

Classification of Argo Profiles in the Mid-latitude Northwest Pacific Ocean by Unsupervised Clustering and Their Potential Use

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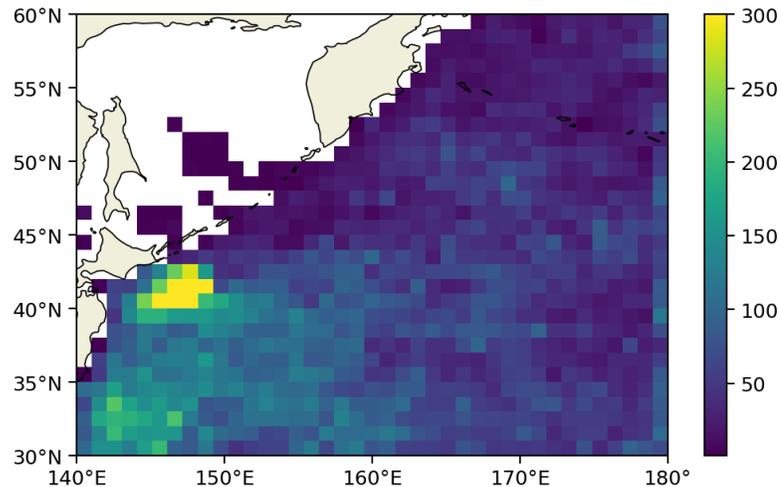
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Frequency distribution of profiles per 1° grid for 56414 points within the analysis range.

Comprehensive analysis of ocean structure data in the mid-latitude Northwest Pacific obtained by Argo floats

1. To apply Unsupervised Clustering to the temperature and salinity profiles of the mid-latitude northwest Pacific Ocean observed by Argo floats.
2. To discuss the characteristics of the clusters and their relationship to the variability in the dynamic state of the KE and mixed water region.

Sambe, F., & Suga, T. (2022). Unsupervised Clustering of Argo Temperature and Salinity Profiles in the Mid-Latitude Northwest Pacific Ocean and Revealed Influence of the Kuroshio Extension Variability on the Vertical Structure Distribution. *J. Geophys. Res. Oceans*, 127(3), e2021JC018138.

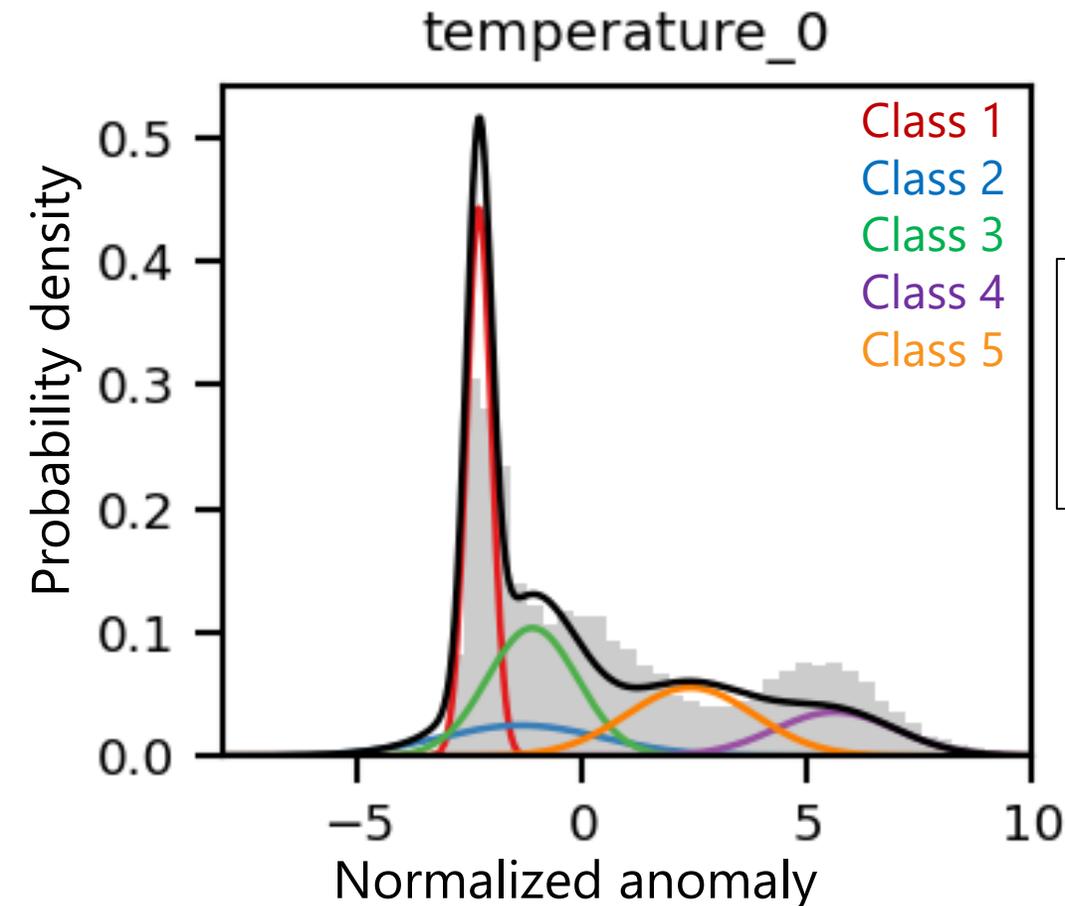
Methods

Profile Classification Model (PCM; Maze et al., 2017)

Classifying ocean vertical structures by **Gaussian Mixture Model**

First, the temperature and salinity profiles are represented by 9 principal components each, and PCM is applied.

$$p(\mathbf{X}) = \sum_{k=1}^K \lambda_k \mathcal{N}(\mathbf{X}; \boldsymbol{\mu}_k, \boldsymbol{\Sigma}_k)$$

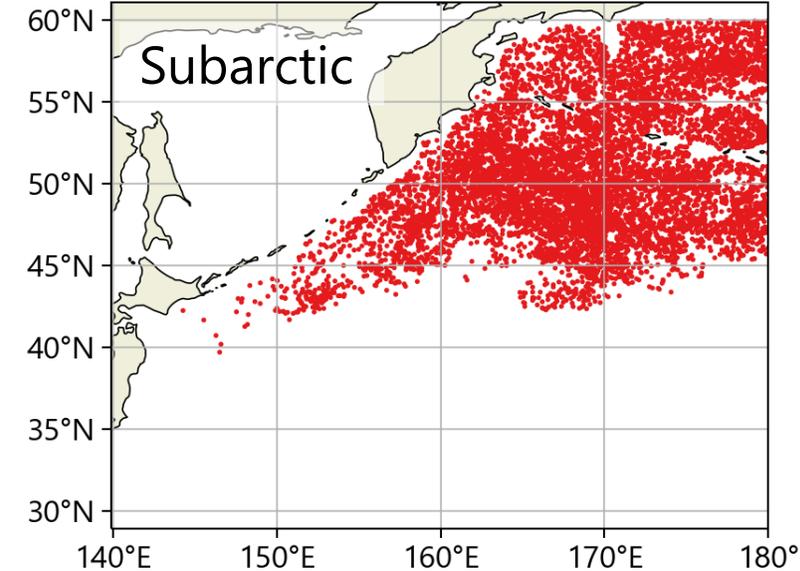


PCM results for the 1st principal component of temperature profiles
Gray : Probability density of normalized temperature anomaly
Cored line : Normal distribution representing each class
Black line : Sum of normal distributions

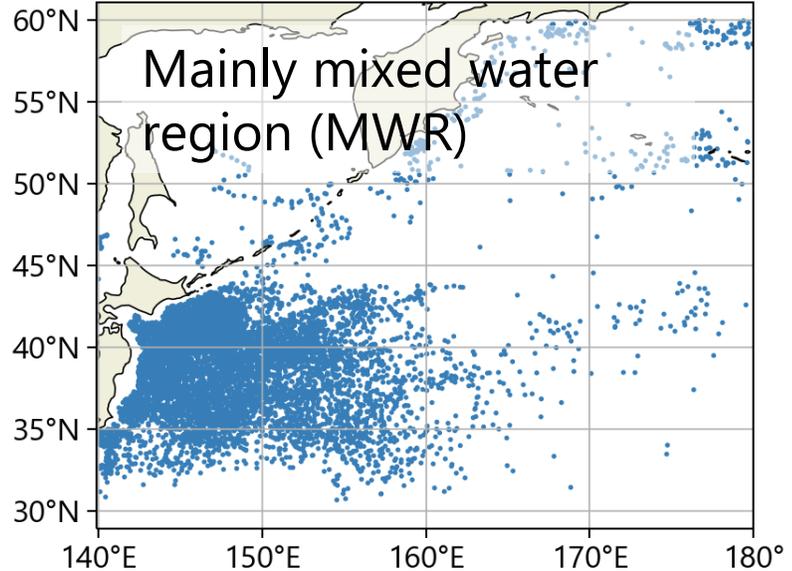
The number of classes is determined by the user.
→5 in this study

Result of clustering

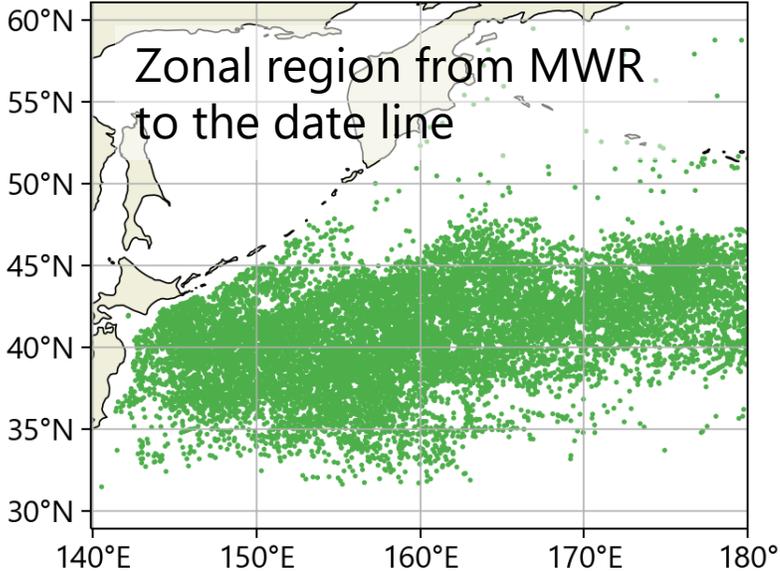
Distribution of Class 1



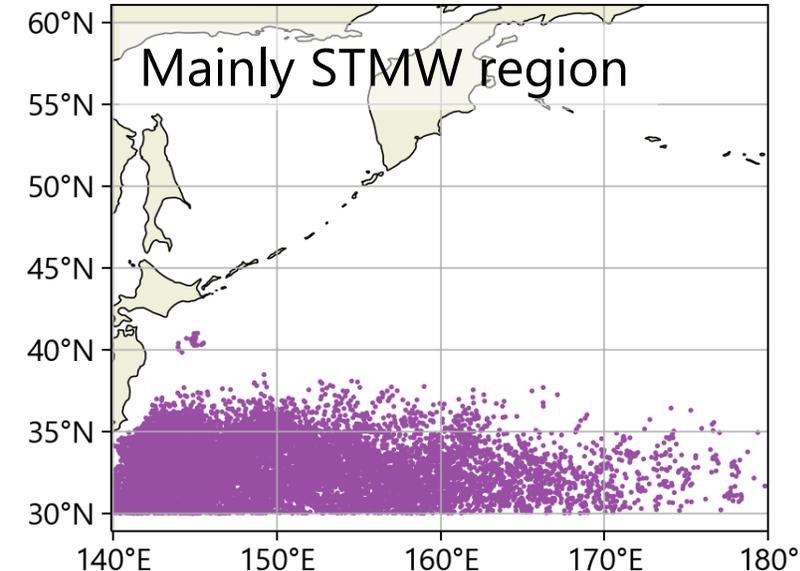
Distribution of Class 2



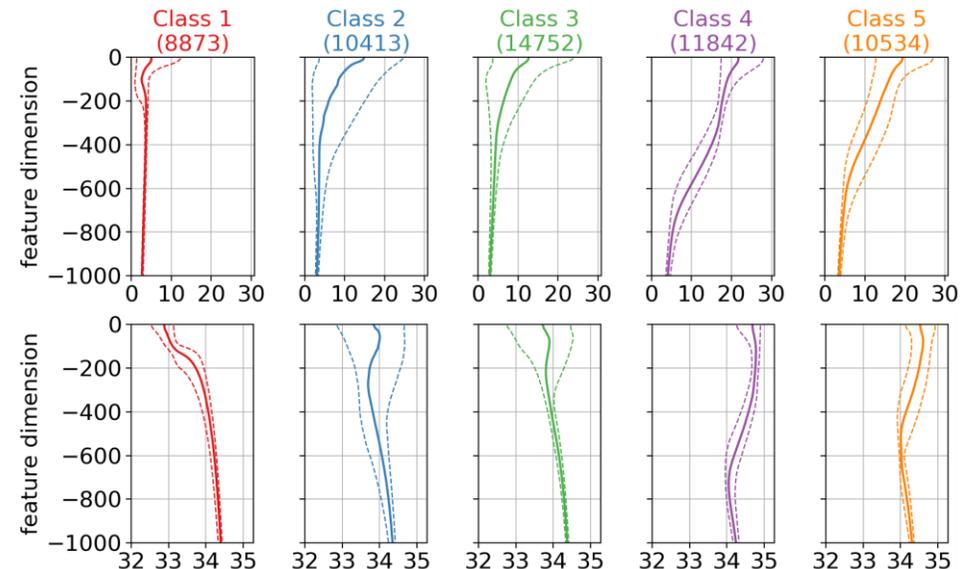
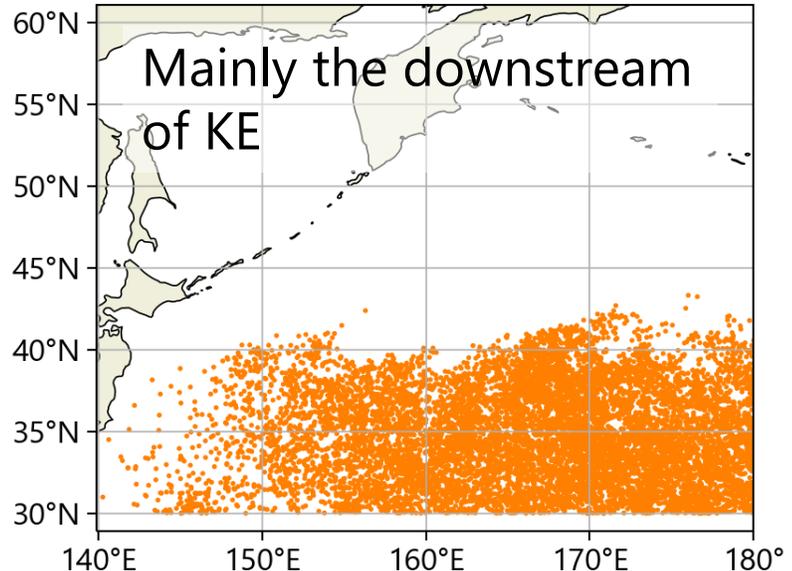
Distribution of Class 3



Distribution of Class 4



Distribution of Class 5



Comparing clustering result to KE index

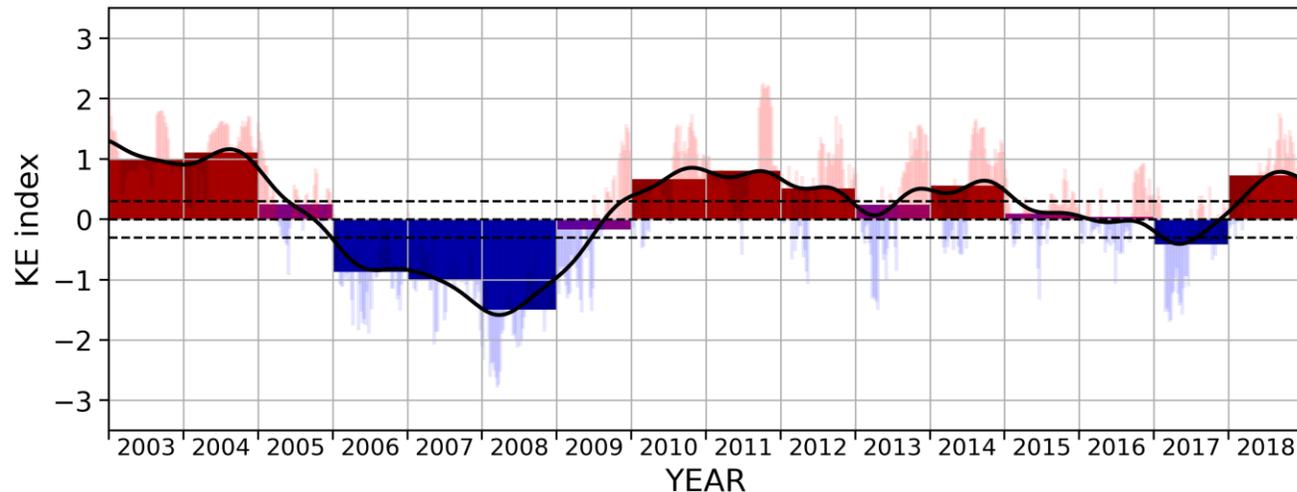
KE Index (Qiu et al., 2014)

The index to identify the dynamic state of KE.
We averaged it over one year and grouped them into 3 groups.

>0.3 : High (KE path stable)

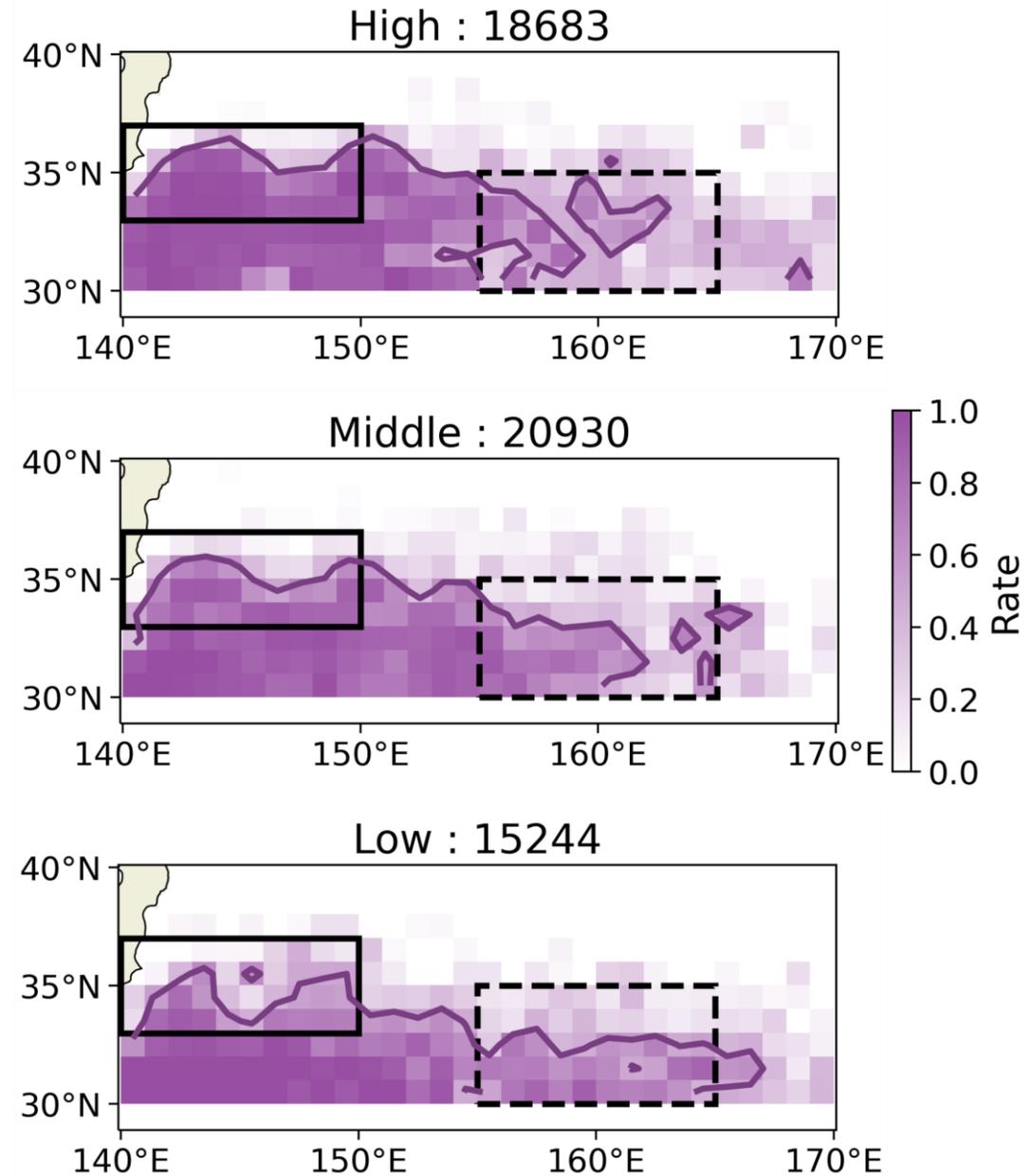
-0.3 – 0.3 : Middle

<-0.3 : Low (KE path unstable)

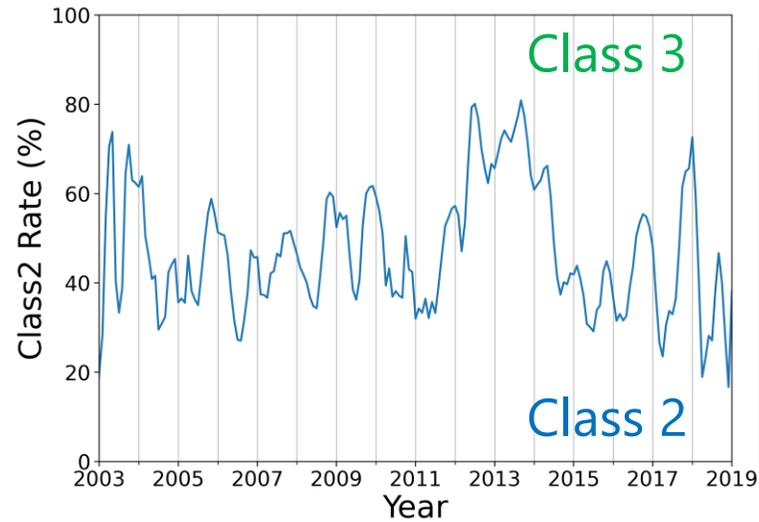


KE index calculated by Qiu et al. (2020)

The rate of Class 4 distribution in each 1° grid.
The purple lines show the contour of 50%.

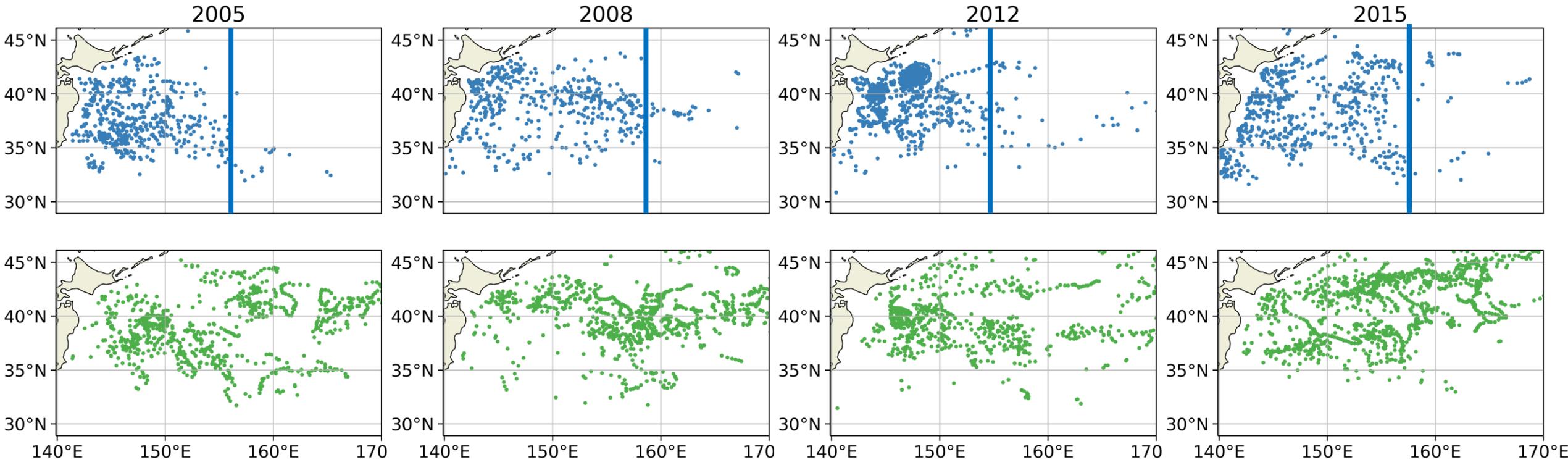


Class 2 and 3 distribution in mixed water region



Ratio of Class 2 in the number of Class 2 and 3 distributions at 35°N-45°N and 140°E-160°E (3-month moving average).

- The dominance of classes 2 and 3 alternates in almost annual cycles.
- The main distribution area of Class 2 changes interannually.



Conclusion and future works

Unsupervised clustering of profiles in the mid-latitude northwest Pacific Ocean

- Successfully classified into five classes with characteristic oceanographic structure.
- The distribution area of Class 4 changed with the KE index.
- Ratio of Class 2 and 3 change roughly one-year cycle.
- Area of Class 2 changes year to year.

Consideration of bias in the number of profiles and locations

Comparison of KE and subarctic front locations

→ Comparison with MWR characteristics and eventually with fisheries data

References

- Maze, G., et al. (2017). Coherent heat patterns revealed by unsupervised classification of Argo temperature profiles in the North Atlantic Ocean. *Prog. Oceanogr.*, 151, 275–292.
- Qiu, B., et al. (2020). On the Reset of the Wind-Forced Decadal Kuroshio Extension Variability in Late 2017. *J. Clim.*, 33(24), 10813–10828.
- Qiu, B., et al. (2014). A Coupled Decadal Prediction of the Dynamic State of the Kuroshio Extension System. *J. Clim.*, 27(4), 1751–1764.

Acknowledgement

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