

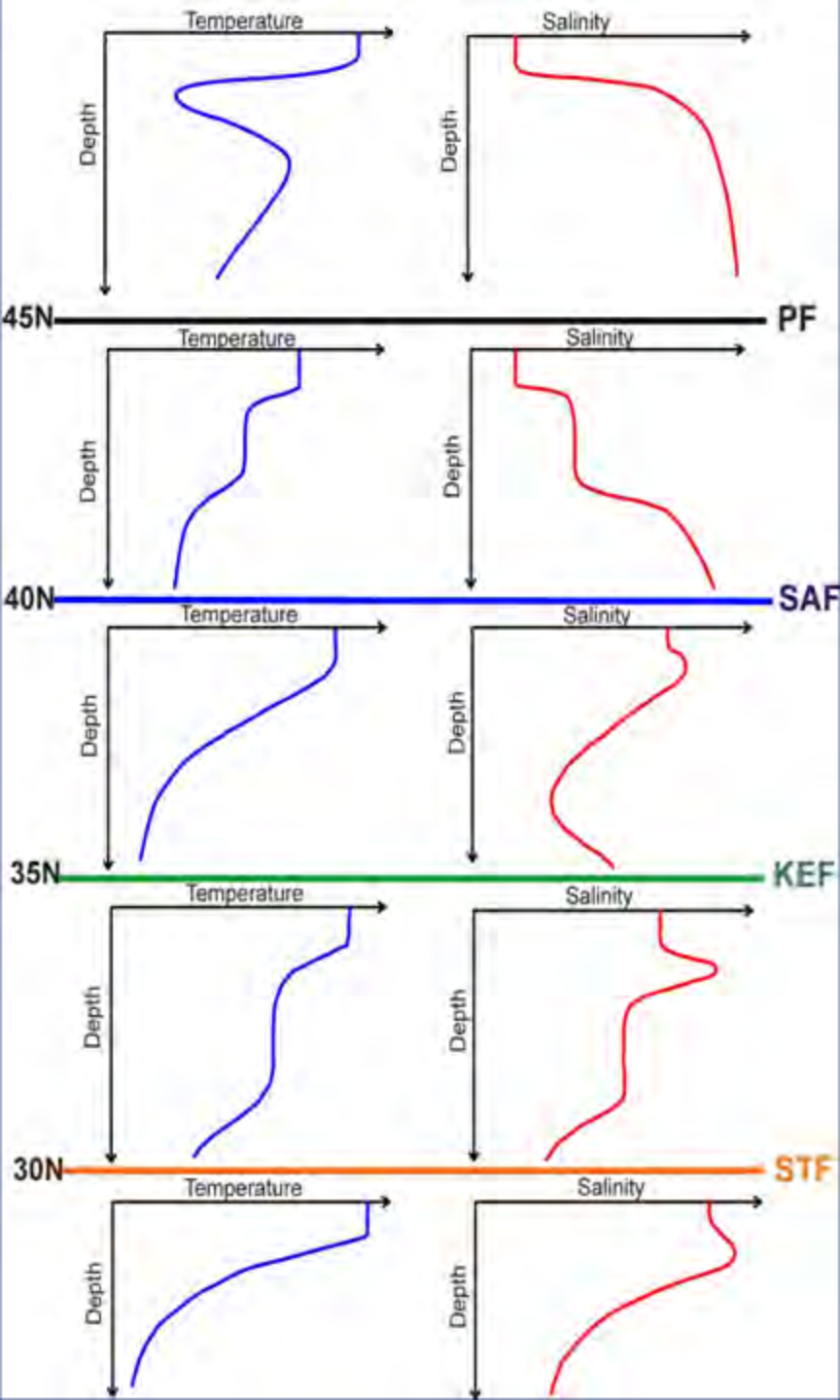
Polar fronts: Major ecosystem boundaries in the North Atlantic, North Pacific, and Southern Ocean

Igor Belkin

University of Rhode Island

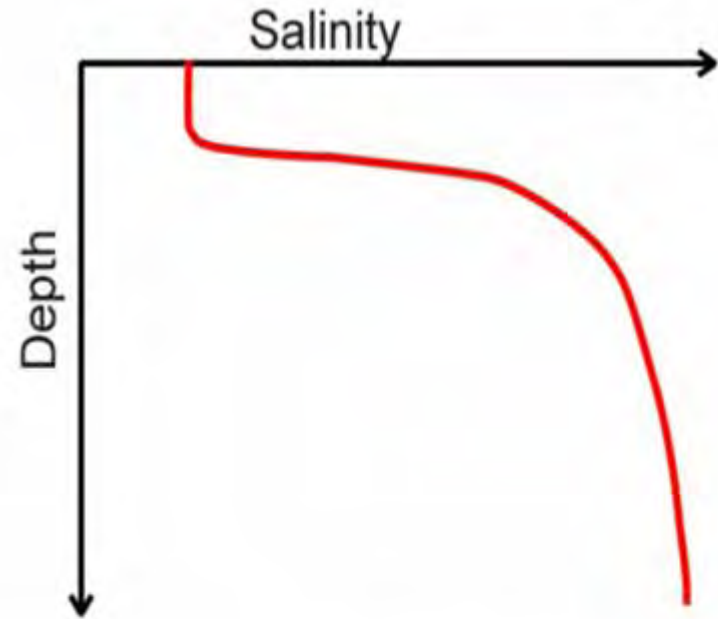
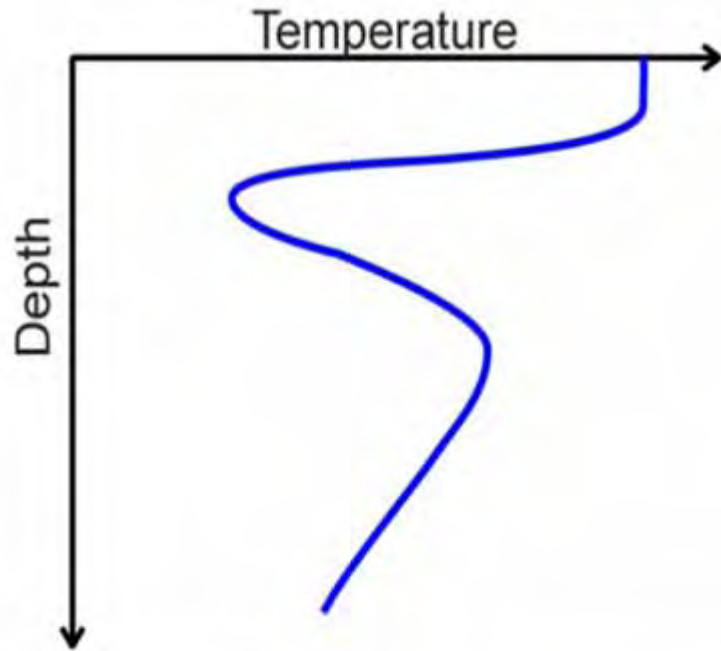
2nd ESSAS Open Science Meeting, Seattle, WA, May 25, 2011



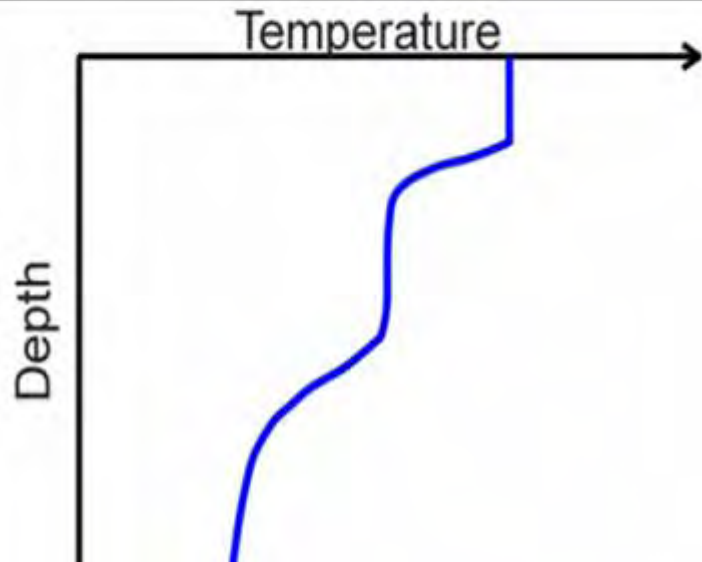


Fronts and vertical TS-structures of the North Pacific

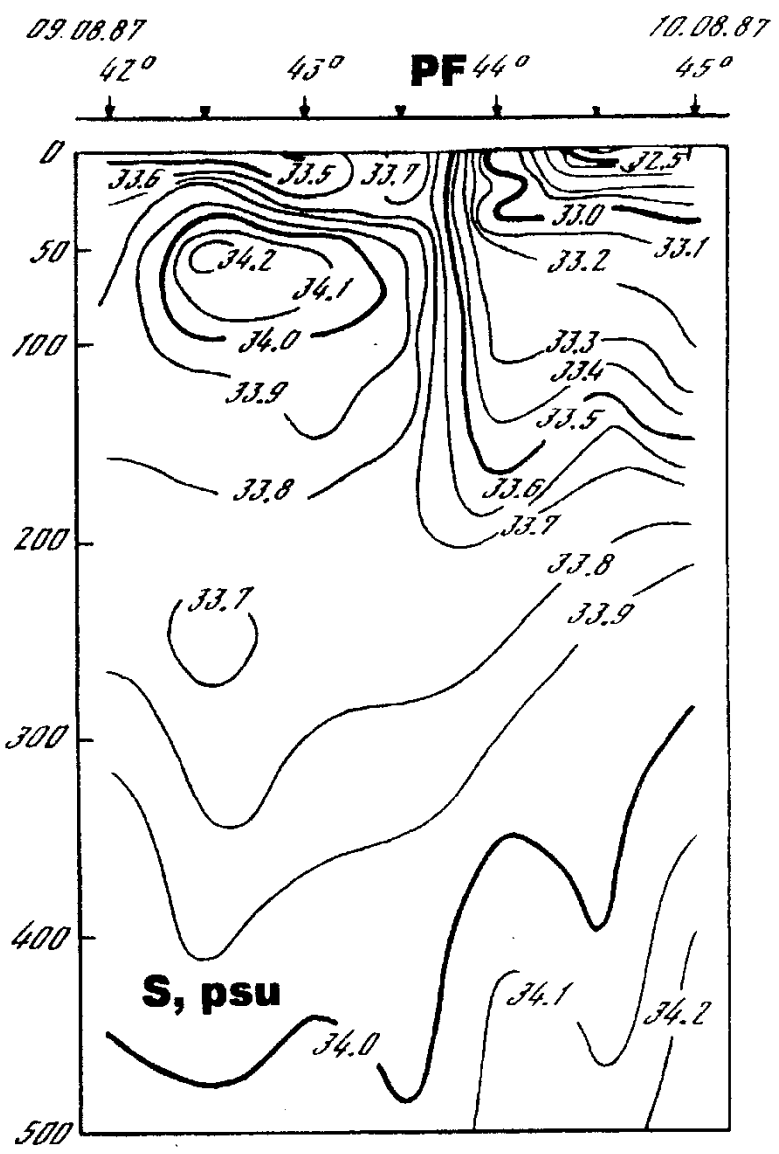
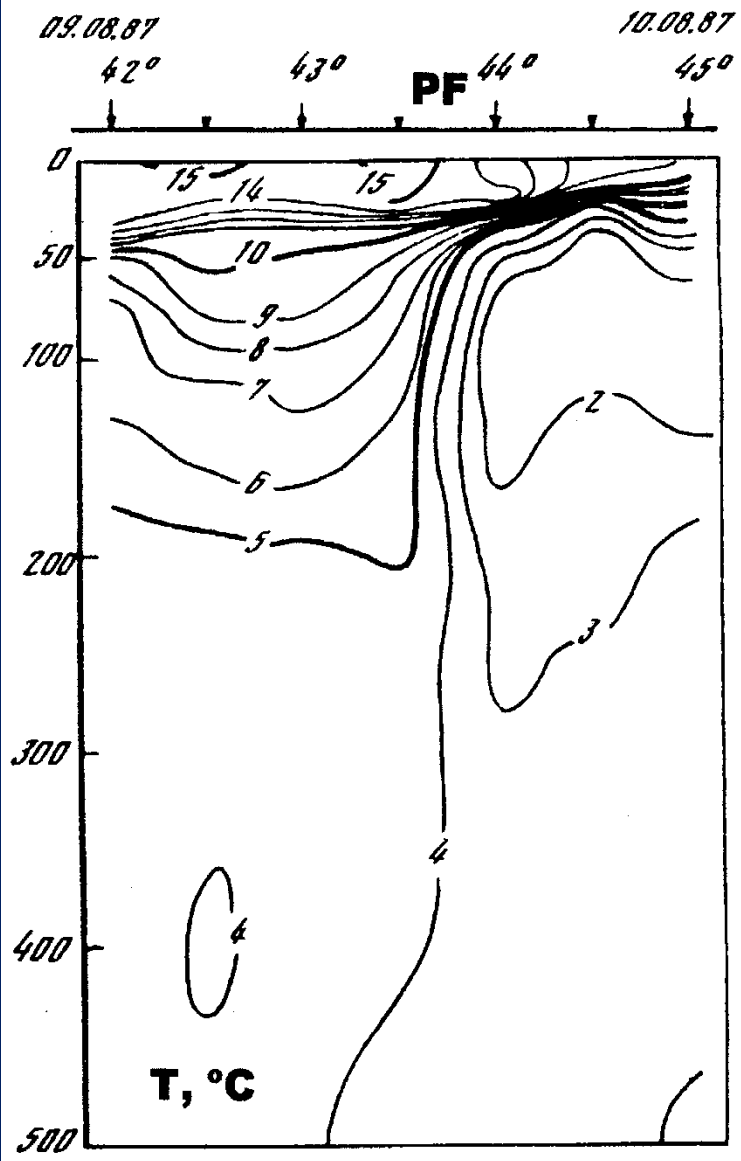
Vertical TS-structures across the North Pacific Polar Front



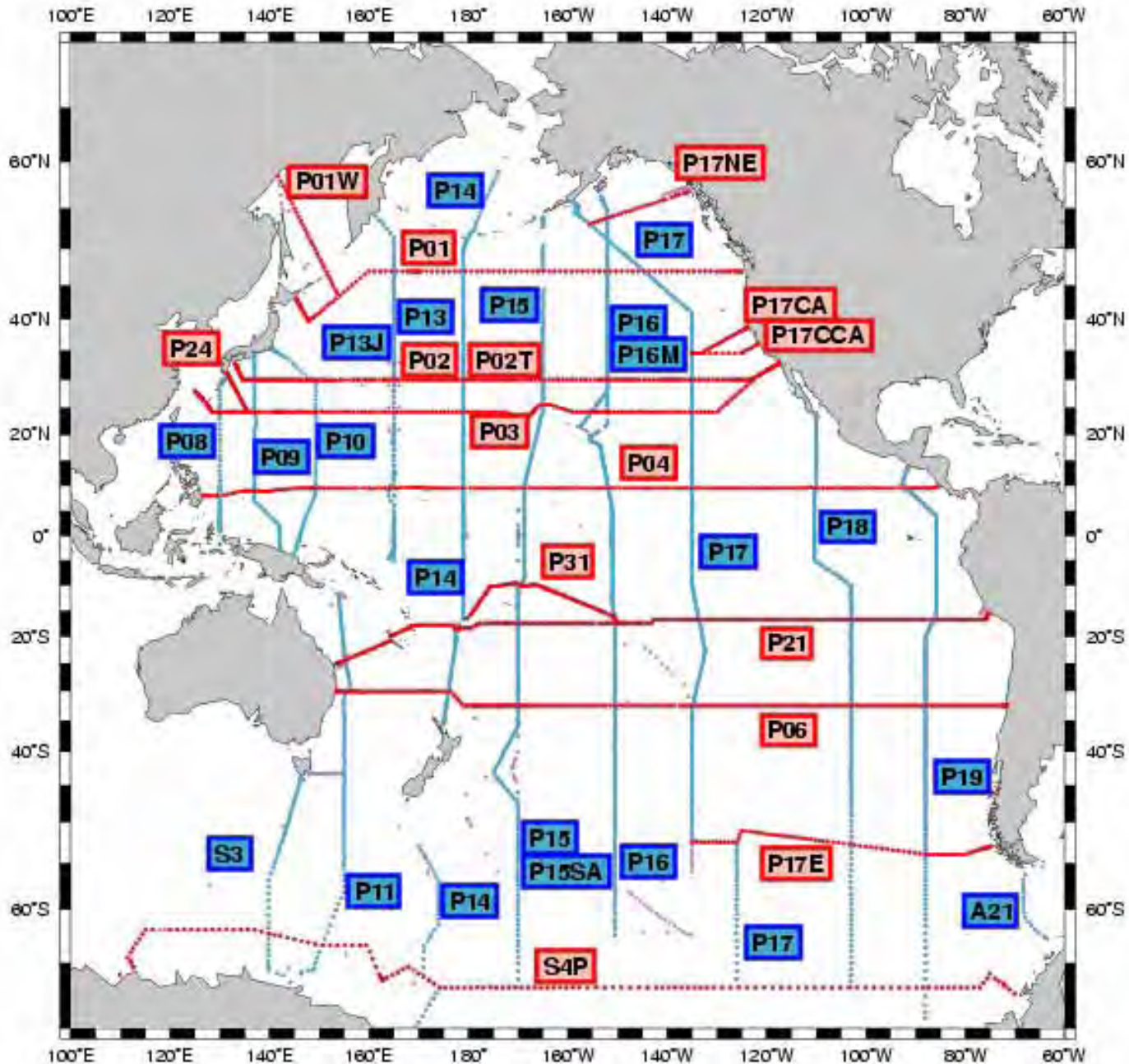
45N PF



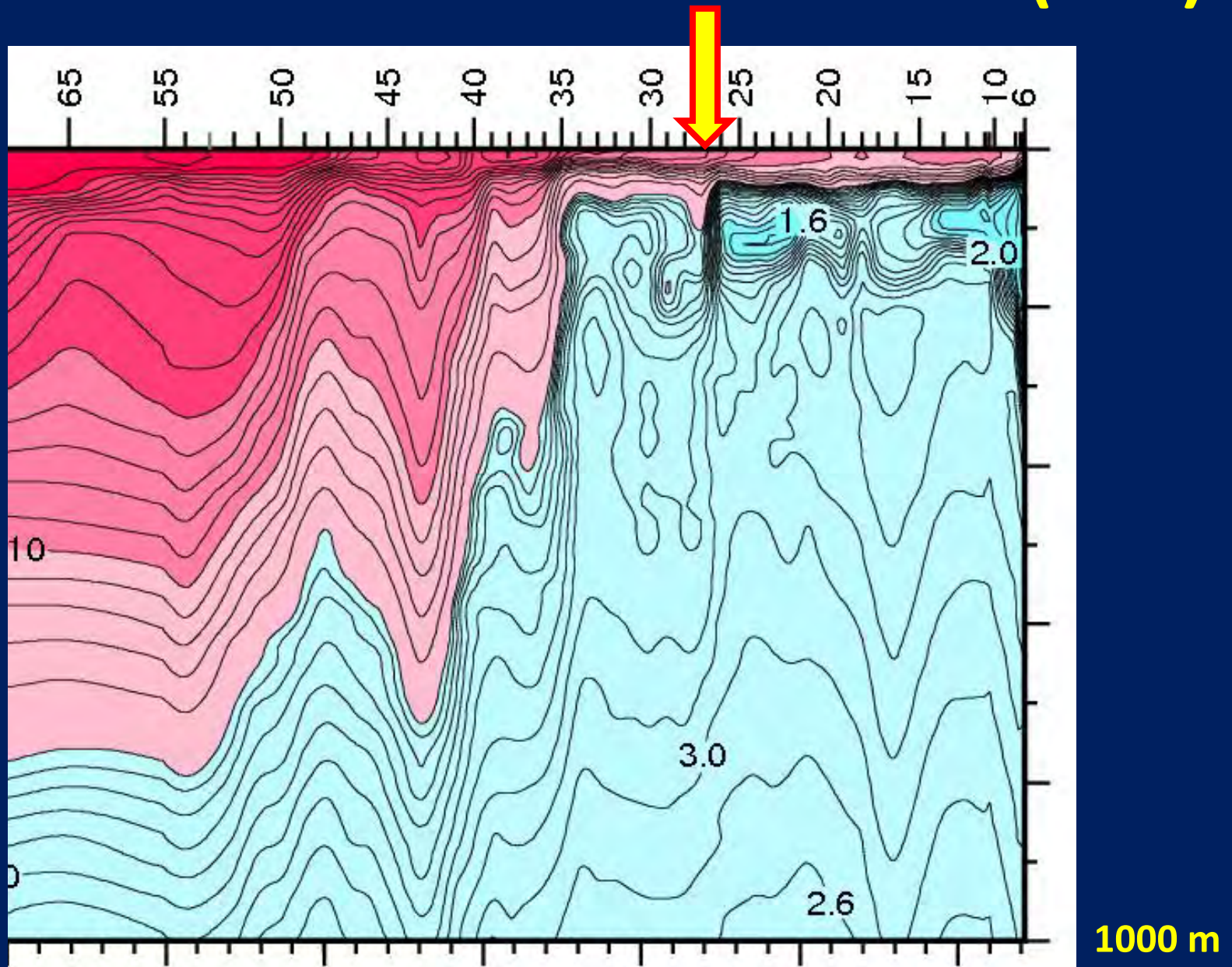
North Pacific Polar Front at 155°E



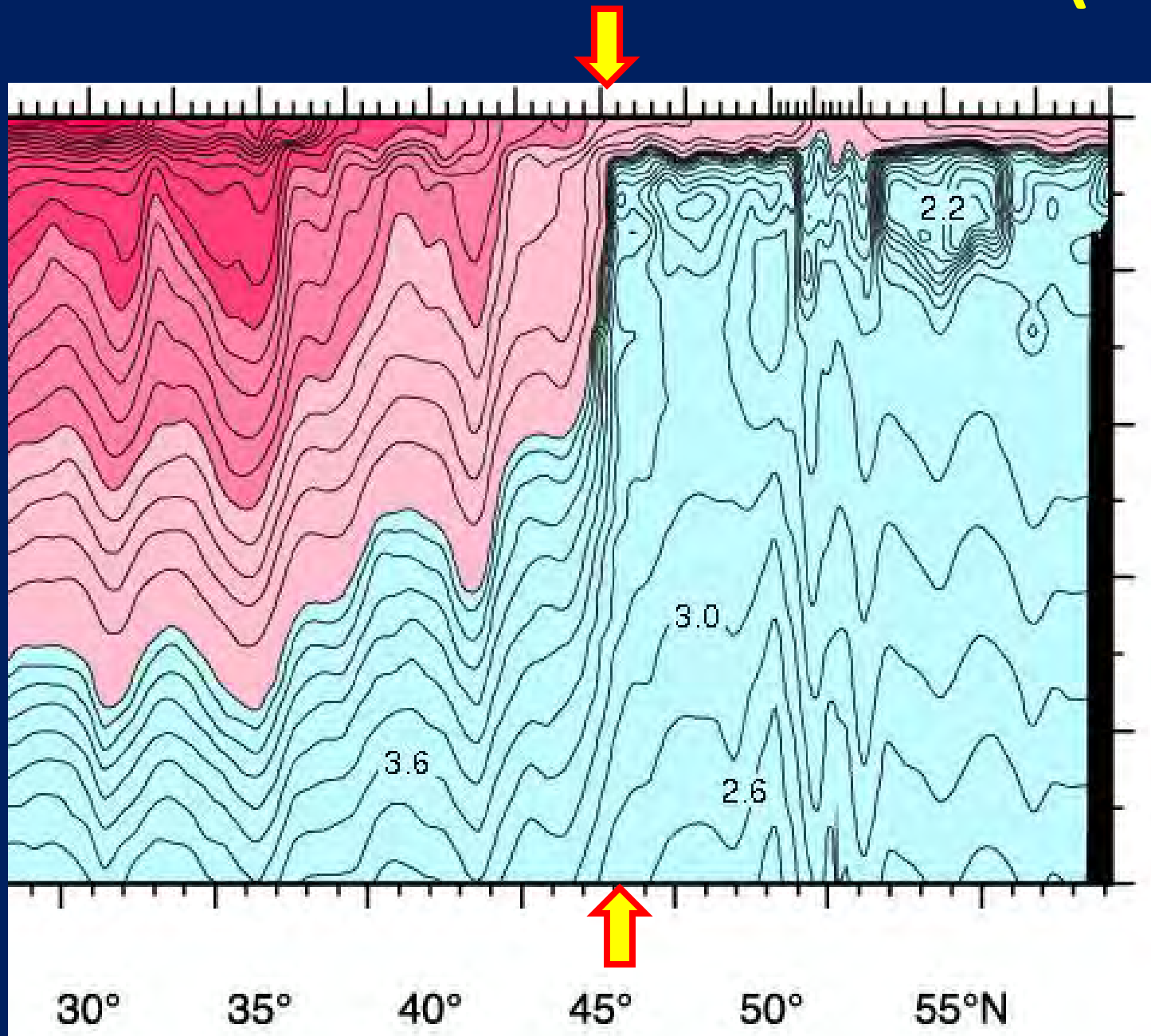
WOCE Hydrographic Atlas



North Pacific Polar Front at 165°E (P13)

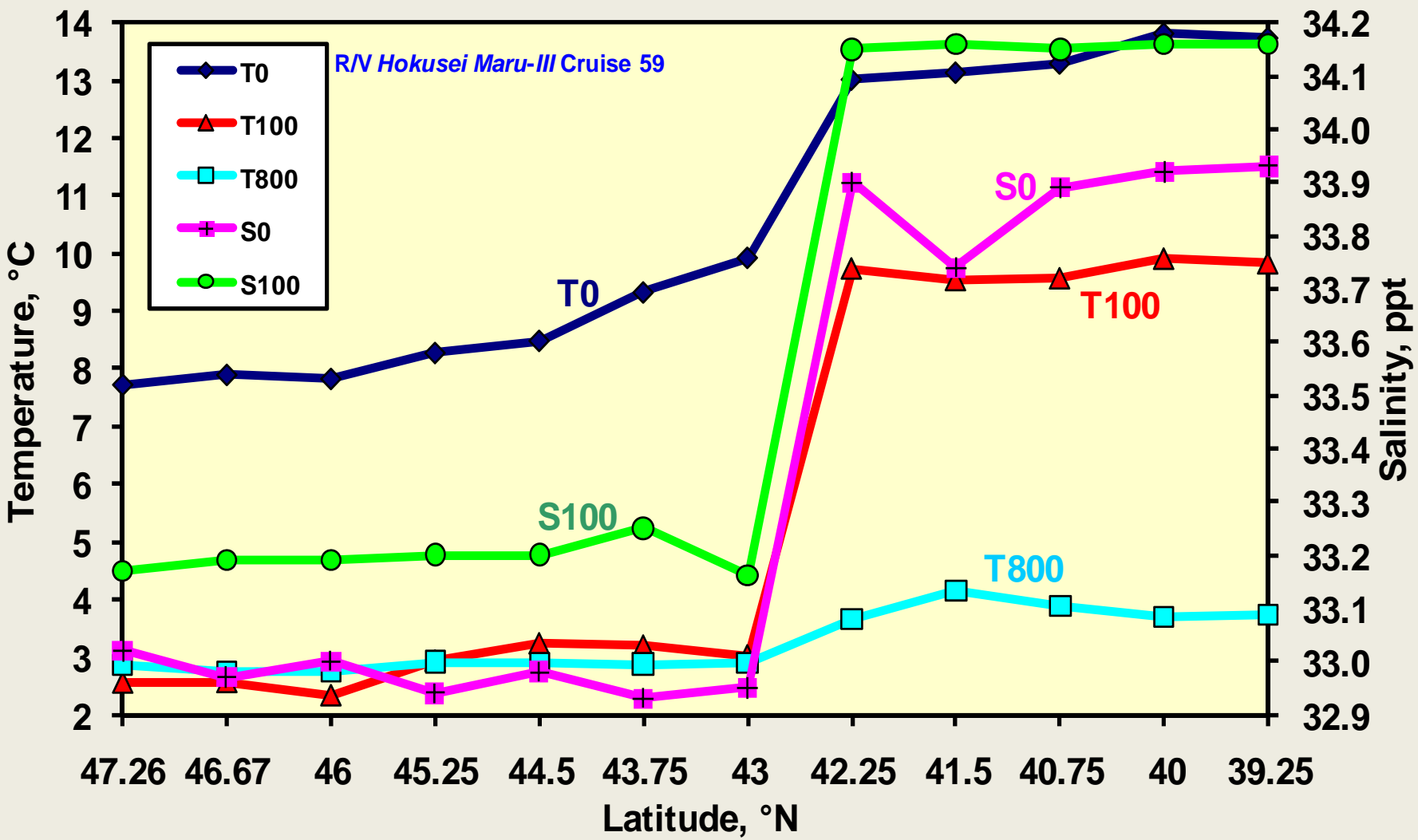


North Pacific Polar Front at 179°E (P14)

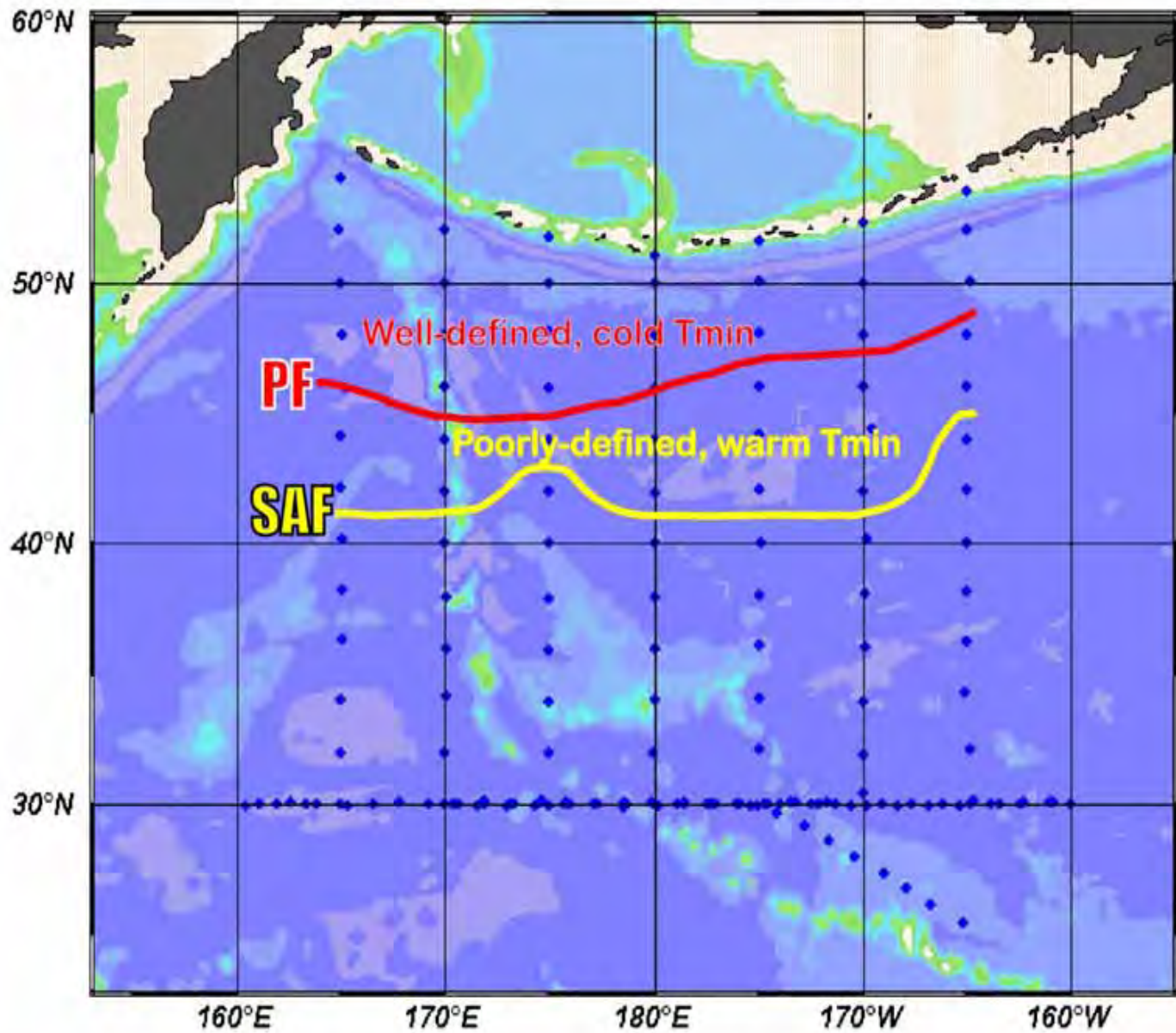


1000 m

Polar Front at 170°E in July 1993

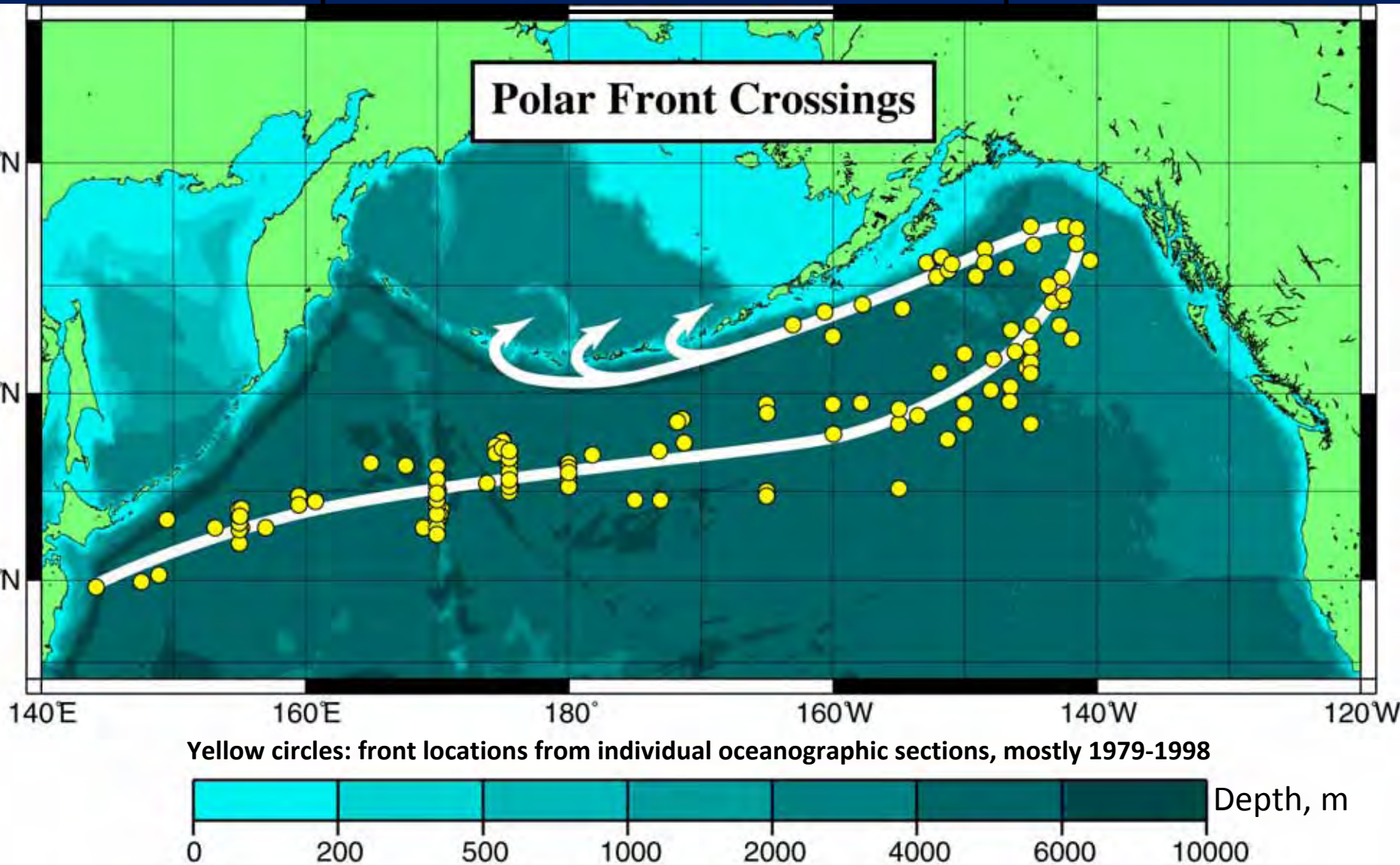


North Pacific Polar Front vs. Subarctic Front



Akademik Shirshov Cruise 16 (5/11/1976 - 8/30/1976)

North Pacific Polar Front



Belkin et al., 2002, GRL

Canada's Three Oceans (C3O) cruise of 2007

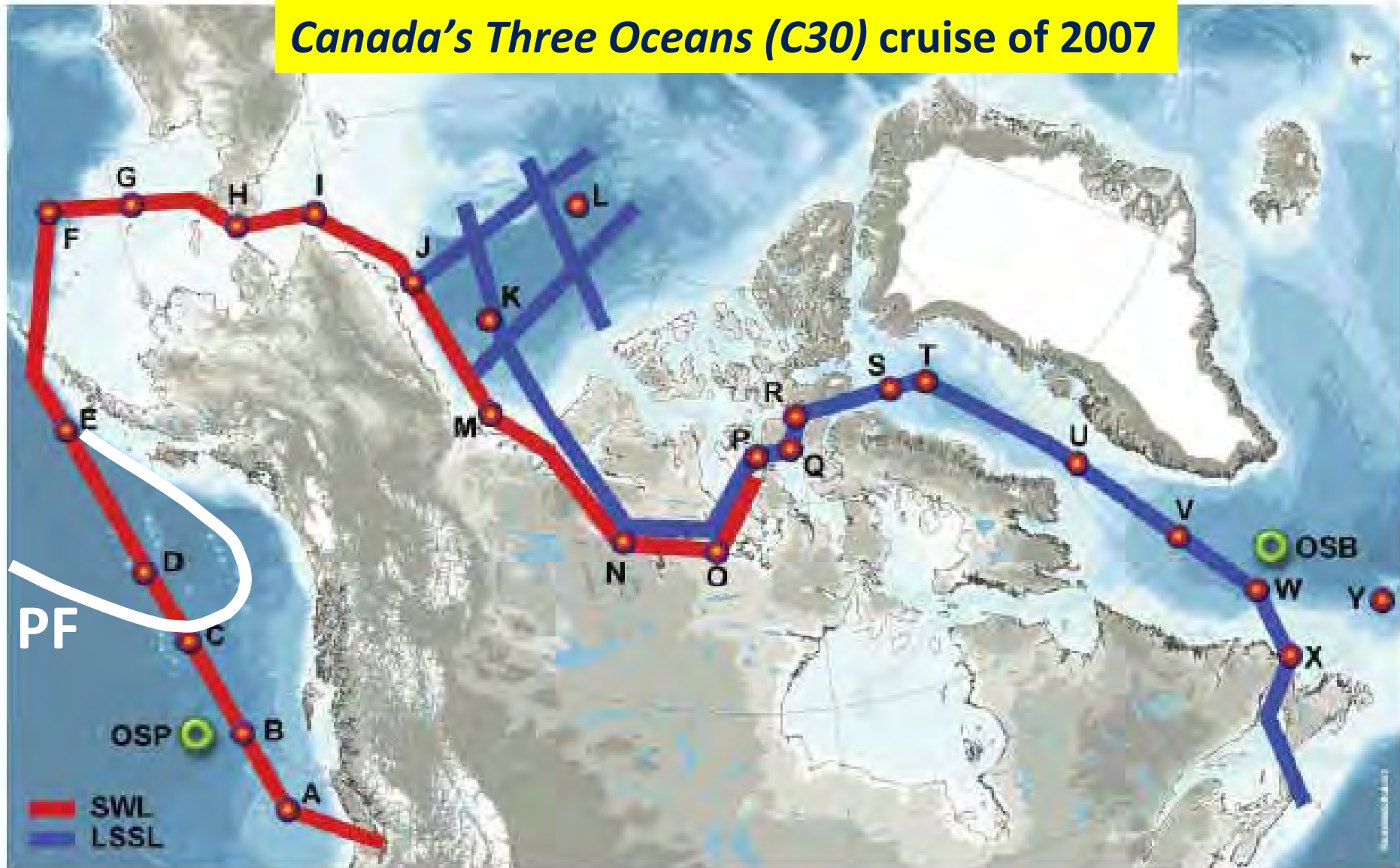
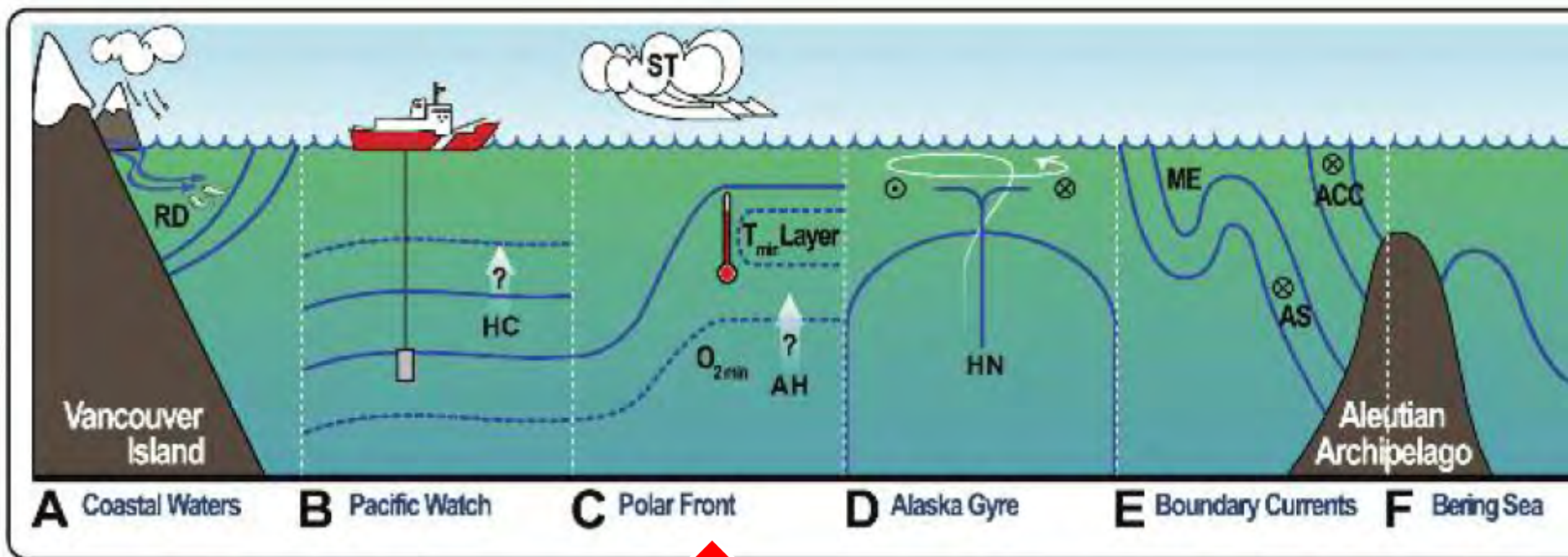


Fig. 1 Map of oceanographic transects occupied by C3O in 2007 by the CCGS *Sir Wilfrid Laurier* (SWL) departing from Victoria, British Columbia, in the west and the CCGS *Louis S. St-Laurent* (LSSL) departing from Dartmouth, Nova Scotia, in the east. Letters are explained in the text and are repeated in Figs 2 and 3.

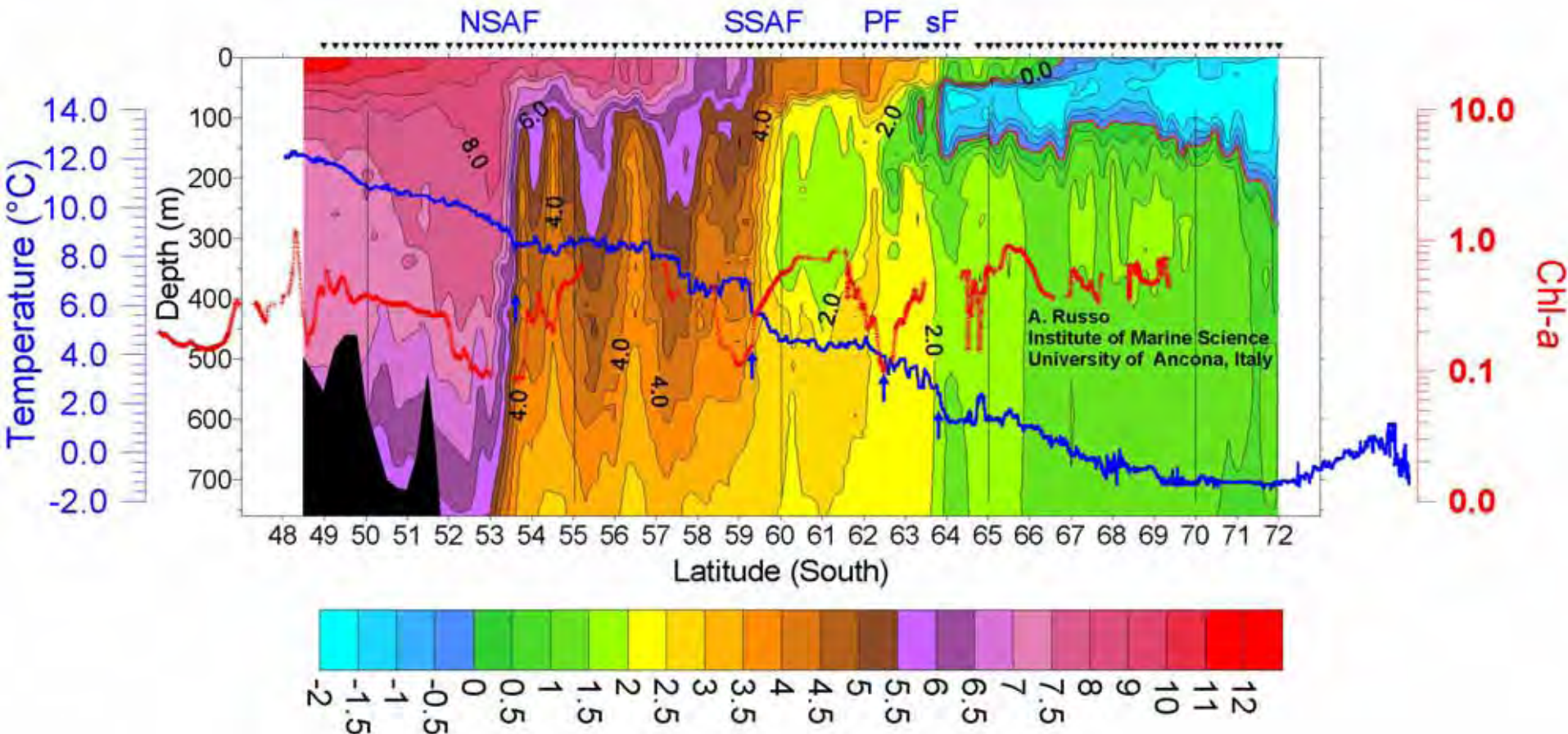
Polar Front in the Gulf of Alaska



Carmack et al., 2010, *Atmosphere-Ocean*

South Pacific Polar Front

XBT Potential Temperature, SST from ship seawater intake, Surface Chl-a by LIDAR
SPANNING TIME: 06-Jan-01 to 13-Jan-01

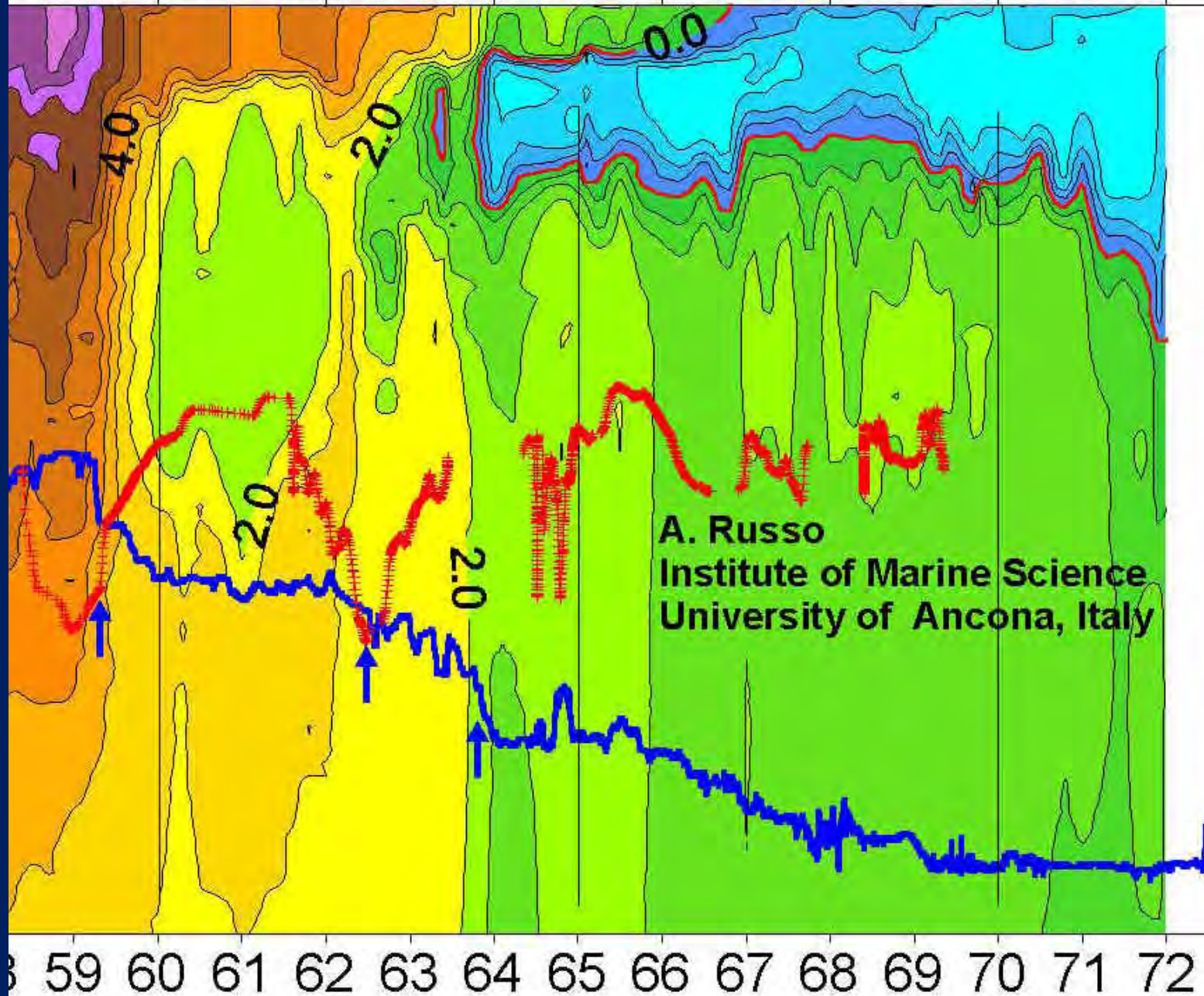


A. Russo, Inst. Mar. Science, Univ. Ancona, Italy

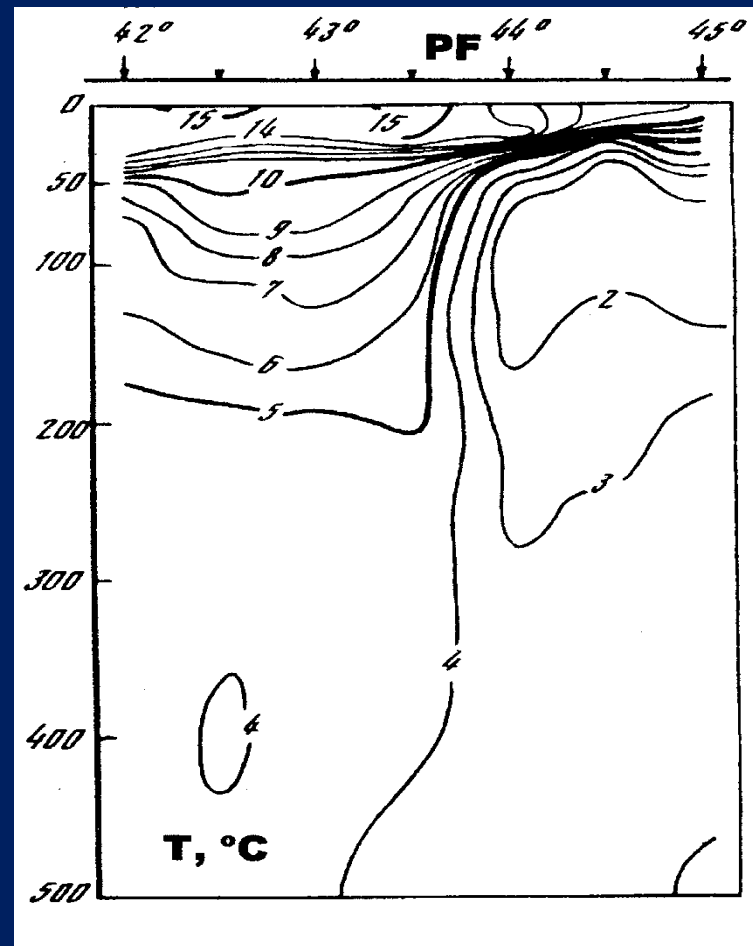
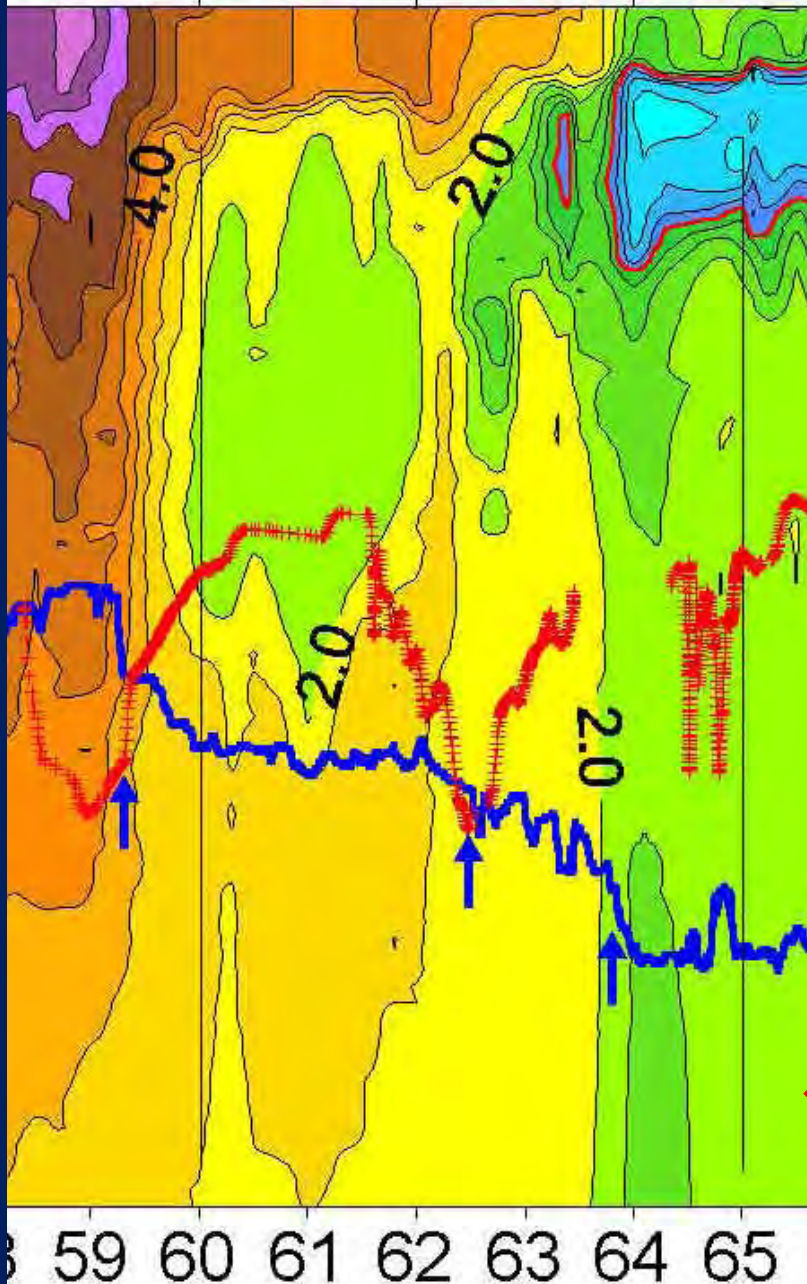
SSAF

PF

sF

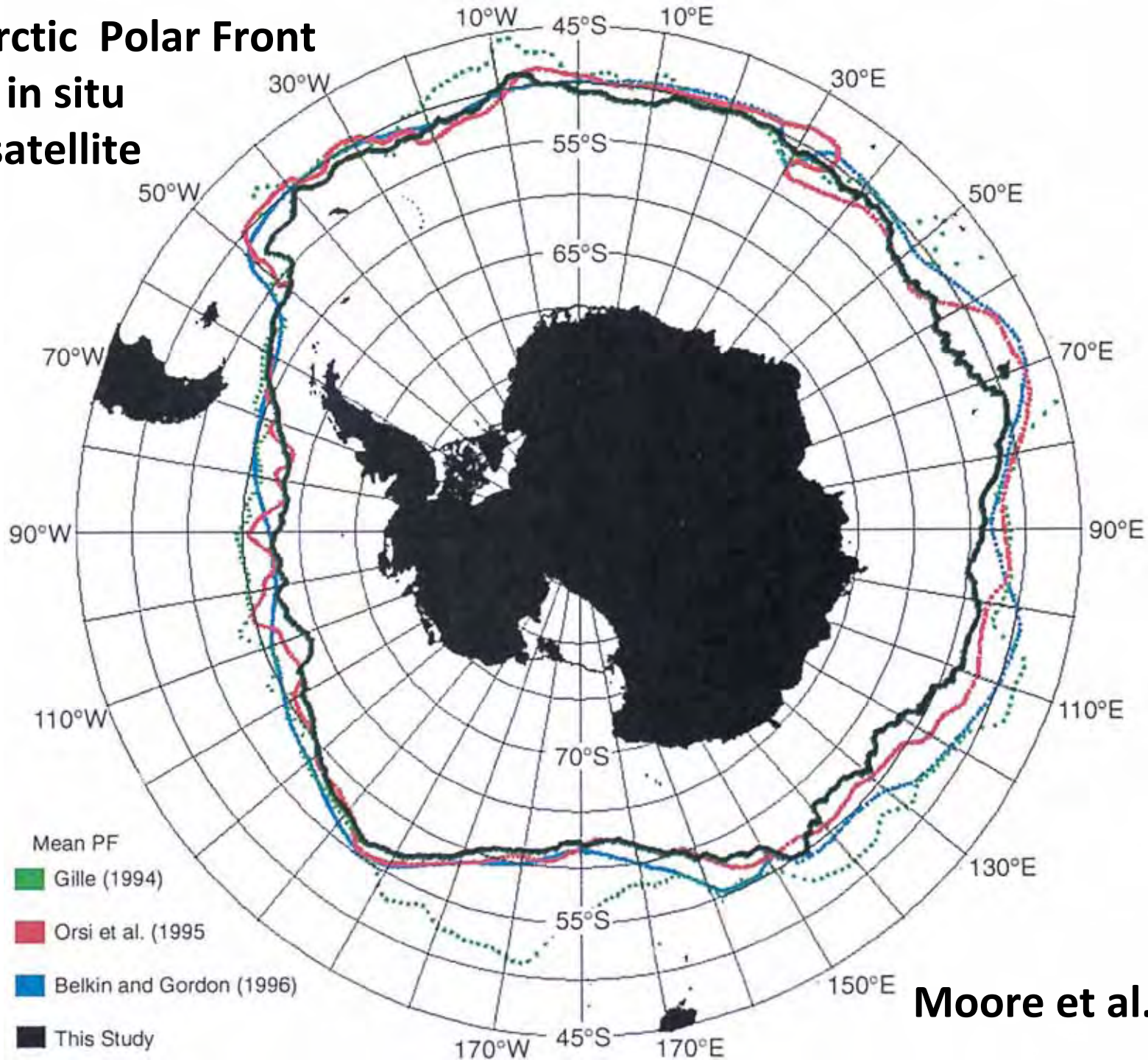


SSAF PF sF

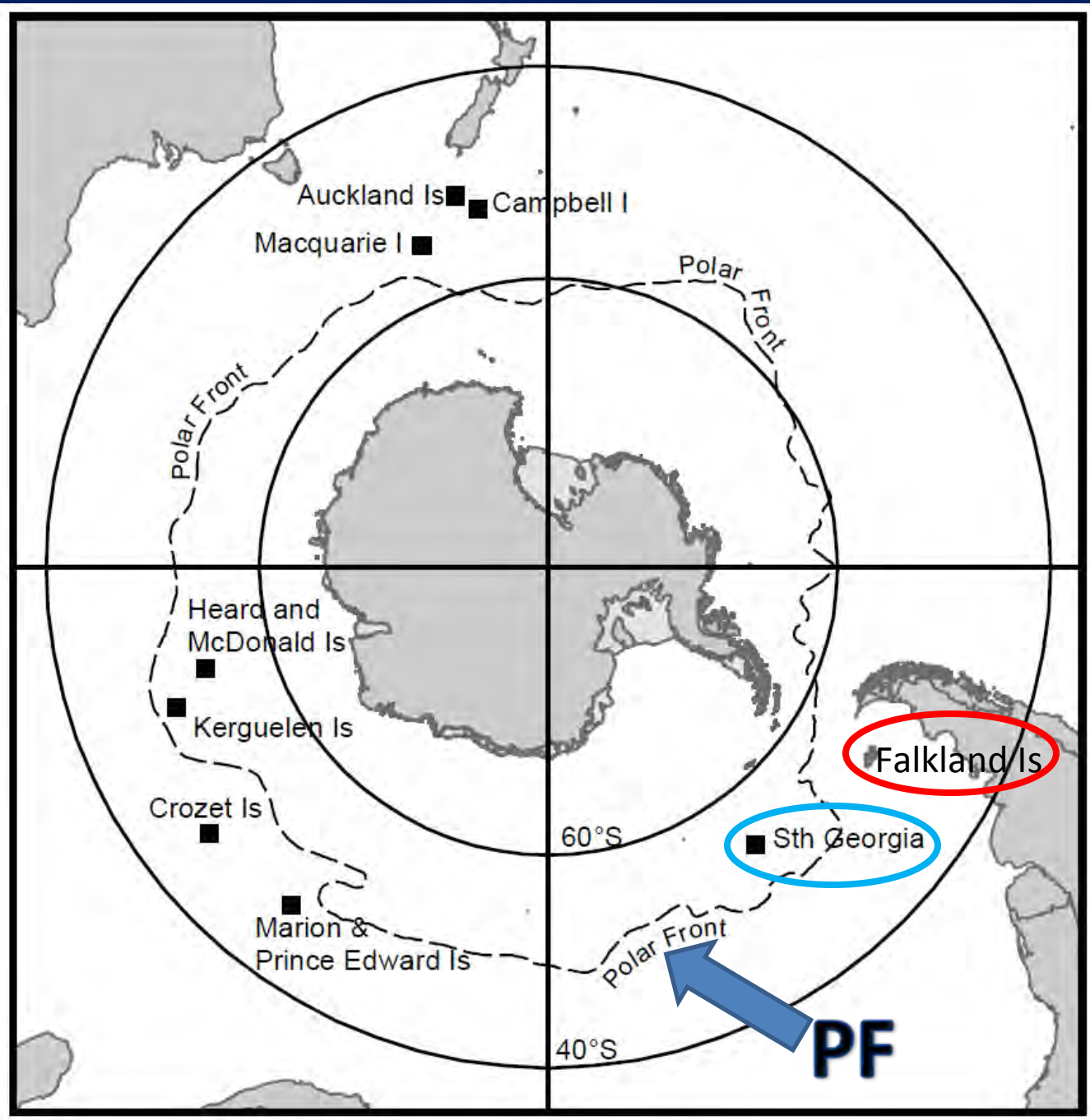


South vs. North
Pacific

Antarctic Polar Front from in situ and satellite data



Credit:
Aus.
Ant.
Data
Centre



Falkland Islands (52°S)

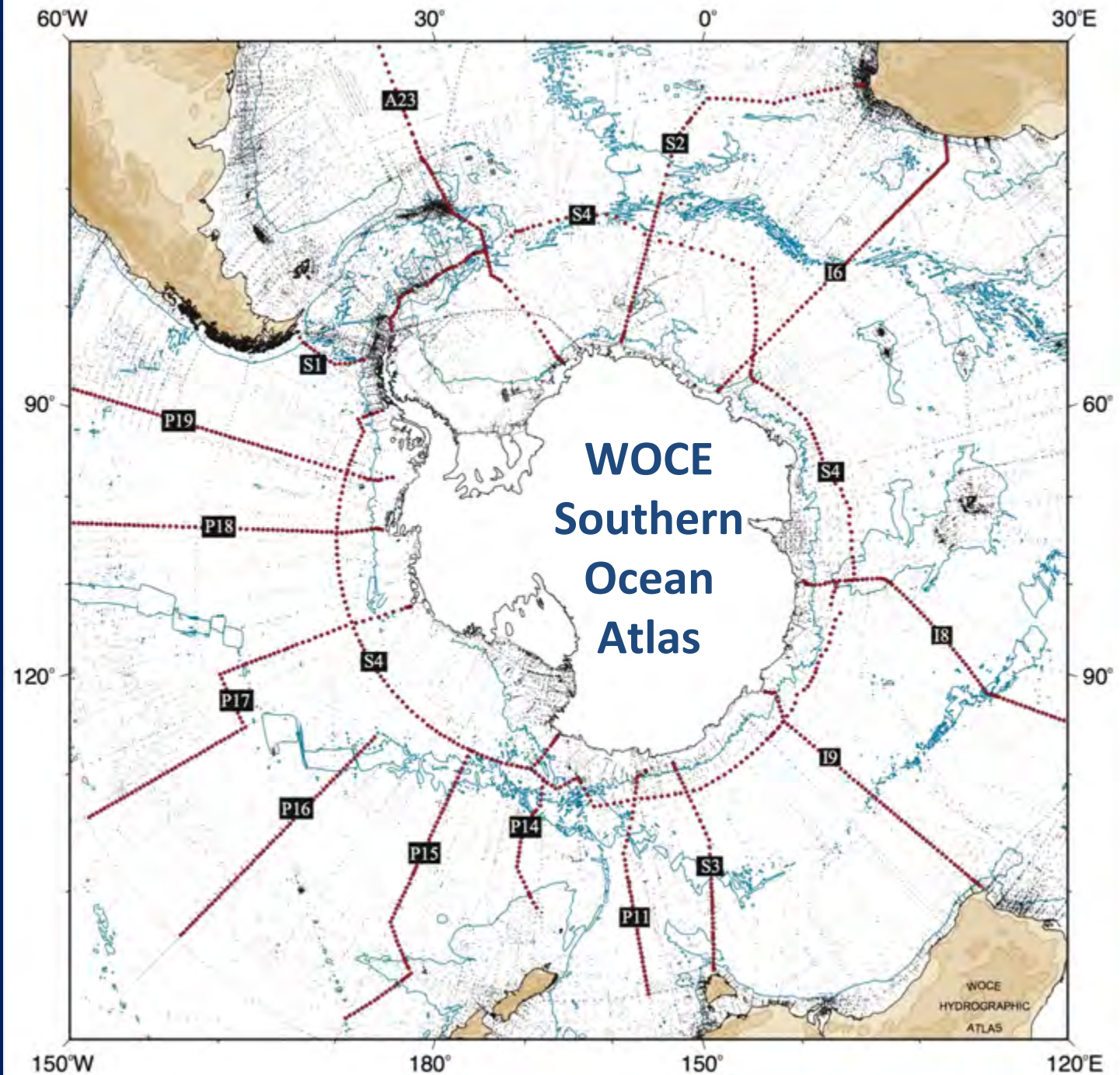


Credit: Wikipedia

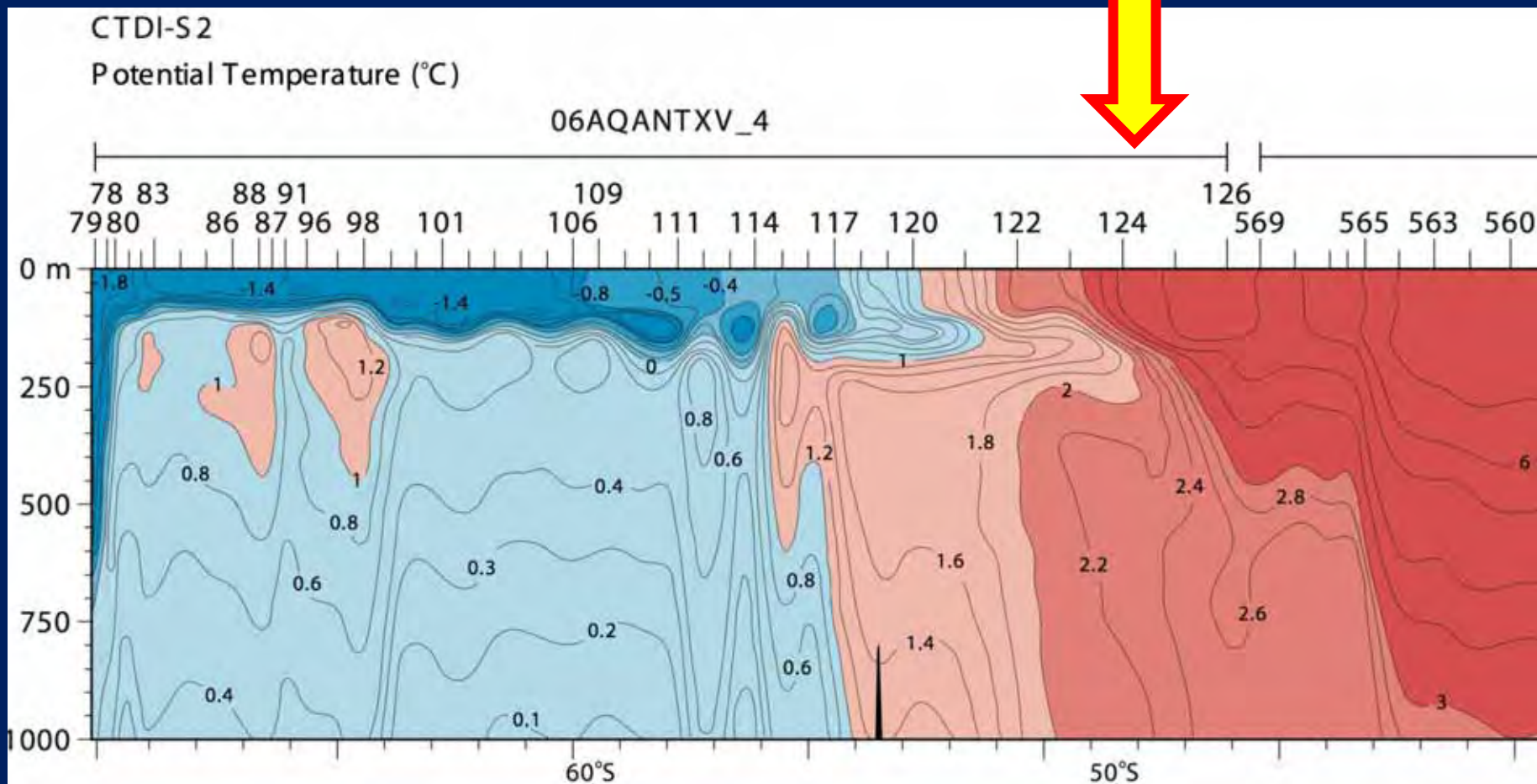
South Georgia (54°S)



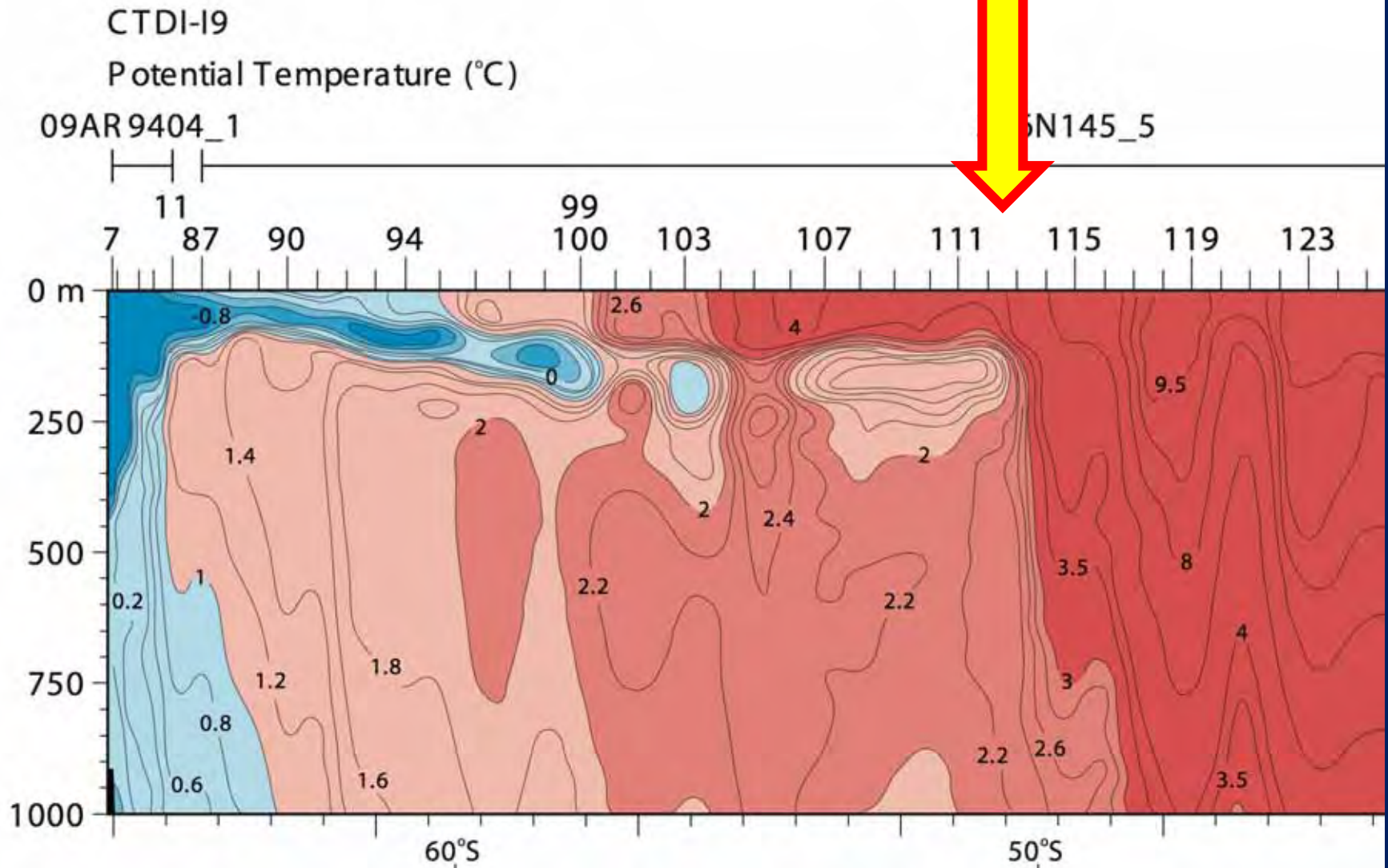
Credit: NASA



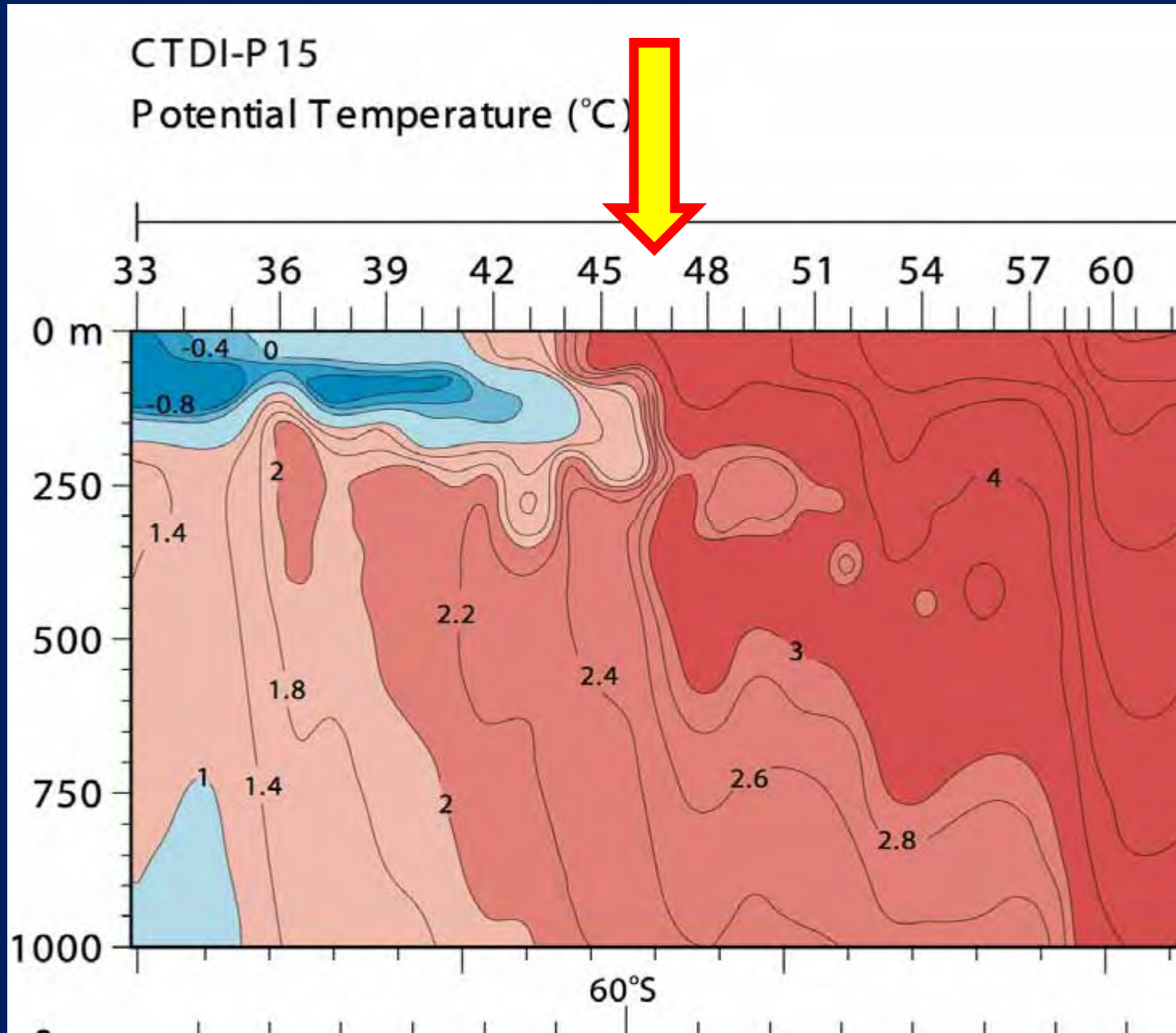
Antarctic Polar Front along 0°E



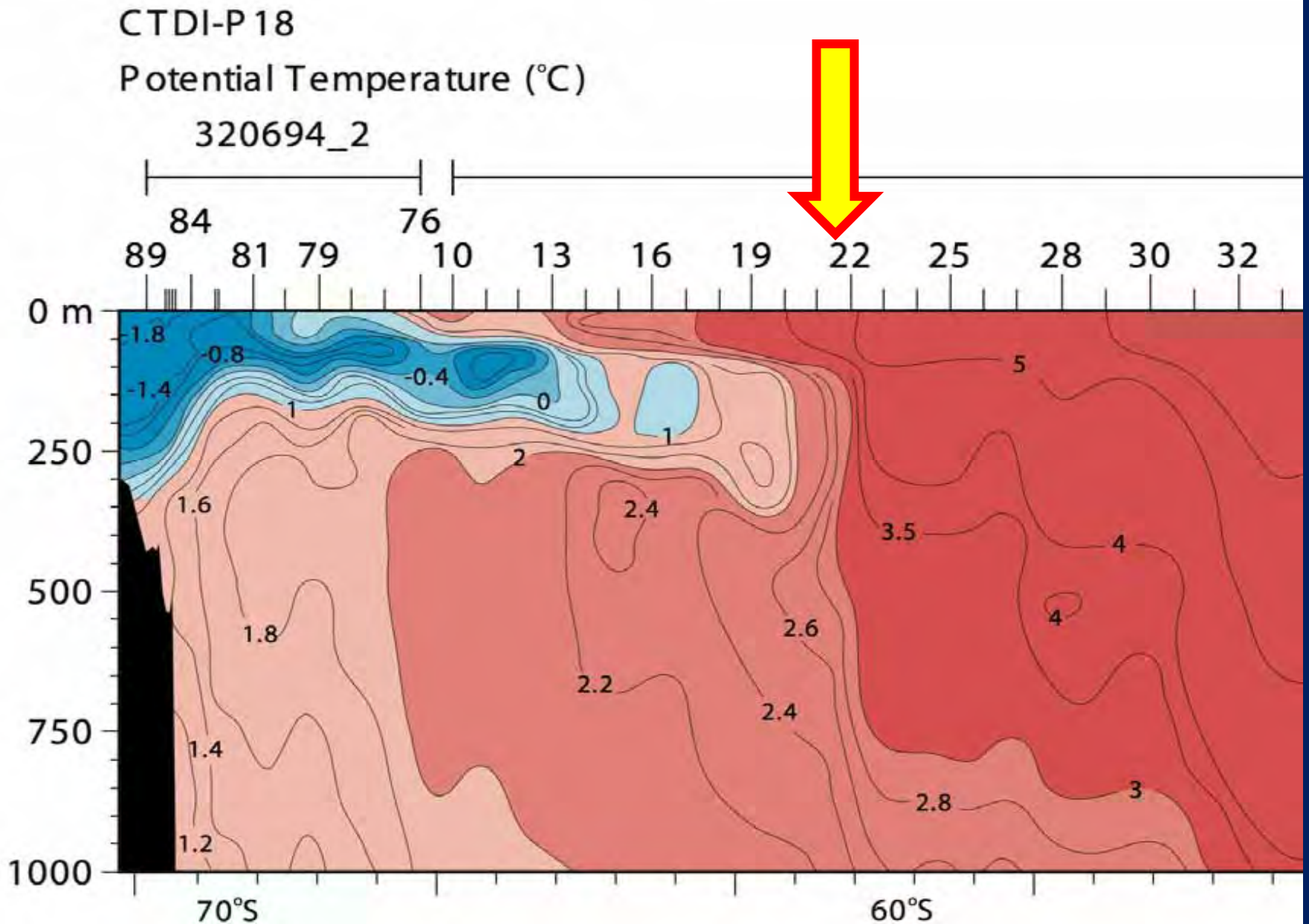
Antarctic Polar Front along 115°E



Antarctic Polar Front along 170°W



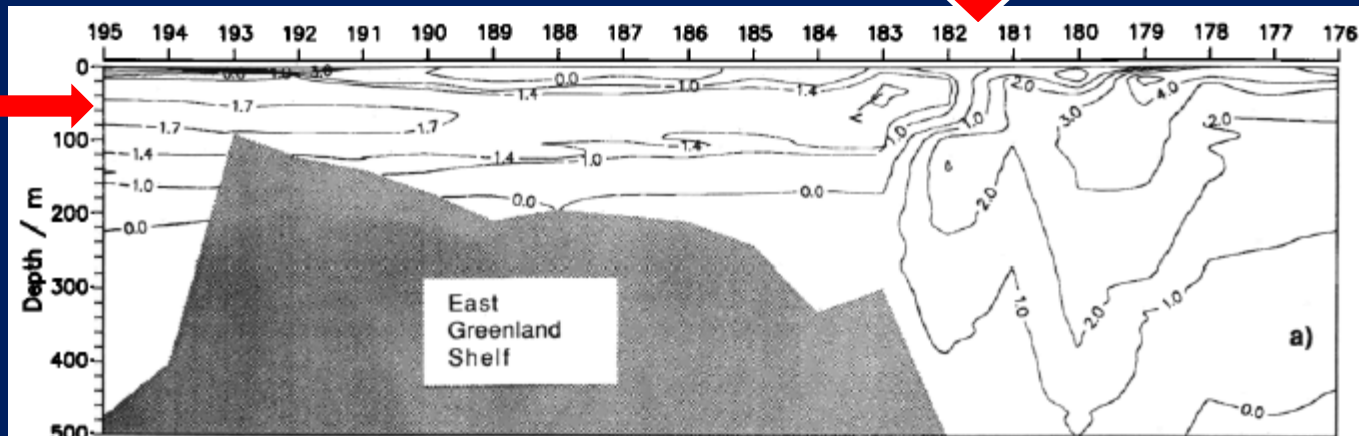
Antarctic Polar Front along 103°W



East Greenland Polar Front at 78°N

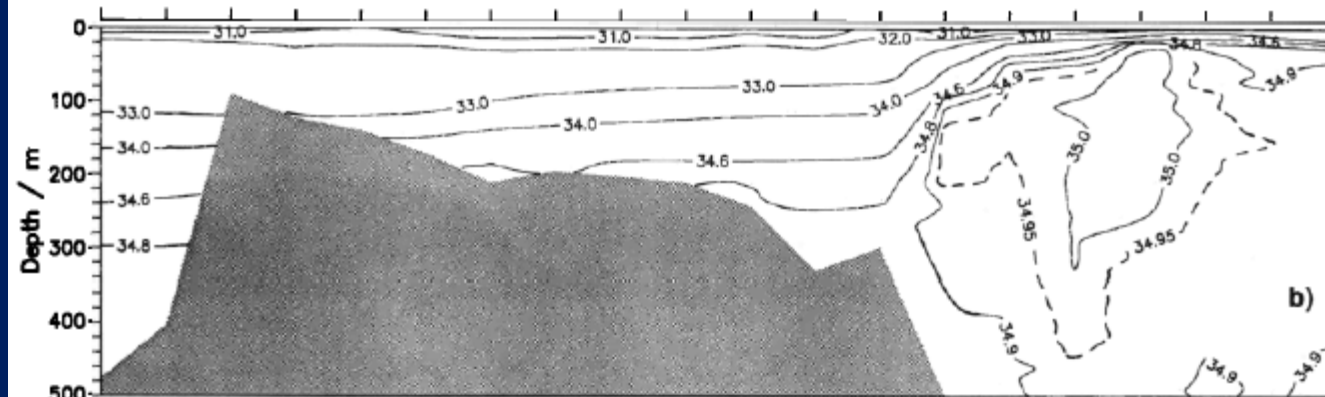


T-min

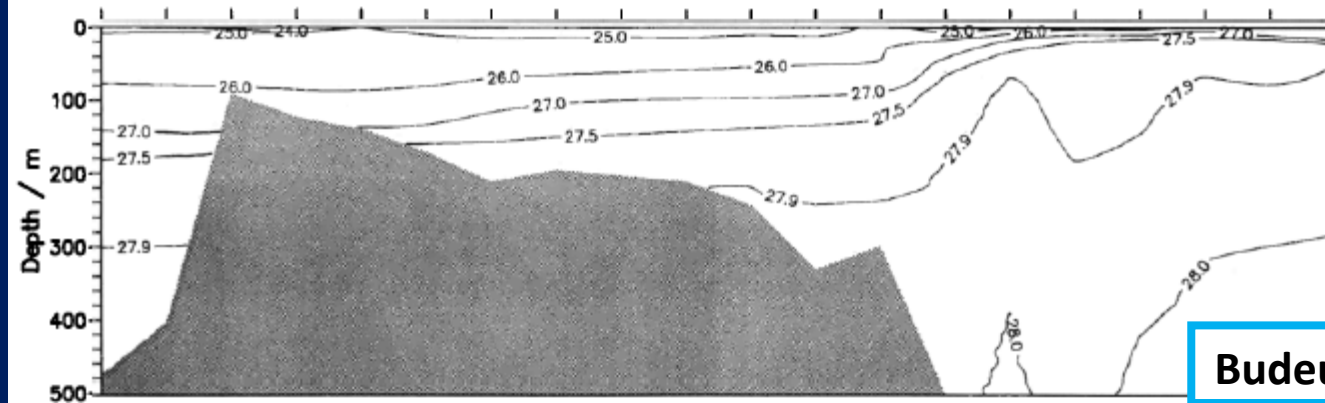


August
1990

T



S

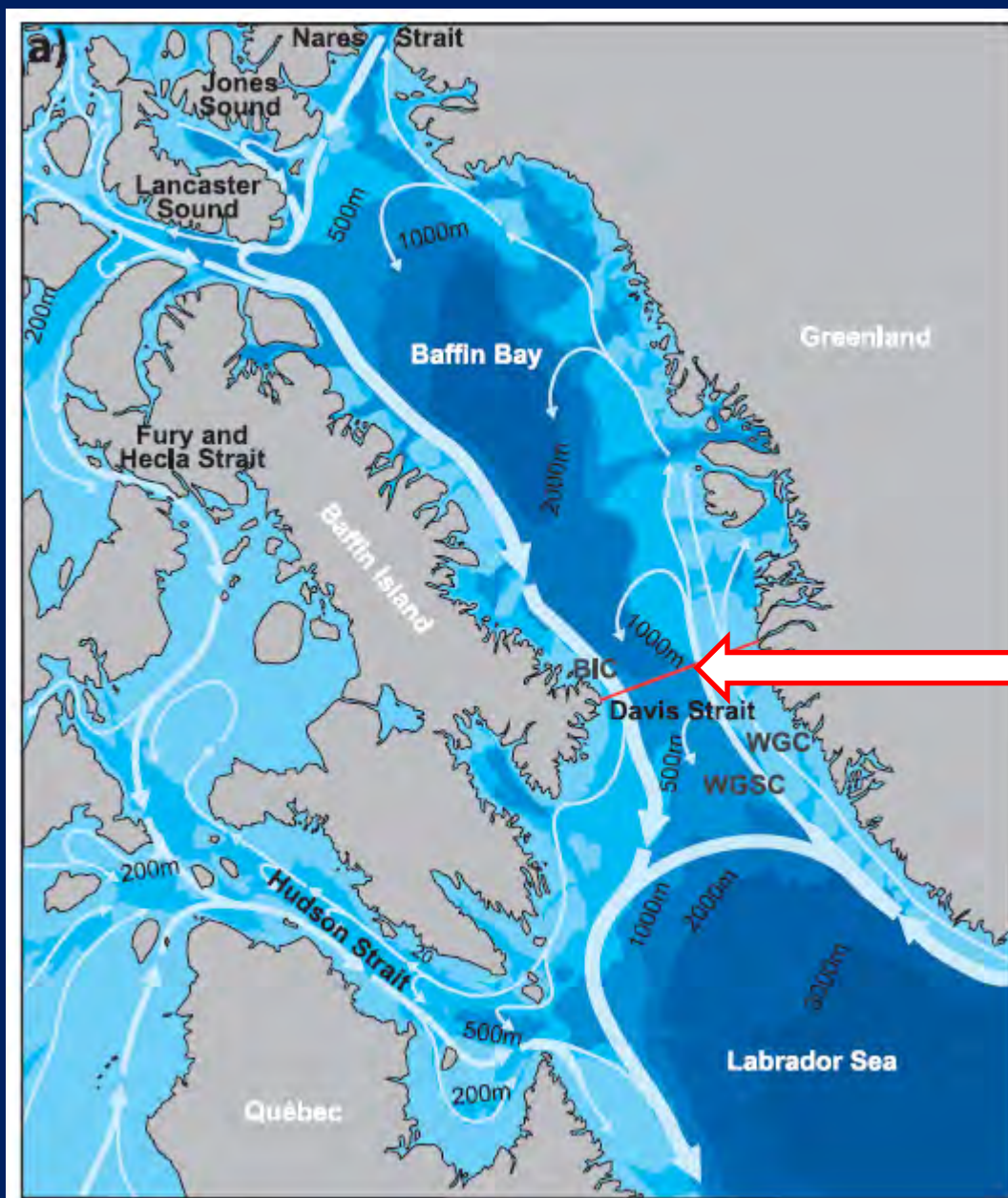


PD

Sigma-t

Budeus et al. (1993)

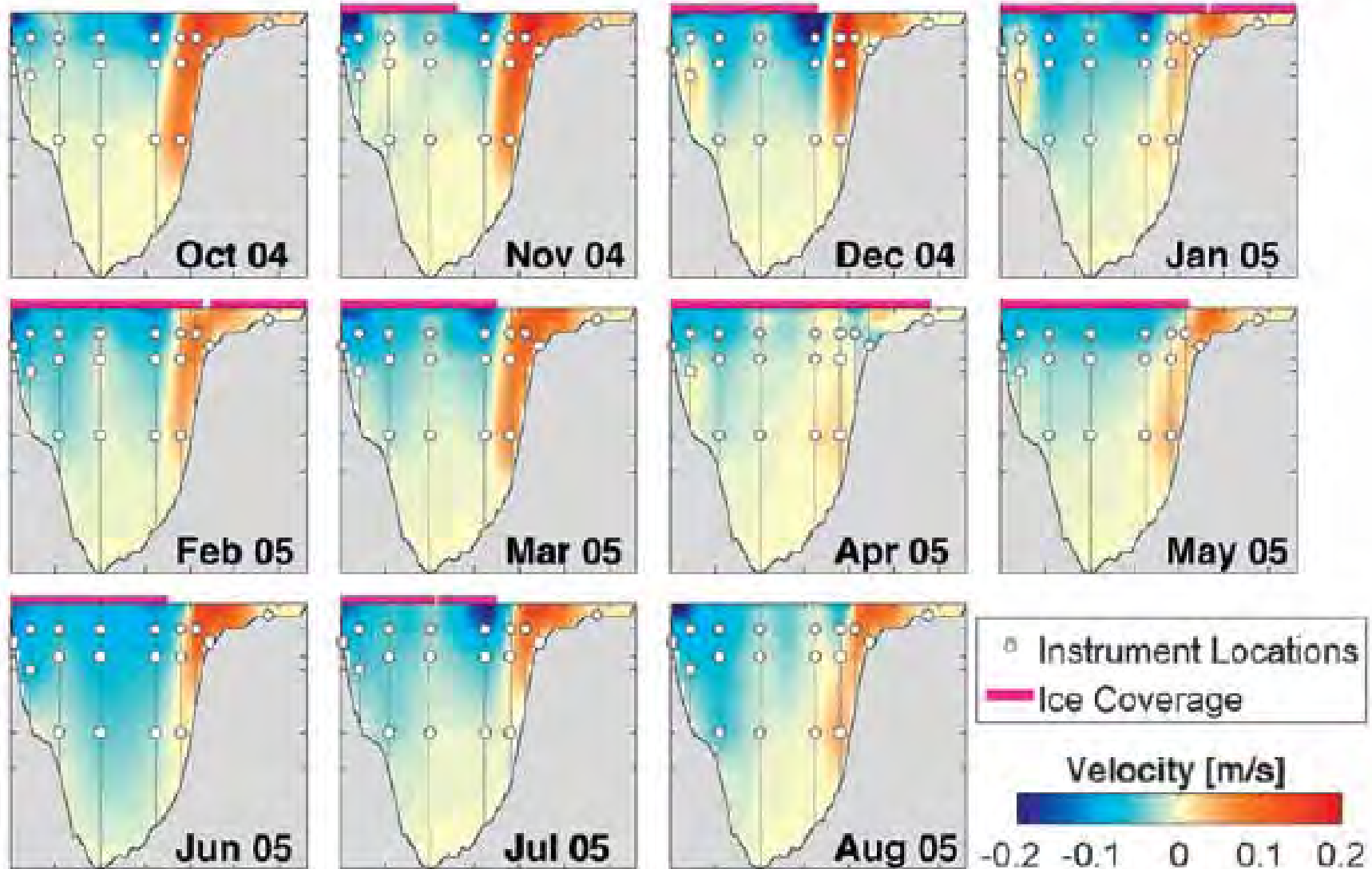
West Greenland Polar Front in Davis Strait



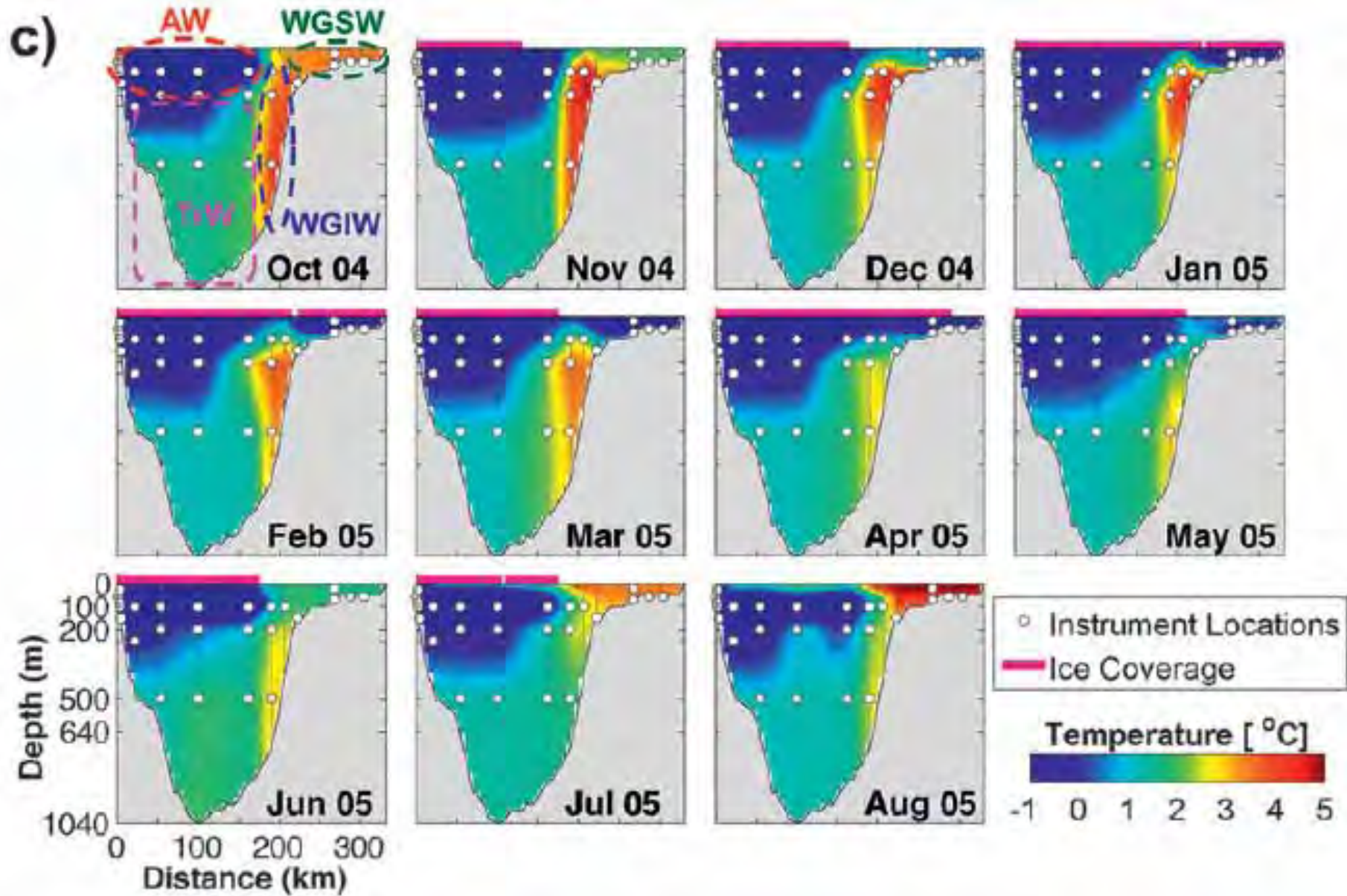
PF

Velocity along Davis Strait

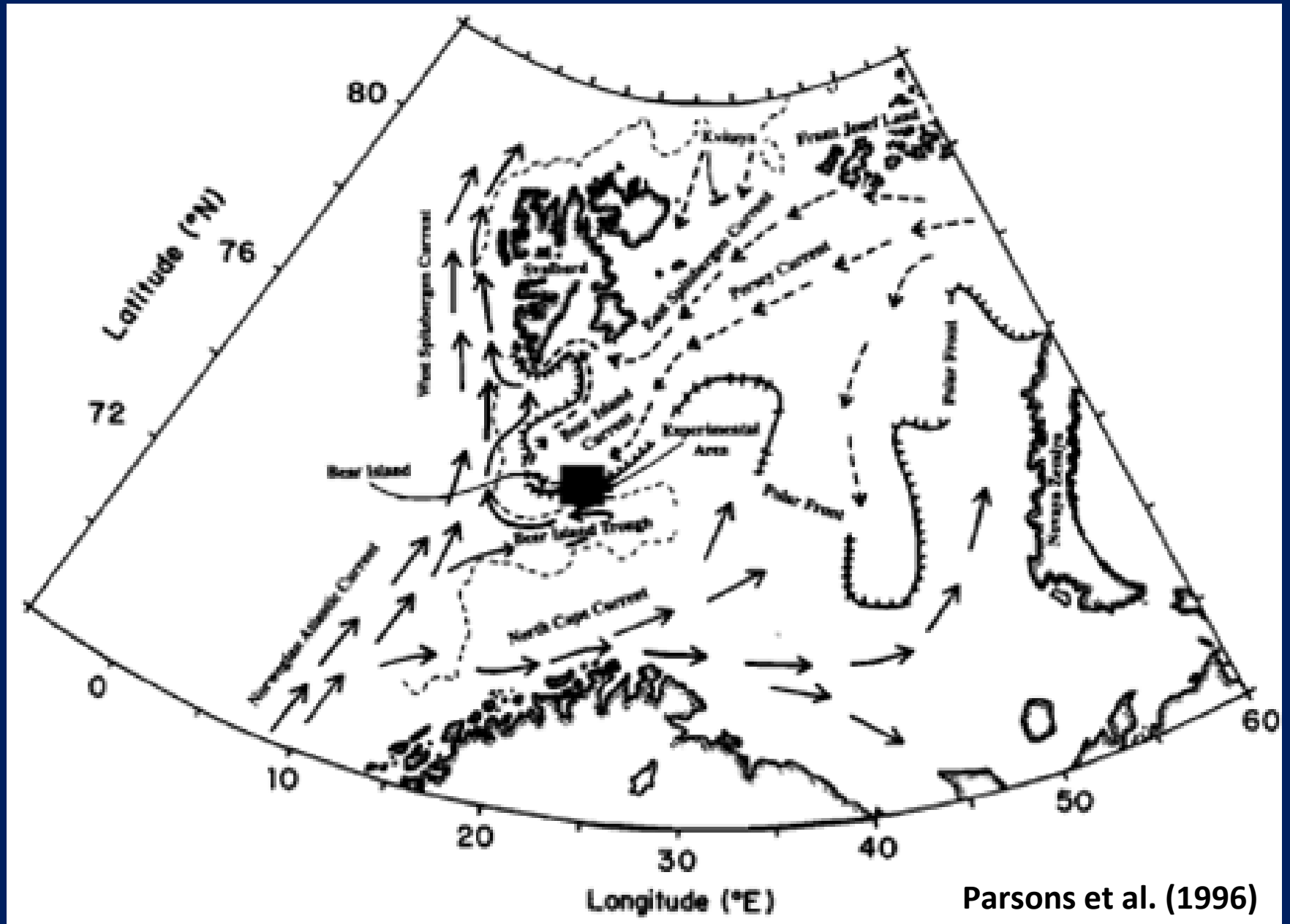
a)

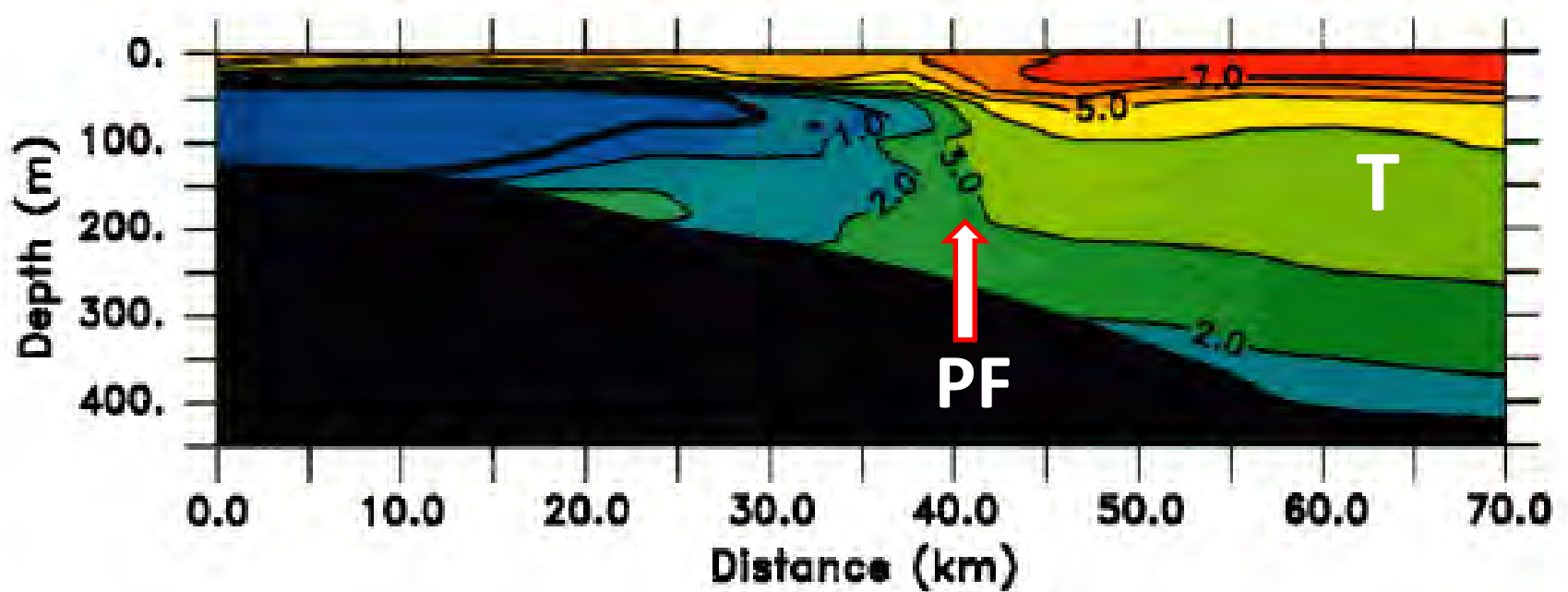


Temperature section across Davis Strait

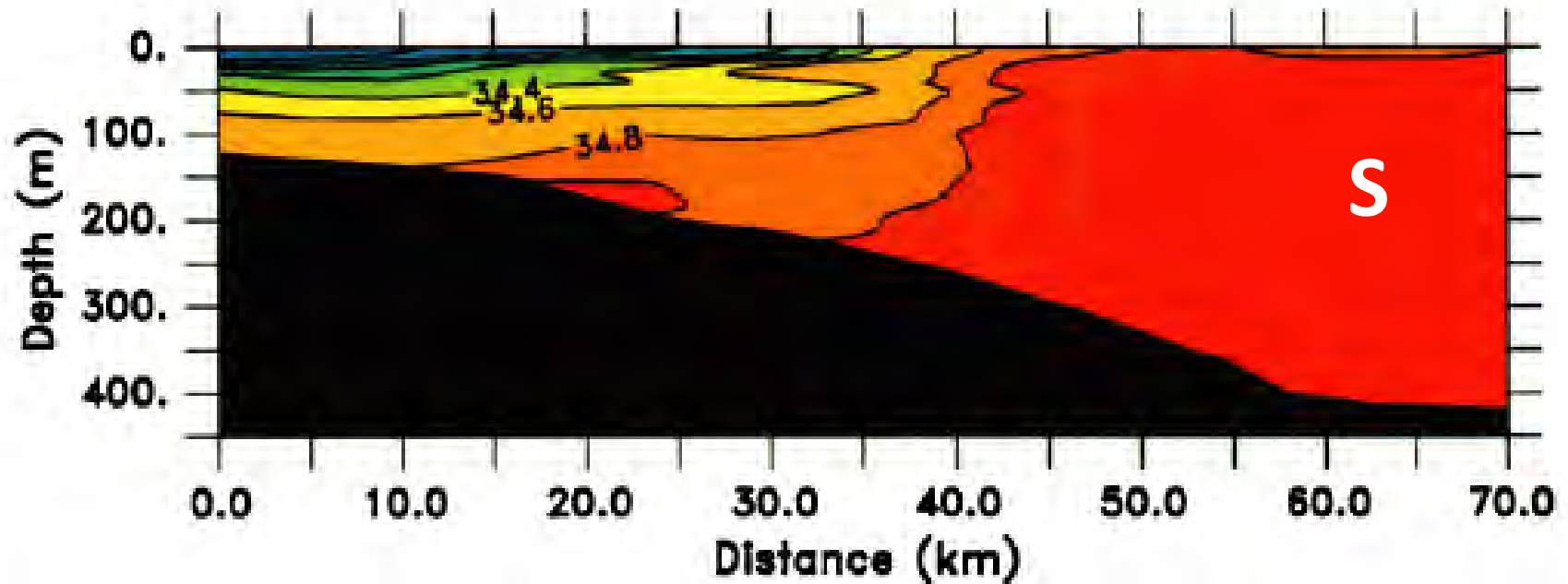


Barents Sea Polar Front

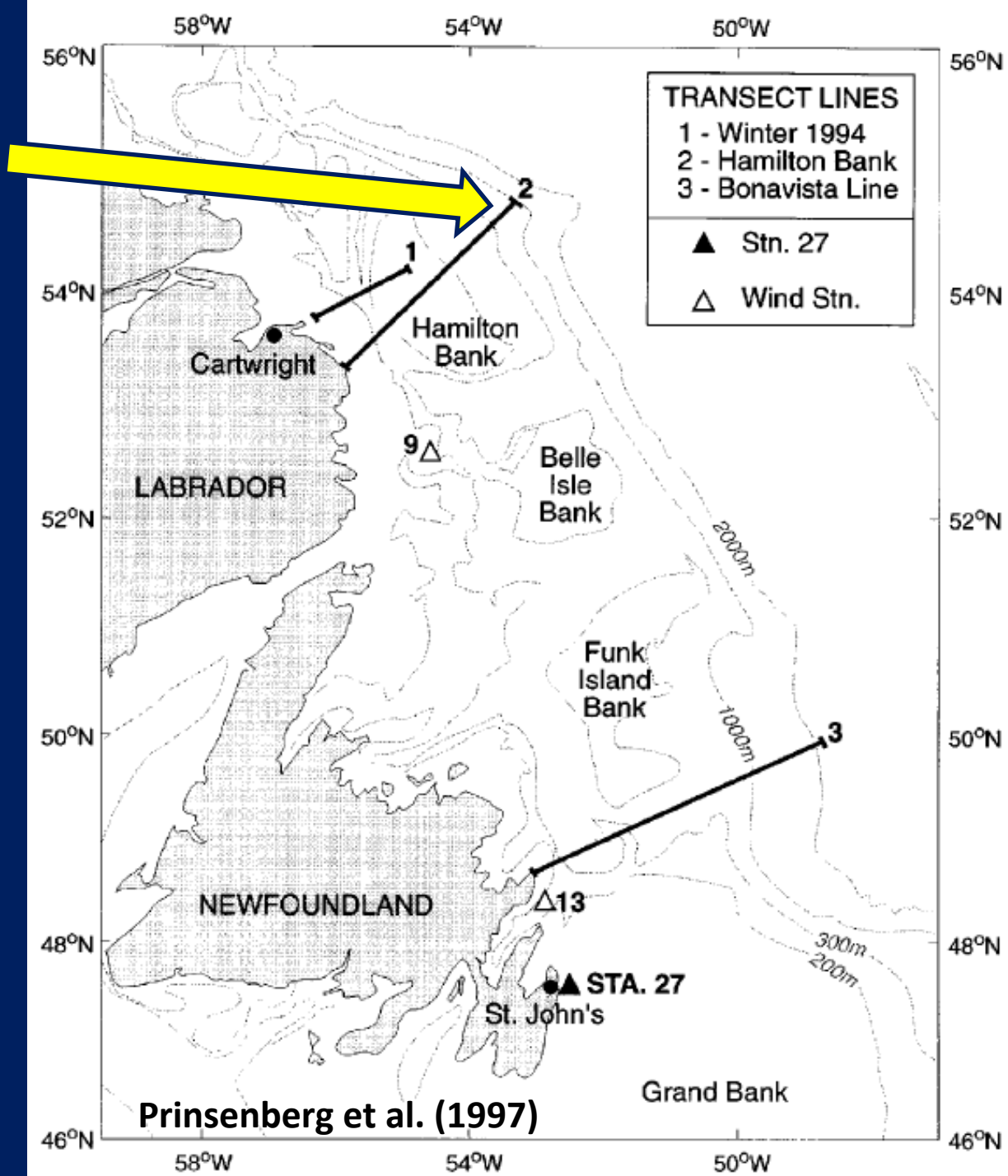




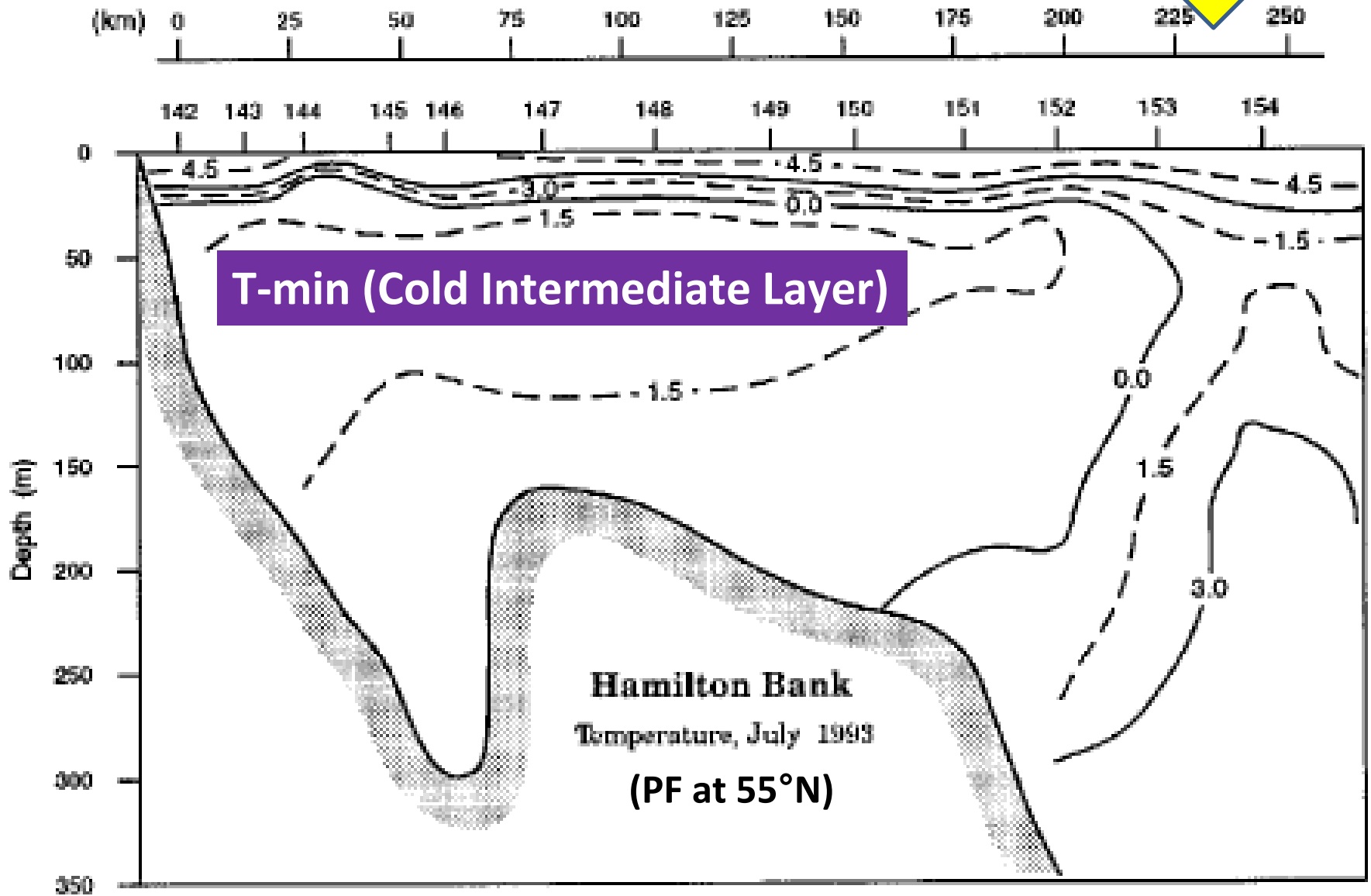
Barents Sea Polar Front (Parsons et al., 1996)



Labrador Polar Front

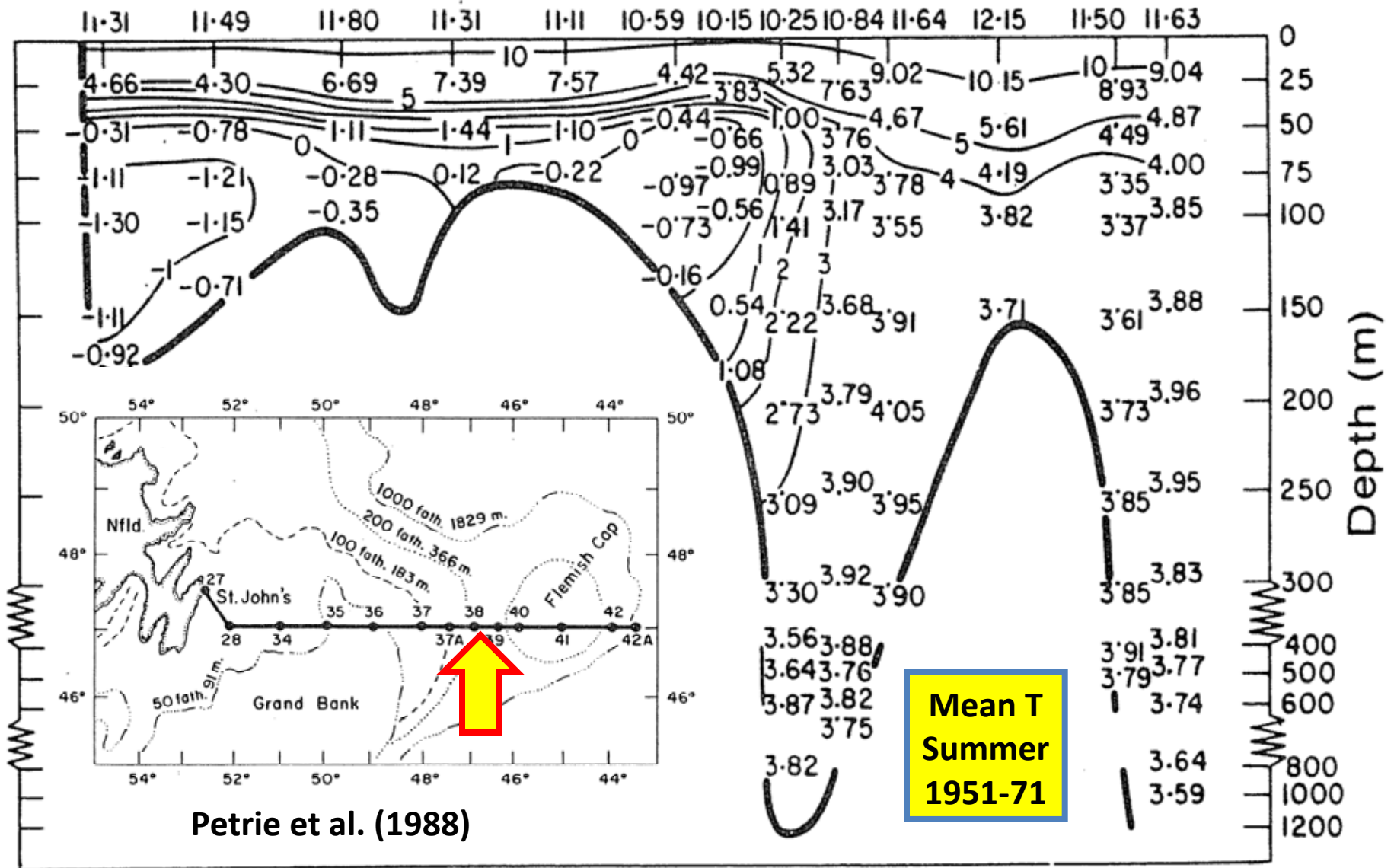


Labrador Polar Front

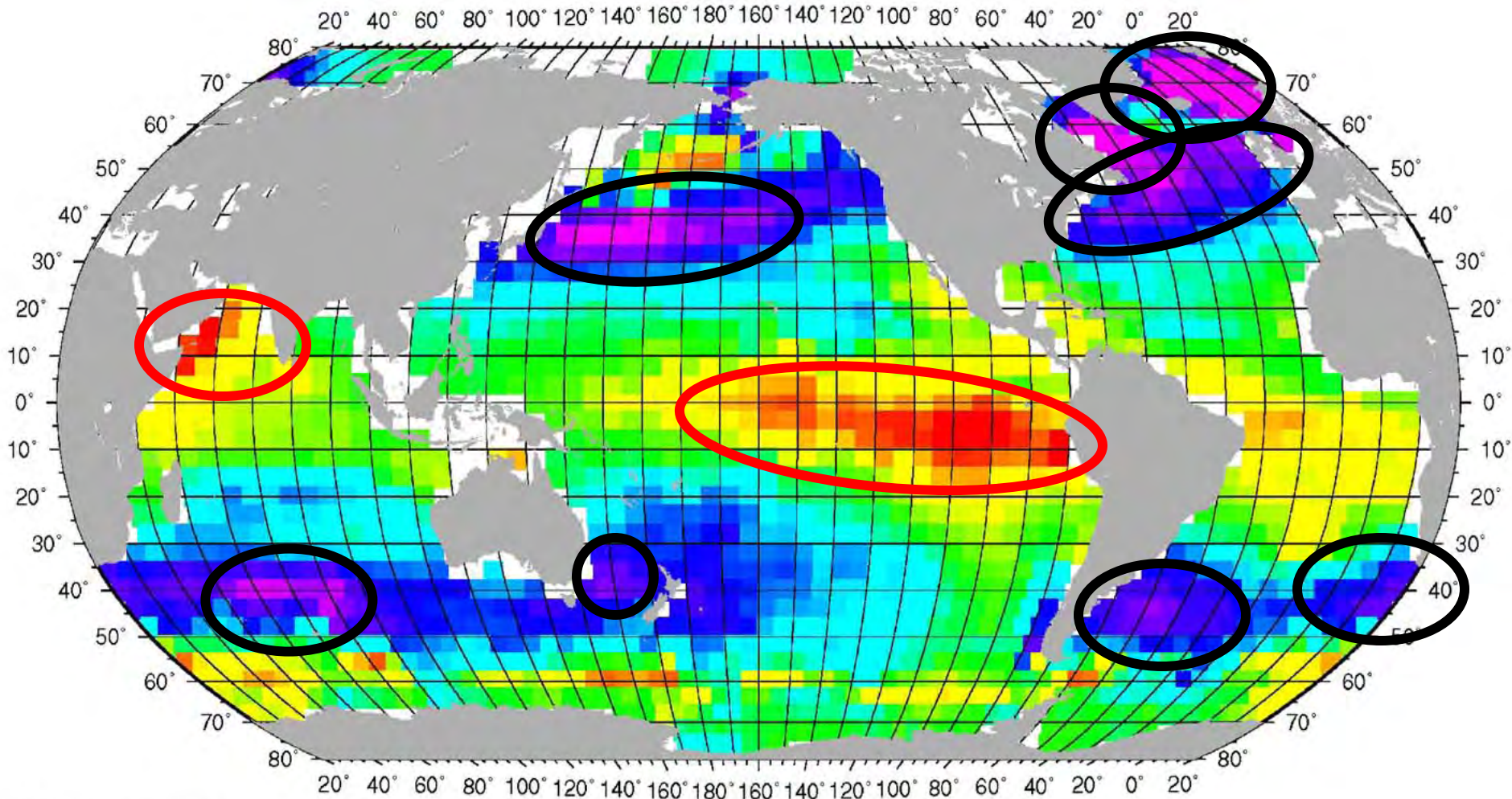


Prinsenberget al. (1997)

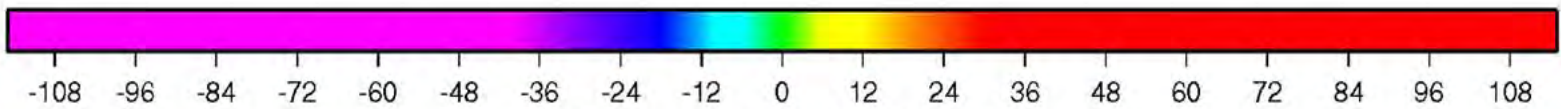
Newfoundland Polar Front at 47°N



Climatological mean annual sea-air CO₂ flux



GMT 2008 Apr 1 13:42:53

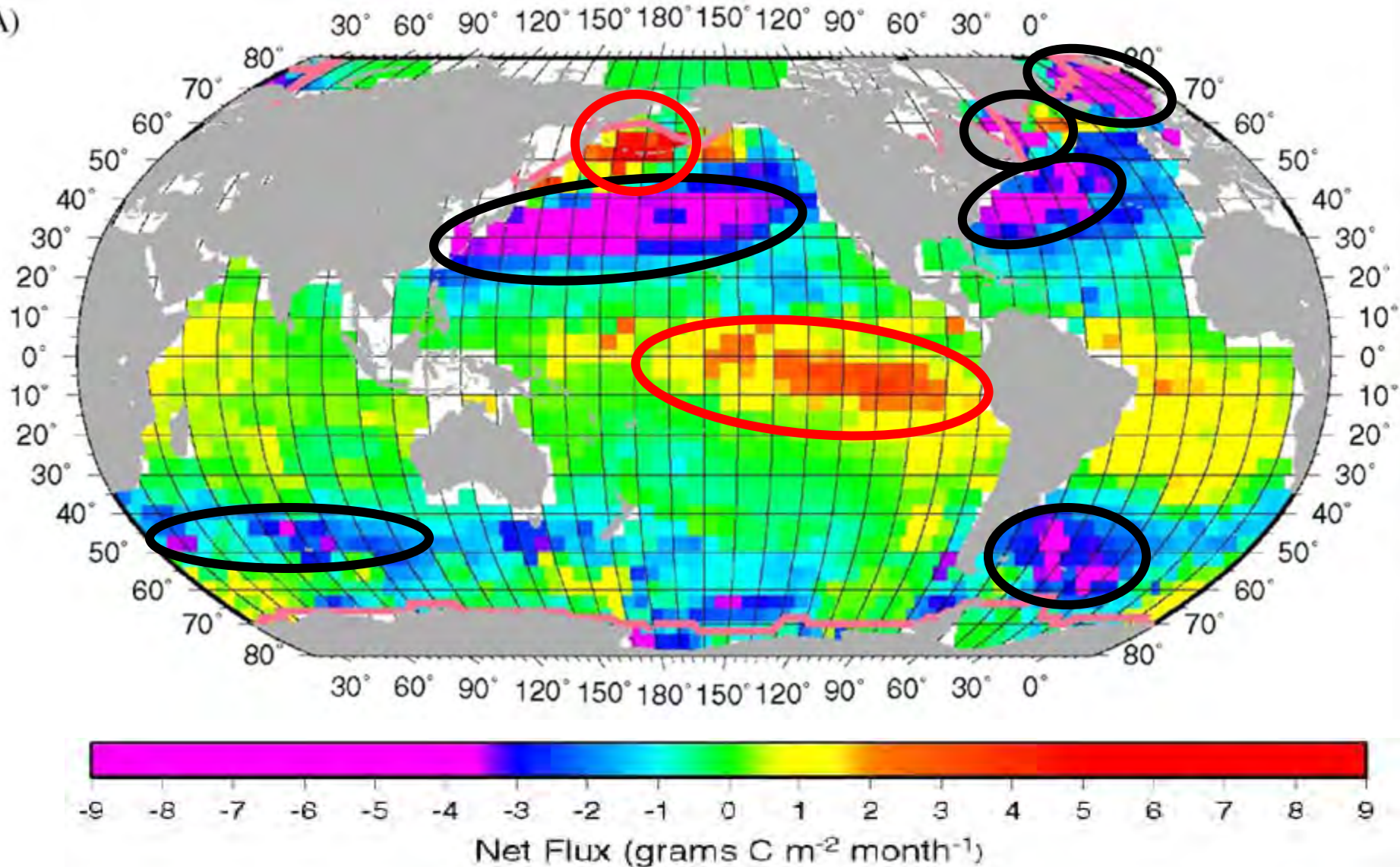


Net Flux (grams C m⁻² year⁻¹)

Takahashi et al., 2009

Climatological mean February sea-air CO₂ flux

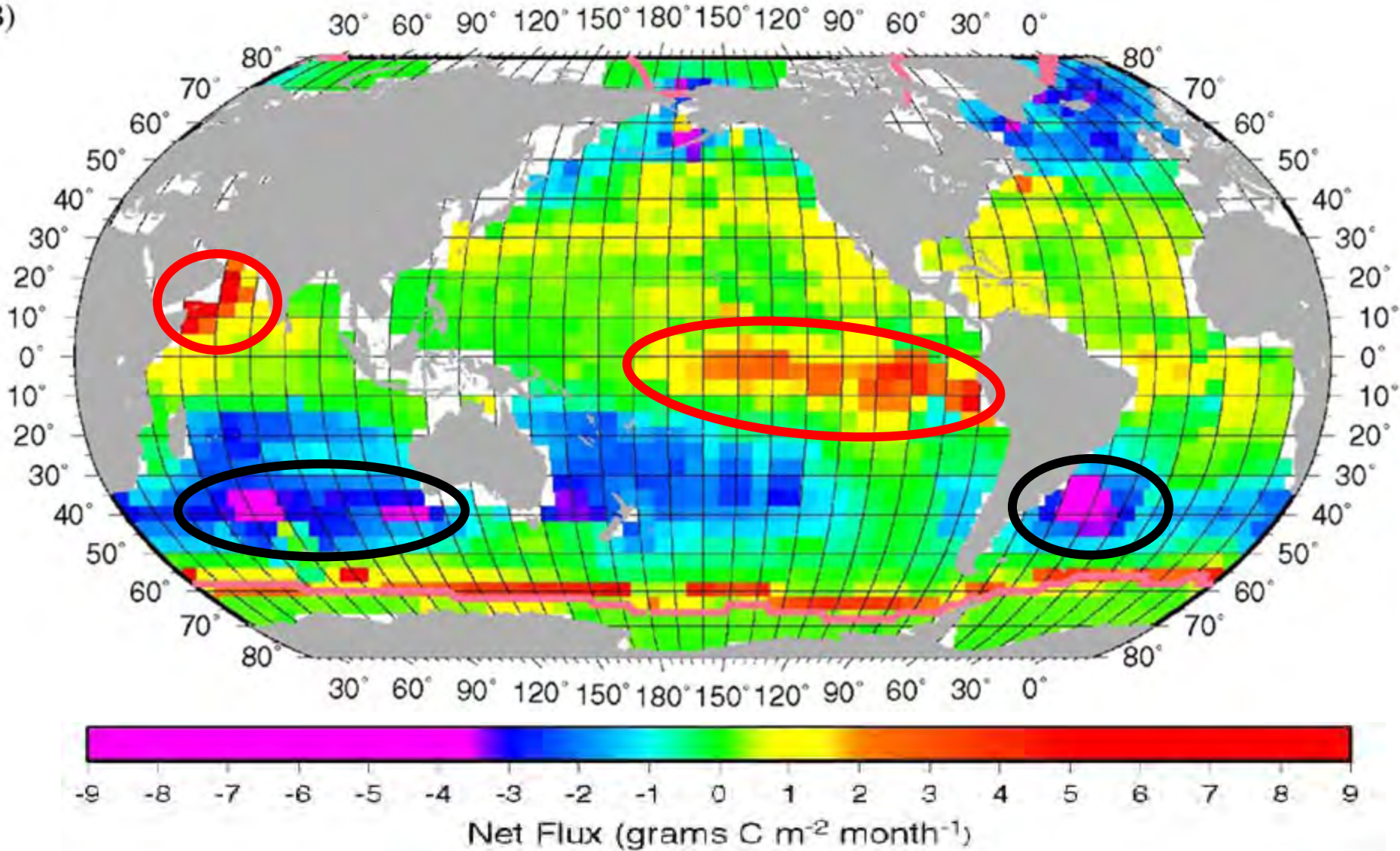
(A)



Takahashi et al., 2009

Climatological mean August sea-air CO₂ flux

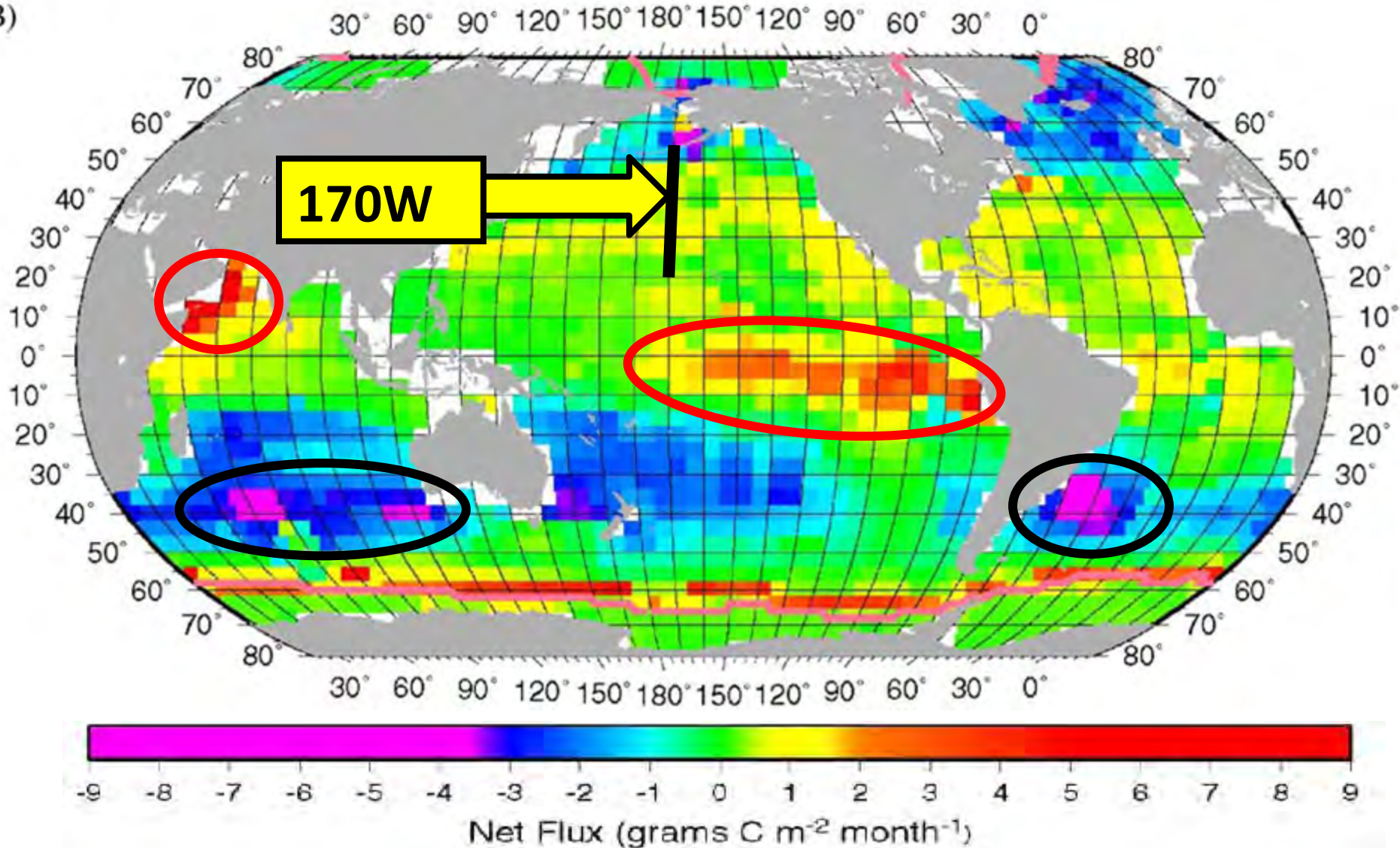
(B)



Takahashi et al., 2009

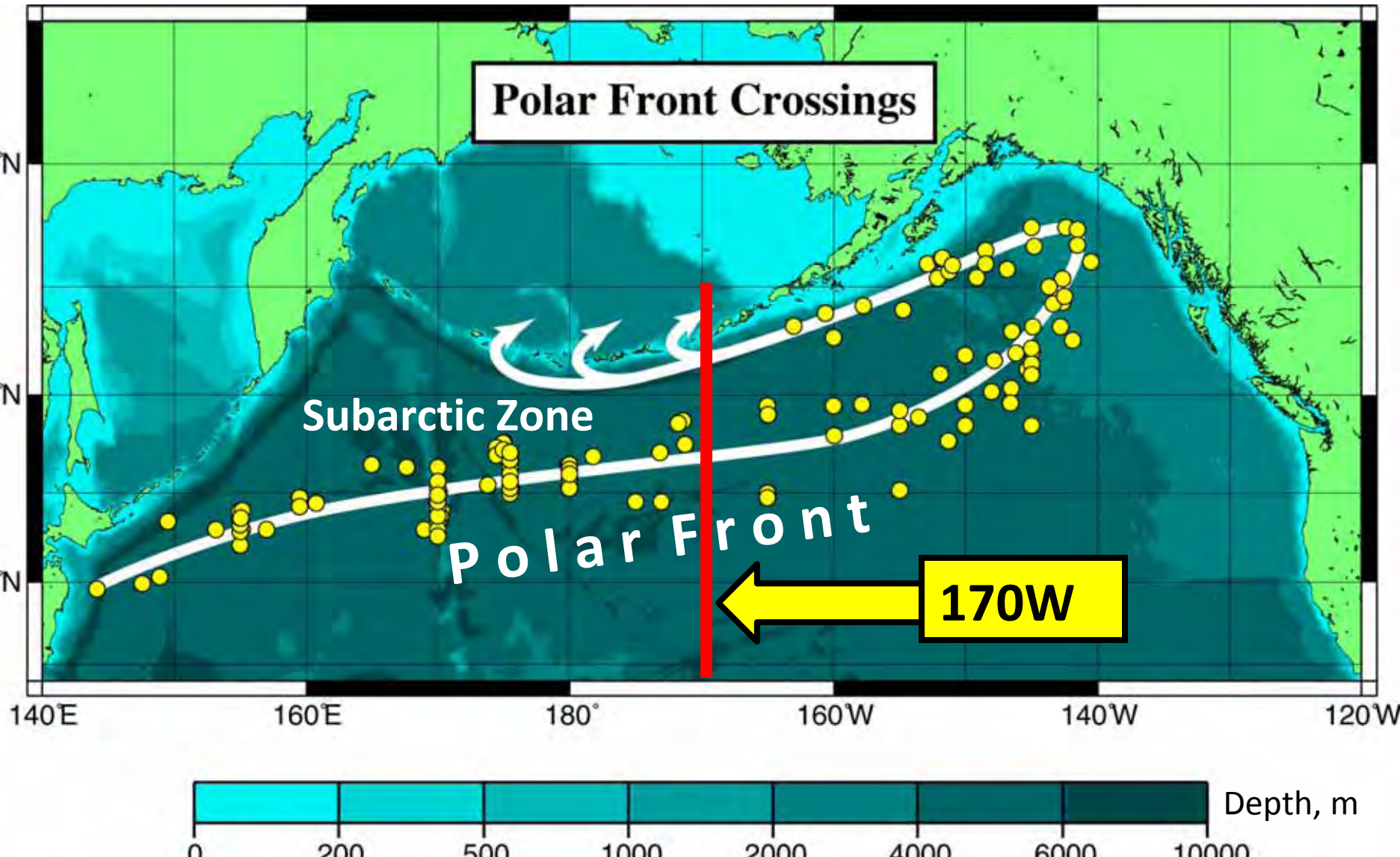
Climatological mean August sea-air CO₂ flux

(B)

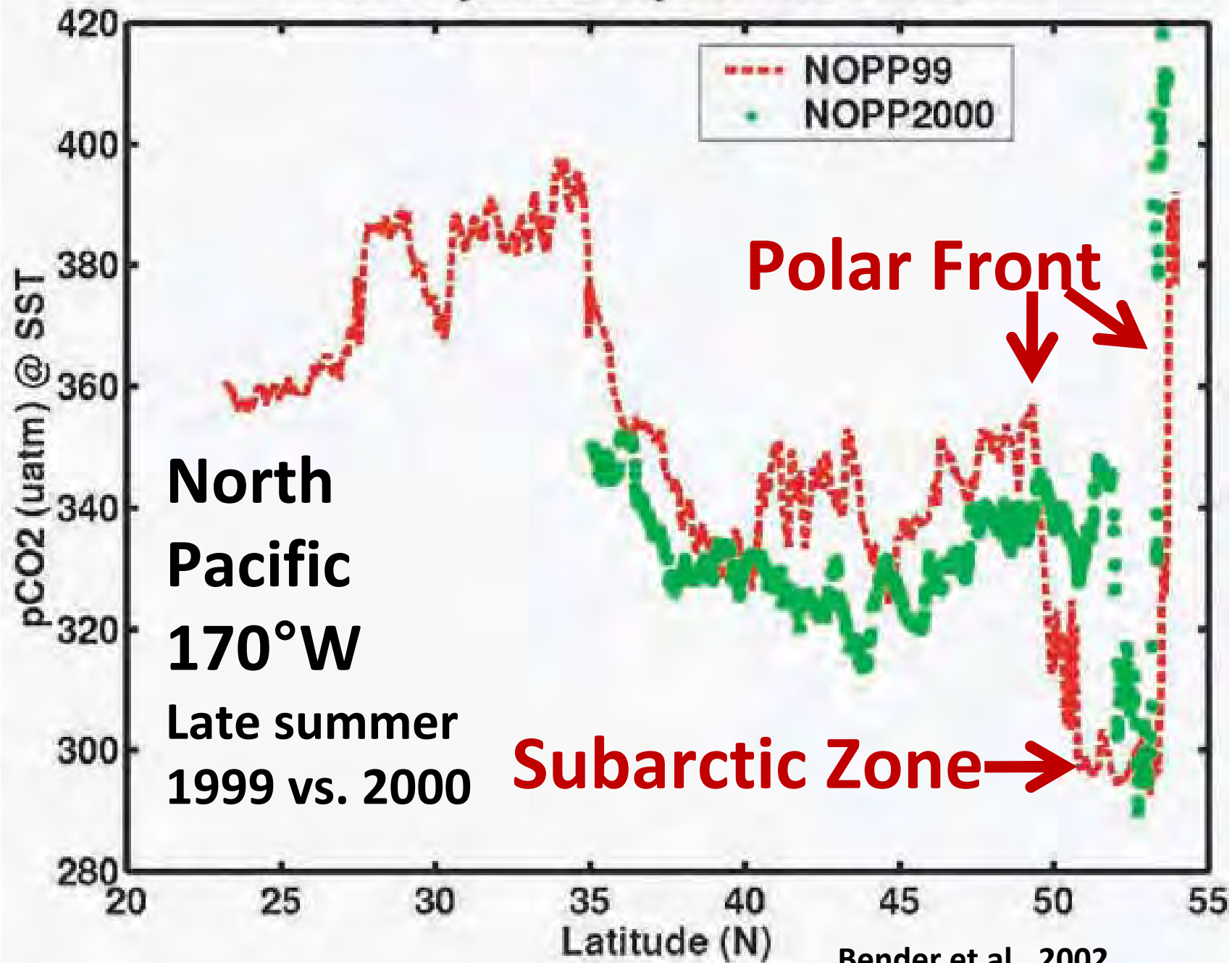


Takahashi et al., 2009

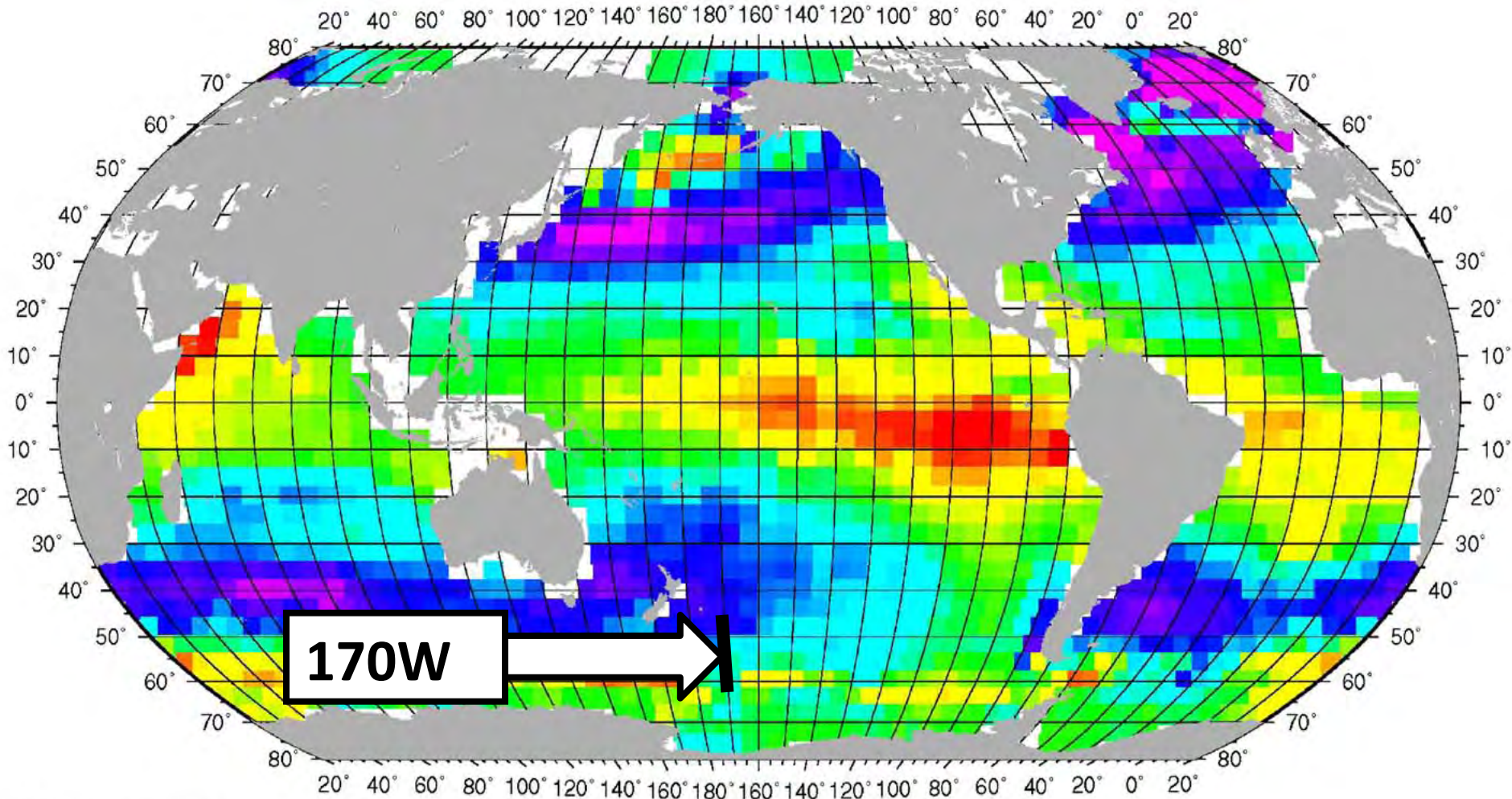
North Pacific Polar Front and Subarctic Zone (Belkin et al., 2002)



NOPP (N.Pacific) R.V. Ron Brown



Climatological mean annual sea-air CO₂ flux



170W



GMT 2008 Apr 1 13:42:53

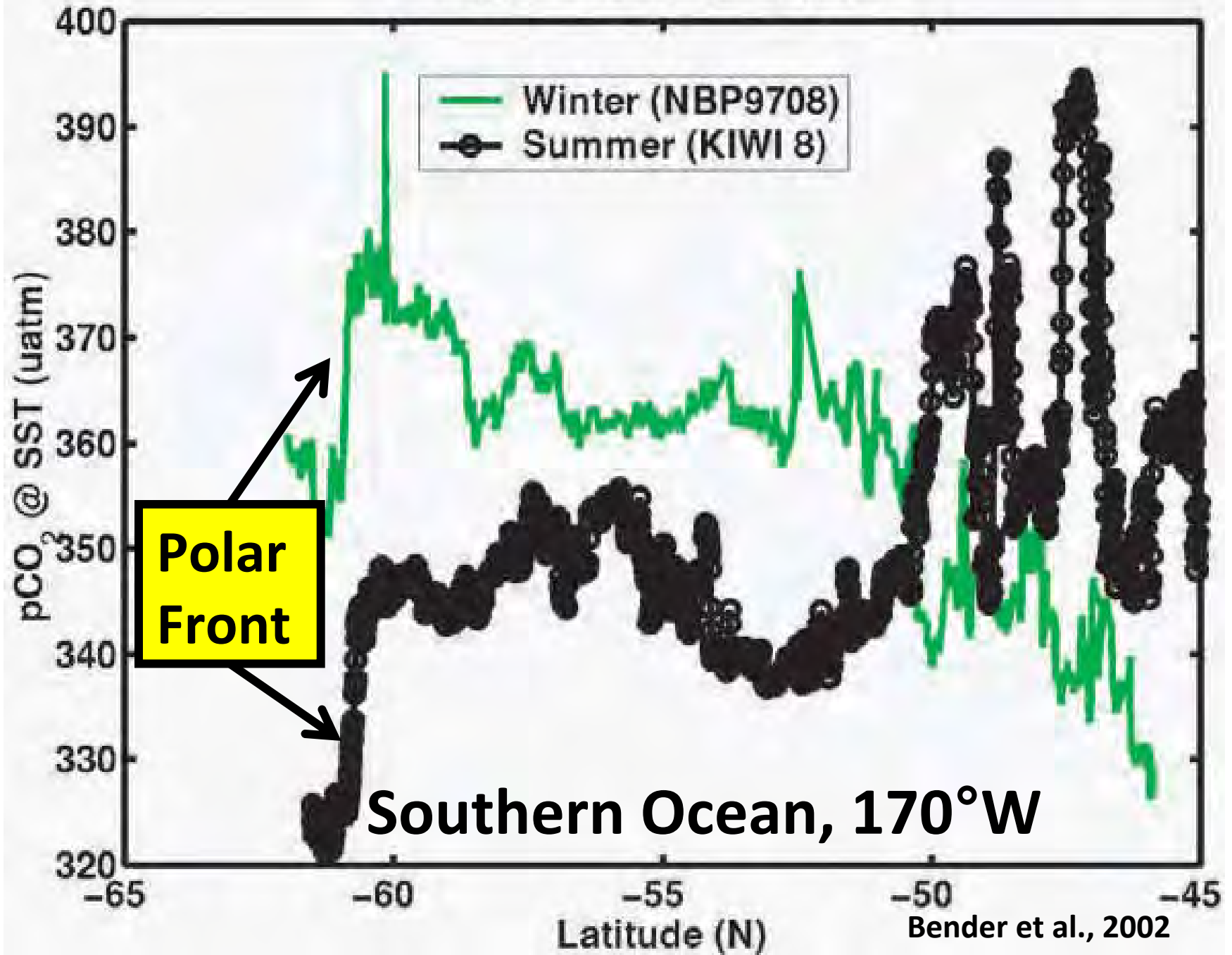


-108 -96 -84 -72 -60 -48 -36 -24 -12 0 12 24 36 48 60 72 84 96 108

Net Flux (grams C m⁻² year⁻¹)

Takahashi et al., 2009

Polar Front- S.Ocean



Polar Front

Southern Ocean, 170°W

In 1993-2008, Southern Ocean fronts at 0°E shifted south – except the Antarctic Polar Front (APF)! (Billany et al., 2010)

