Integrating Altimetry and Glider Measurements to Assess Eddy Influence on Line P

Tetjana **Ross**[1,2], Bernard Yang[2], Jody M. Klymak[2] and Lauryn Talbot[2,3]

[1]Fisheries and Ocean Canada, Institute of Ocean Sciences, Sidney, BC, Canada.
E-mail: tetjana.ross@dfo-mpo.gc.ca

[2]School of Earth and Oceans Sciences, University Victoria, Victoria BC, Canada.

[3]Department of Oceanography, Dalhousie University, Halifax NS, Canada.

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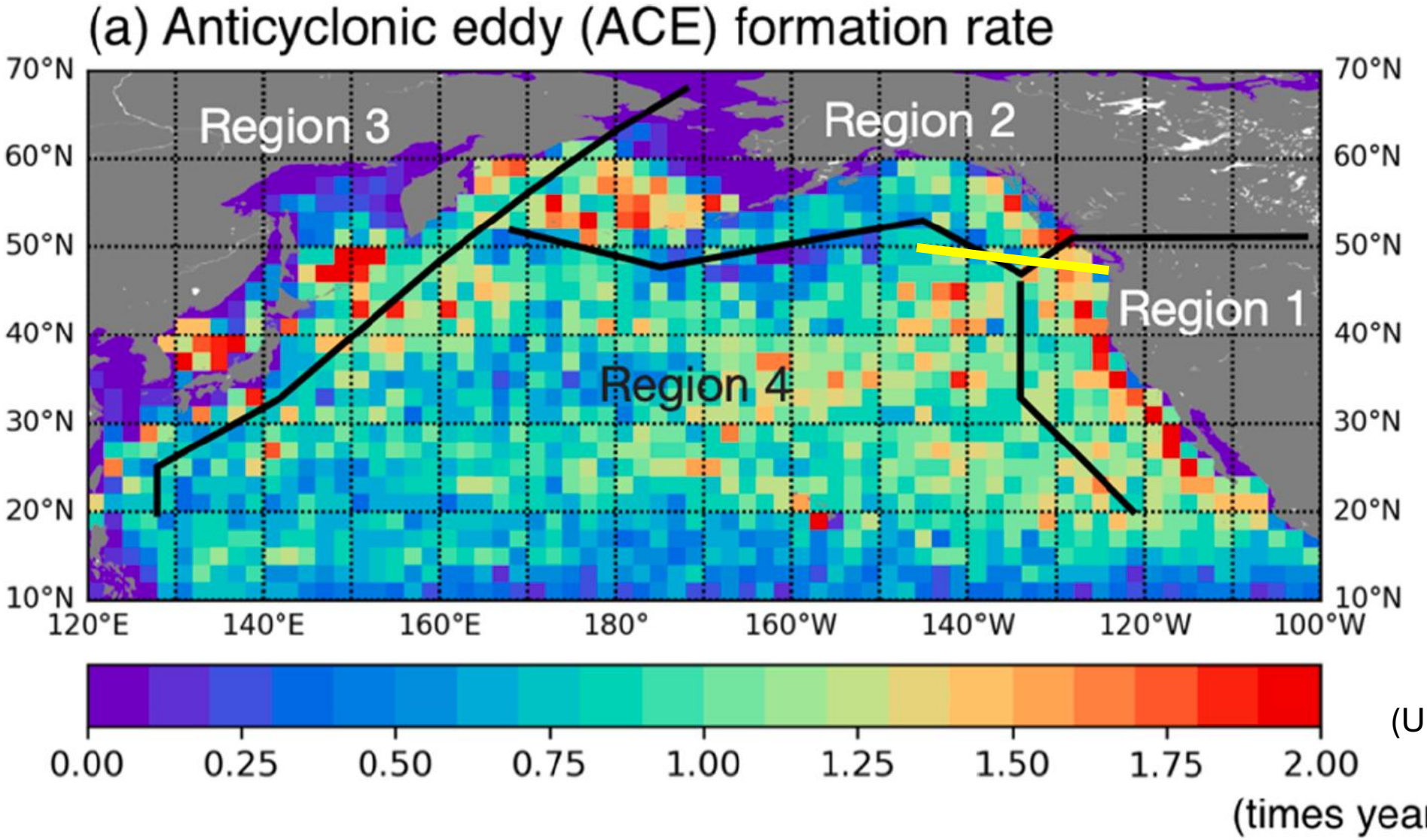
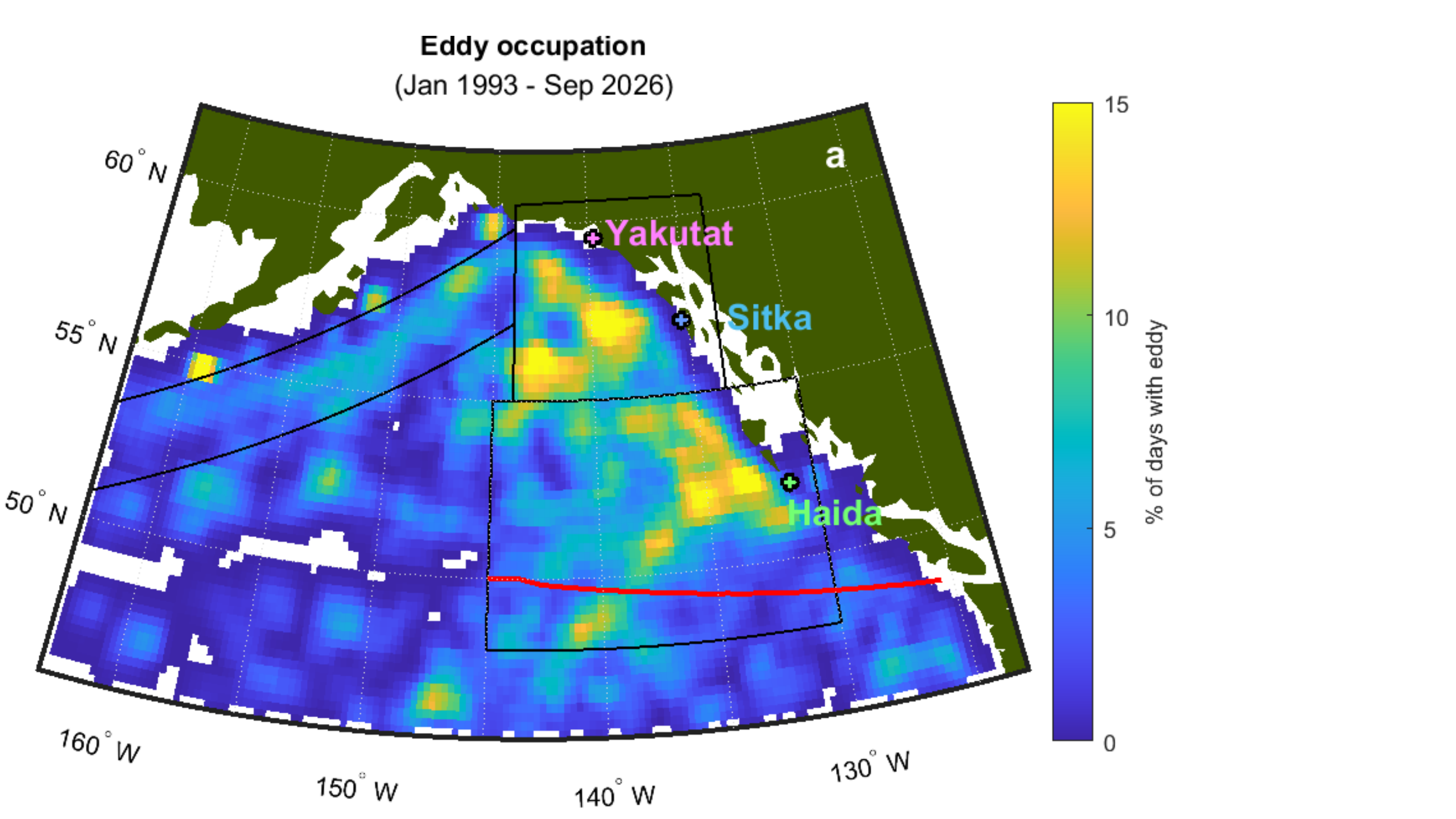
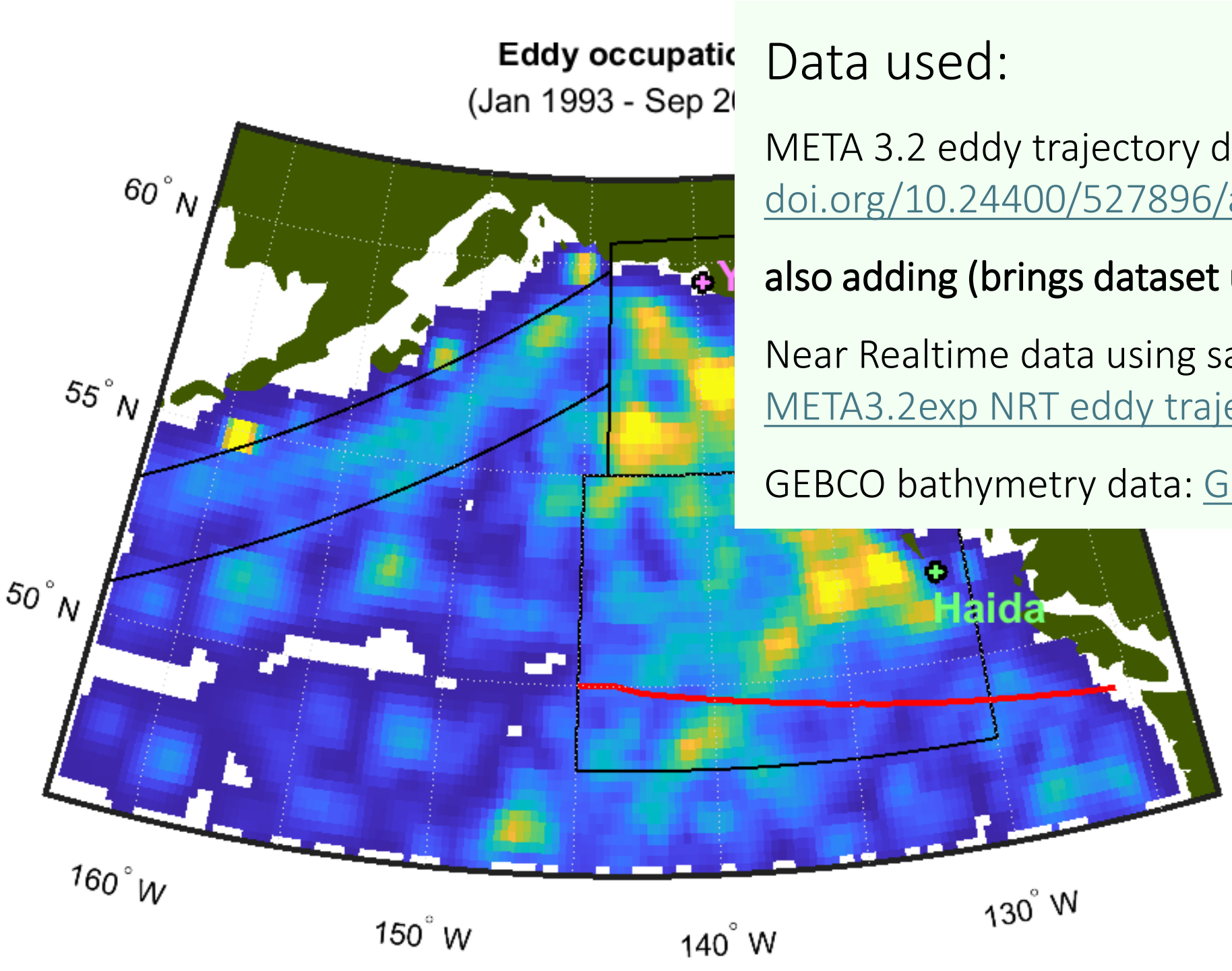
Eddies in the North Pacific



(Ueno et al, 2023)


Eddy occupation
(Jan 1993 - Sep 2026)
a
Yakutat
Sitka
Haida
60° N
55° N
50° N
160° W
150° W
140° W
130° W
15
10
5
0
% of days with eddy



Data used:

META 3.2 eddy trajectory dataset
doi.org/10.24400/527896/a01-2022.005

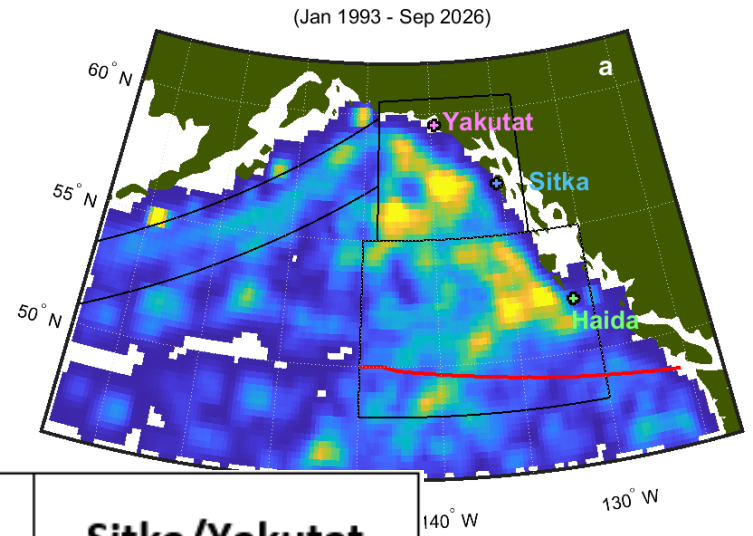
also adding (brings dataset up to Sep 2026)

Near Realtime data using same algorithm
META3.2exp NRT eddy trajectory dataset

GEBCO bathymetry data: GEBCO_2024 Grid

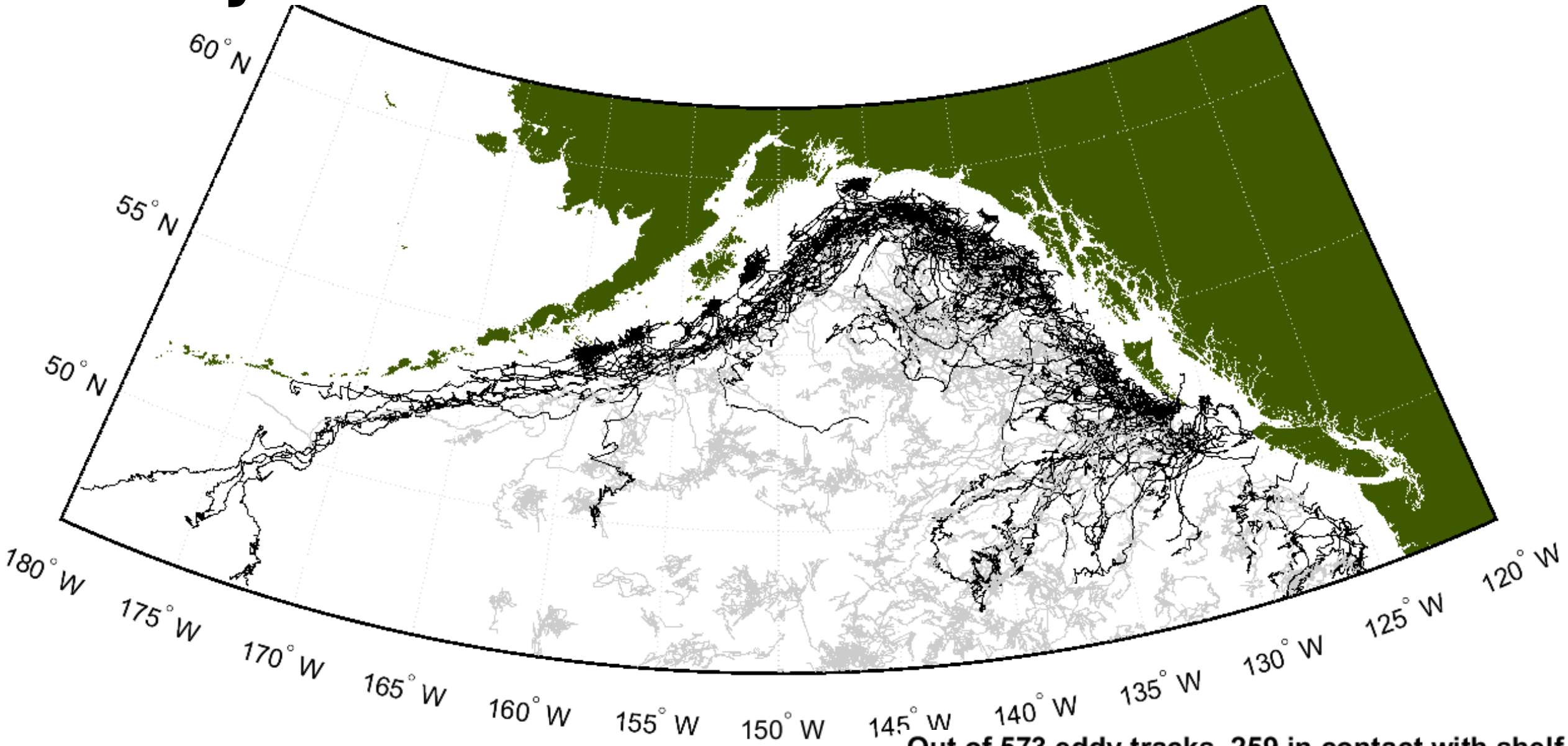
New analysis based on META 3.2 (Pegliasco et al., 2022)

An update on Henson and Thomas (2008)'s "*A census of oceanic anticyclonic eddies in the Gulf of Alaska*"



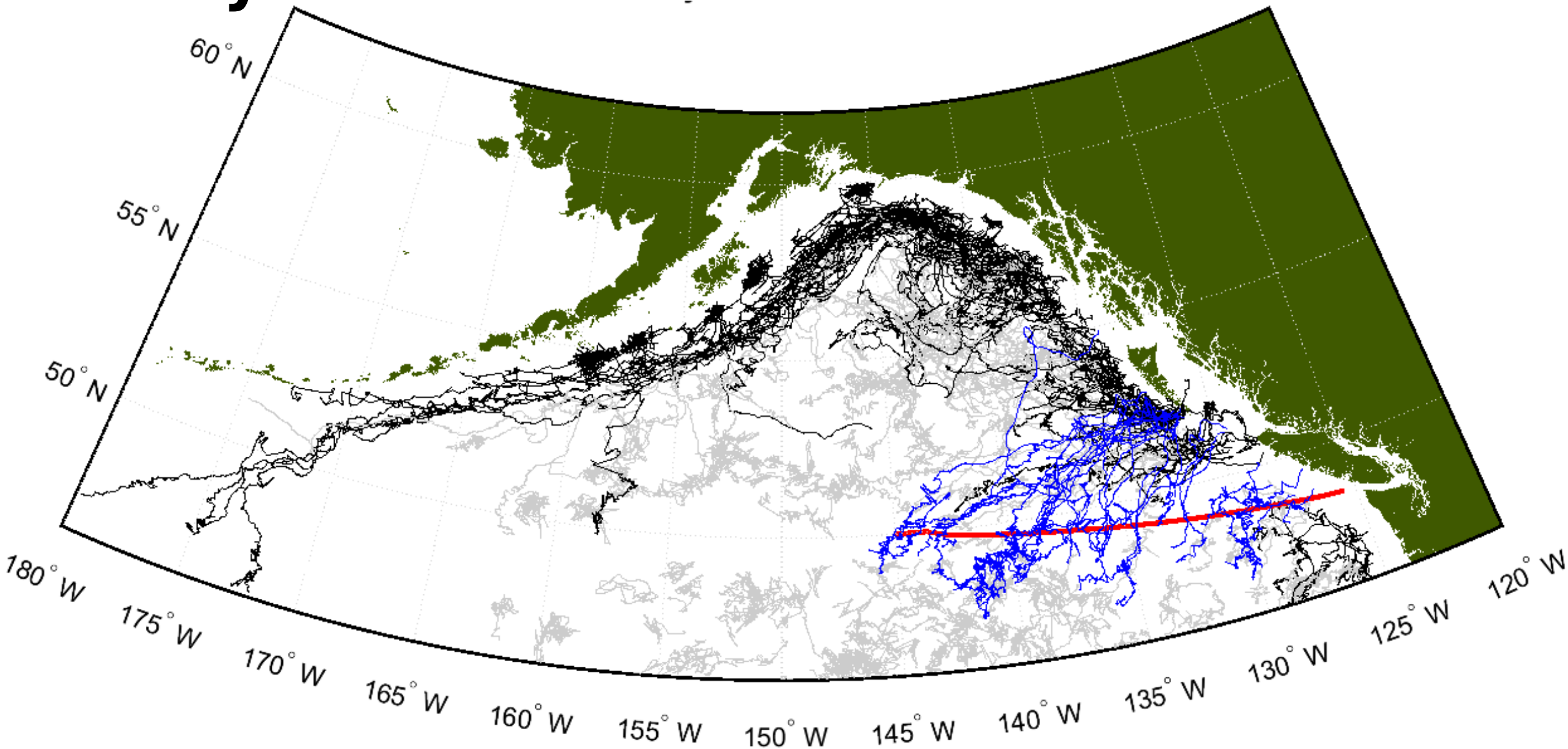
	Gulf of Alaska	Alaskan Stream	Haida	Sitka/Yakutat
Eddies formed/year	17 (8,23)	3.9 (0,9)	6.7 (1,11)	4.5 (2,7)
Eddies present/year	28 (19,36)	4.9 (1,9)	11 (5,18)	6.1 (3,9)
Amplitude (cm)	8.2 [1.4,22]	13 [2.4,26]	7.6 [1.7,18]	11 [2.6,23]
Diameter (km)	135 [66,220]	127 [65,198]	139 [69,222]	126 [63,213]
Duration (weeks)	42 [15,99]	41 [15,111]	45 [16,102]	41 [15,93]
Prop. speed (km/day)	2.7 [0.5,7.5]	2.9 [0.6,7.2]	2.2 [0.4,6]	2.4 [0.5,6.1]
E/W velocity (km/day)	-0.7 [-4.8,3.3]	-1.3 [-5.3,2.4]	-0.7 [-3.9,2.5]	-0.9 [-4.4,2.2]
N/S velocity (km/day)	-0.1 [-3.8,3.4]	-0.8 [-4.3,2.4]	-0.05 [-3.1,2.9]	0.2 [-2.9,3.3]

Eddy tracks

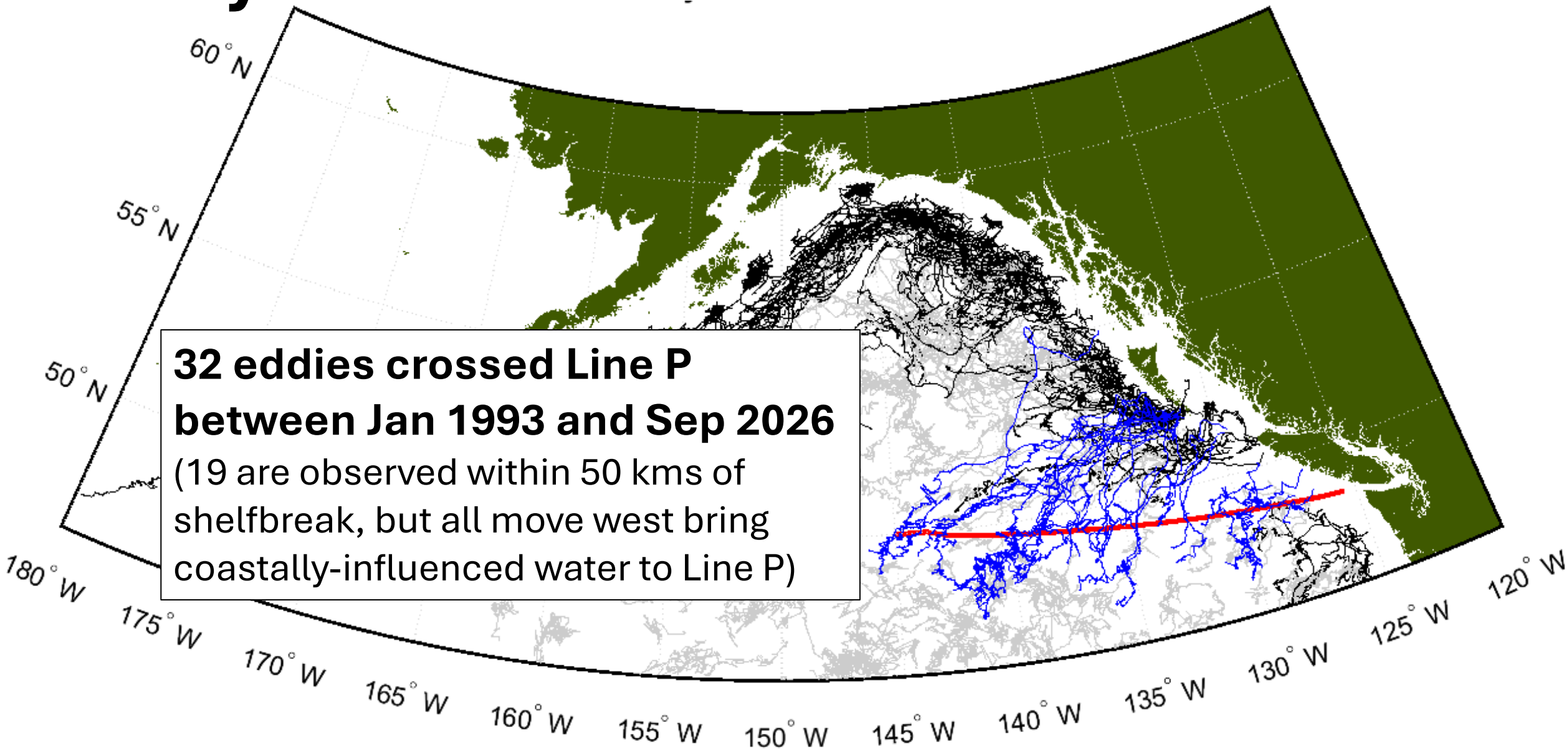


Out of 573 eddy tracks, 259 in contact with shelf

Eddy tracks: Line P Visitation



Eddy tracks: Line P Visitation



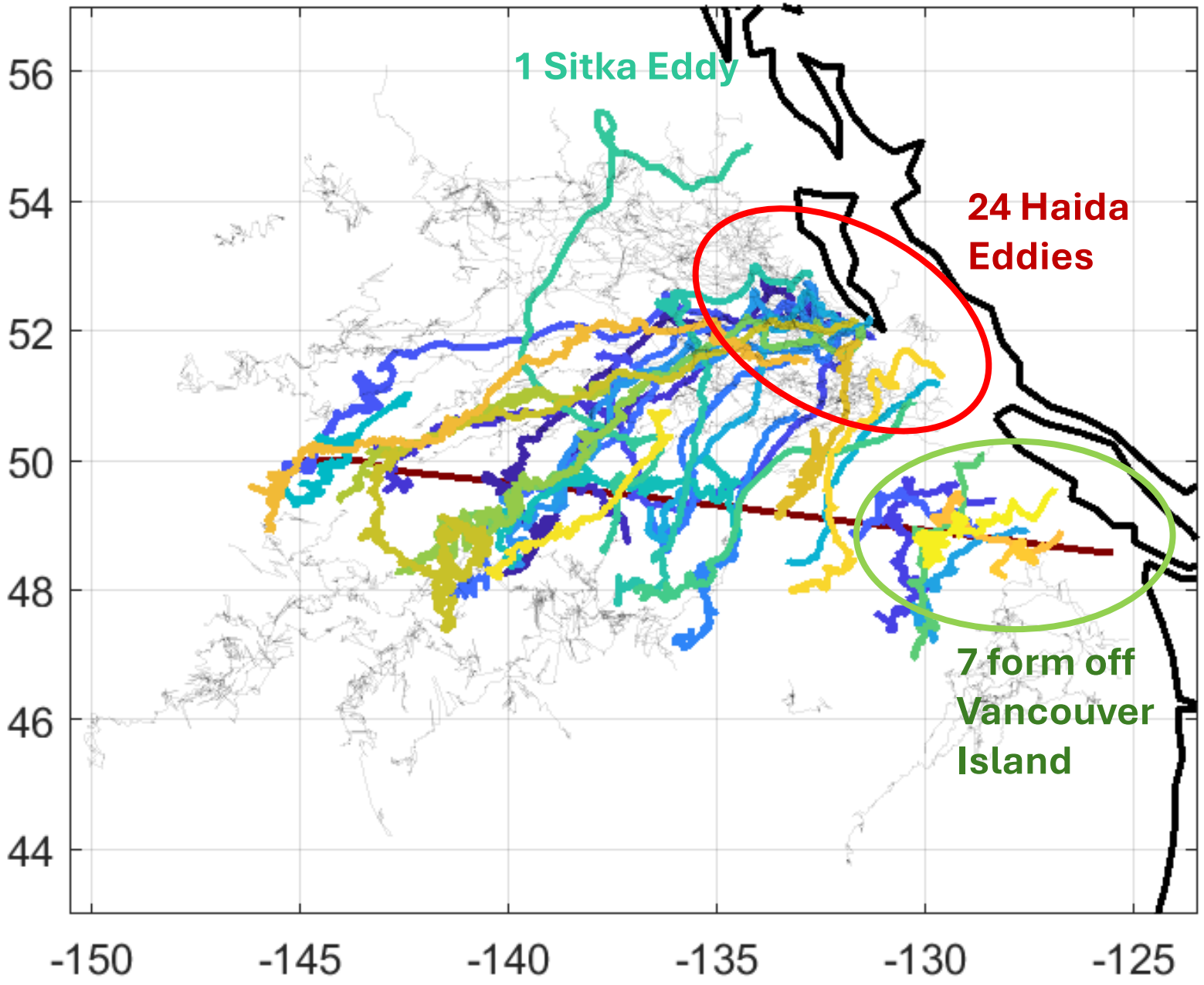
32 eddies crossed Line P between Jan 1993 and Sep 2026

(19 are observed within 50 kms of shelfbreak, but all move west bring coastally-influenced water to Line P)

Where are they from?

+ 1 Sitka
+ 24 Haida
+ 7 Vancouver Island
=

32 eddies crossed Line P between Jan 1993 and Sep 2026



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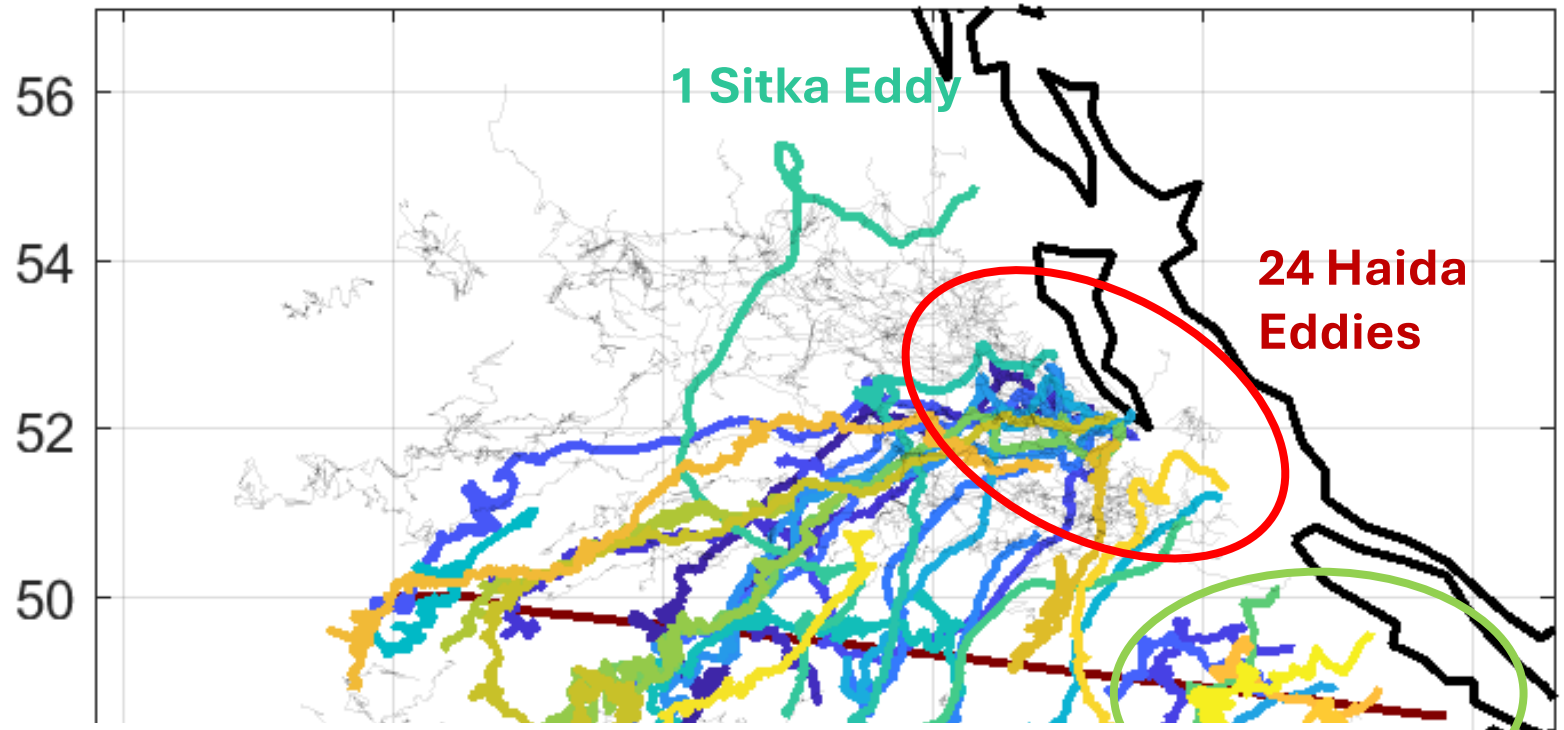

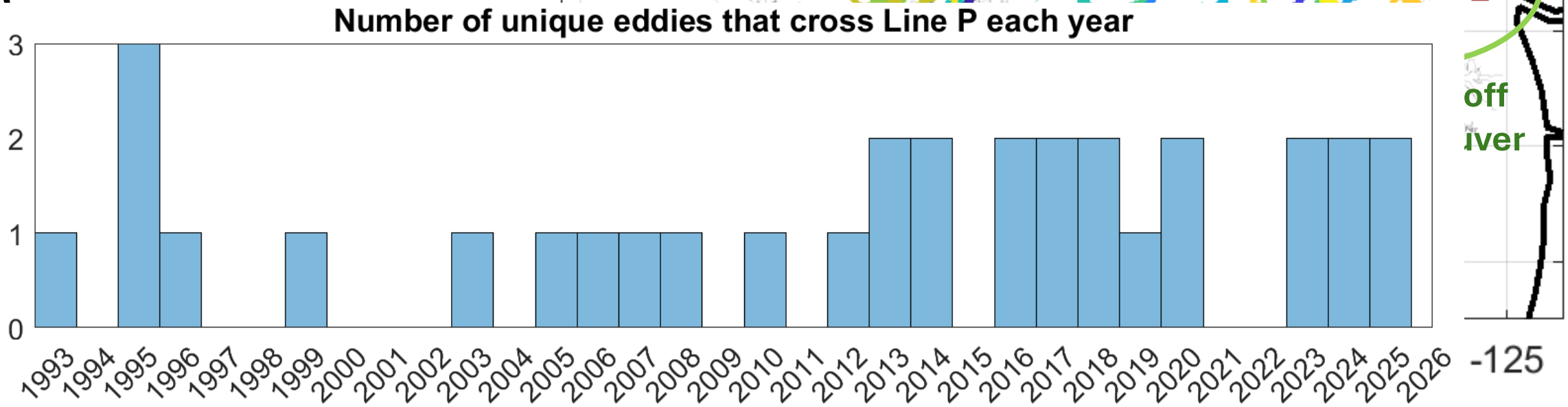

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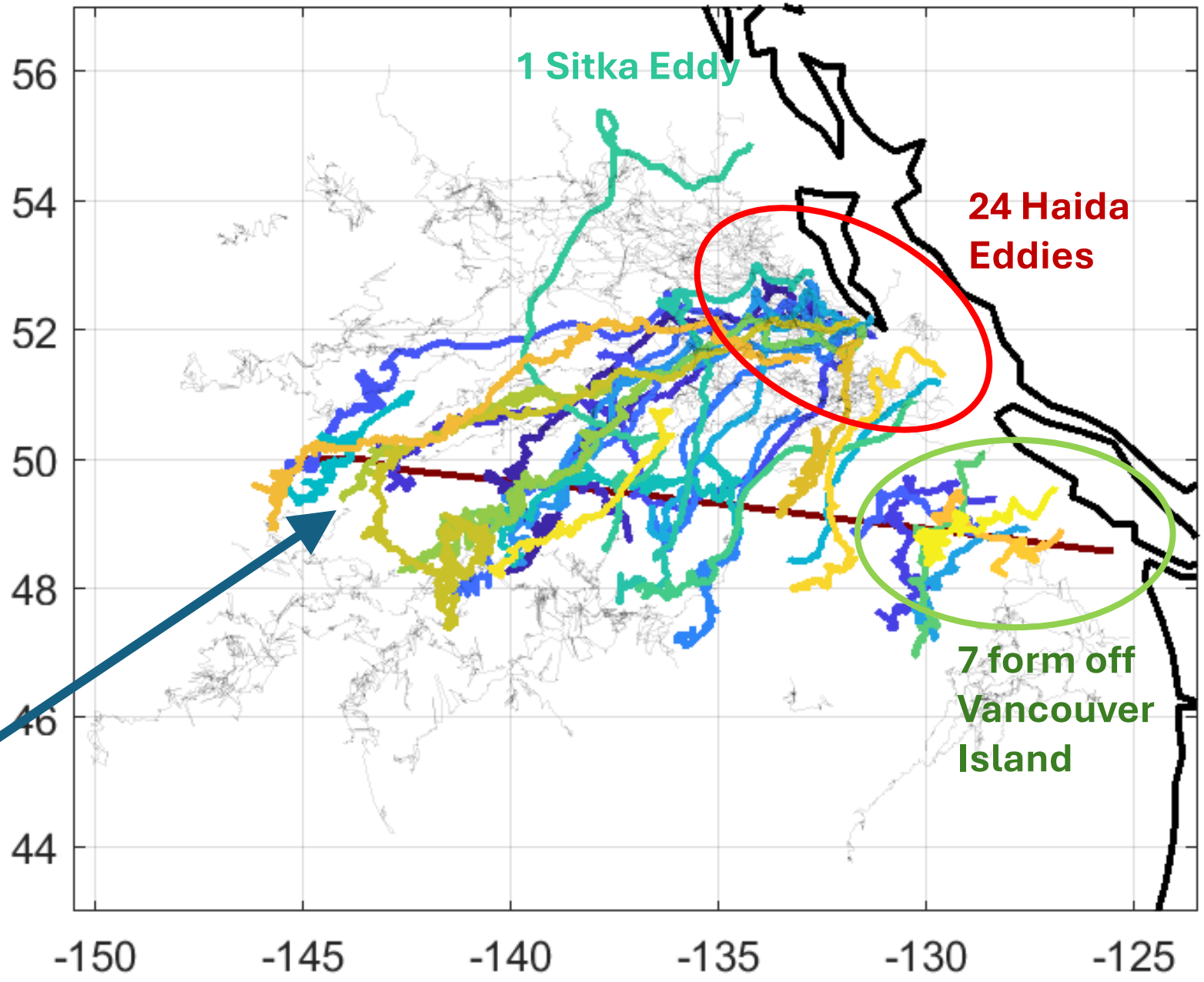
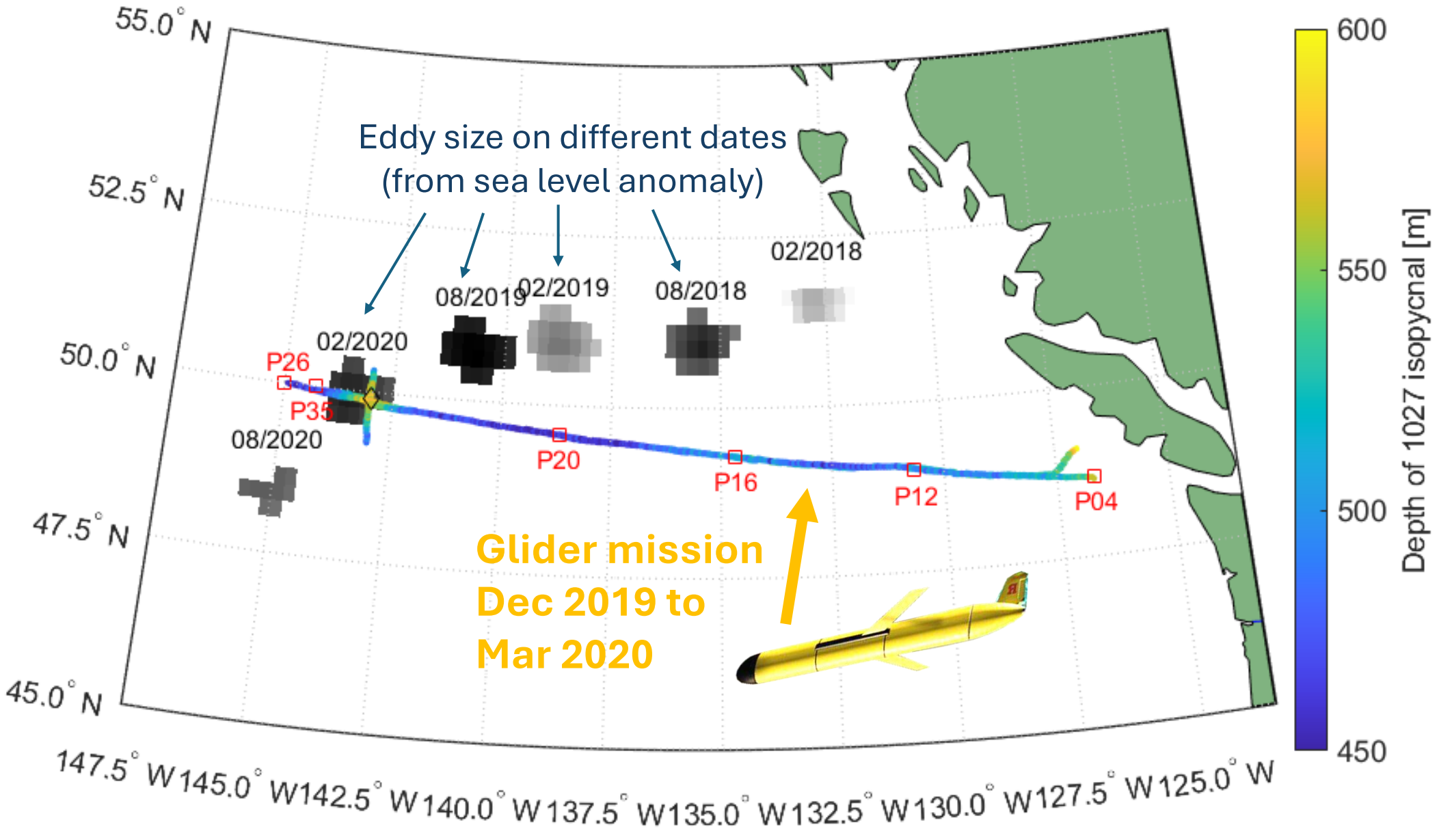
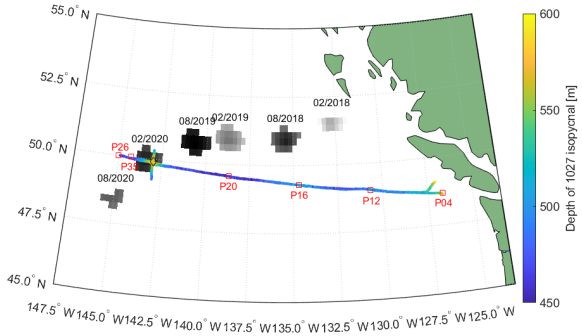
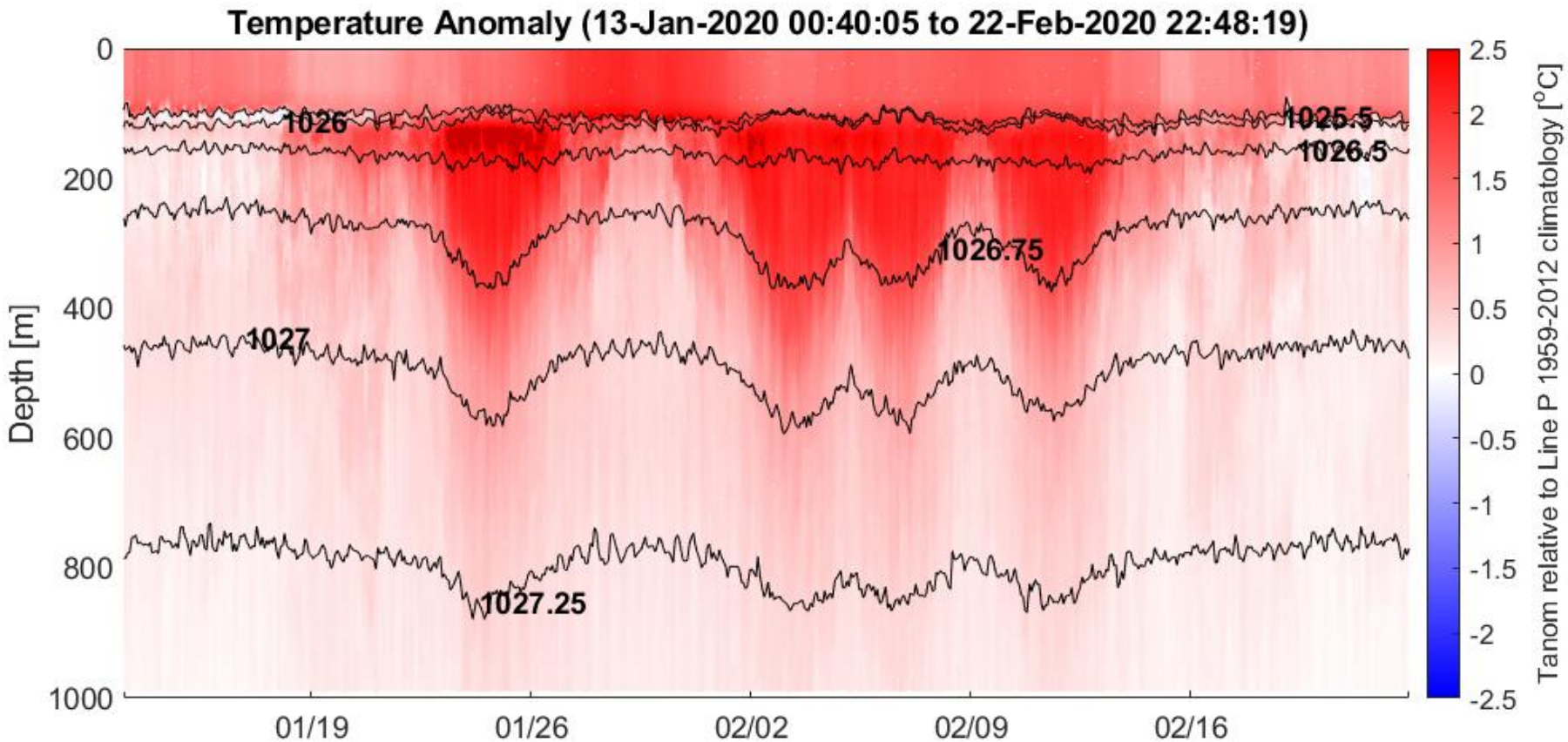
32 eddies crossed Line P between Jan 1993 and Sep 2026

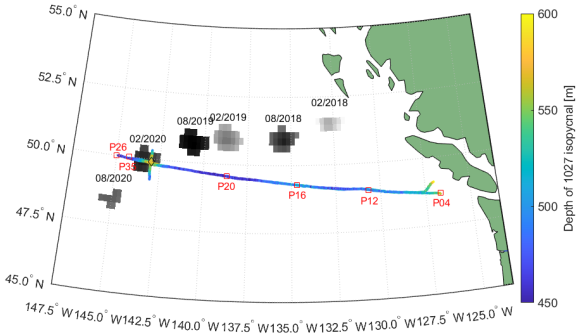
Let's focus on this one

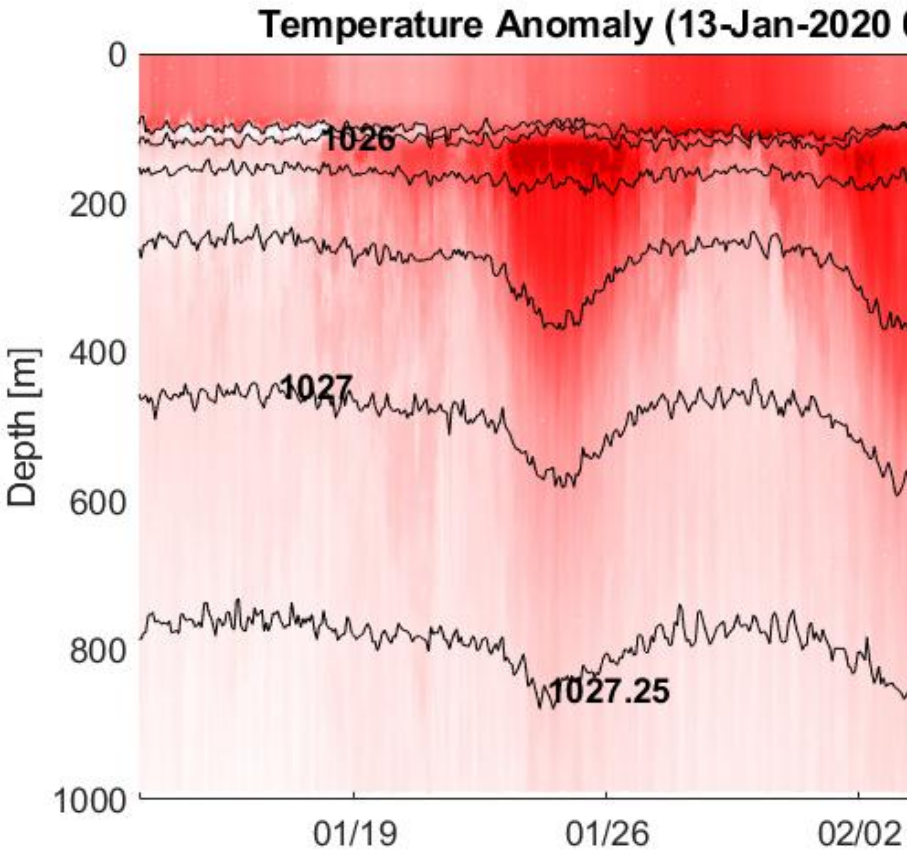


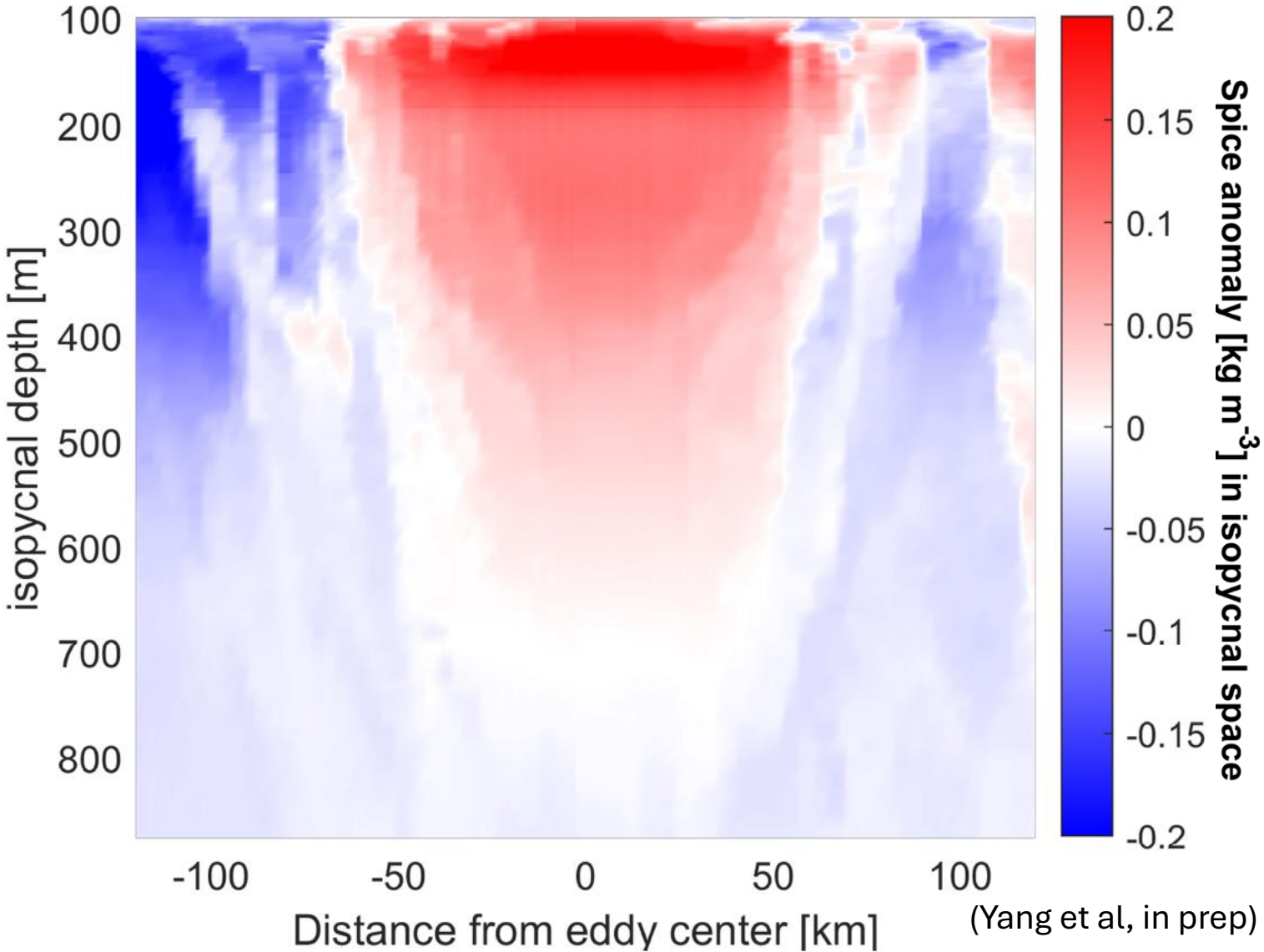

Eddy size on different dates
(from sea level anomaly)
02/2020
08/2019
02/2019
08/2018
02/2018
08/2020
P26
P35
P20
P16
P12
P04
Glider mission
Dec 2019 to
Mar 2020
55.0° N
52.5° N
50.0° N
47.5° N
45.0° N
147.5° W
145.0° W
142.5° W
140.0° W
137.5° W
135.0° W
132.5° W
130.0° W
127.5° W
125.0° W
600
550
500
450
Depth of 1027 isopycnal [m]


55.0° N
52.5° N
50.0° N
47.5° N
45.0° N
147.5° W 145.0° W 142.5° W 140.0° W 137.5° W 135.0° W 132.5° W 130.0° W 127.5° W 125.0° W
08/2019
02/2019
08/2018
02/2018
02/2020
P26
P35
08/2020
P20
P16
P12
P04
600
550
500
450
Depth of 1027 isopycnal [m]


Temperature Anomaly (13-Jan-2020 00:40:05 to 22-Feb-2020 22:48:19)
Depth [m]
0
200
400
600
800
1000
01/19
01/26
02/02
02/09
02/16
1026
1025.5
1026.5
1026.75
1027
1027.25
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
Tanom relative to Line P 1959-2012 climatology [°C]



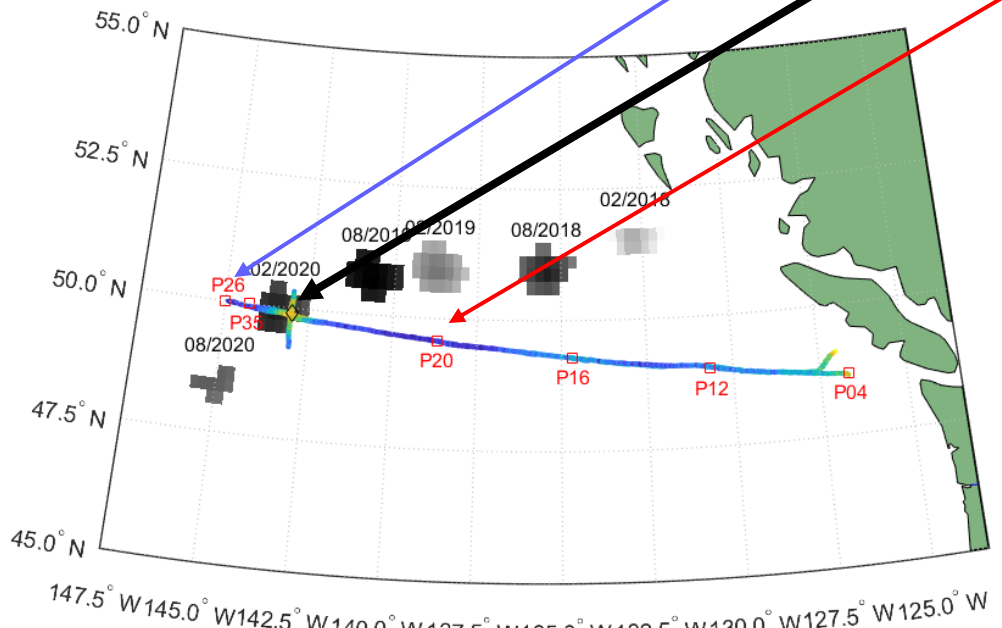


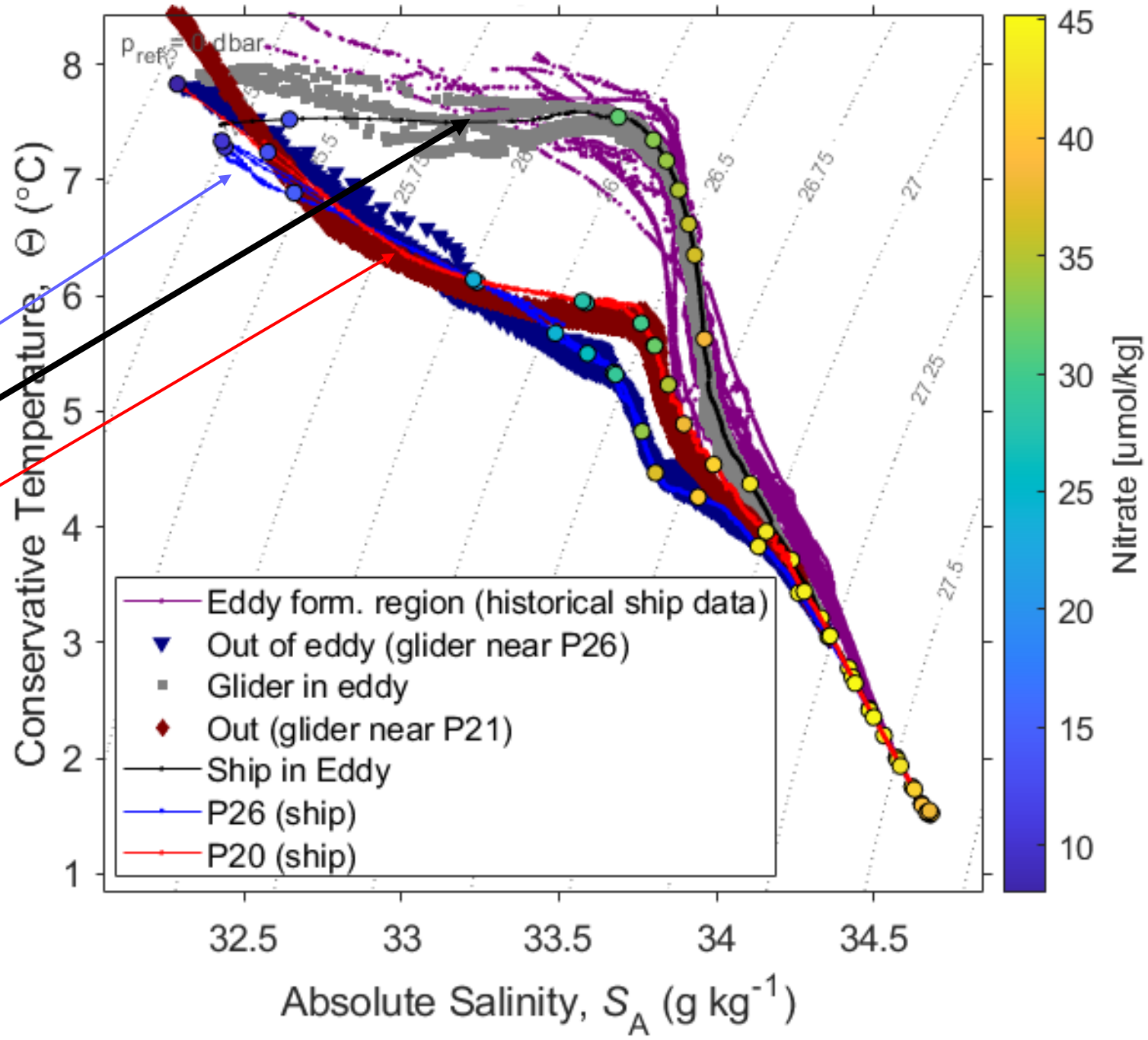


(Yang et al, in prep)

Ship sampling in and near the eddy

Rosette casts at regular Line P stations and additional one in eddy center





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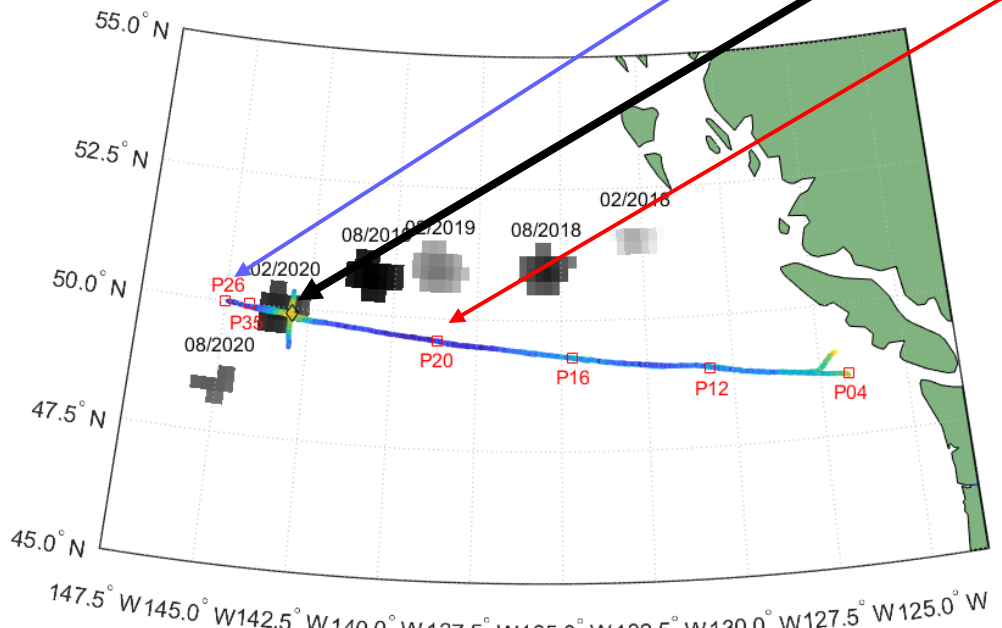
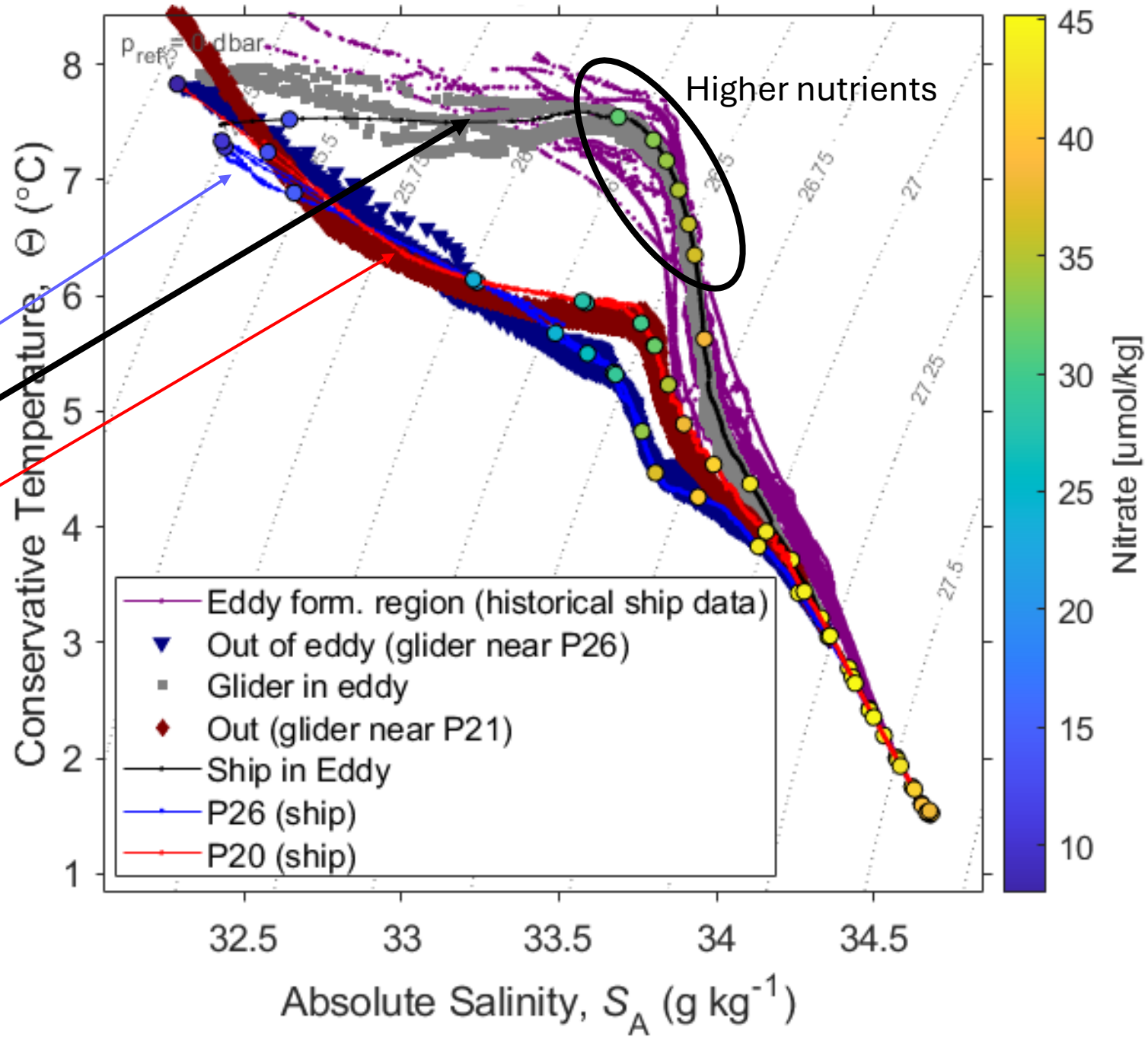
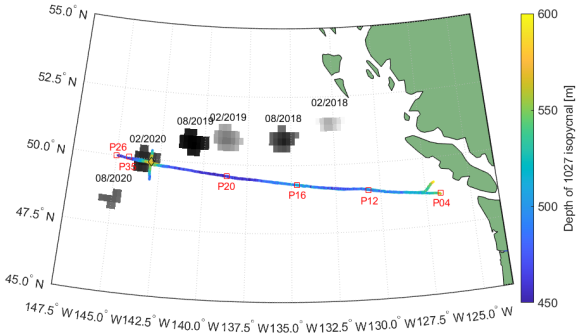
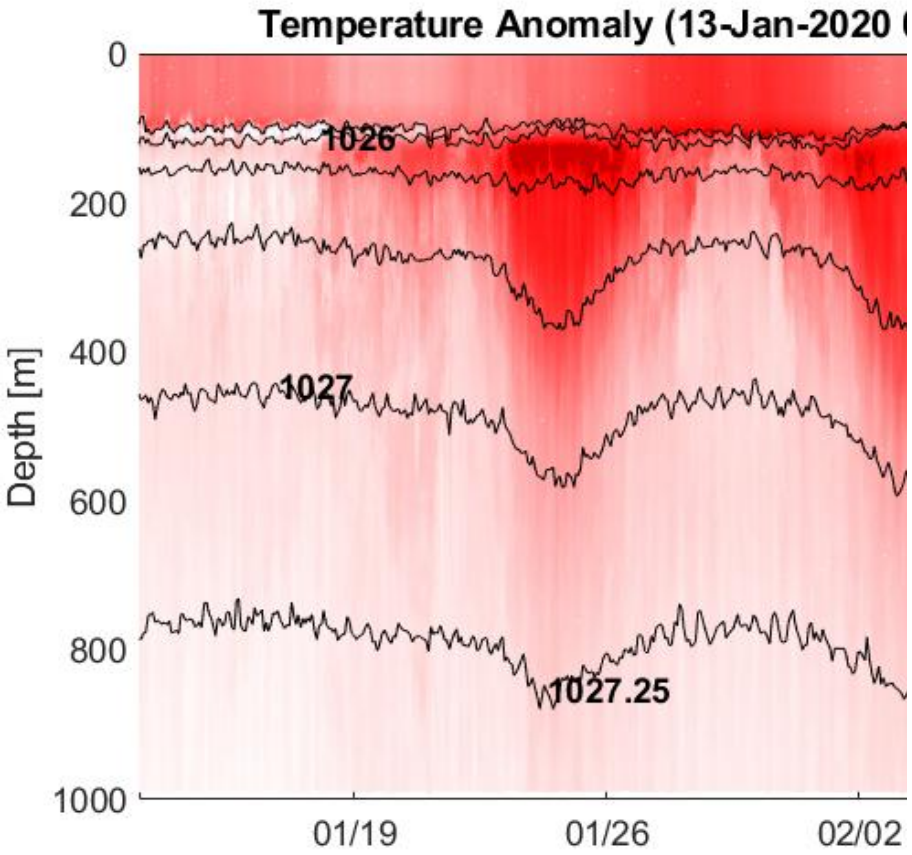
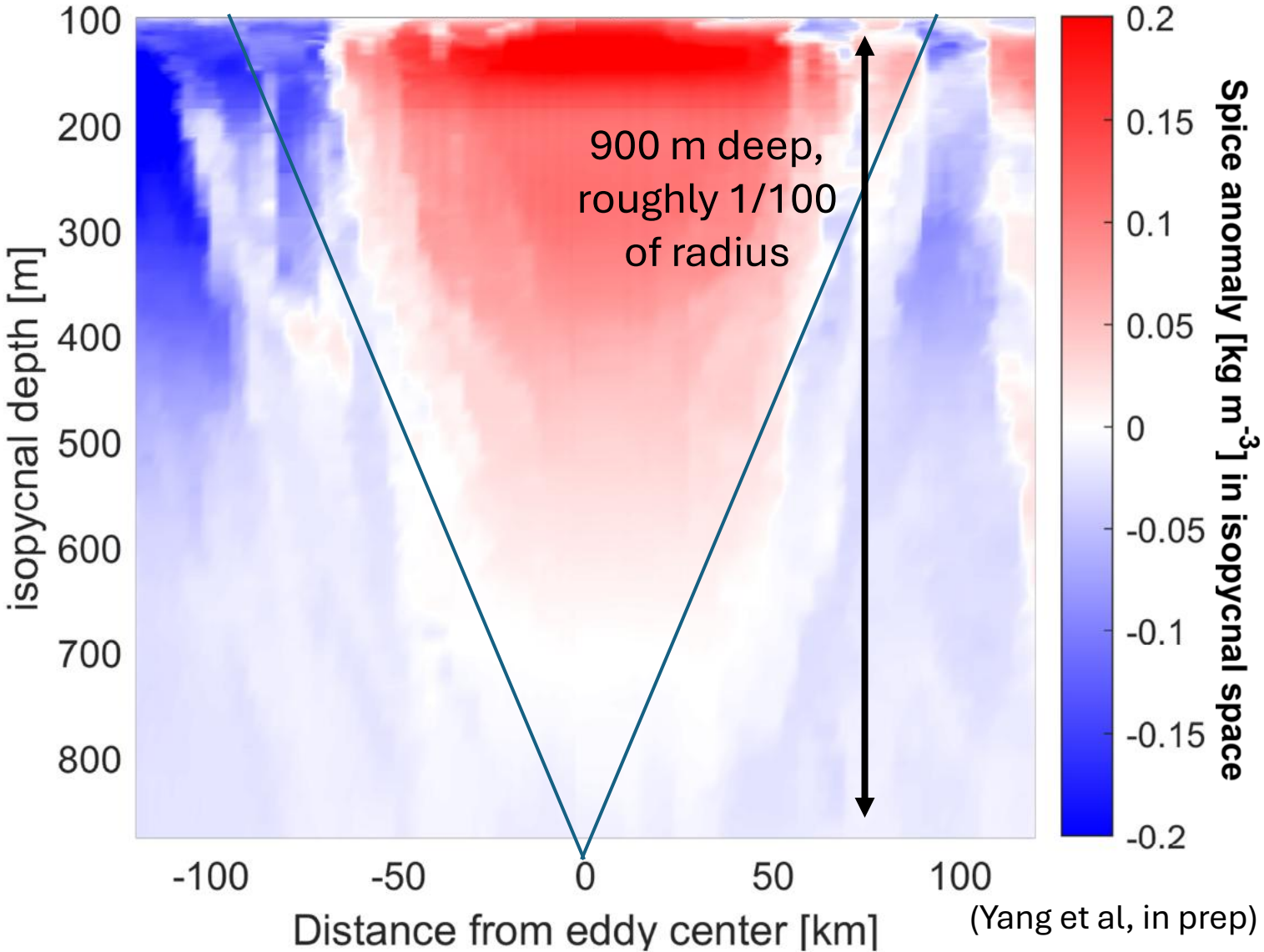








META 3.2 estimate of eddy radius is 93 ± 12 km



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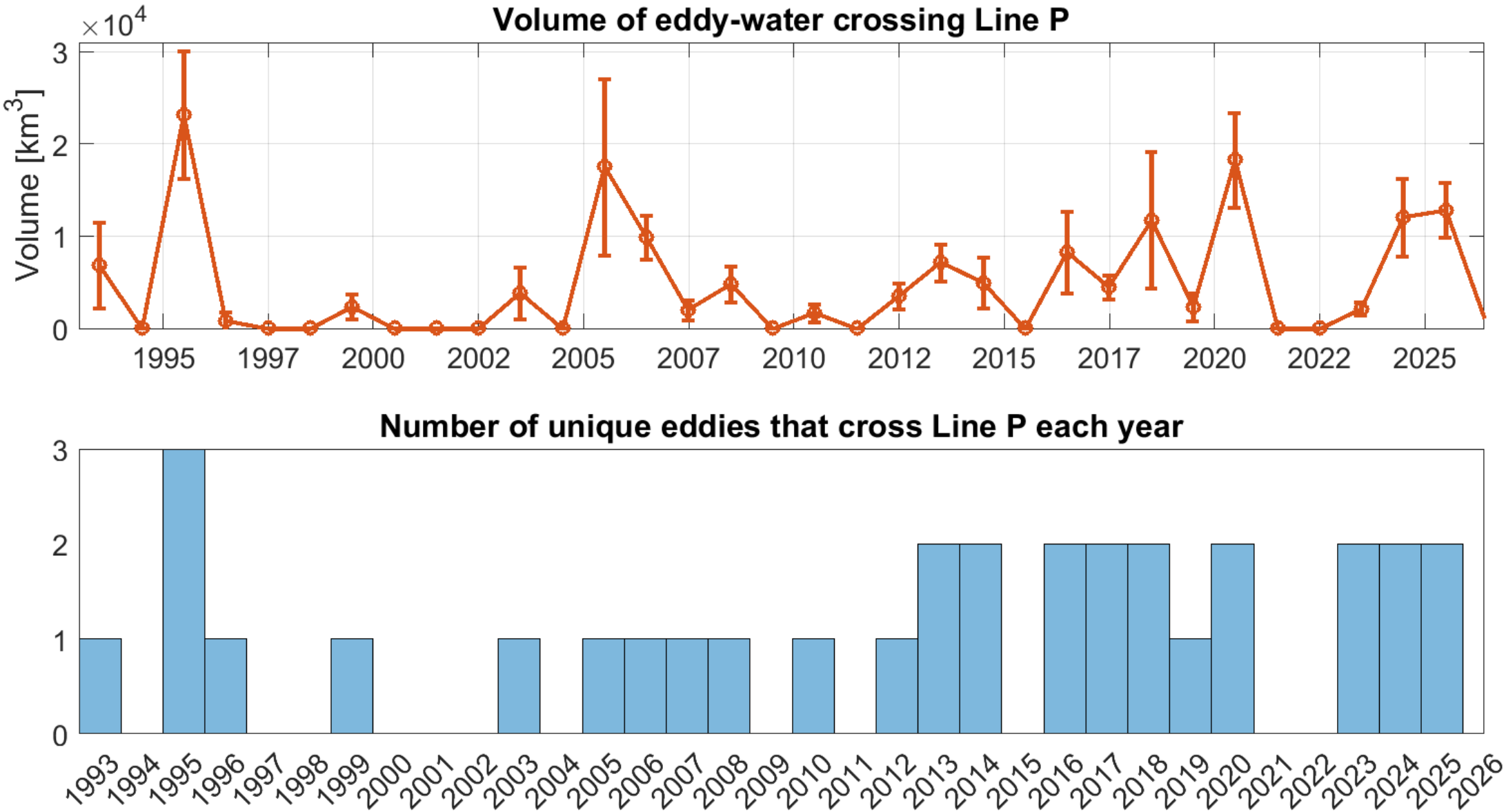
Volume of eddy-water crossing Line P
×10^4
Volume [km^3]
3
2
1
0
1995
1997
2000
2002
2005
2007
2010
2012
2015
2017
2020
2022
2025
Number of unique eddies that cross Line P each year
3
2
1
0
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026

Take aways

- Roughly one large eddy visits Line P each year
- The majority are Haida Eddies – formed near the southern tip of Haida Gwaii
  - These carry “coastal” waters with different water properties, including higher nutrients (including micronutrients like iron, e.g. Xiu et al, 2011)
  - They sporadically increase variability along the line (see Klymak presentation for more details)
  - These Haida Eddies are old (e.g. 2 years, for the 2020 eddy) and decaying and (likely) leaving coastal water behind









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Thank you.

Questions?

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