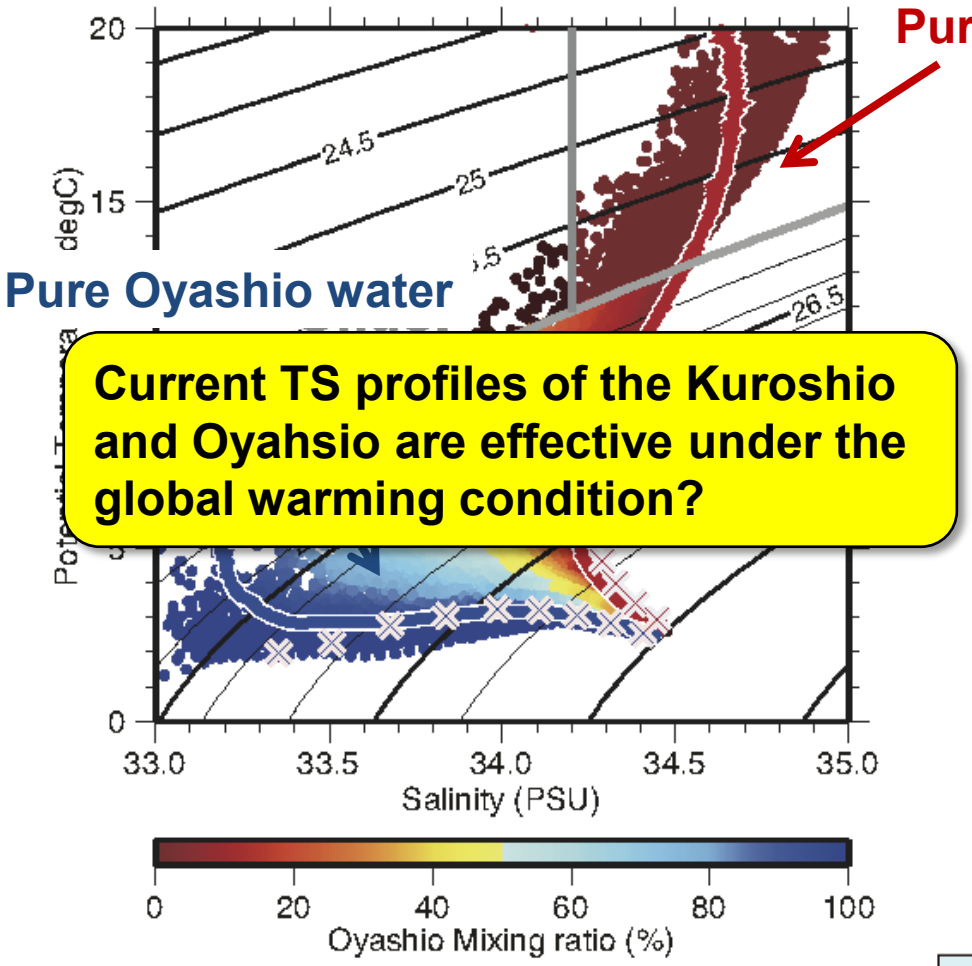

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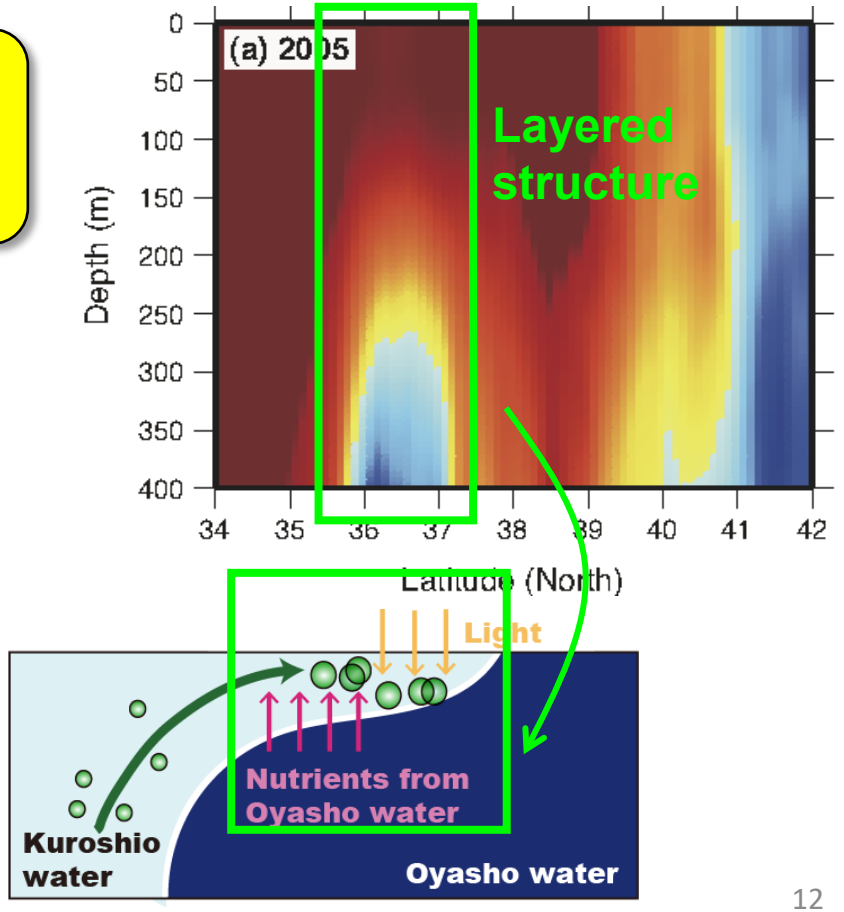
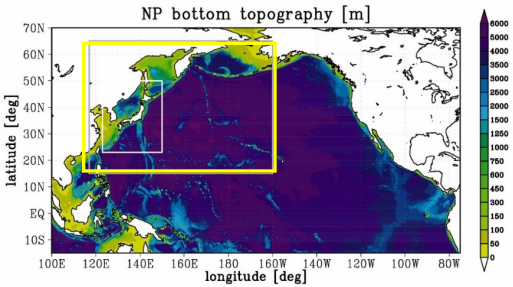


Purpose of this study

- **Redefine the Kuroshio and Oyashio TS profiles on the basis of the results of global warming simulations.**
- **Estimate the distribution of the layered structure by using newly defined the Kurohsio and Oyashio profiles for discussing the future primary production in the KOTR.**

Global warming simulation



The meso-scale global warming simulation

We downscaled a series of OGCM experiments of past to future ocean climate projection in the Northwestern Pacific with 10 km resolution.

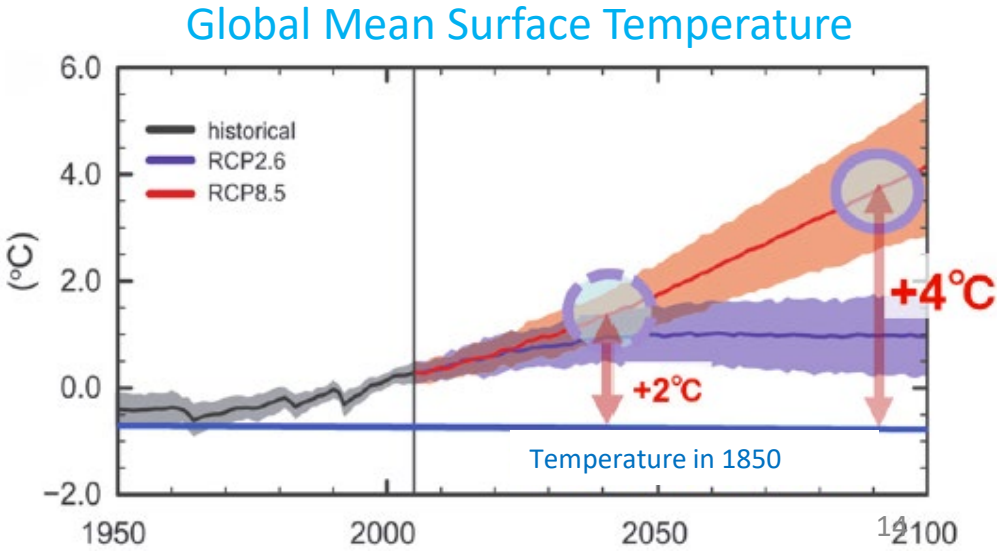
Historical simulation: 1982–2005

Future simulation: 2006–2100

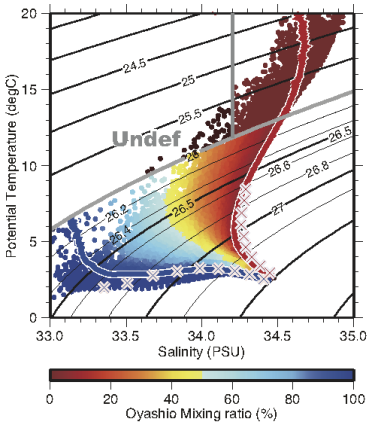
2 models of CMIP5 with **2 RCP scenarios** are chosen for the atmospheric forcing.

RCP2.6 and RCP8.5

MIROC5 (AORI, NIES, JAMSTEC)
MRI-CGCM3 (Meteorological Research Institute JAPAN)



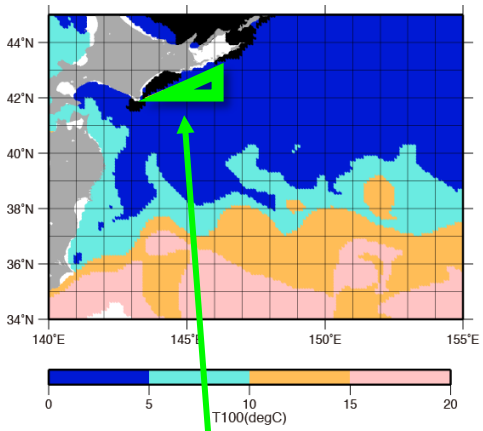
Detection of Kuroshio water and Oyashio water



- **Kuroshio water**

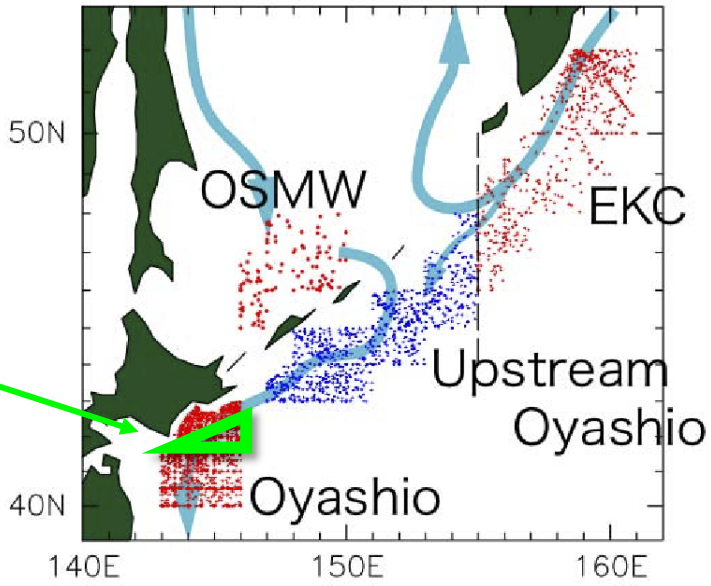
140–160ºE, 0–100 km south from the Kuroshio axis

- **Oyashio water**



General definition of the Oyashio water is the 100 m temperature < 5ºC (Hanawa and Mitsudera, 1986).
But this study, we used **the water from the region near Oyashio formation area** because the Oyashio water temperature and salinity could change by the global warming.
We define the TS profiles each year from 2006 to 2100.

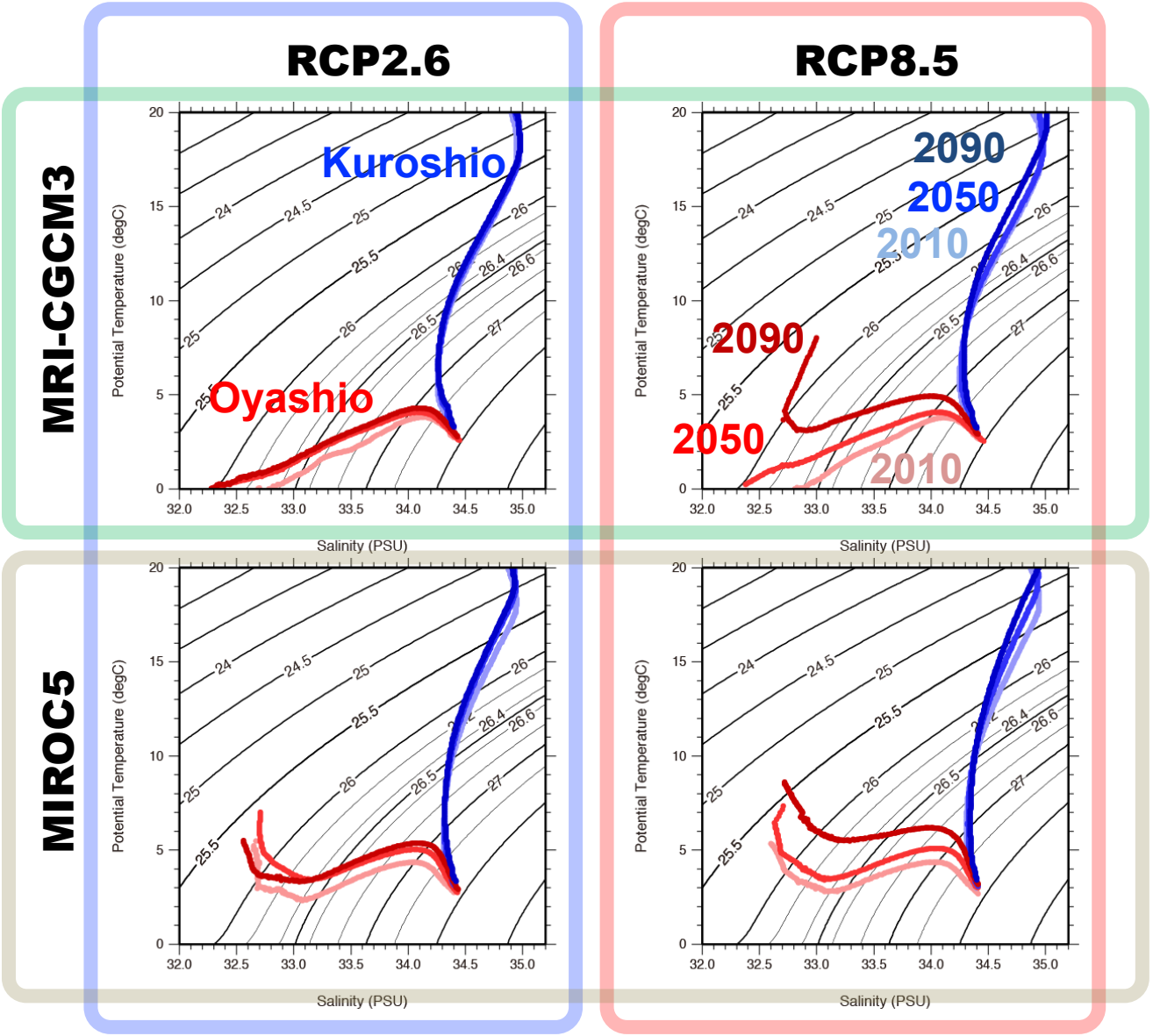
Oyashio water



Oyashio is mixture of Okhotsk Sea Mode Water and East Kamchatka Current.
(Osafune et al., 2006)

Result
Change of TS profiles for the Kuroshio and Oyashio waters

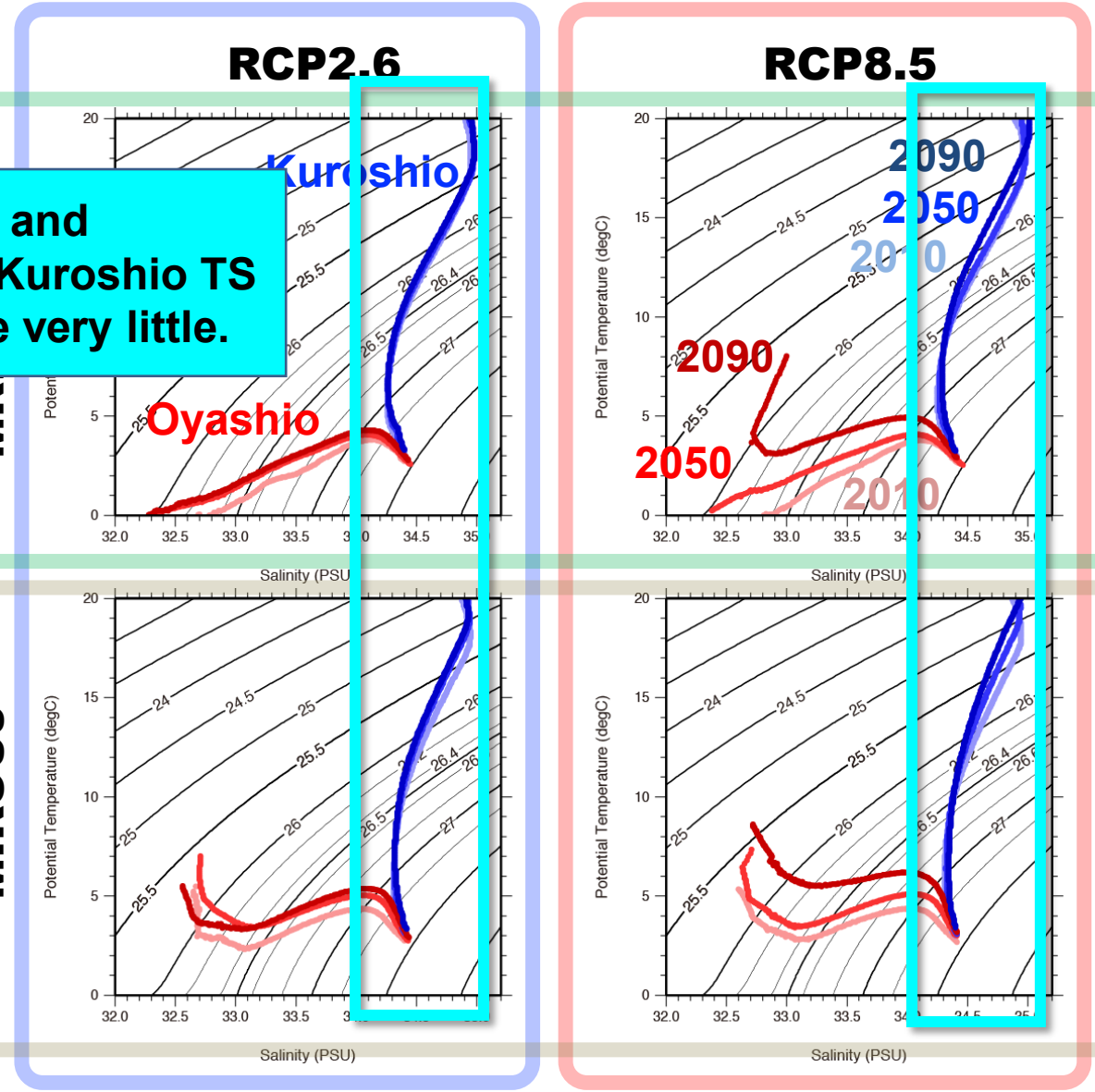
April



Result
Change of TS profiles for the Kuroshio and Oyashio waters

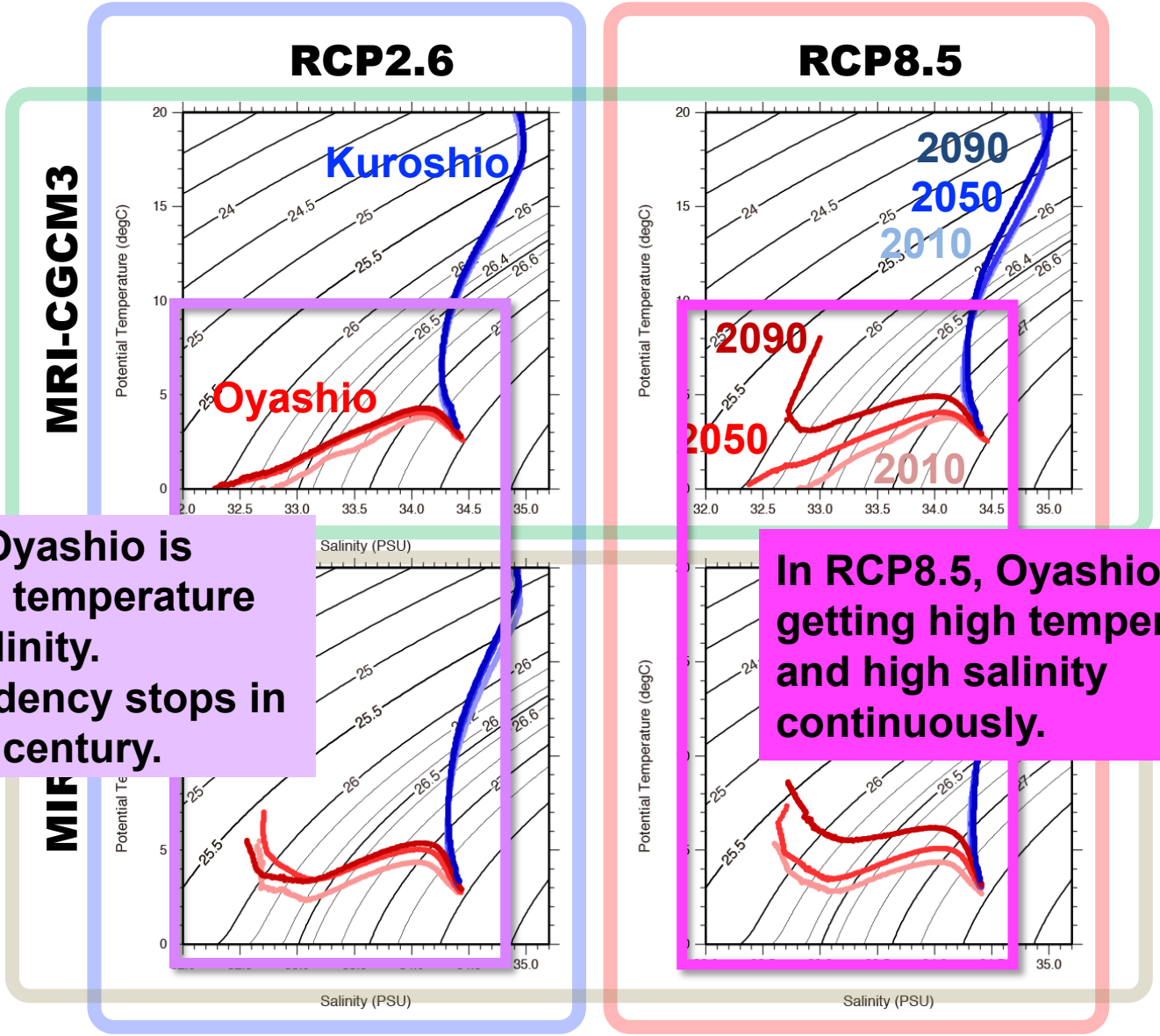
April

In both models and scenarios, the Kuroshio TS profiles change very little.



Result
Change of TS profiles for the Kuroshio and Oyashio waters

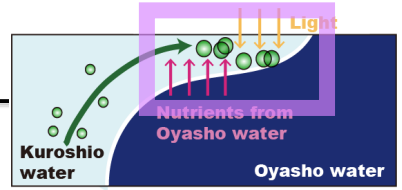
April

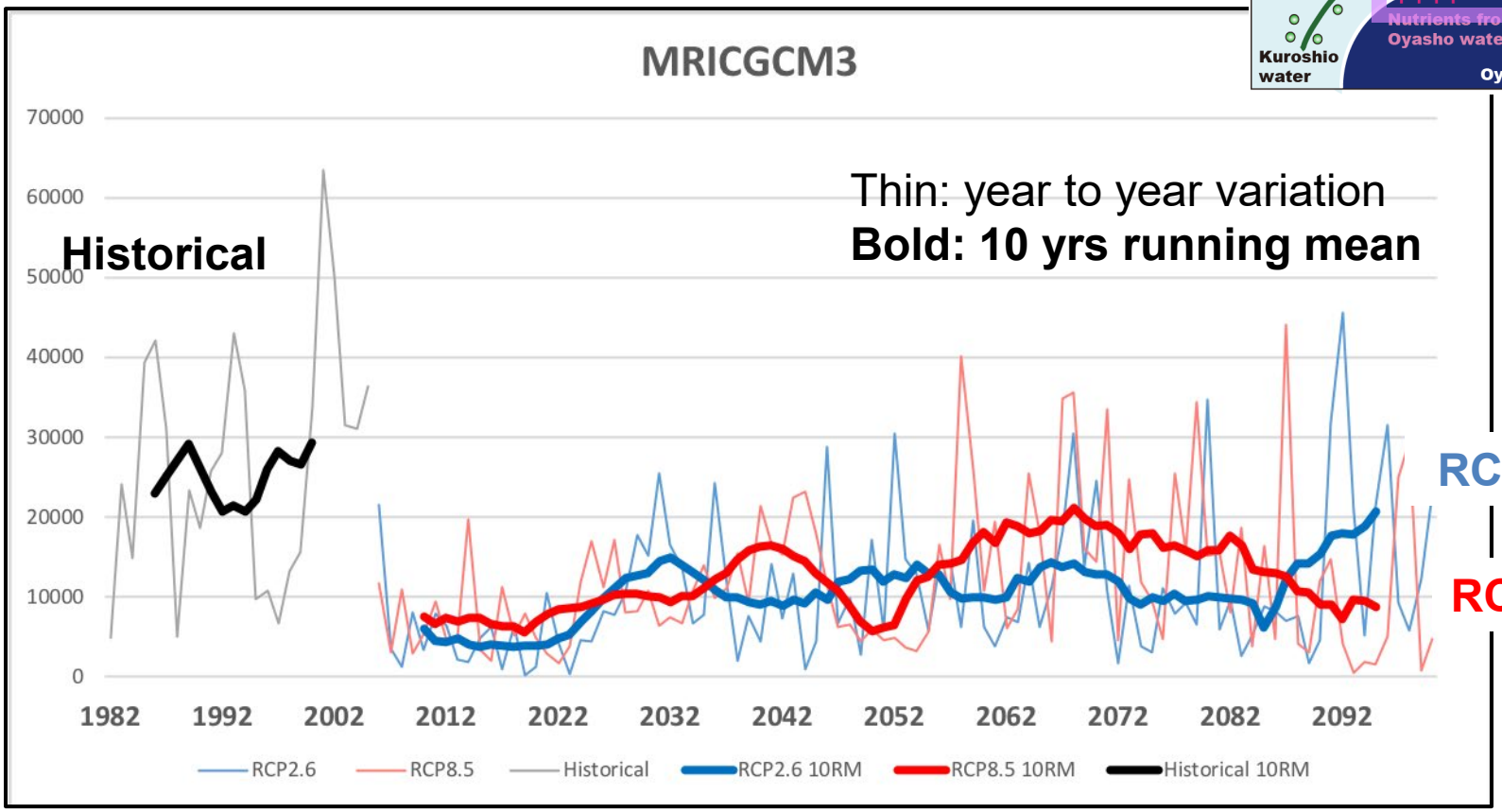


**In RCP2.6, Oyashio is getting high temperature and high salinity.
But this tendency stops in the late 21st century.**

In RCP8.5, Oyashio is getting high temperature and high salinity continuously.

Result
Distribution of layered structure (MRI-CGCM3)

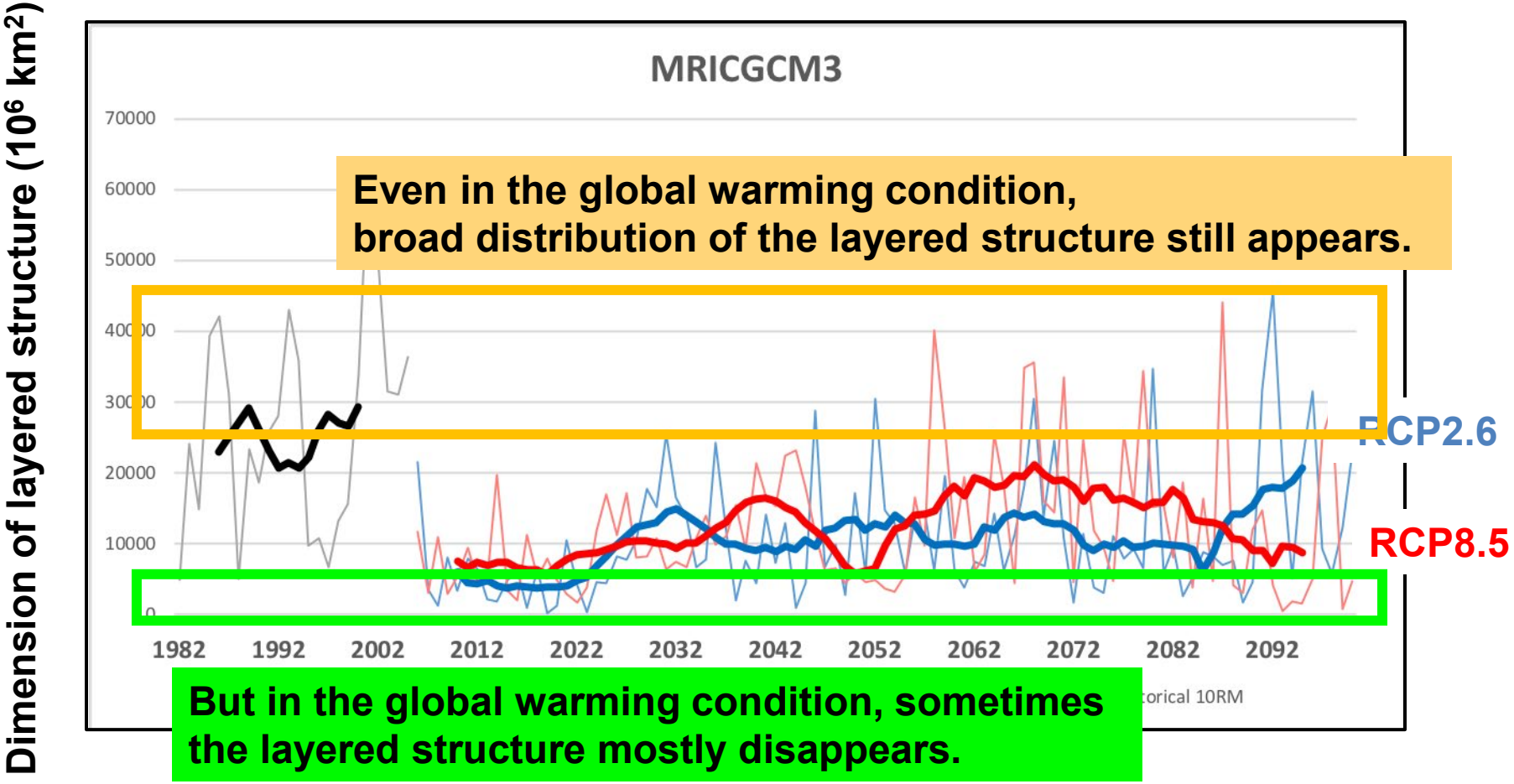




RCP2.6

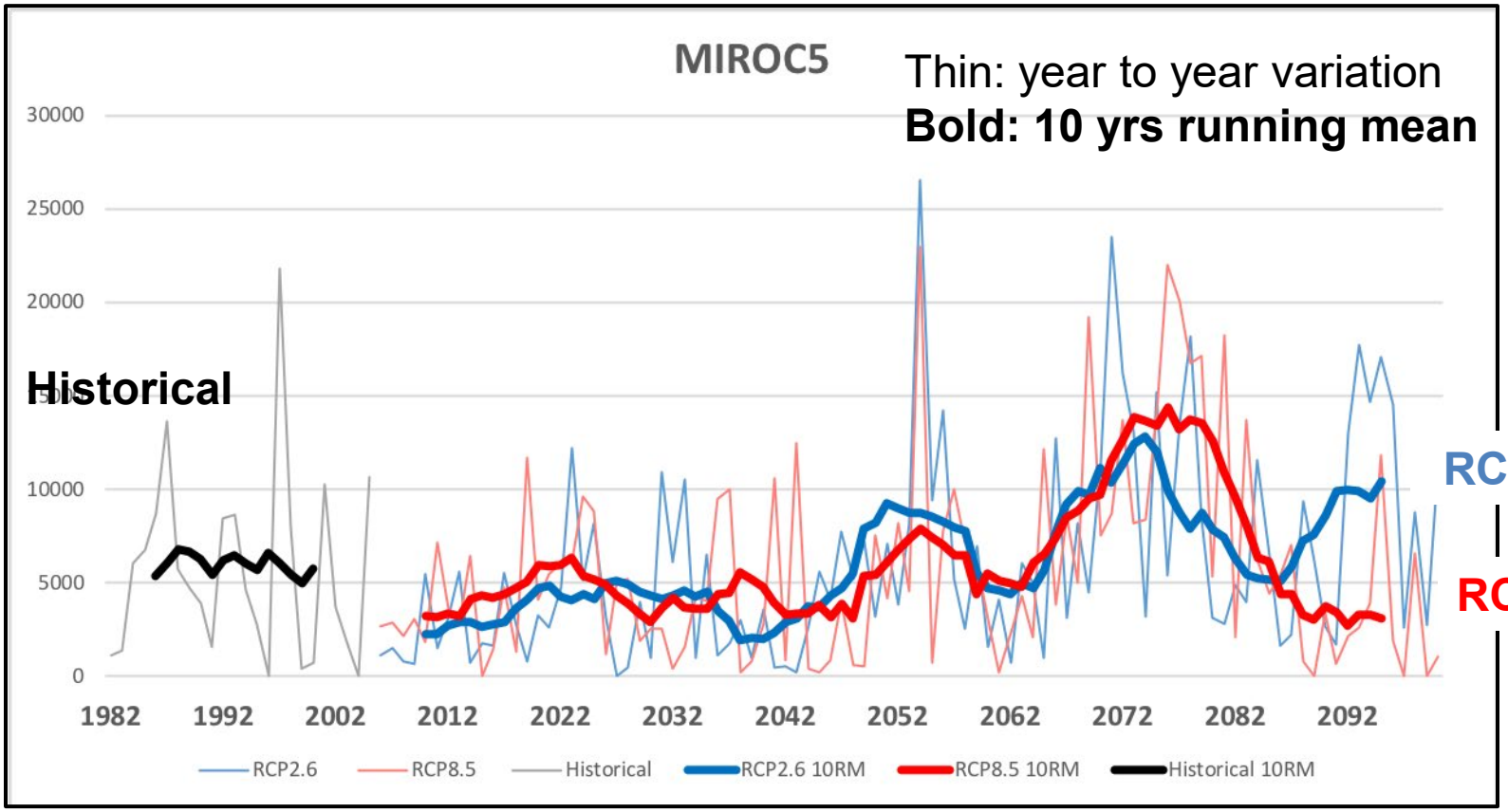
RCP8.5

Result
Distribution of layered structure (MRI-CGCM3)

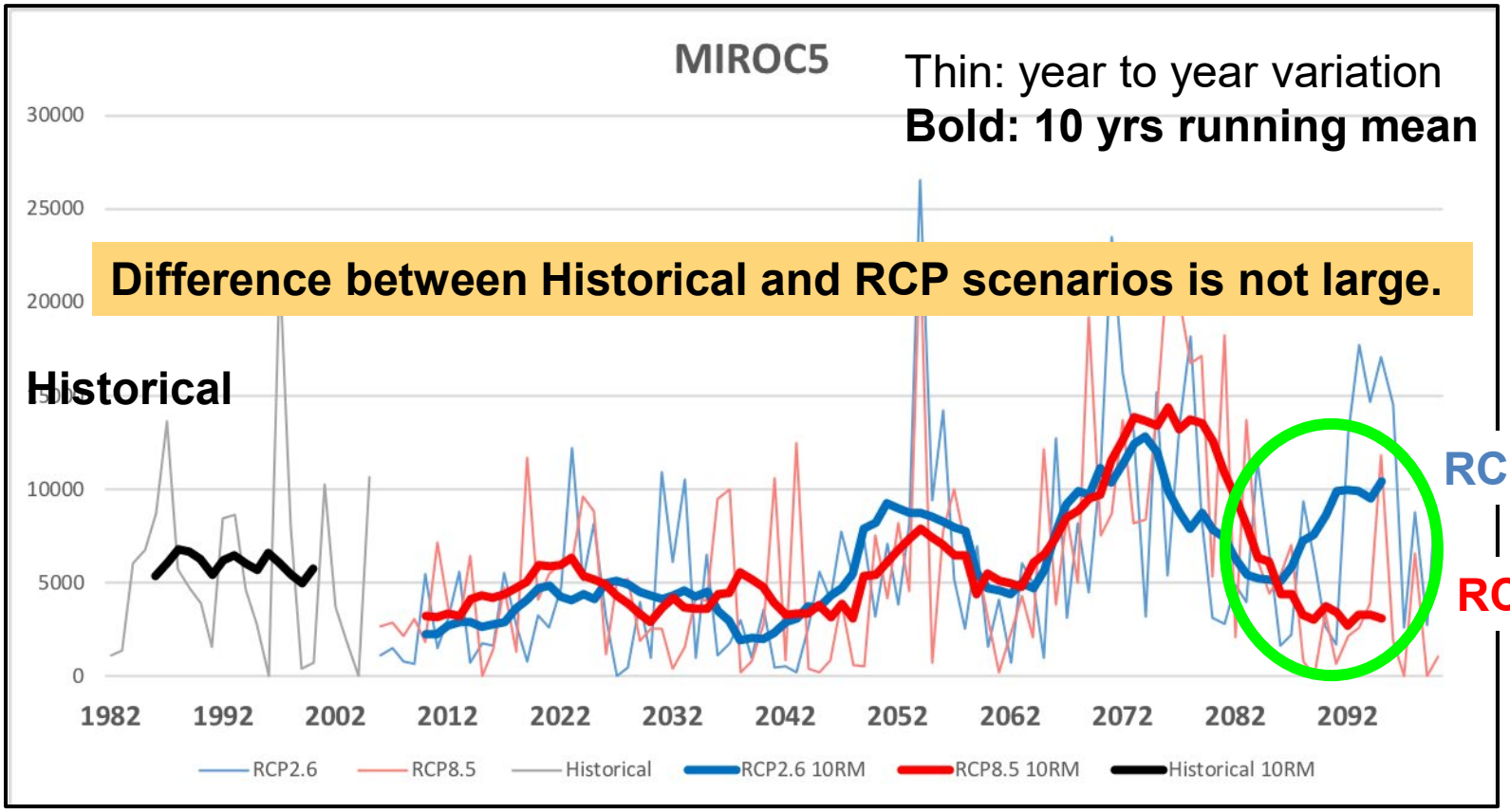


No significant difference is shown between RCP2.6 and RCP8.5.

Result
Distribution of layered structure (MIROC5)



Result
Distribution of layered structure (MIROC5)



Variations of RCP 2.6 and 8.5 are similar before 2080s. Layered structure becomes small in RCP8.5 in 2090s due to the global warming?

Conclusion and Discussion

- **TS Profiles of the Kuroshio and Oyashio**

TS of Kuroshio is not affected by the global warming.
Both TS of Oyashio tend to be high due to progress of the global warming but it stops in RCP2.6.

- **Layered structure distribution**

In MRI-CGCM3, the distribution decreased in the global warming condition.
In MIROC5, the distribution seems to become low in RCP8.5.

Future spring primary production in the KOTR

If the result that the global warming decreases the layered structure is correct, the primary production will decrease.

Conclusion and Discussion

- **TS Profiles of the Kuroshio and Oyashio**

TS of Kuroshio is not affected by the global warming.
TS of Oyashio tend to be high due to progress of the global warming but it stops in RCP2.6.

- **Layered structure distribution**

In MRI-CGCM3, the distribution decreased in the global warming condition.
In MIROC5, it seems to become low in RCP8.5 but not clear.

Future spring primary production in the KOTR

If the result that the global warming decrease the layered structure is correct, the primary production will decrease.

But note that the high productivity in the layered structure depending on high nutrient density in the Oyashio water.

Since our study suggested the change of characteristic of the Oyashio water, we have to consider the explicit nutrient cycle under the global warming condition in the next step.