Environmental effects on forage and longline fishery performance for albacore tuna in the American Samoa EEZ

Réka Domokos

(***Fisheries Oceanography***, **18:6, 2009**)

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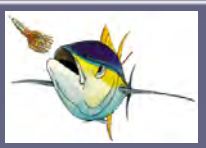


Background

- **Motivation**
  - **exponential growth of fishery targeting albacore**
  - **Seasonal and interannual variability in albacore CPUE**
- **Previous results* suggest**
  - **seasonally and interannually varying South Equatorial Counter Current (SECC) has significant effects on fishery performance for albacore**
  - **distribution of albacore forage plays an important role**

***Domokos et al., 2007**

Objectives

- Investigate the characteristics of the SECC
- Investigate the effects of the SECC in the American Samoa EEZ on
  - the environment
  - micronekton composition, distribution, and biomass
  - albacore CPUE

NOAA Ship *Oscar Elton Sette*

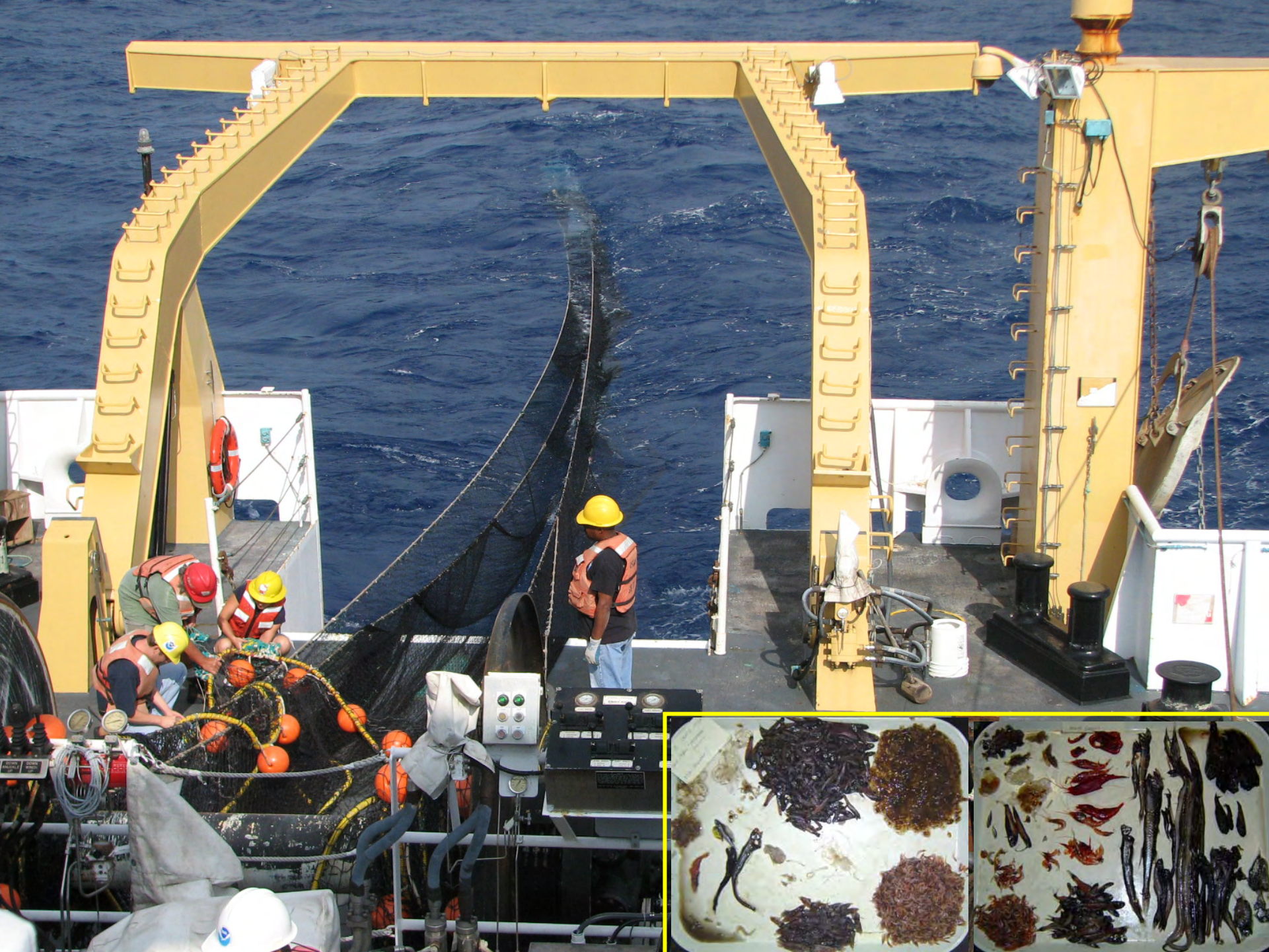
***In situ* data**

- **Micronekton:**
  - Simrad EK60 (38 & 120 kHz) acoustic system
  - midwater trawl samples
- **Environment:**
  - ADCP (75 kHz)
  - CTD (T, S, DO, Chl)

Satellite data

- **AVISO altimetry (SLA & $\vec{u}_g$)**
- **SeaWiFS ocean color (Chl-a)**


38 kHz
200 kHz
120 kHz
speed log
50 kHz fathom
12 kHz fathom
200 kHz fathom
75 kHz ADCP
70 kHz
38/200 kHz
50/200 kHz



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200 kHz
120 kHz
speed log
50 kHz fathom
12 kHz fathom
200 kHz fathom
75 kHz ADCP
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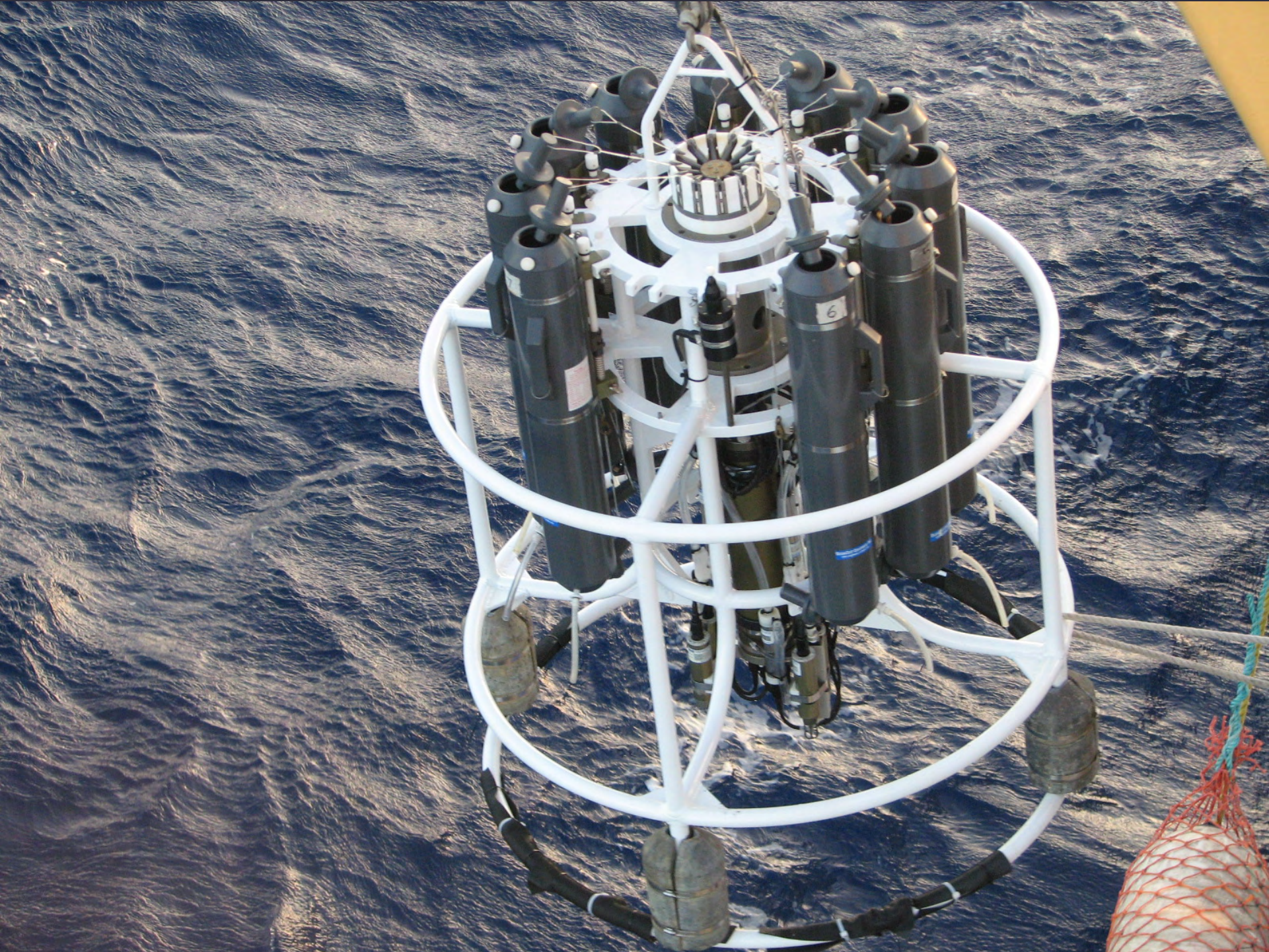
38/200 kHz
50/200 kHz



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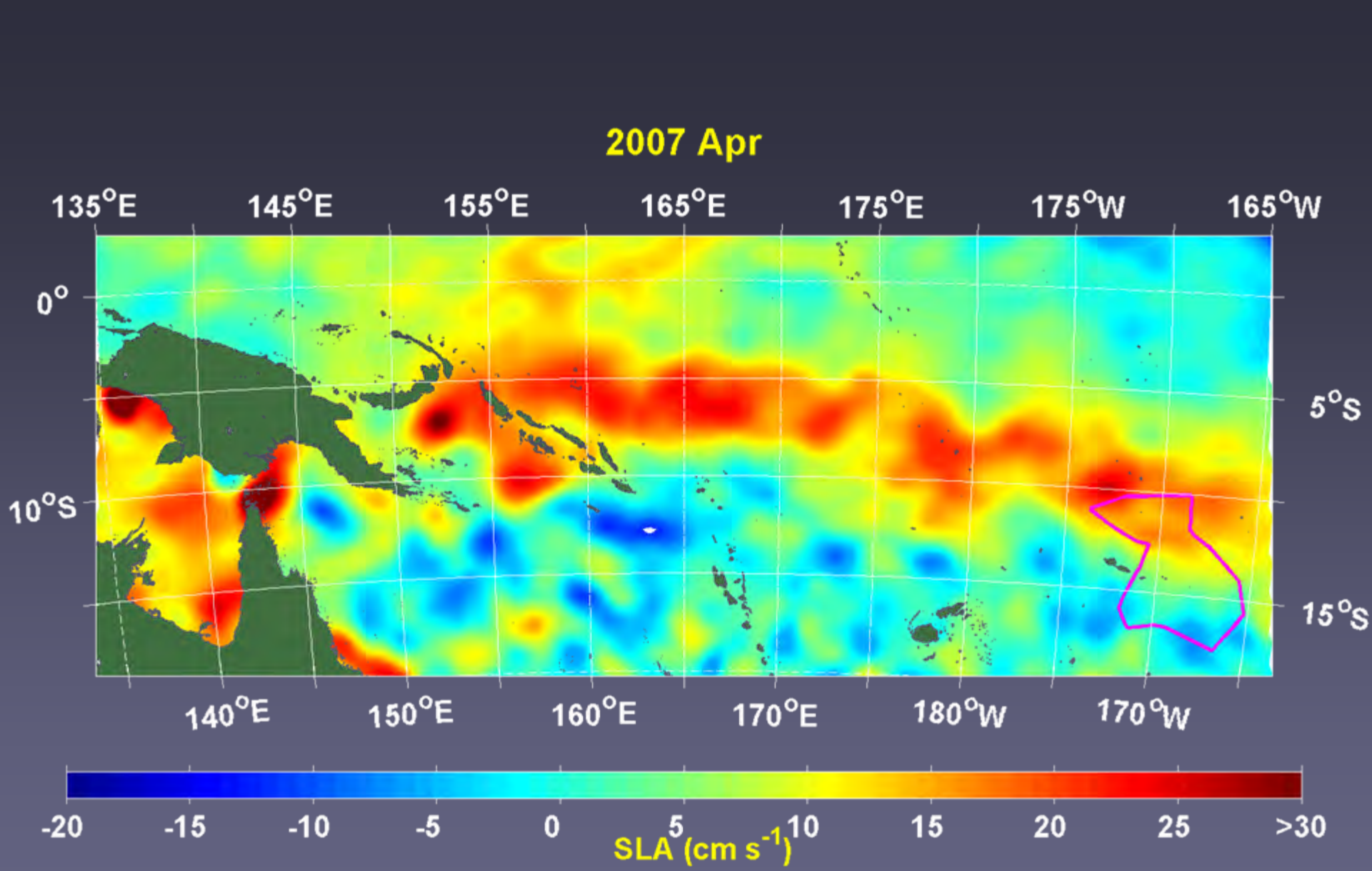

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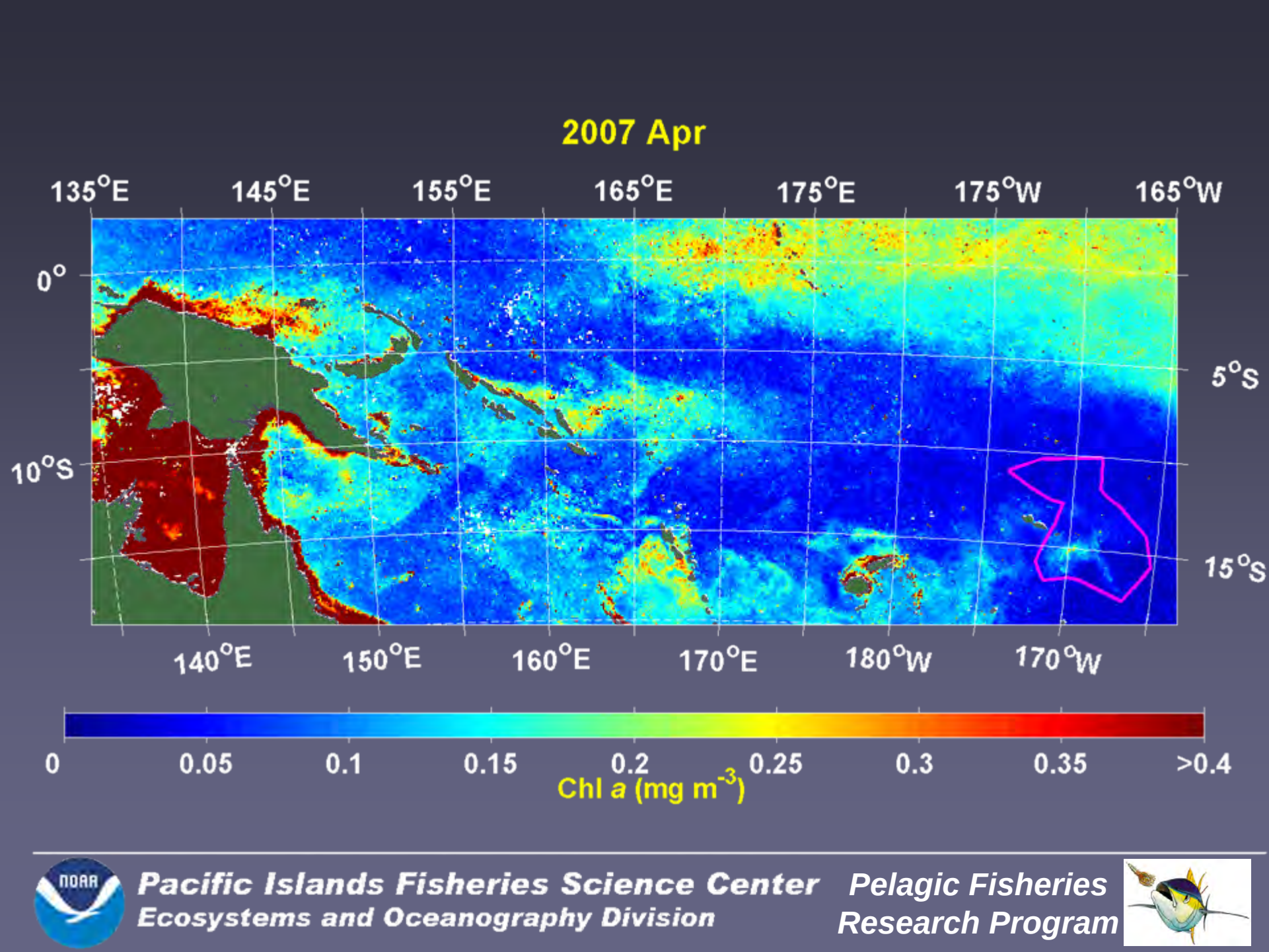
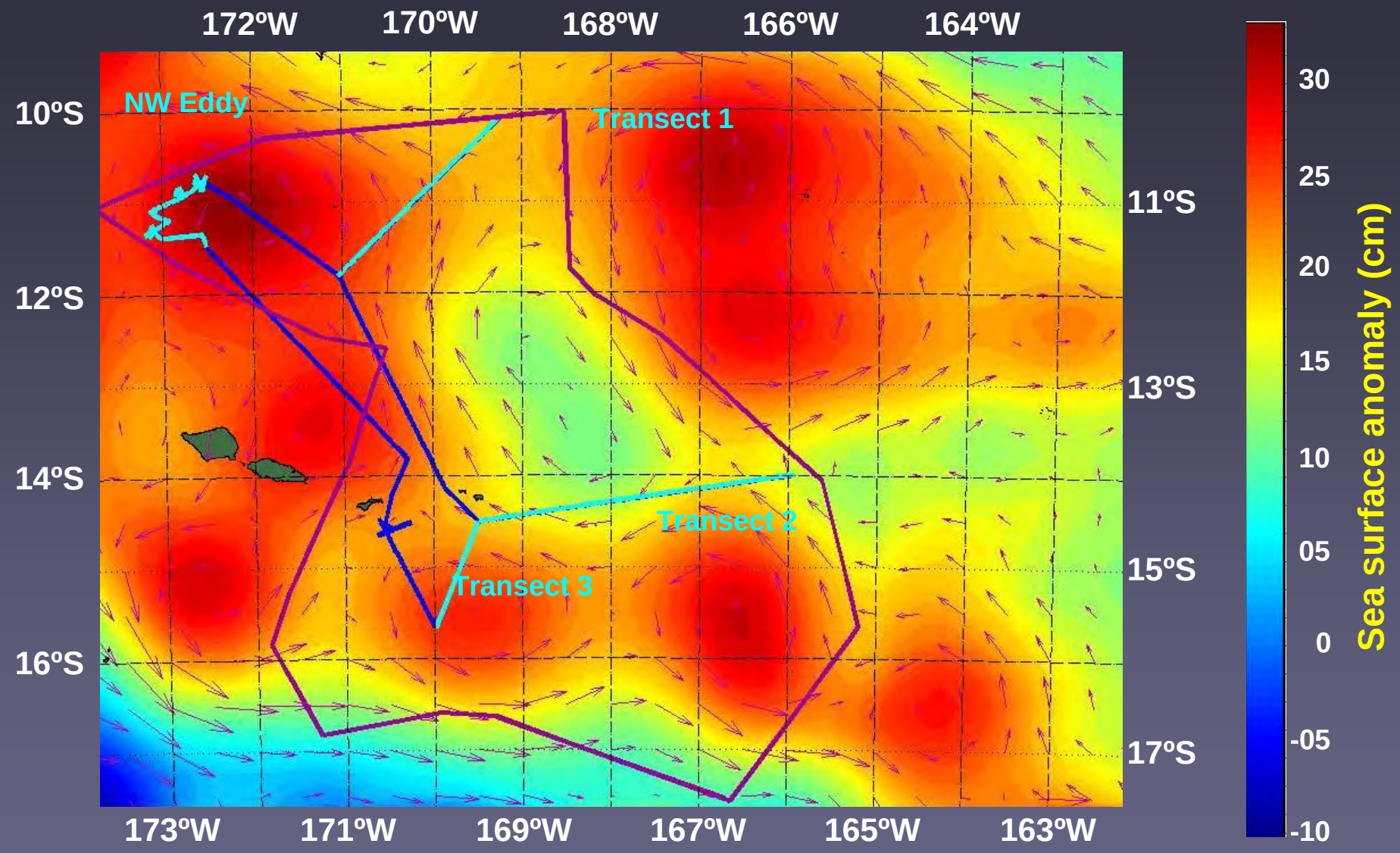

2007 Apr
135°E
145°E
155°E
165°E
175°E
175°W
165°W
0°
5°S
10°S
15°S
140°E
150°E
160°E
170°E
180°W
170°W
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
>0.4
Chl a (mg m-3)

Strength of SECC and # of anticyclonic eddies: $r^2 = 0.67$, $p = 0.009$
Strength of SECC and strength of anticylonic eddies: $r^2 = 0.74$, $p = 10^{-4}$



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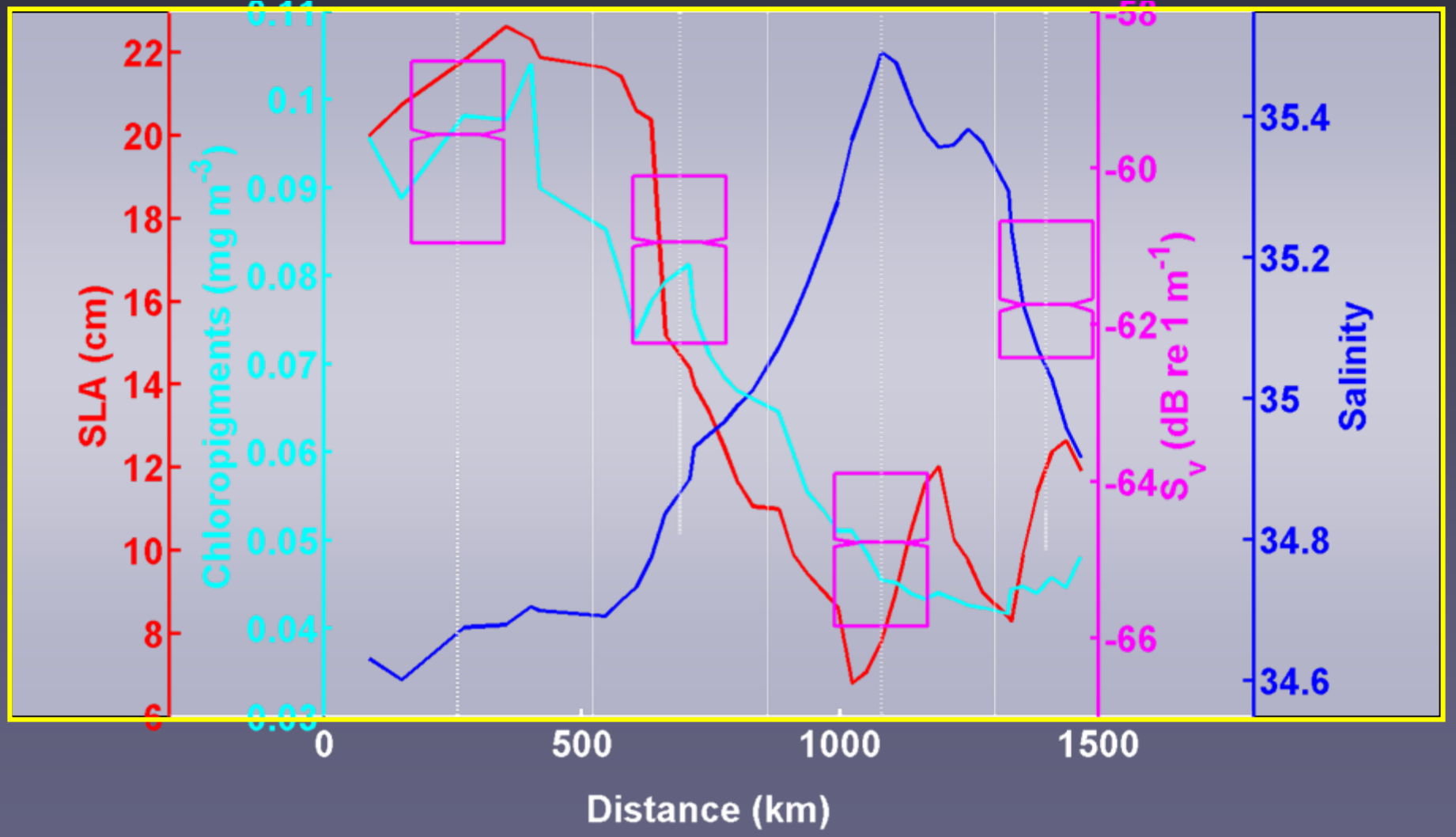
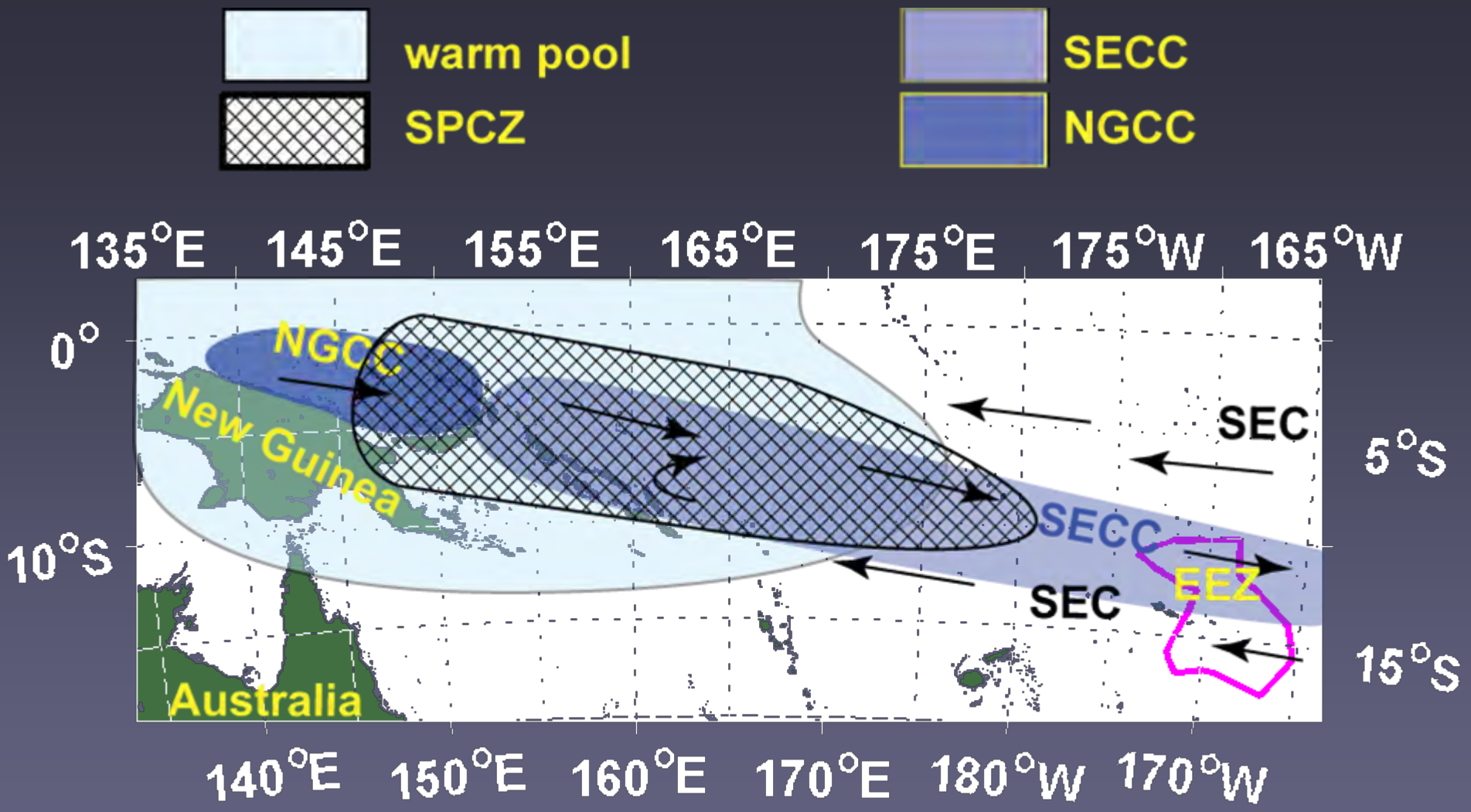
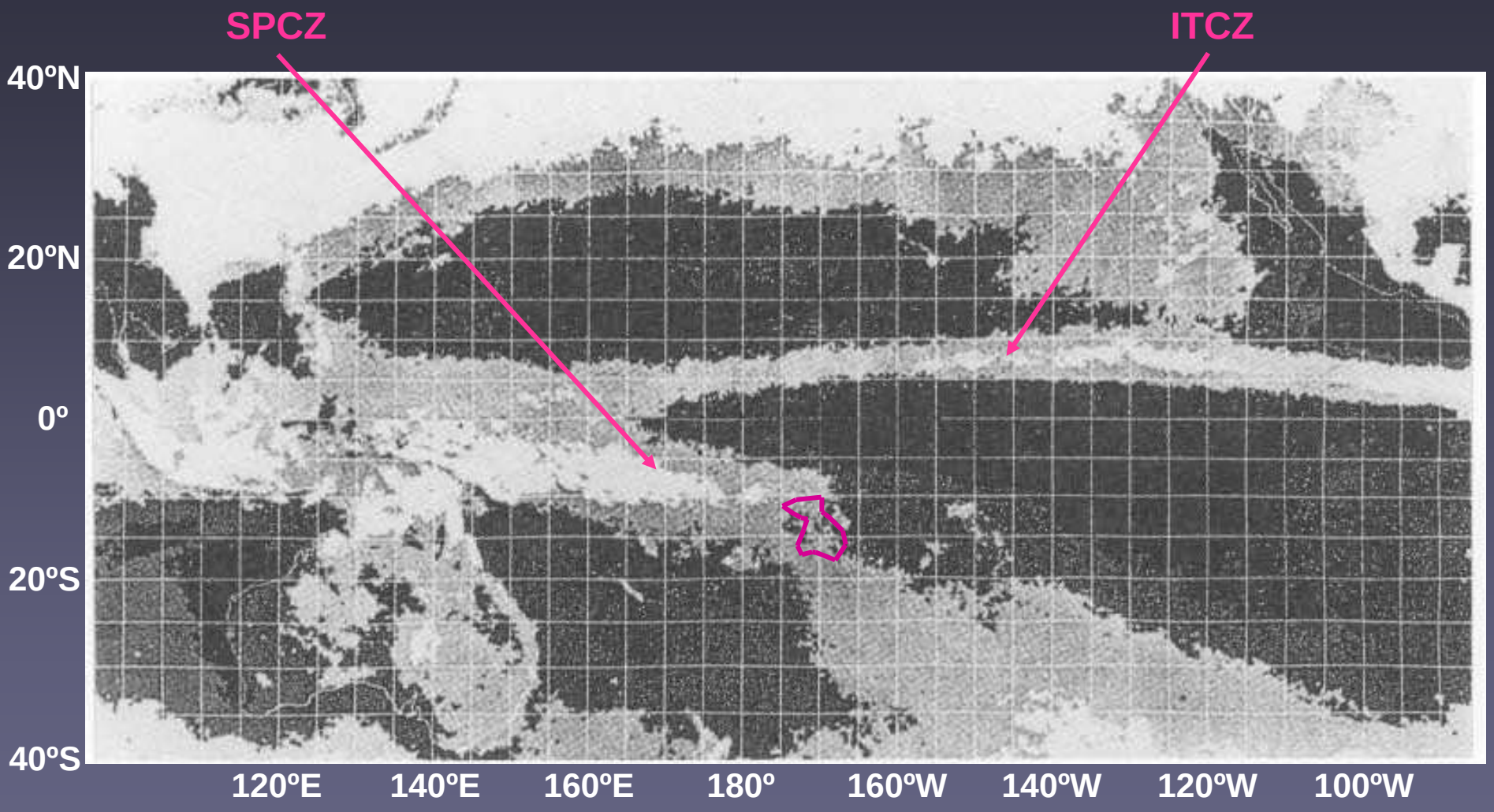
NW Eddy TR1 TR2 TR3



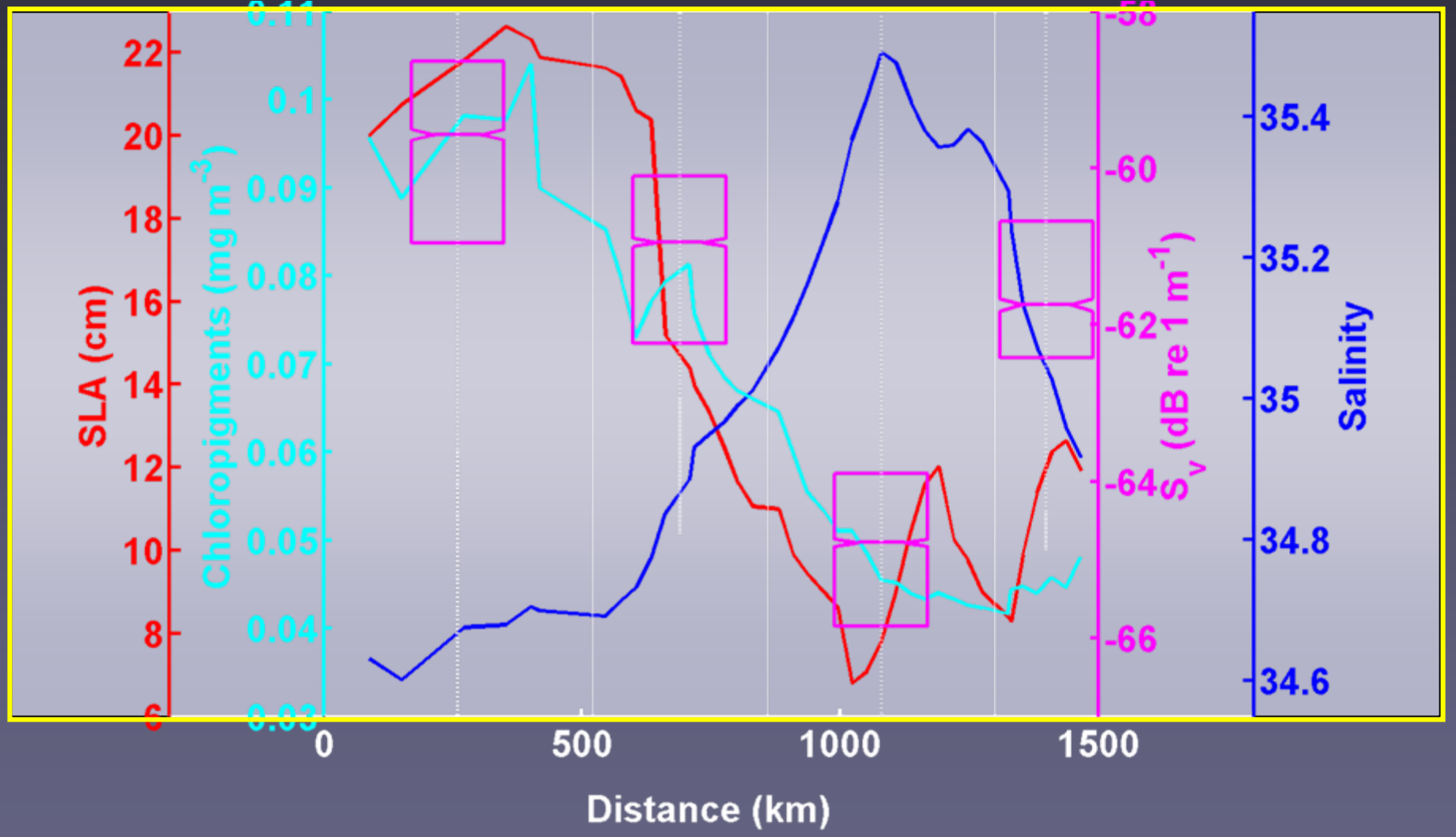

warm pool
SPCZ
SECC
NGCC
135°E
145°E
155°E
165°E
175°E
175°W
165°W
0°
5°S
10°S
15°S
140°E
150°E
160°E
170°E
180°W
170°W
NGCC
New Guinea
Australia
SEC
SECC
SEC
EEZ

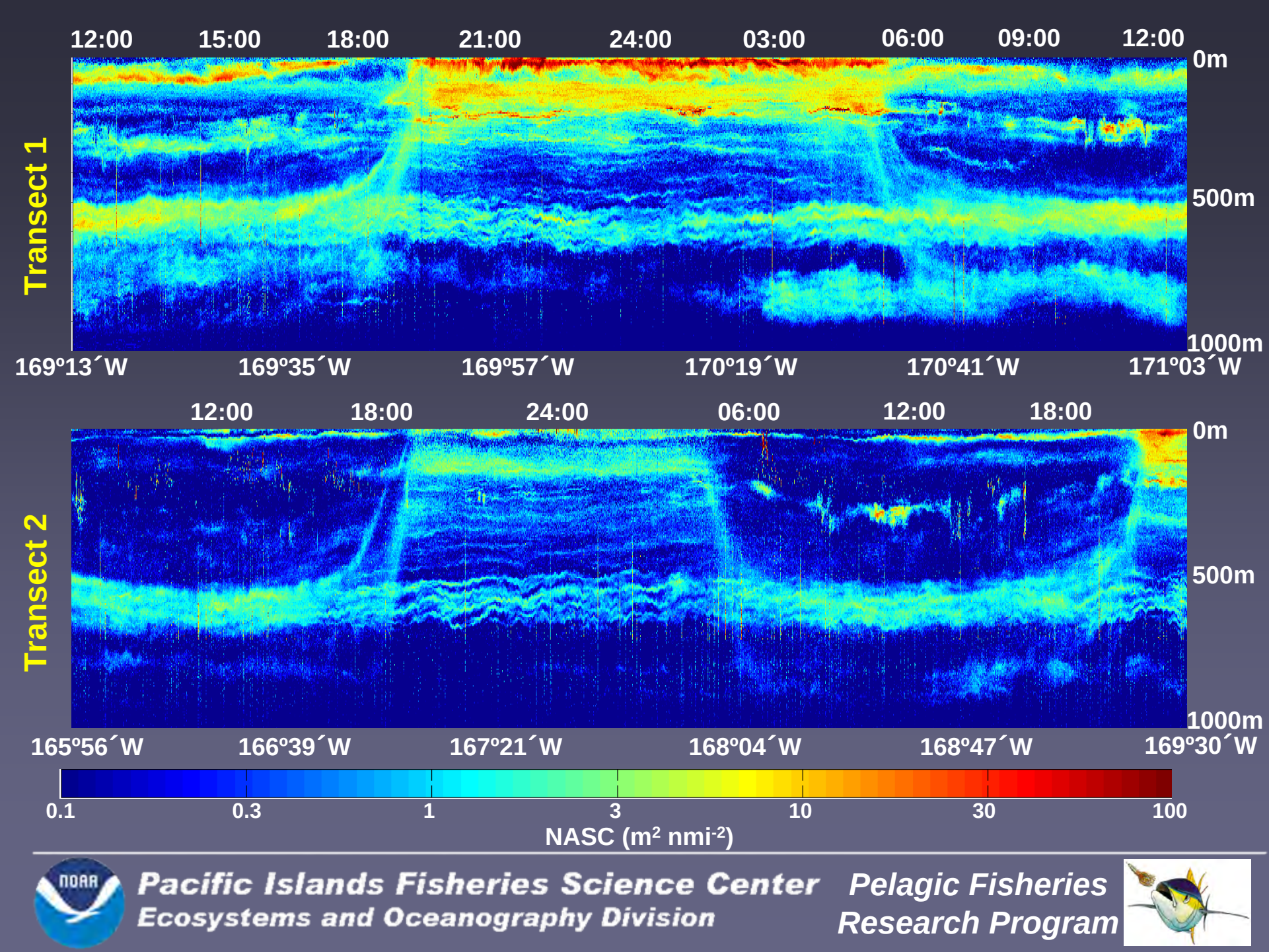
Satellite Cloud Image of the Pacific Ocean

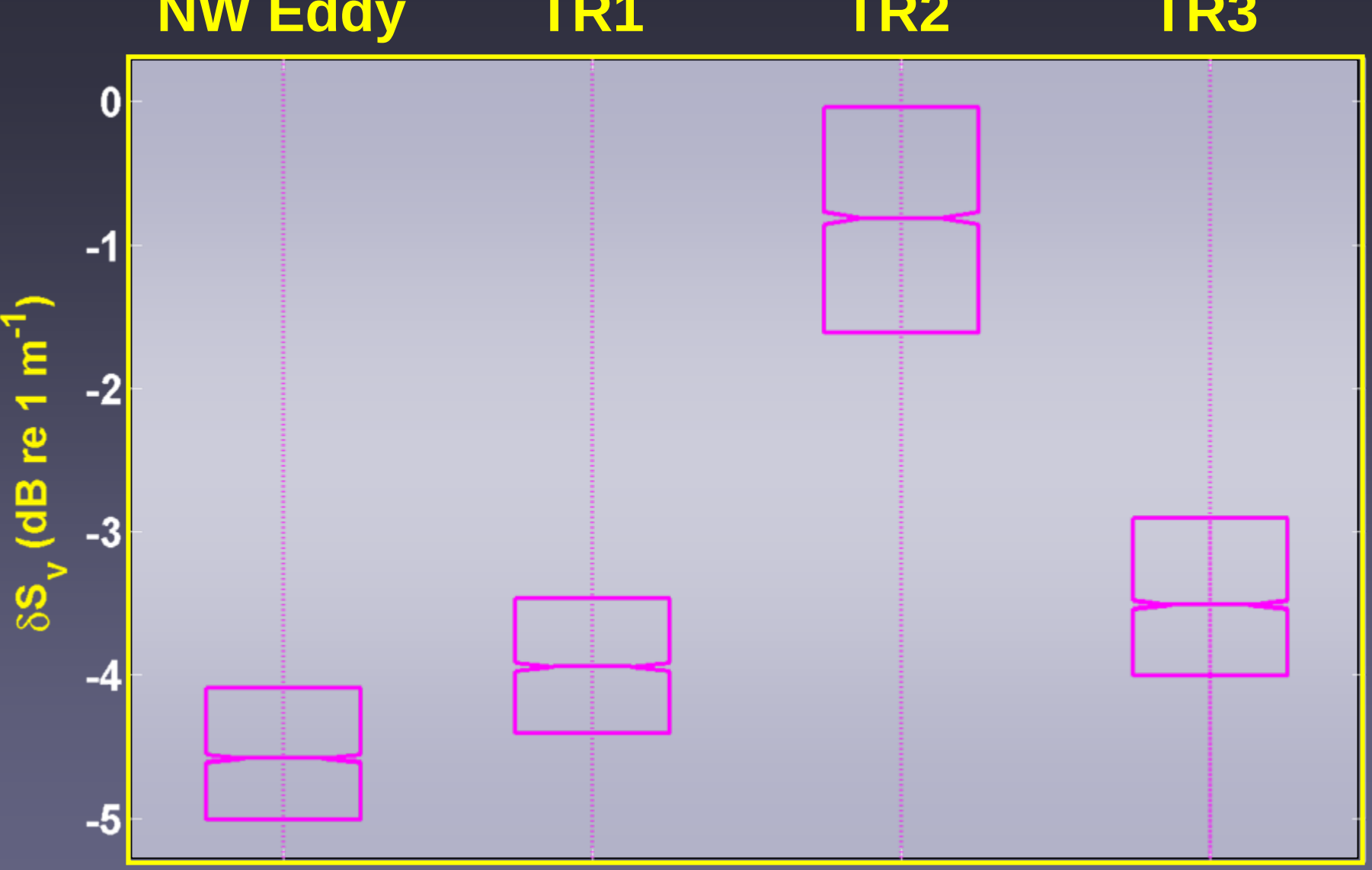


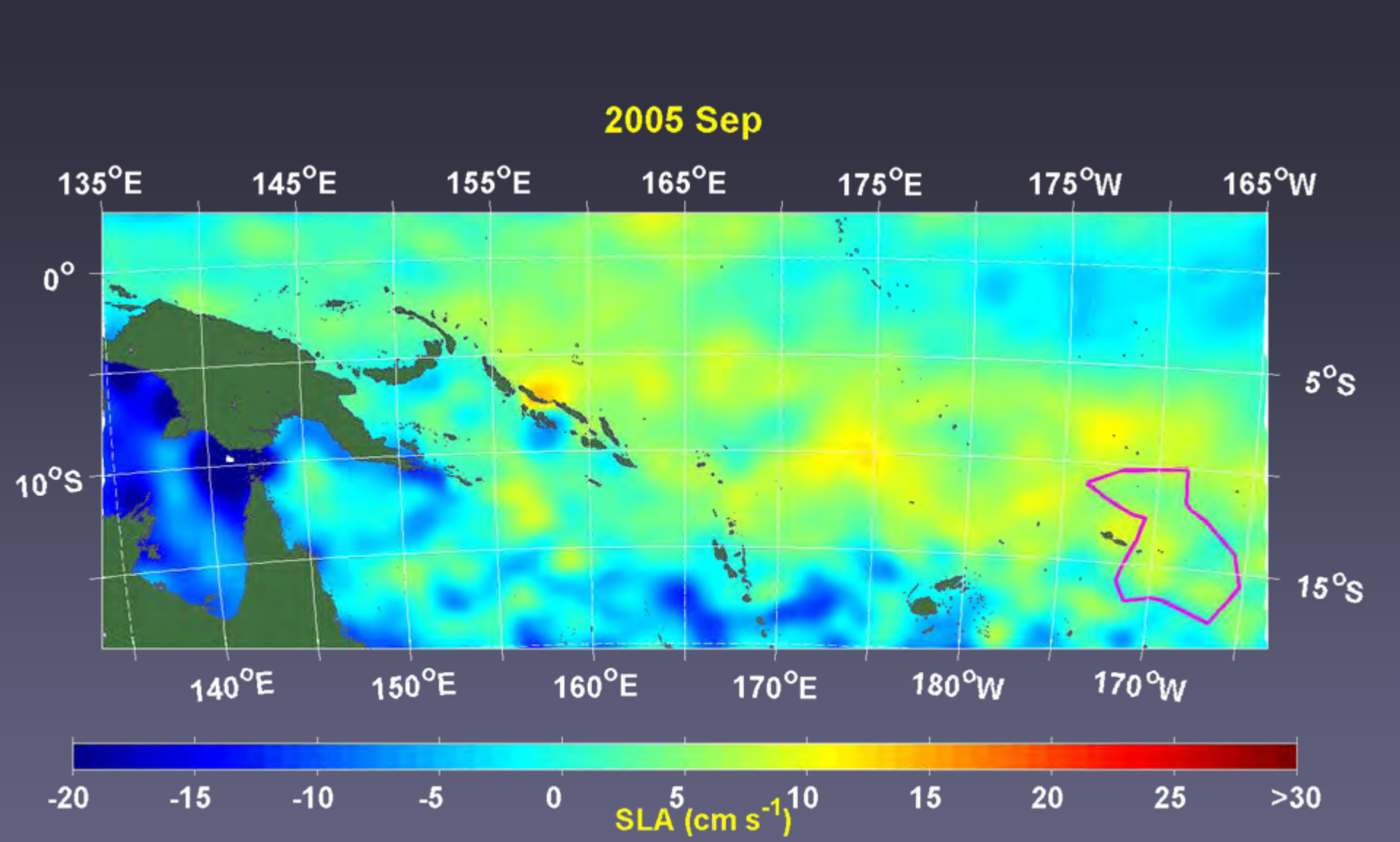
(from Tomczak and Godfrey, 1994)

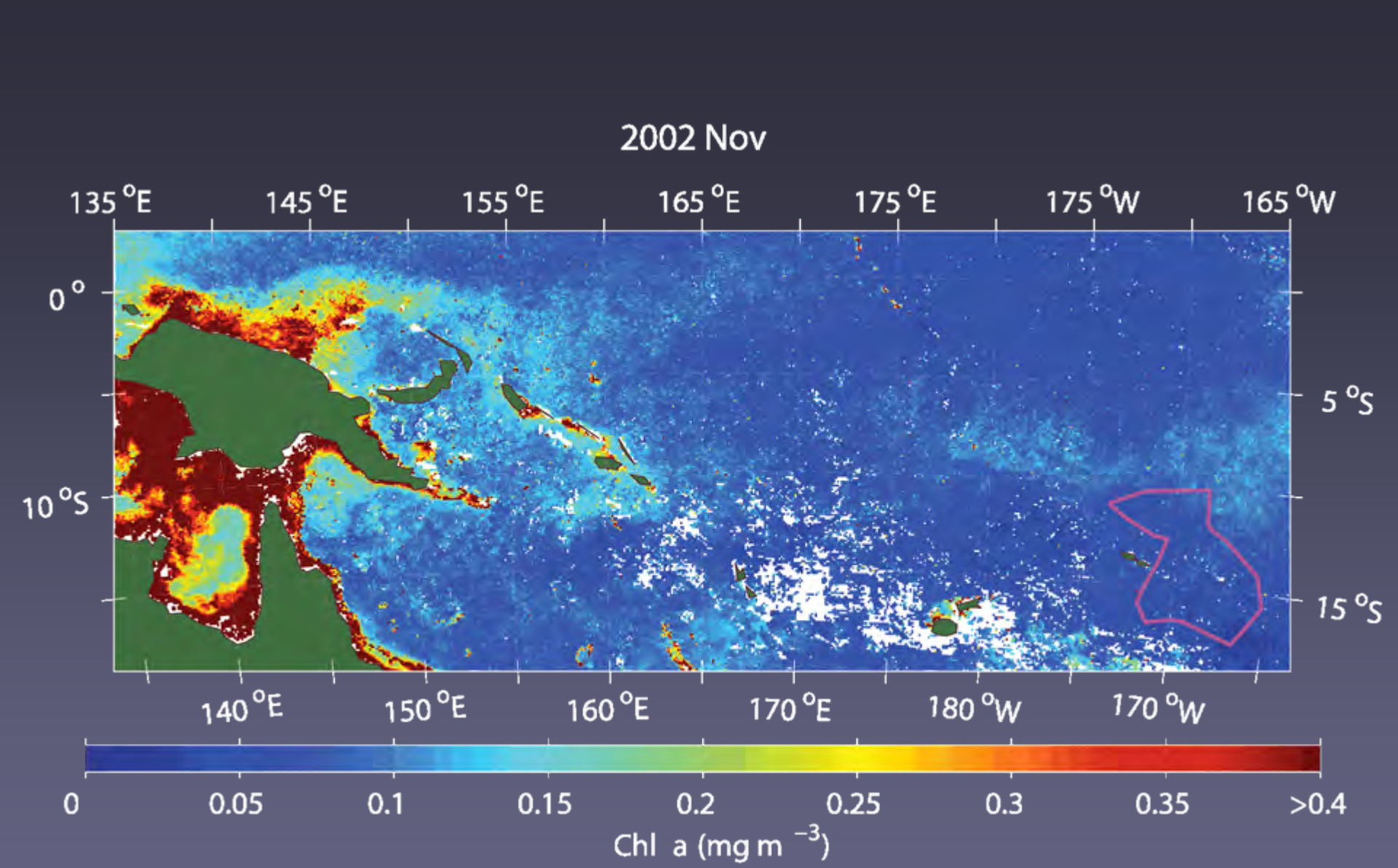
NW Eddy TR1 TR2 TR3

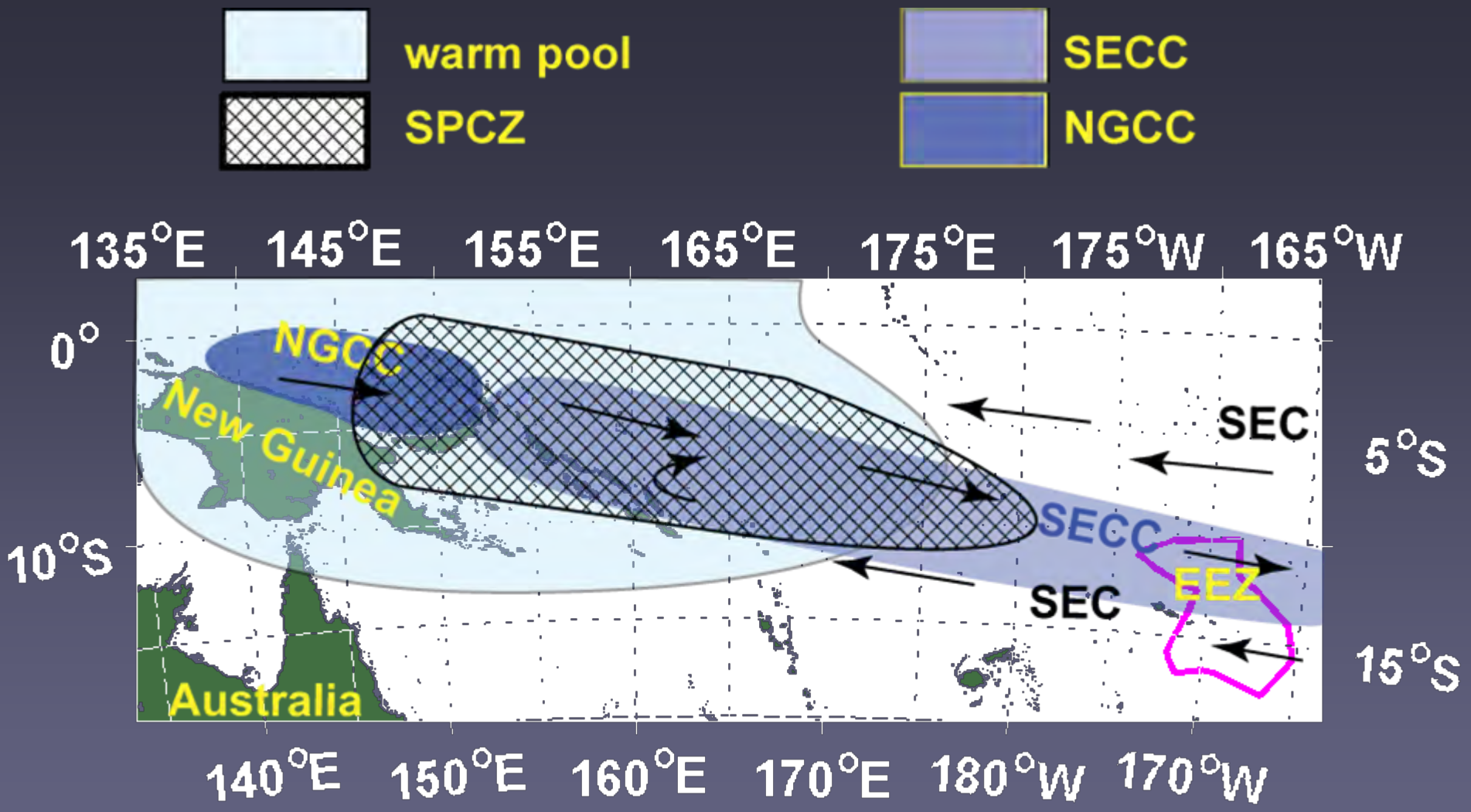



12:00
15:00
18:00
21:00
24:00
03:00
06:00
09:00
12:00
Transect 1
0m
500m
1000m
169°13´W
169°35´W
169°57´W
170°19´W
170°41´W
171°03´W
12:00
18:00
24:00
06:00
12:00
18:00
Transect 2
0m
500m
1000m
165°56´W
166°39´W
167°21´W
168°04´W
168°47´W
169°30´W
0.1
0.3
1
3
10
30
100
NASC (m² nmi⁻²)
NOAA
Pacific Islands Fisheries Science Center
Ecosystems and Oceanography Division
Pelagic Fisheries
Research Program

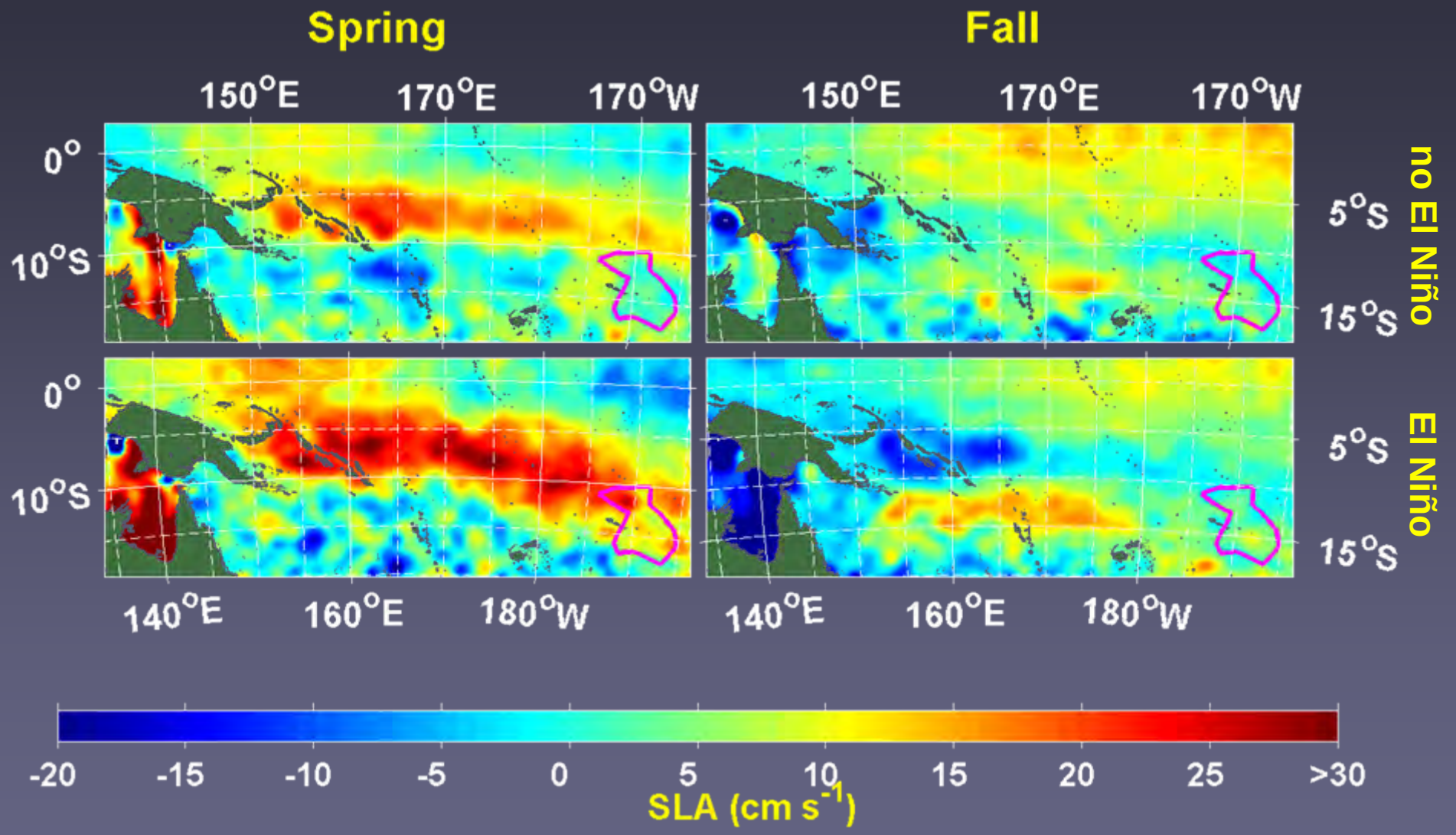

NW Eddy
TR1
TR2
TR3
0
-1
-2
-3
-4
-5
δS_v (dB re 1 m^-1)


2005 Sep
135°E
145°E
155°E
165°E
175°E
175°W
165°W
0°
5°S
10°S
15°S
140°E
150°E
160°E
170°E
180°W
170°W
-20
-15
-10
-5
0
5
10
15
20
25
>30
SLA (cm s-1)


2002 Nov
135 °E
145 °E
155 °E
165 °E
175 °E
175 °W
165 °W
0 °
5 °S
10 °S
15 °S
140 °E
150 °E
160 °E
170 °E
180 °W
170 °W
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
>0.4
Chl a (mg m −3)


warm pool
SPCZ
SECC
NGCC
135°E
145°E
155°E
165°E
175°E
175°W
165°W
0°
5°S
10°S
15°S
140°E
150°E
160°E
170°E
180°W
170°W
NGCC
New Guinea
Australia
SEC
SECC
SEC
EEZ

Correlation between SOI & SLA SD from 1992 to present:
$r^2 = 0.31$, $p = 10^{-3}$



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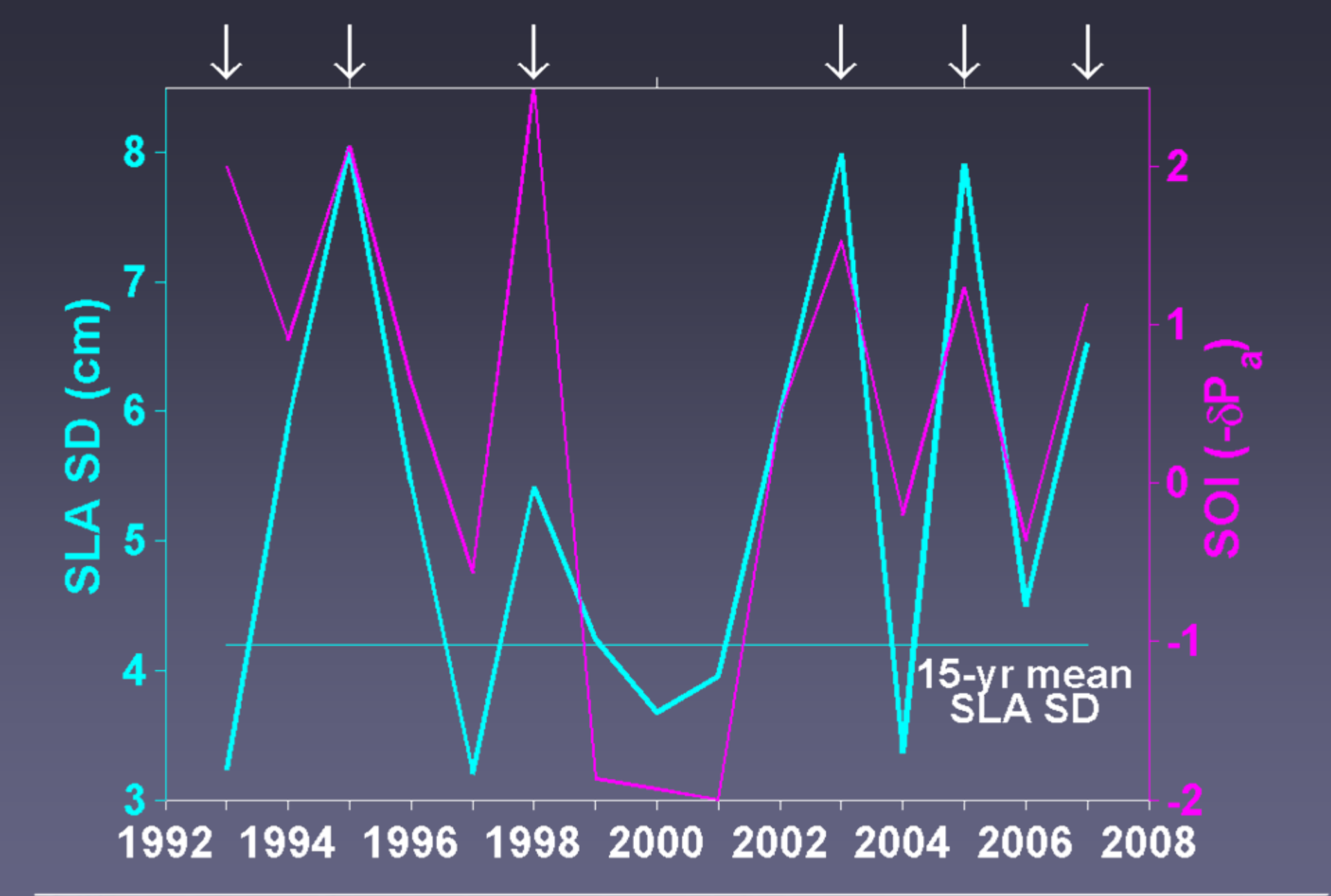
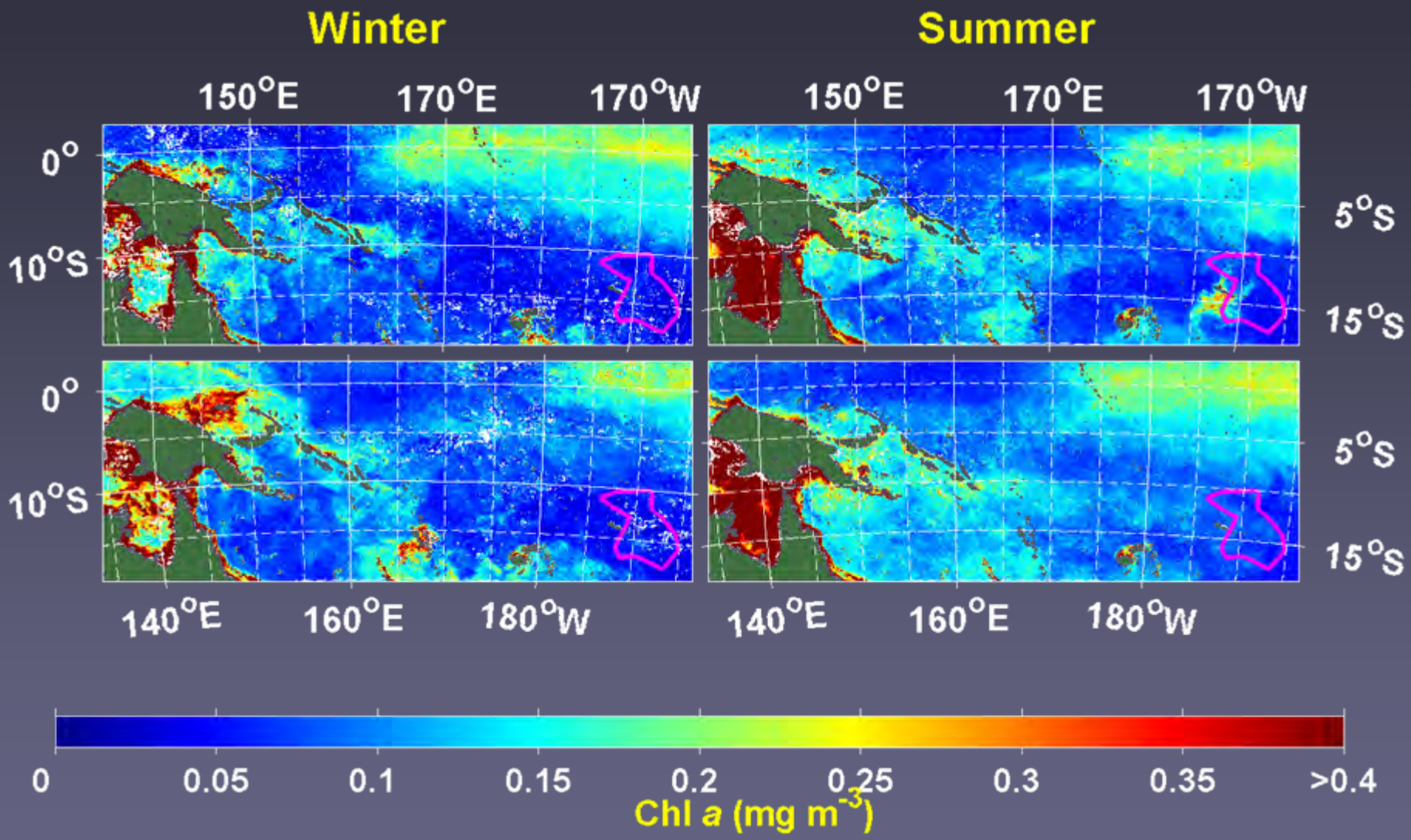

SLA SD (cm)
8
7
6
5
4
3
SOI (-δP a)
2
1
0
-1
-2
1992
1994
1996
1998
2000
2002
2004
2006
2008
15-yr mean
SLA SD

Correlation between SOI & CPUE: $r^2 = 0.35$, $p = 10^{-4}$



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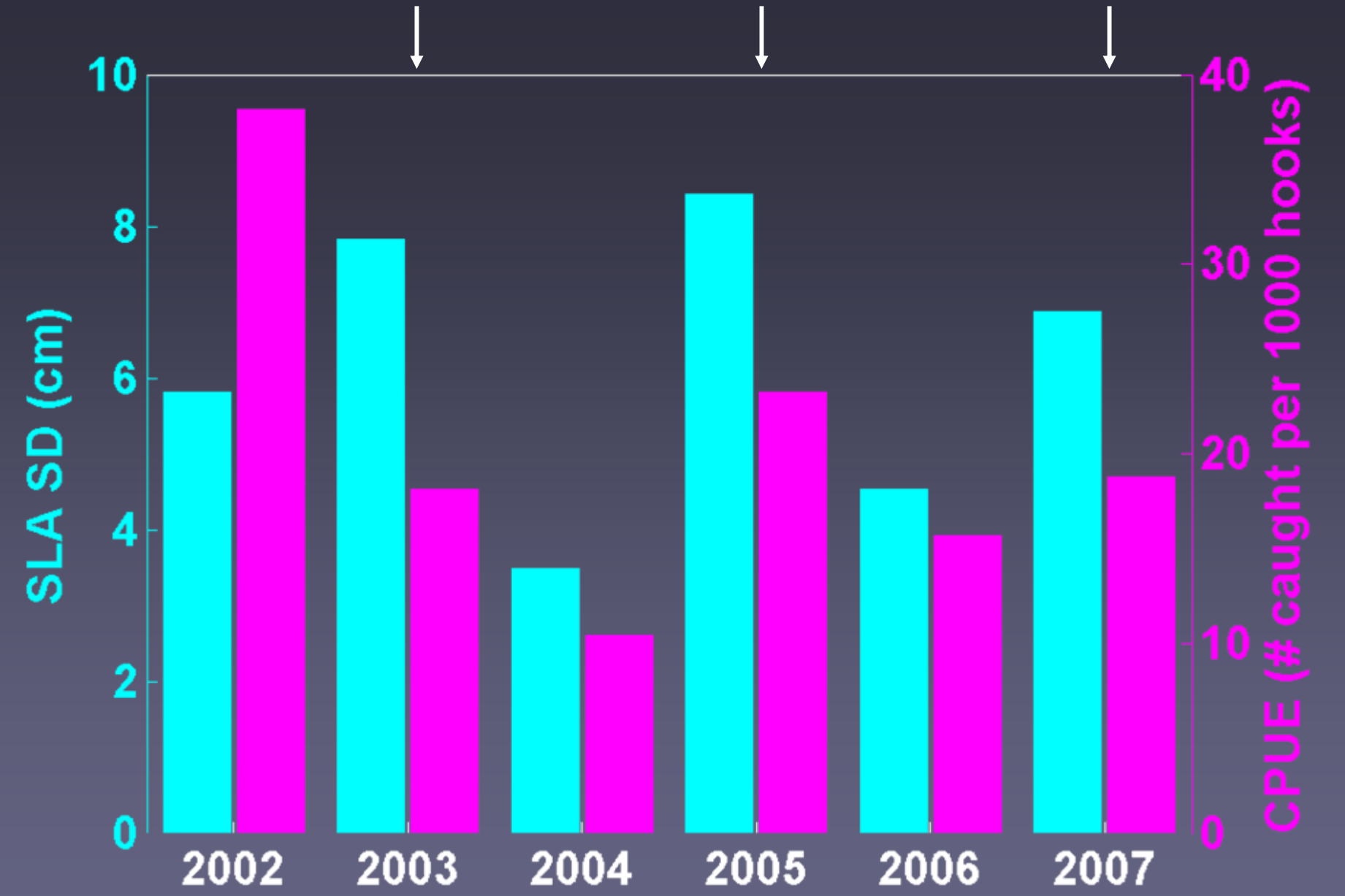
10
8
6
4
2
0
SLA SD (cm)
40
30
20
10
0
CPUE (# caught per 1000 hooks)
2002
2003
2004
2005
2006
2007

Conclusion

- During peak times, SECC carries Chl-a rich waters towards east from upwelling regions at NGCC
- Enhanced primary productivity in SECC allows for an increase in micronekton biomass, reaching the EEZ
- Anticlyclonic eddies advect Chl and micronekton from surrounding SECC waters
- Seasonal signals in primary productivity at NGCC and strength of SECC are exceptionally strong during El Niños
- Albacore CPUE in EEZ and strength of SECC positively correlate with El Niño events
- Observed micronekton biomass in the SECC and albacore CPUE are most likely linked by higher concentration of albacore in presence of forage
- Results indicate that the local longline fishery performance for albacore may be predicted from
  - strength of upwelling and eastward velocity of NGCC
  - Chl-a concentrations in the NGCC and SECC
  - Strength of the seasonal intensification of the SECC
  - SOI