PICES 2025 Annual Meeting
Innovative Approaches and Applications to Foster Resilience in North Pacific Ecosystems

Assessing the impact of oceanographic field variability on the spatial distribution of chub mackerel in the northwestern Pacific fishing grounds

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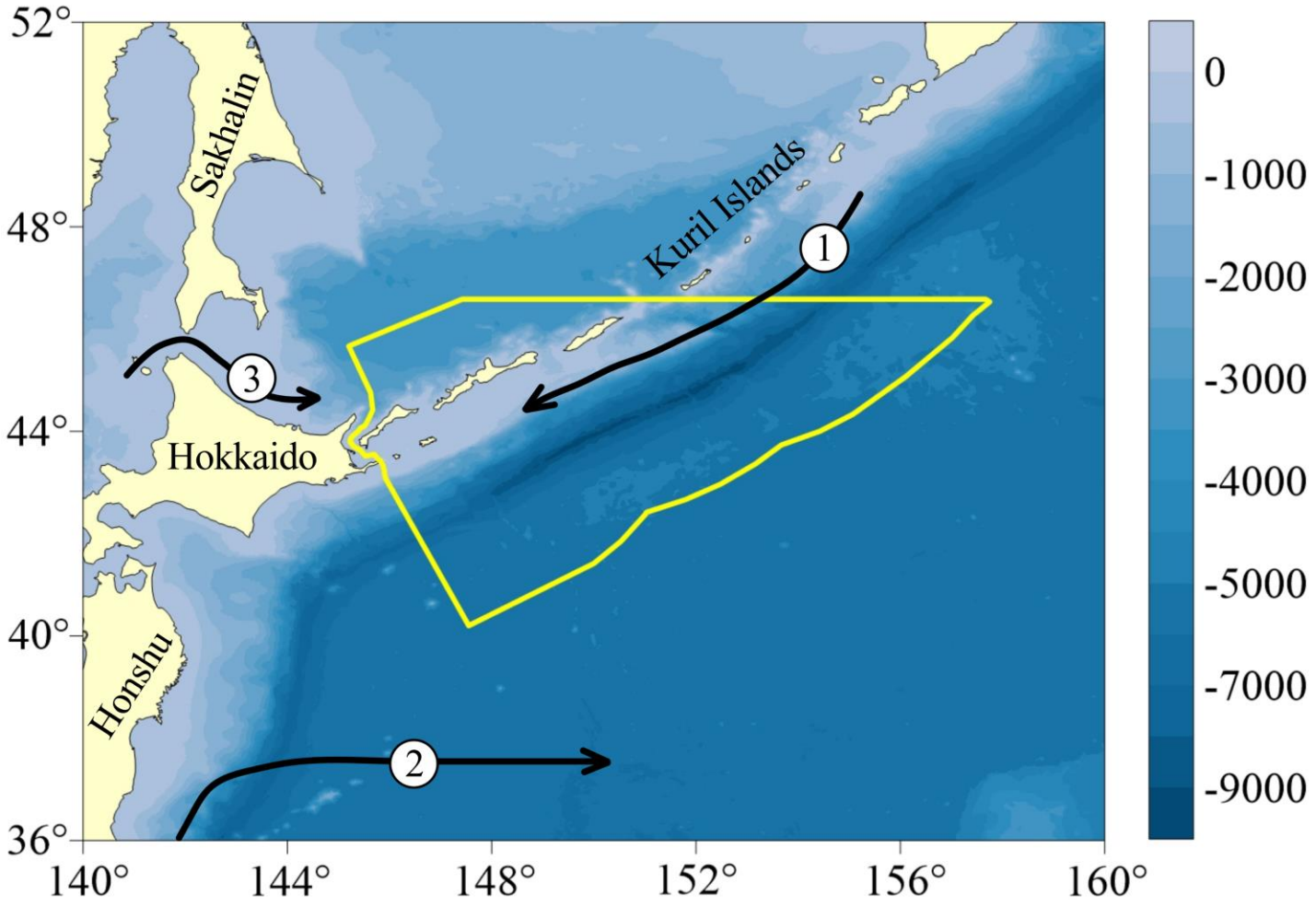
Yokohama, 2025

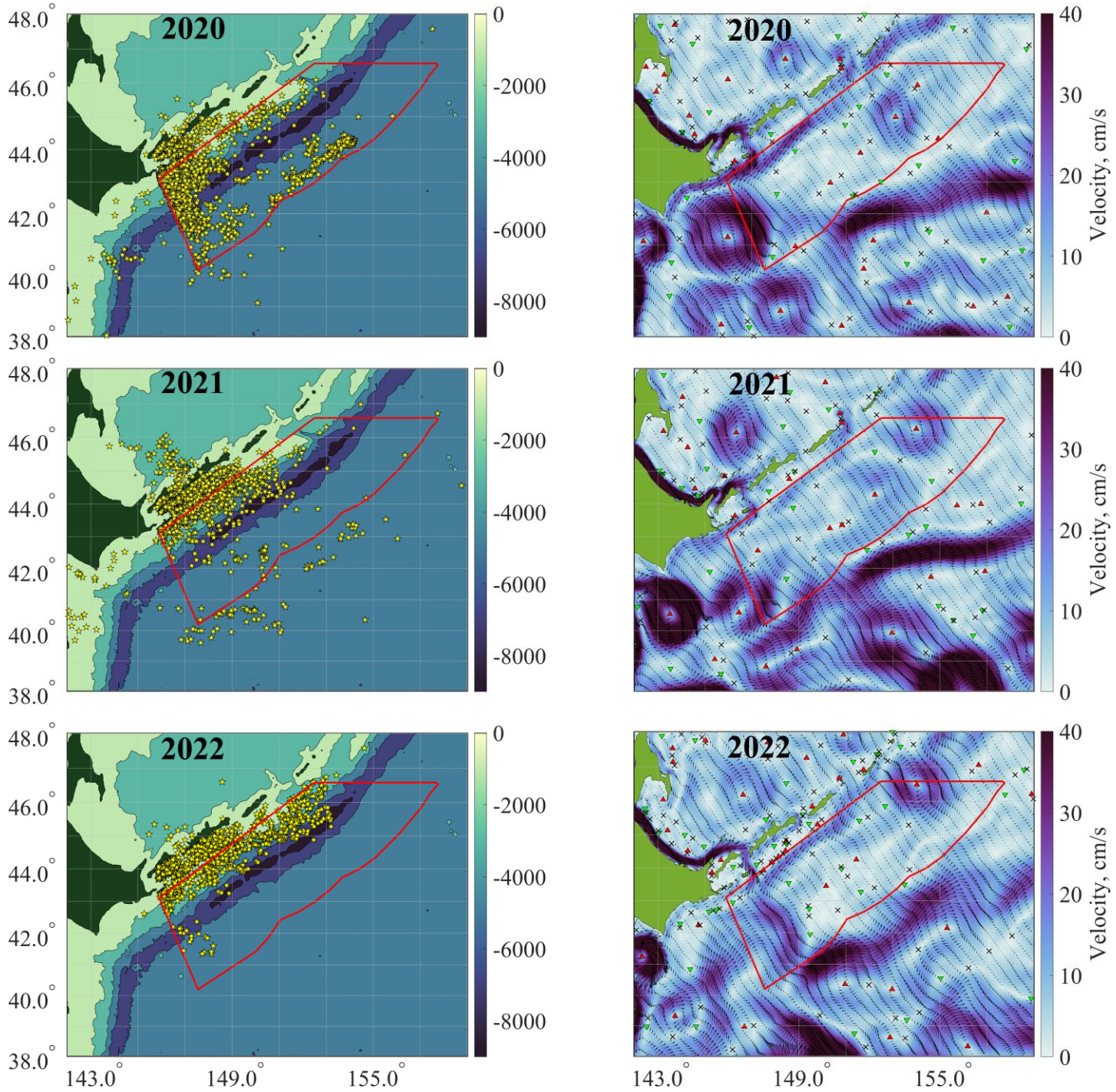
Geographical description of the area



Yellow line – boundary of South Kuril fishing zone;

1 – Oyashio;
2 – Kuroshio Extention;
3 – Soya.

Scomber japonicus

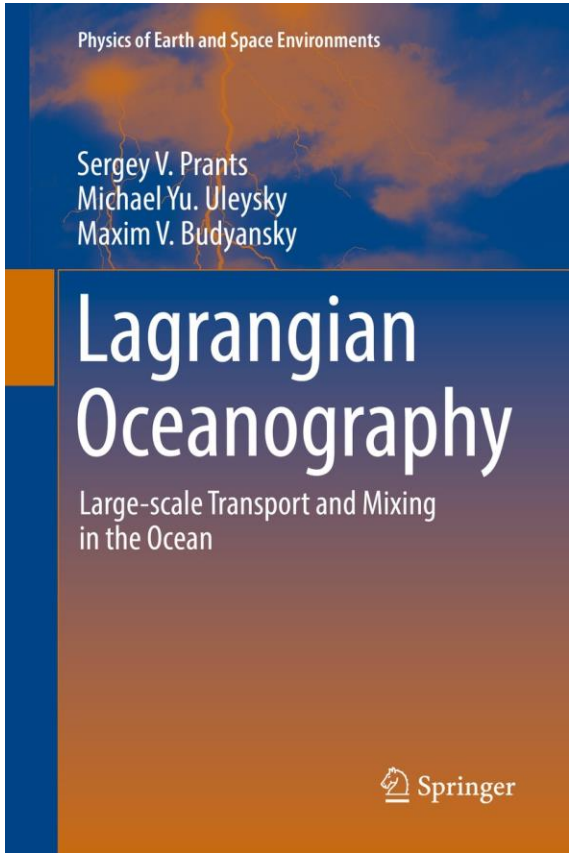


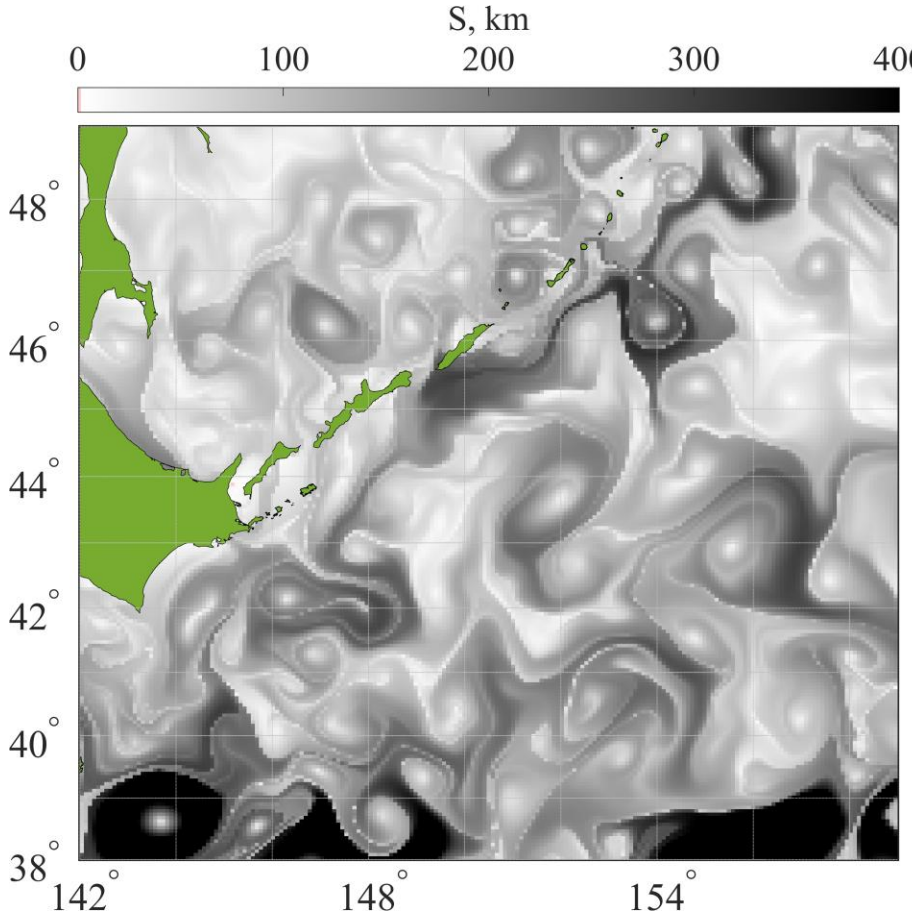
Used data:

- Velocity, temperature, salinity and density from GLORYS12V1 (surface layer).
- Data on mackerel fishery provided by Pacific branch of VNIRO (vessel positions and catches).

Lagrangian method

- Prants, S.V. Fisheries at Lagrangian fronts. Fisheries Research, vol. 279, 2024.
- Budyansky, M.V., et al. Lagrangian Analysis of Pacific Waters in the Sea of Okhotsk Based on Satellite Data in Application to the Walleye Pollock Fishery. Izv. Atmos. Ocean. Phys., vol. 58, 2022.
- Prants, S.V. Marine life at Lagrangian fronts. Progress in Oceanography, vol. 204, 2022.





An example of what the Lagrangian indicator S looks like. The darker the colour – the faster the water moves here.

Frontal zones – purple color indicates zones where gradient values correspond to the distribution function within the [0.8 1.0] interval. Example for July 3, 2020.

Finding all the values inside the fishing zone

↓

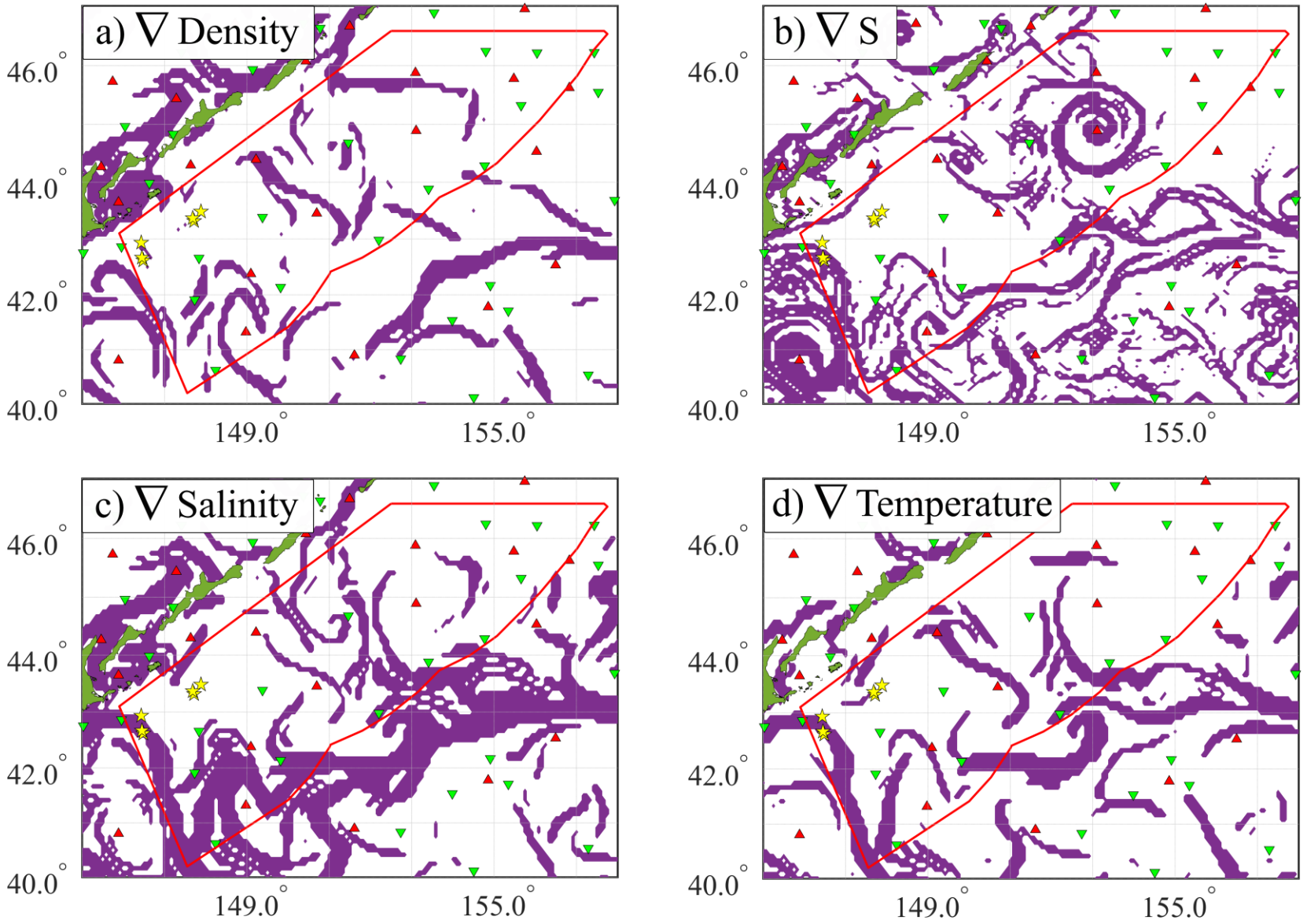
Calculating the distribution function

↓

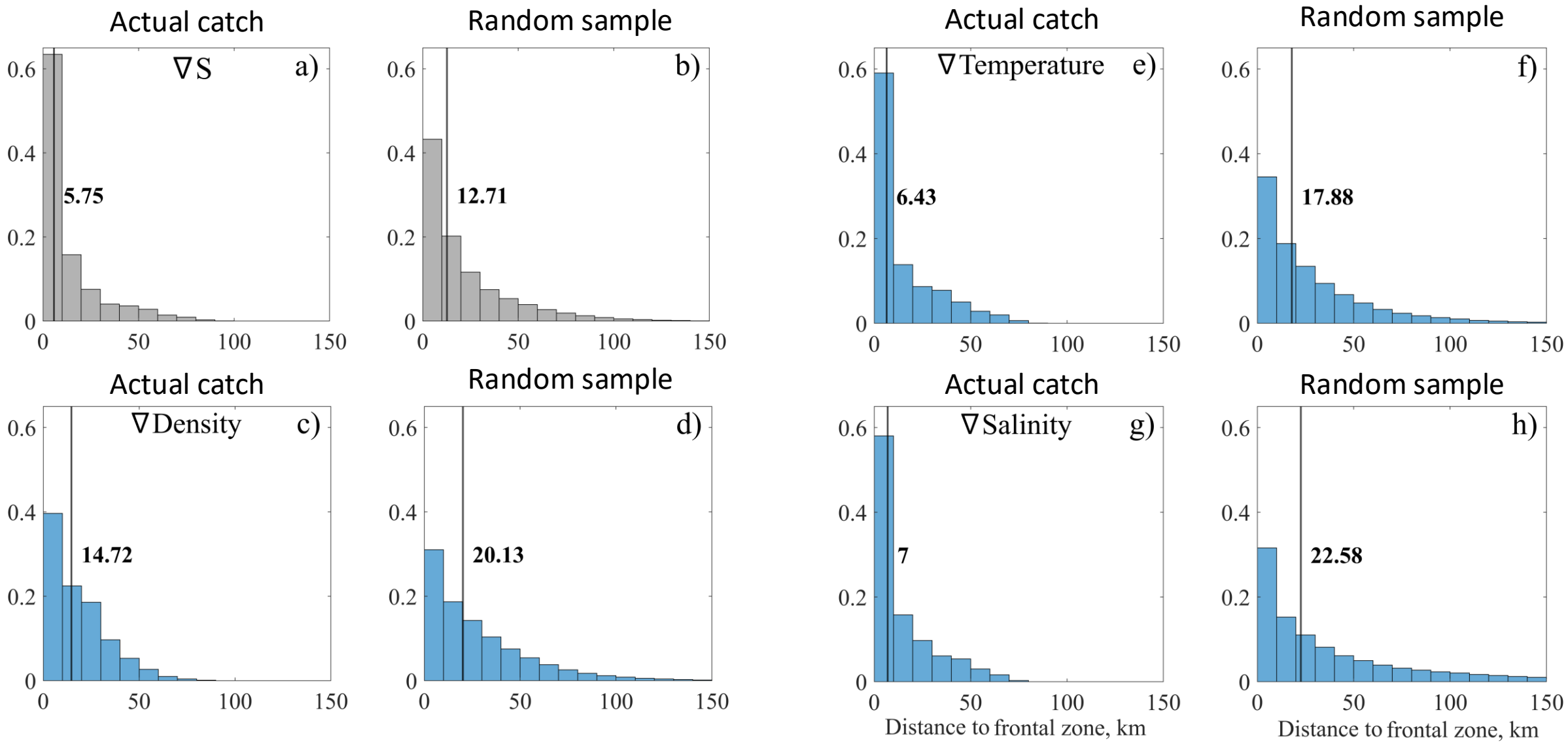
Finding the 80th percentile of the distribution function

↓

Nodes with values > the 80th percentile value are marked as frontal zone

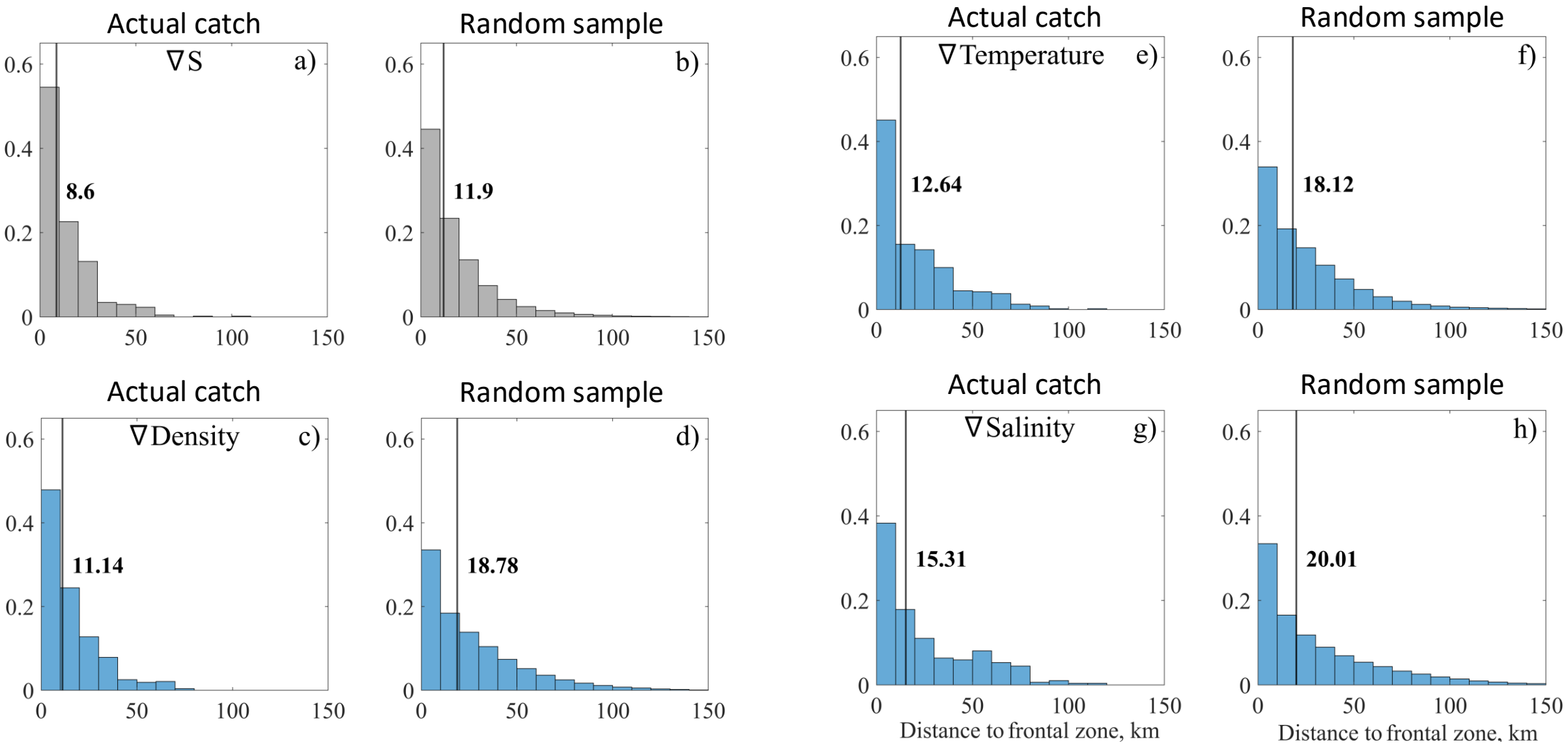


2020



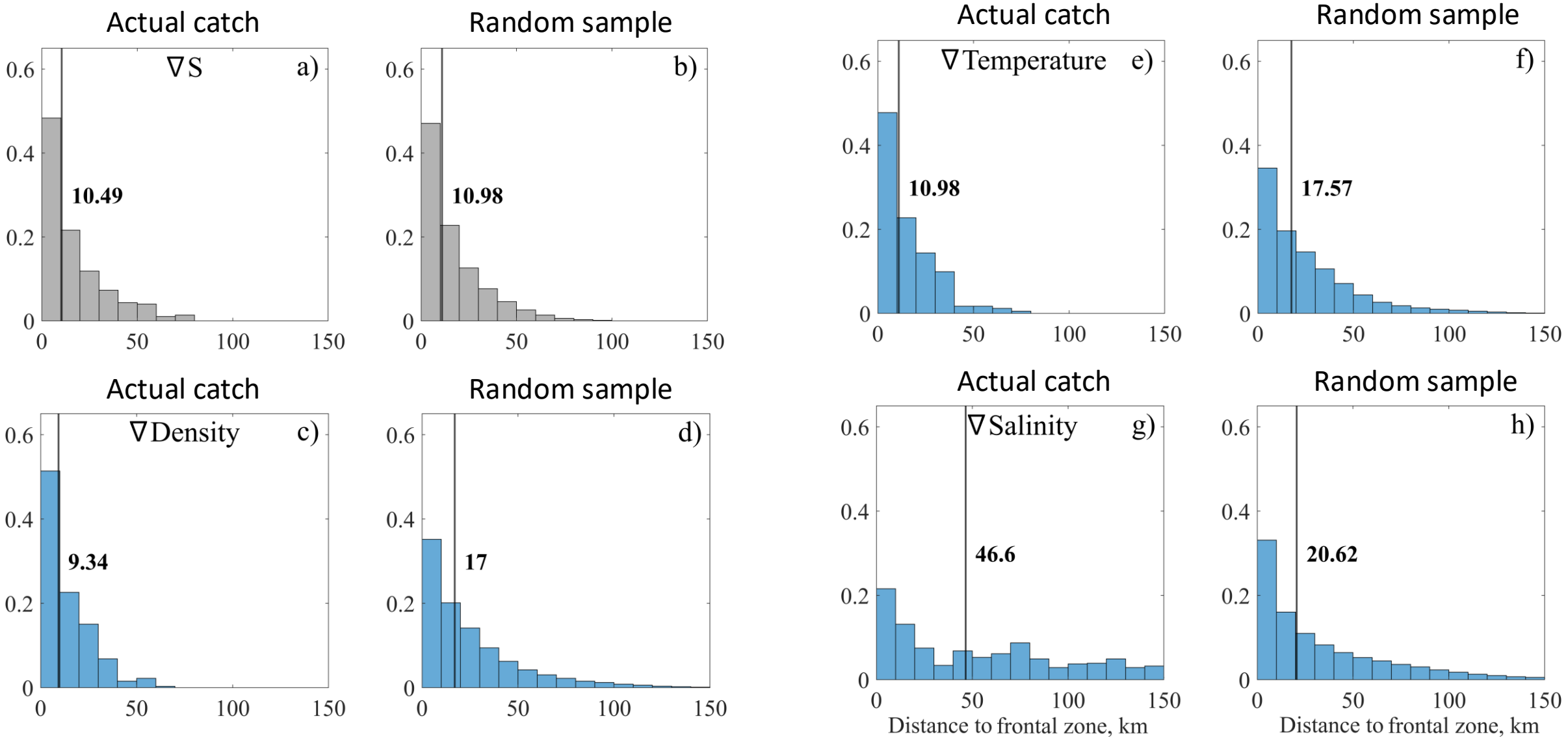
Histograms of the distance distribution from fishing locations to the nearest frontal zone

2021



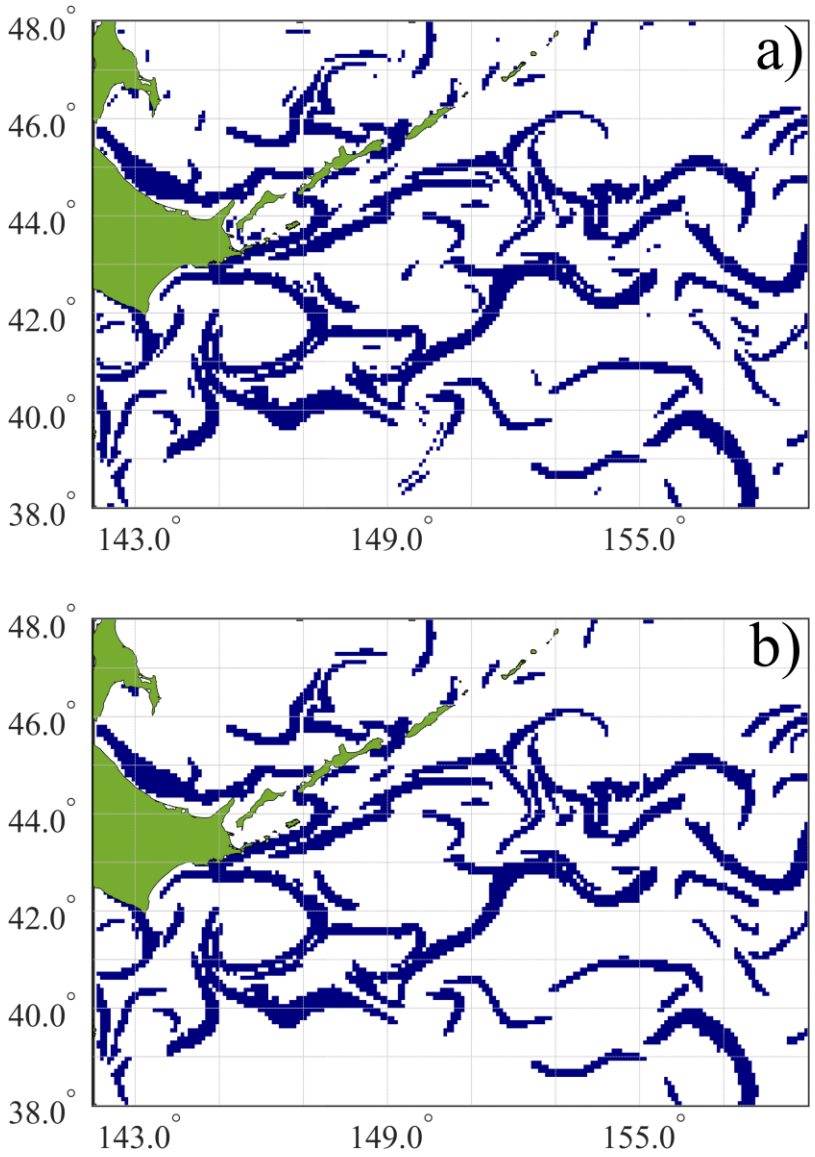
Histograms of the distance distribution from fishing locations to the nearest frontal zone

2022

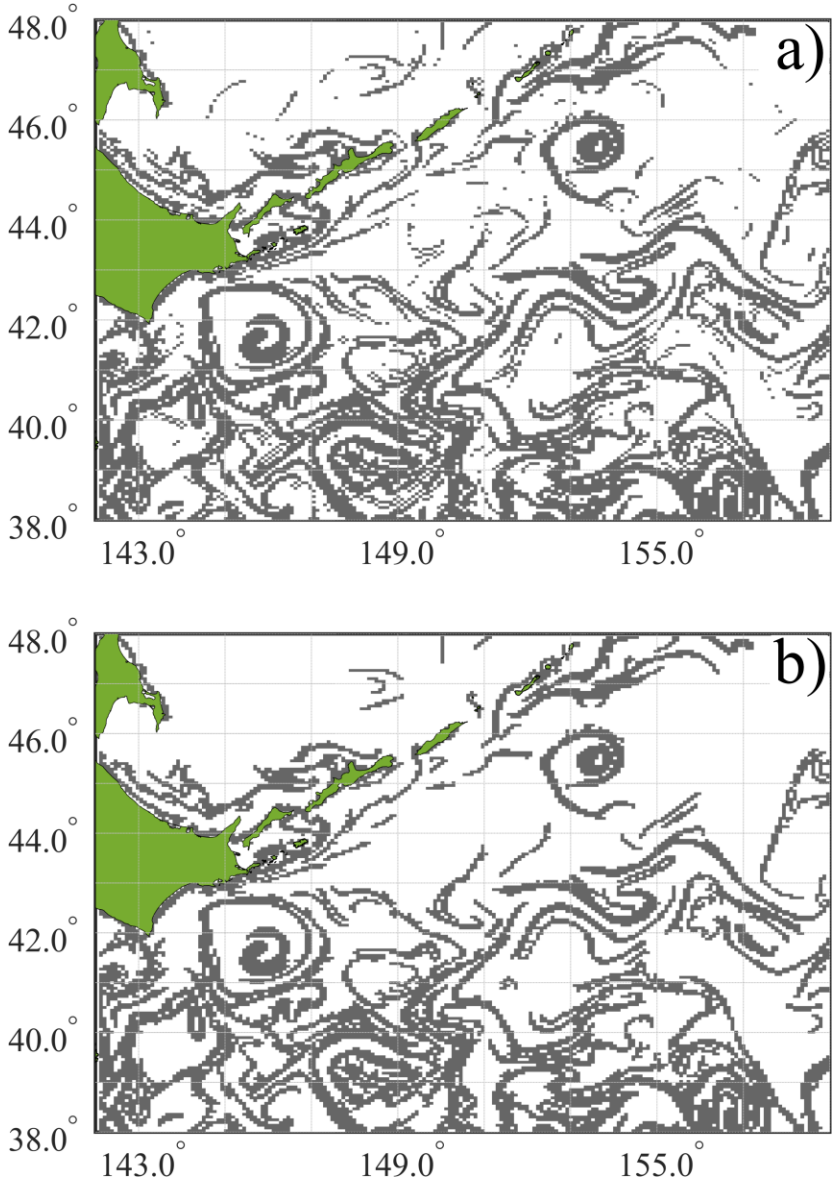


Histograms of the distance distribution from fishing locations to the nearest frontal zone

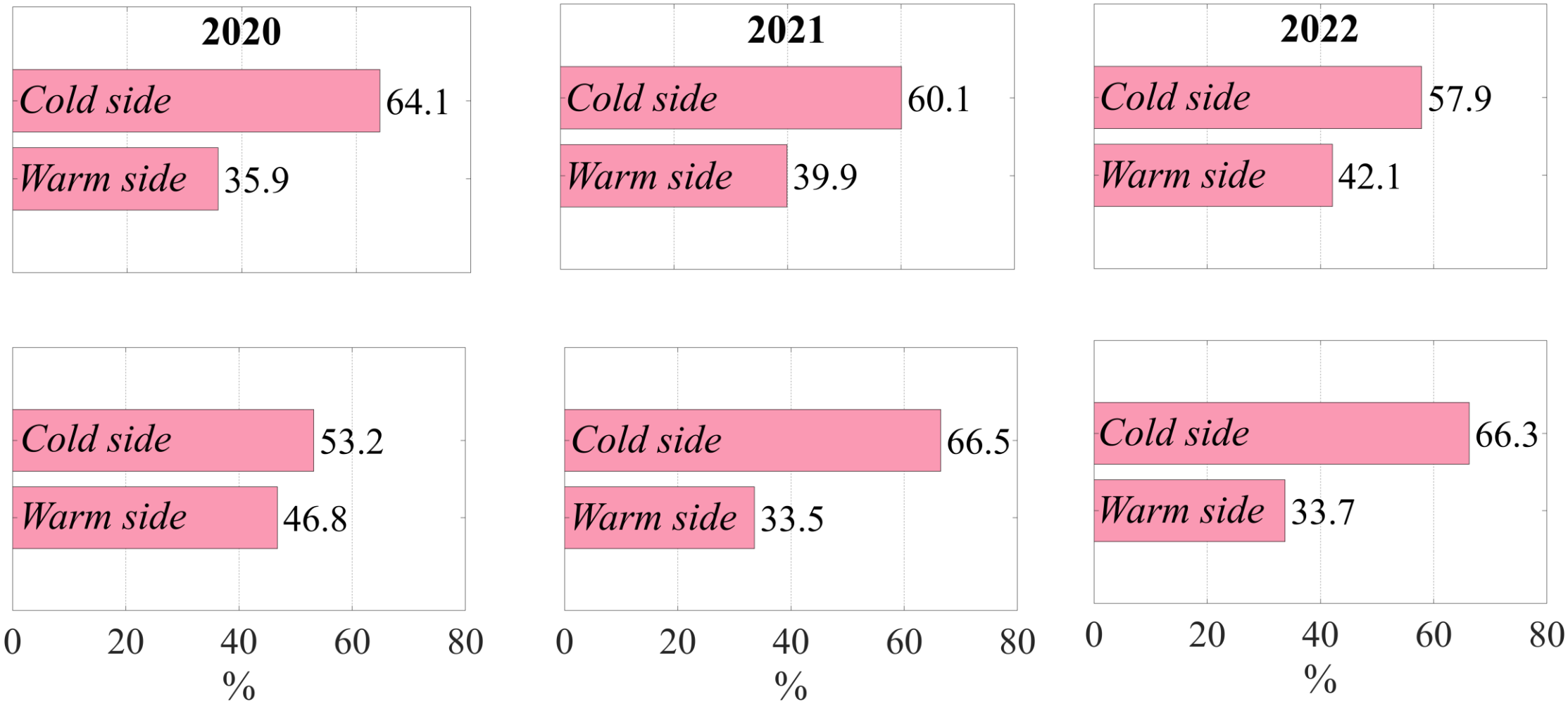
Temperature gradient-derived frontal zones: (a) all grid cells meeting criteria, (b) filtered clusters containing >10 connected cells.



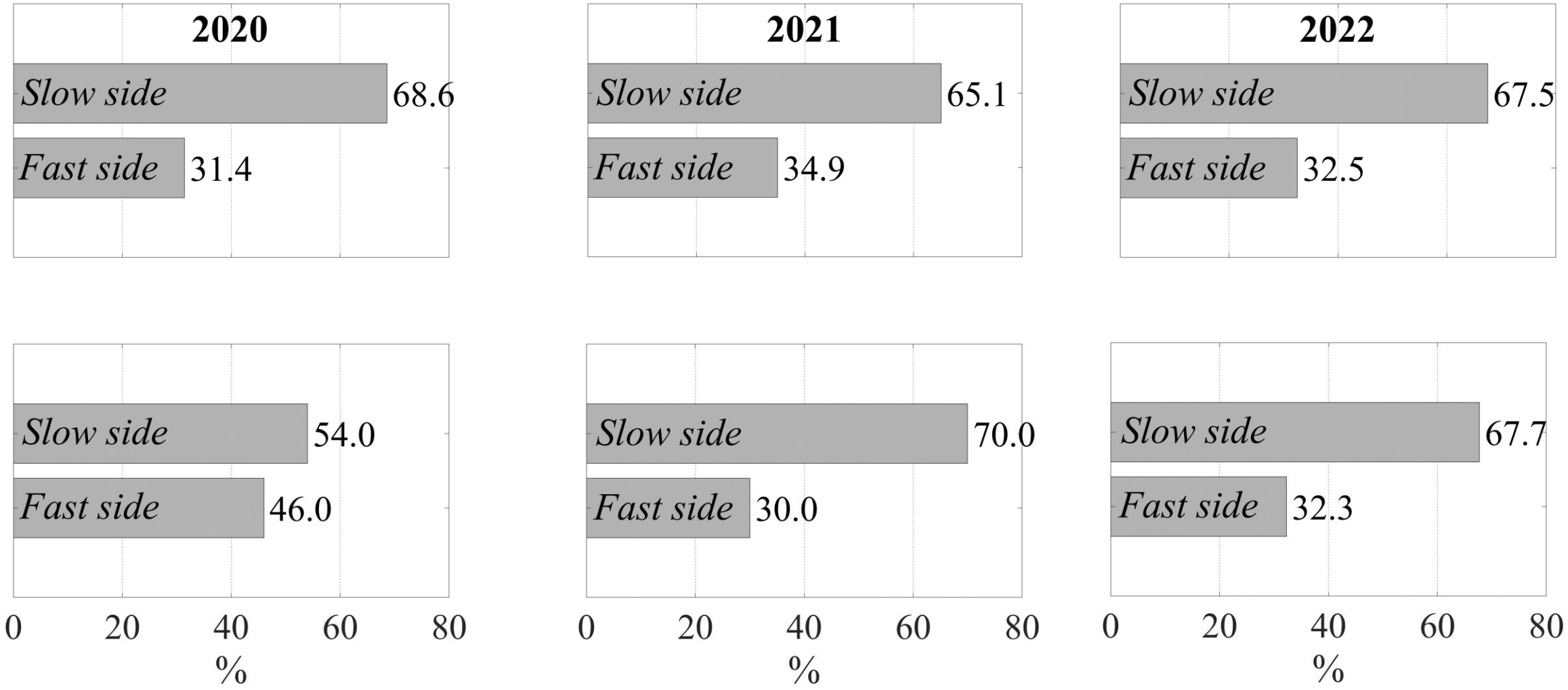
Lagrangian indicator S gradient-derived frontal zones: (a) all grid cells meeting criteria, (b) filtered clusters containing >10 connected cells.



Positions of fishing catches and randomly sampled points in relation to **temperature**-derived frontal boundaries. Upper panel: randomly generated points; Lower panel: observed fishing catch locations.



Positions of fishing catches and randomly sampled points in relation to **Lagrangian indicator S**-derived frontal boundaries. Upper panel: randomly generated points; Lower panel: observed fishing catch locations.



Conclusions

- The analysis integrated both Eulerian and Lagrangian methodologies.
- Frontal zones were automatically identified using a threshold based on the probability distribution function.
- High gradients of density and temperature were identified as the key parameters indicating conditions favorable for fish aggregation.

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Publications

- Budyansky et.al. Analysis of oceanographic conditions for Japanese mackerel fishery based on satellite and modelling data in the South Kuril Strait in 2020–2022. *Sovr. Probl. Dist. Zond. Zemli iz kosmosa, vol. 21(2):286-299, 2024 [in Russian] DOI: 10.21046/2070-7401-2024-21-2-286-299*;

- Lebedeva et.al. Evaluating the Impact of Oceanographic Field Variability on Atlantic Mackerel Distribution within Russian Fishing Grounds in the Northern Norwegian Sea. *Fisheries Oceanography, 2025. DOI: 10.1111/fog.12744*;

- Lebedeva et.al. Frontal Zones and Fishing Aggregations of Chub Mackerel in the South Kuril Area. *Fisheries Oceanography [Manuscript submitted].*

Supplementary slide