Leveraging 4-Dimensionally Mapped Ocean Biogeochemistry Data Products to Inform Species Distribution Modeling

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CISESS COOPERATIVE INSTITUTE FOR SATELLITE EARTH SYSTEM STUDIES

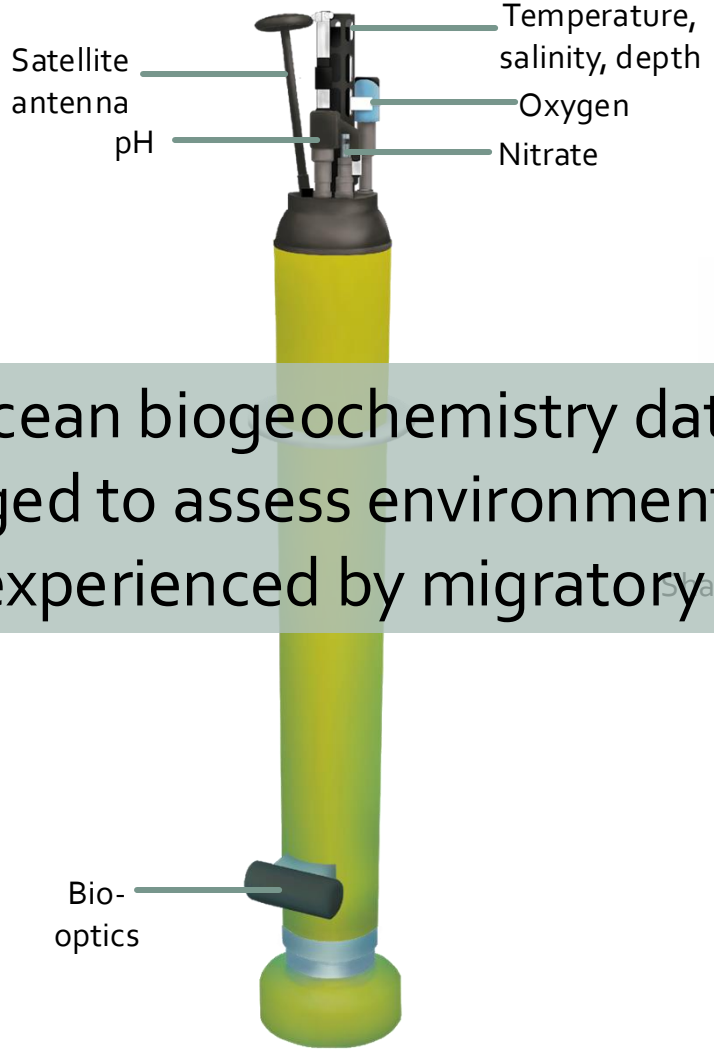
PICES 2024

BGC-Argo has revolutionized our spatial and temporal view of ocean biogeochemistry

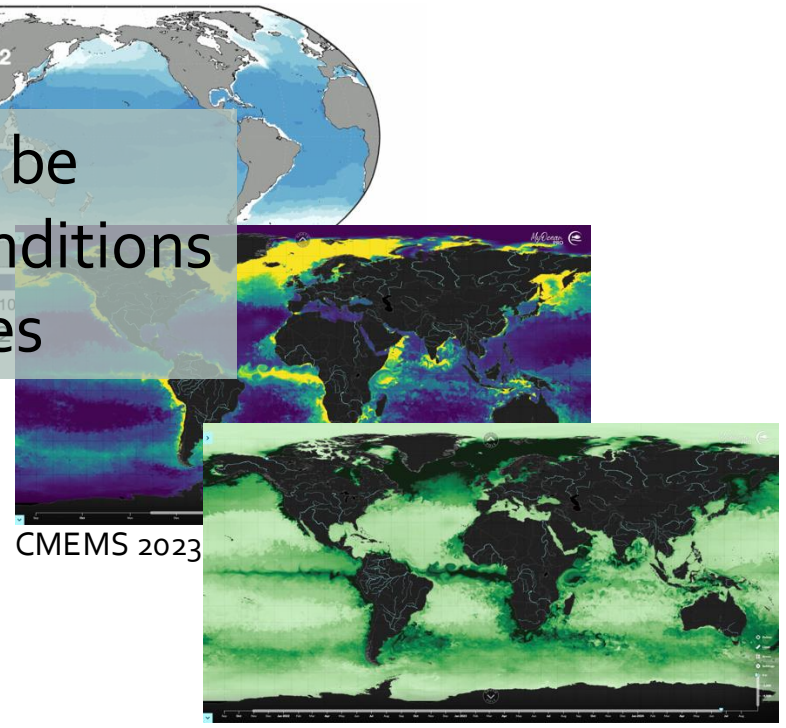
Subsurface resolution

Global coverage

In-situ measurements



The robust coverage of BGC-Argo observations has facilitated the creation of 4-D mapped biogeochemistry data products



CMEMS 2023

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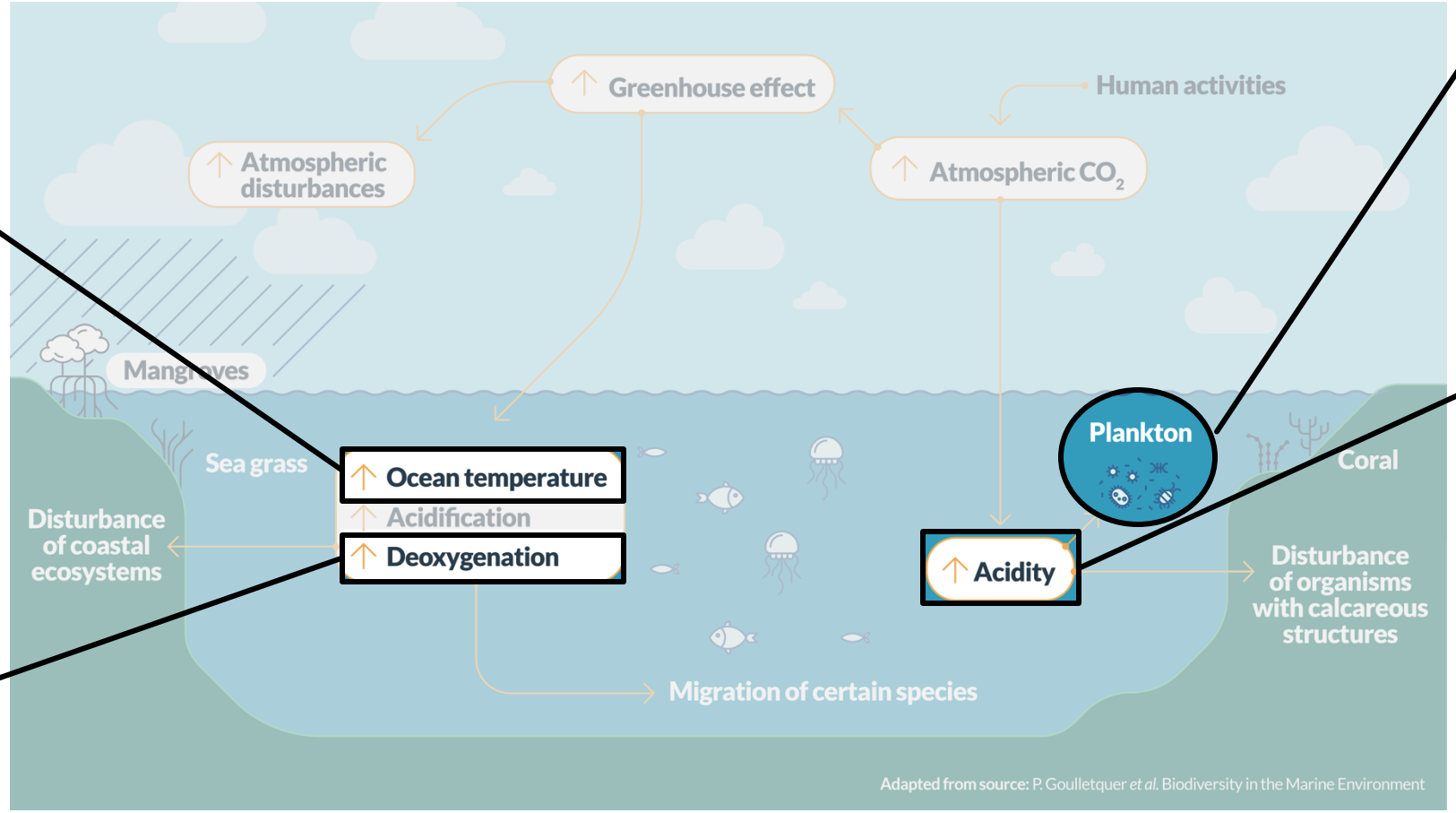
Ocean biogeochemistry data can be leveraged to assess environmental conditions experienced by migratory species

biogeochemical Argo

The biogeochemical landscape imposes constraints on suitable marine habitat and is critical to inform SDMs

Temperature thresholds

Oxygen → hypoxia



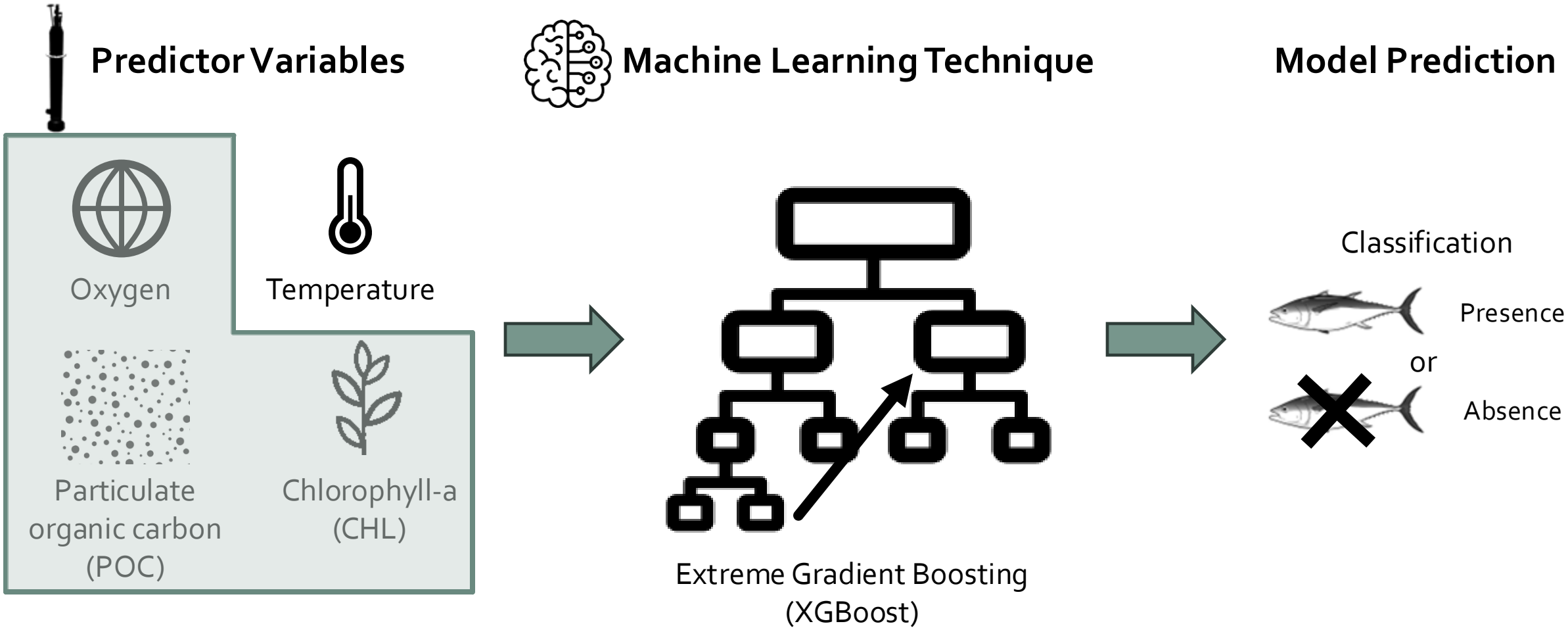
Optimal foraging grounds

Acidification → hypercapnia

Species Distribution Models (SDMs):

- Define suitable habitat
- Avoid protected species bycatch
- Project ecosystem shifts
- Inform ecosystem models

Methods: leverage machine learning techniques to predict albacore 3D habitat utilization



Data Products: Roemmich & Gilson Temperature, GOBAI-O_2, and CMEMS Global Ocean 3D POC and Chl

Contents lists available at ScienceDirect

Progress in Oceanography

journal homepage: www.elsevier.com/locate/pocean

The 2004–2008 mean and annual cycle of temperature, salinity, and steric height in the global ocean from the Argo Program

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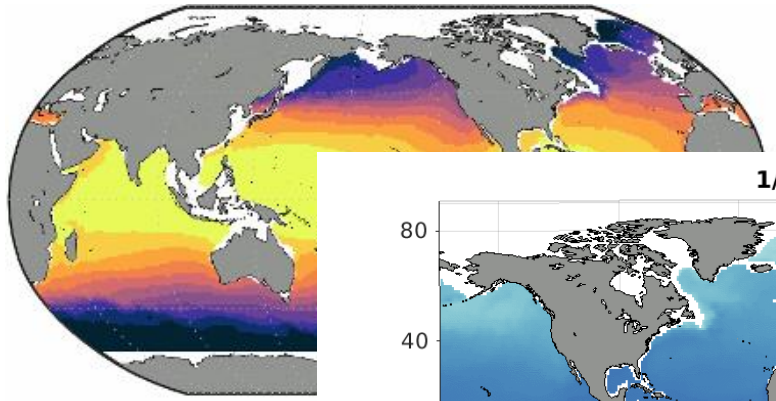
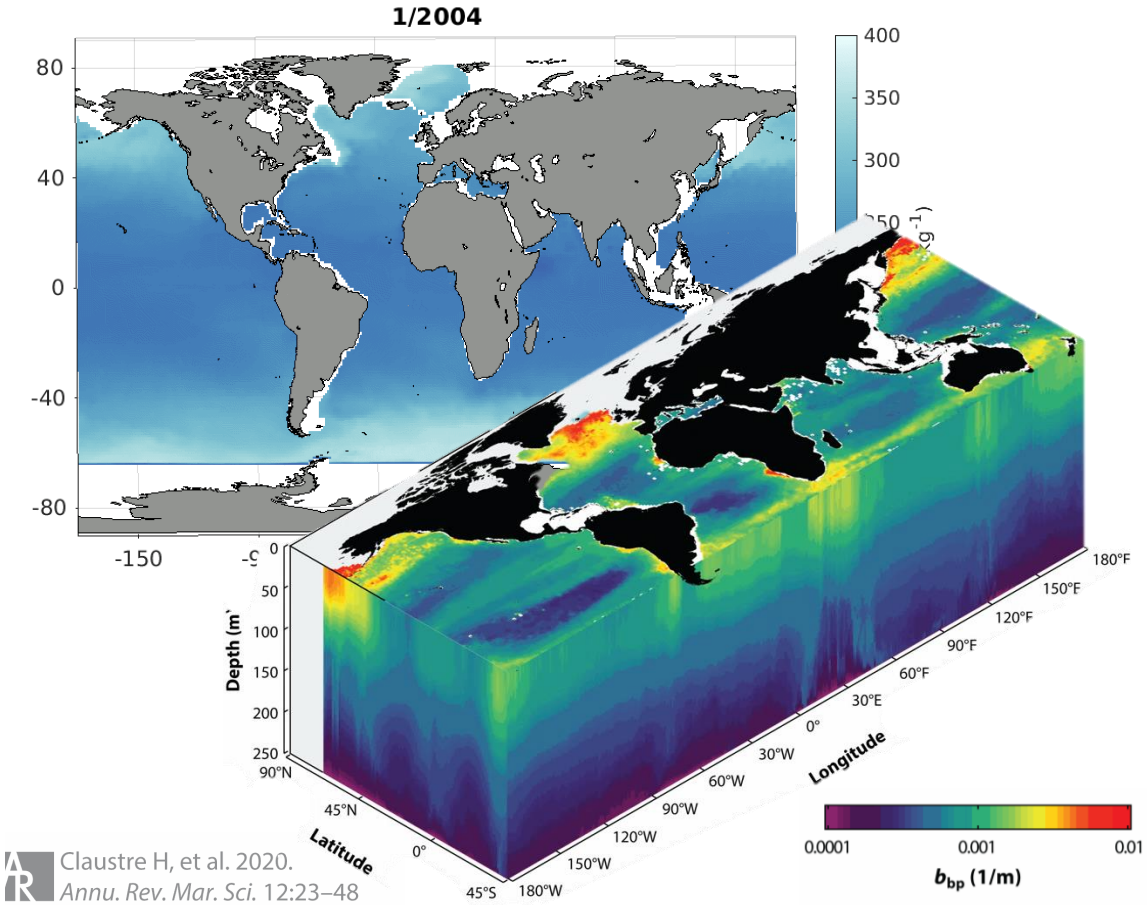


Earth Syst. Sci. Data, 15, 4481–4518, 2023
https://doi.org/10.5194/essd-15-4481-2023

Open Access Earth System Science Data

GOBAI-O_2: temporally and spatially resolved fields of ocean interior dissolved oxygen over nearly 2 decades

Jonathan D. Sharp[1,2], Andrea J. Fassbender[2], Brendan R. Carter[1,2], Gregory C. Johnson[2], Cristina Schultz[3,4], and John P. Dunne[3]



Copernicus Marine Service

AGU PUBLICATIONS

JGR

Journal of Geophysical Research: Oceans

RESEARCH ARTICLE
10.1002/2015JC011408

A neural network-based method for merging ocean color and Argo data to extend surface bio-optical properties to depth: Retrieval of the particulate backscattering coefficient

Key Points:
- A neural network is developed to infer the vertical distribution of the backscattering coefficient
- The neural network requires as input

R. Sauzède[1], H. Claustre[1], J. Uitz[1], C. Jamet[2], G. Dall'Olmo[3,4], F. D'Ortenzio[1], B. Gentili[1], A. Poteau[1], and C. Schmechtig[1]

Claustre H, et al. 2020.
Annu. Rev. Mar. Sci. 12:23–48

Our model accurately captures albacore 3D habitat utilization and seasonal migratory movements

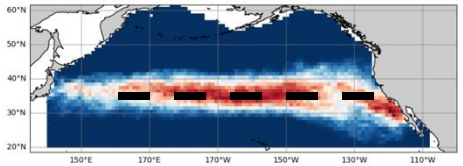
Predictor Variables

Surface: Depth-resolved:

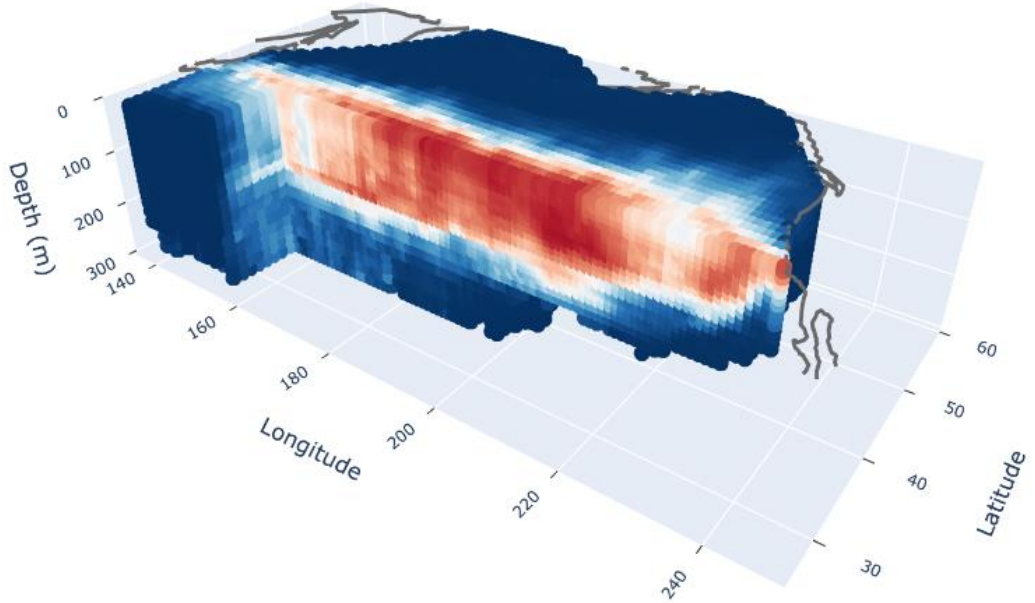
3D Model Prediction

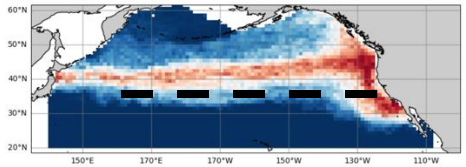
Presence or Absence

Model	Accuracy	F-1 Score	AUC-ROC
Score	0.86 (±0.02)	0.86 (±0.03)	0.94 (±0.01)

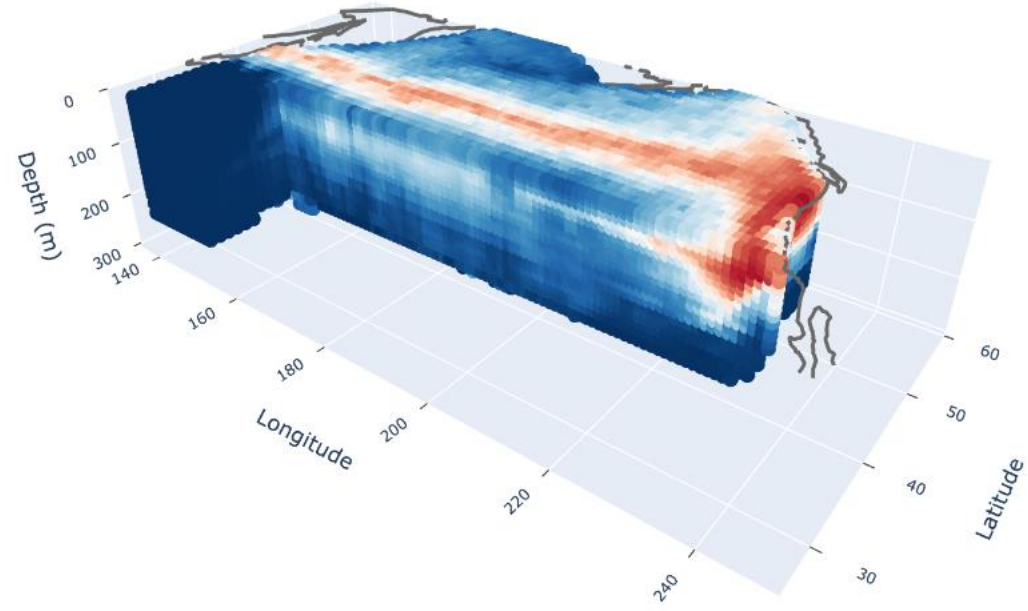


Winter

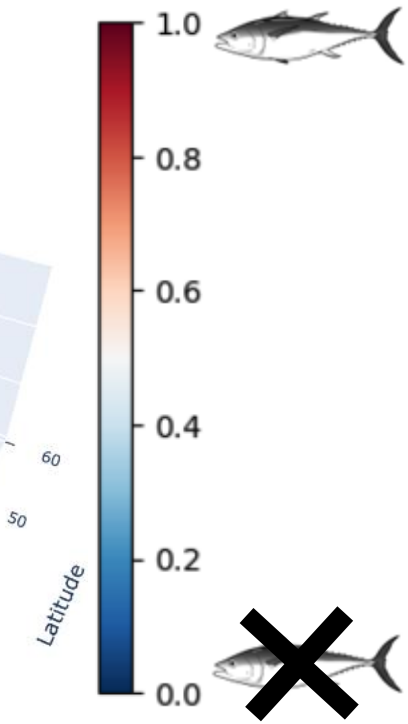




Summer



Mean Probability of Occurrence



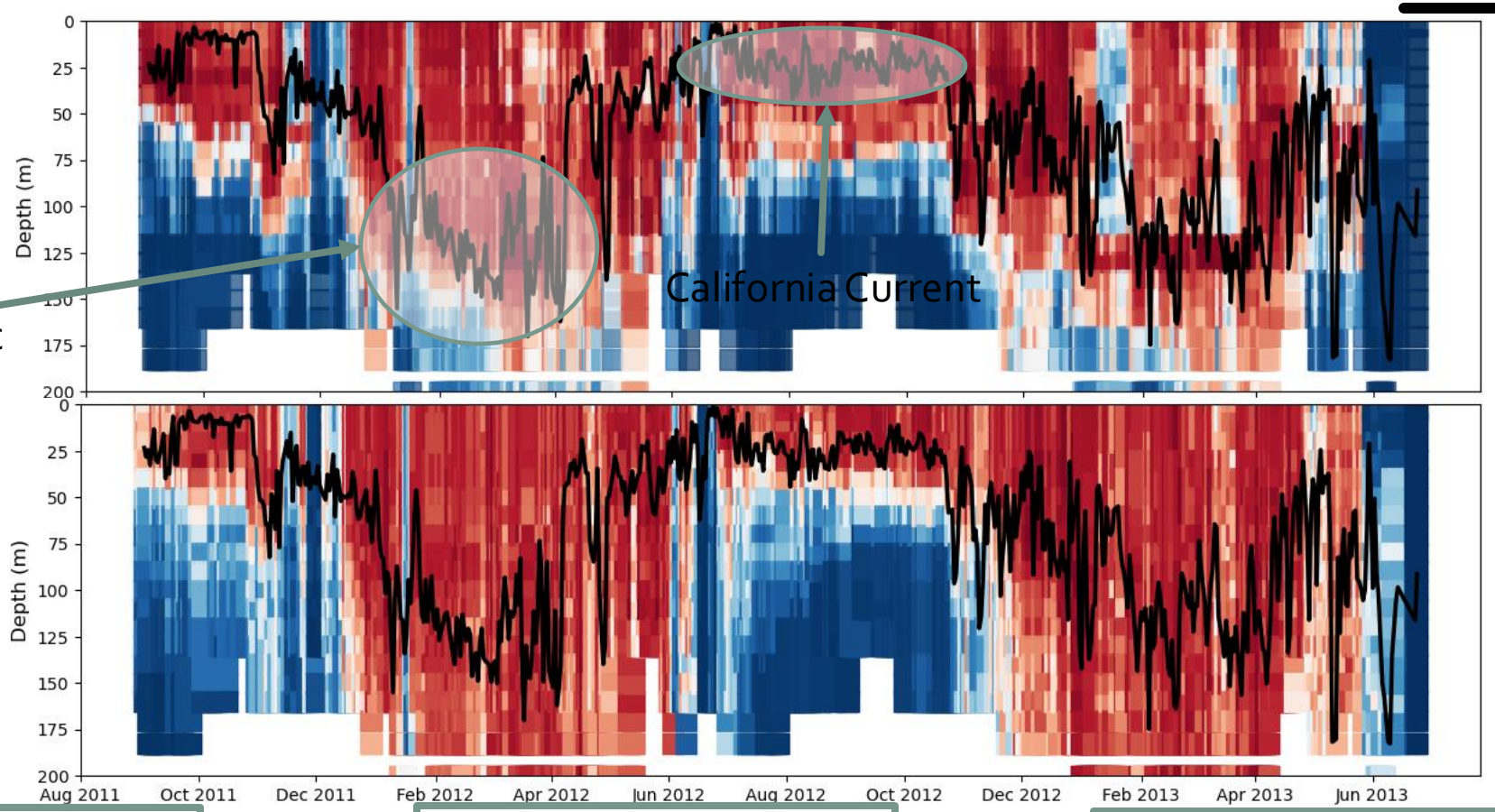
How do different environmental variables modulate predictions of 3D albacore habitat utilization?

Predictor Variables

Surface: Depth-resolved:

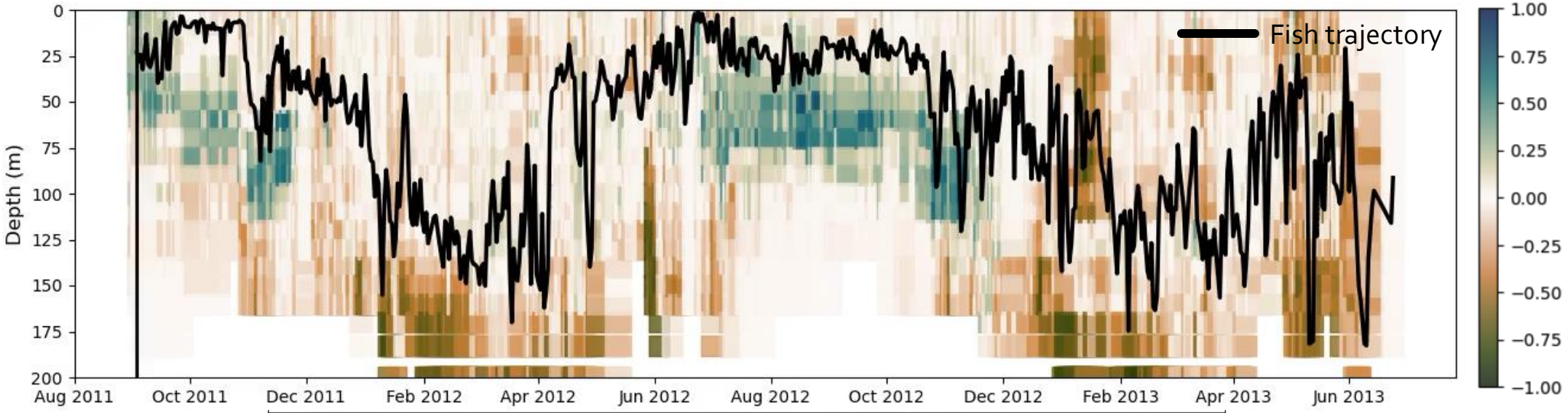
Subtropical North Pacific

Surface: Depth-resolved:



Surface: Depth-resolved: — Surface: Depth-resolved: = **Value of BGC:**

Biogeochemistry serves as a control on habitat suitability across space and time



Difference between Mean Probabilities of Occurrence

Biogeochemistry serves as a control on habitat suitability across space and time

Surface: Depth-resolved:

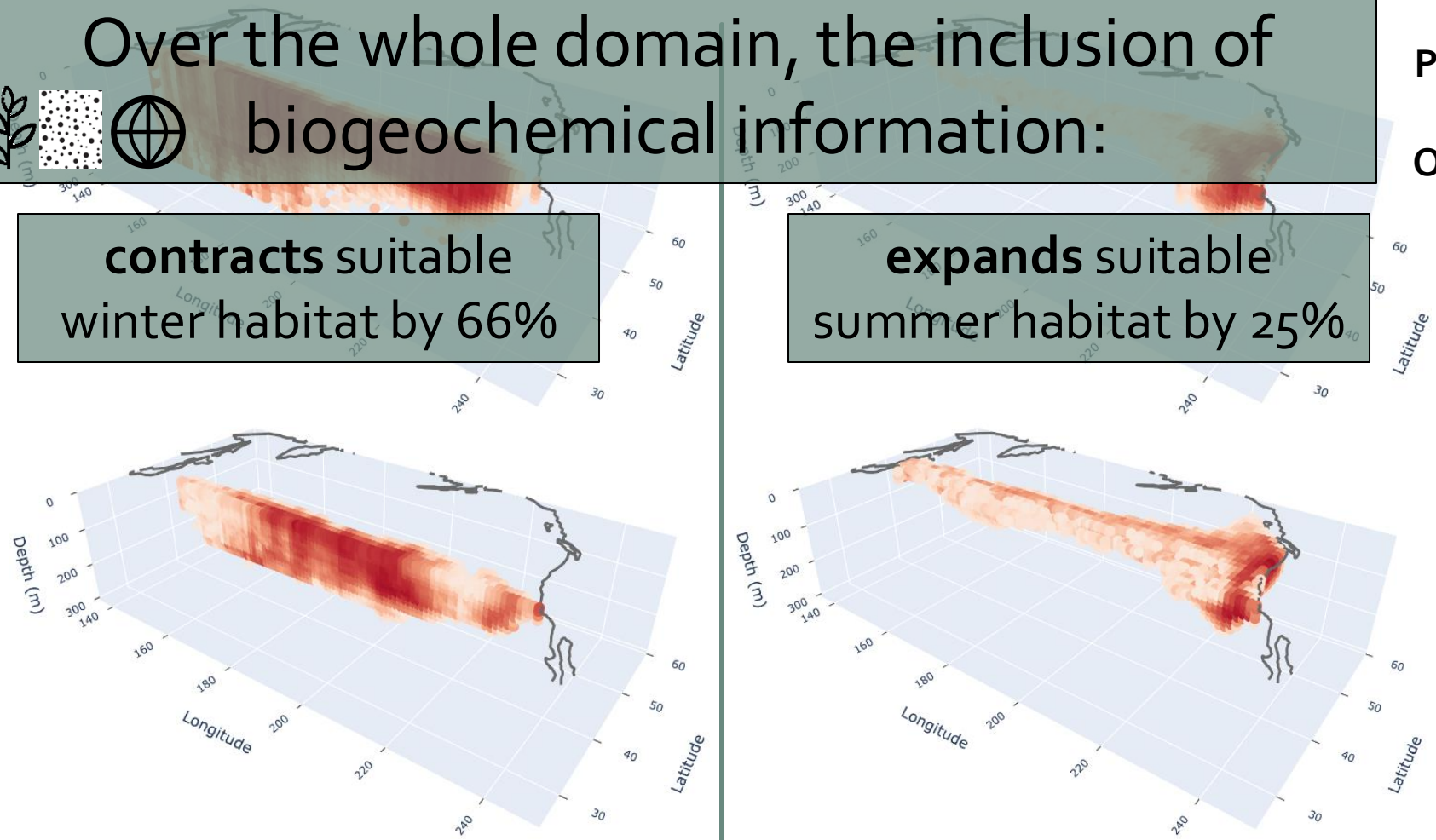
Surface: Depth-resolved:

Winter **Summer**

Over the whole domain, the inclusion of biogeochemical information:

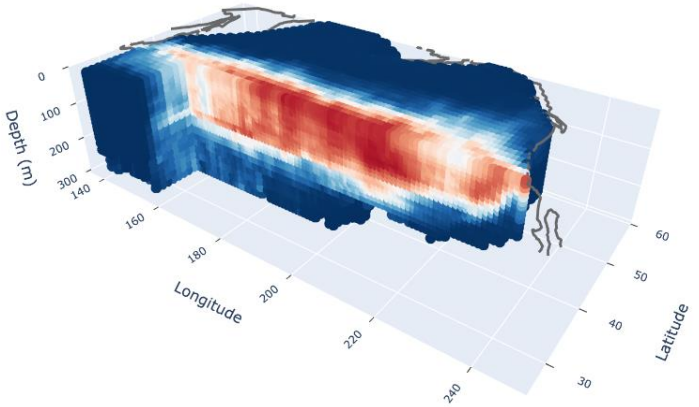
contracts suitable winter habitat by 66%

expands suitable summer habitat by 25%



4-dimensionally mapped ocean biogeochemistry provides a new perspective to understand habitat utilization

- Four-dimensional biogeochemical data products provide a new perspective to identify biogeographic regimes and migratory patterns associated with environmental context
- 4D-mapped ocean biogeochemistry data products depend on the persistence and growth of the global BGC-Argo float array
- BGC Argo can be applied to countless ecological and fisheries questions to inform species distribution modeling



biogeochemical Argo