Intraseasonal Wind Oscillations and their Influence on Northern California Current Coastal Ecosystems

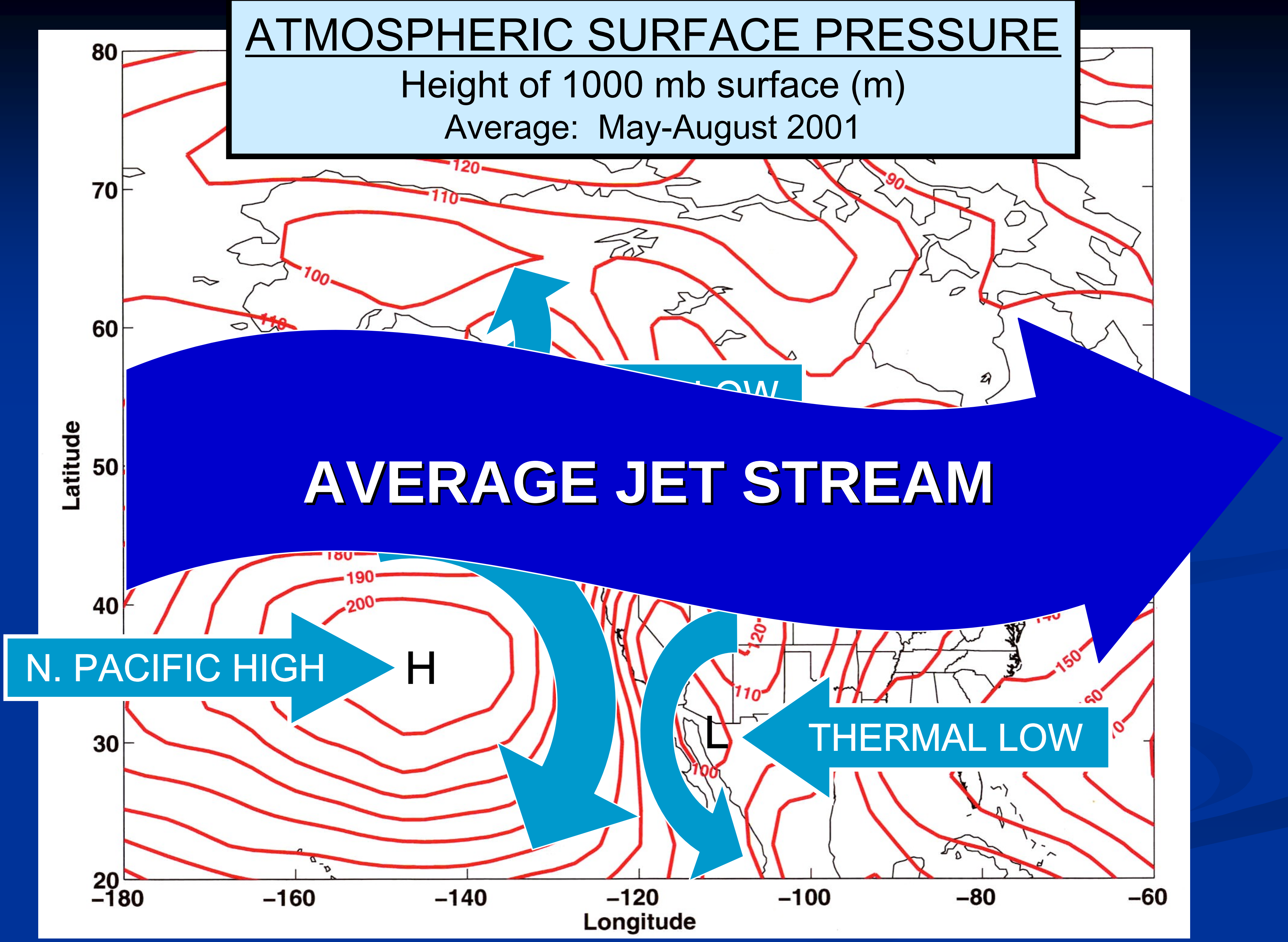
John (Jack) Barth[1] and John Bane[2]

with contributions from:

Physics: Anthony Kirincich[1], Margaret McManus[3] , Steve Pierce[1], Libe Washburn[4]
Chlorophyll/Nutrients: Francis Chan[1], Karina Nielsen[5], Ricardo Letelier[1]
Barnacles/Mussels: Jane Lubchenco[1], Bruce Menge[1]
Zooplankton: Bill Peterson[1,6]
Ecosystem Modeling: Yvette Spitz[1]

[1]Oregon State University
[2]University of North Carolina
[3]University of Hawaii/University of California Santa Cruz
[4]University of California Santa Barbara
[5]Sonoma State University
[6]NOAA Fisheries

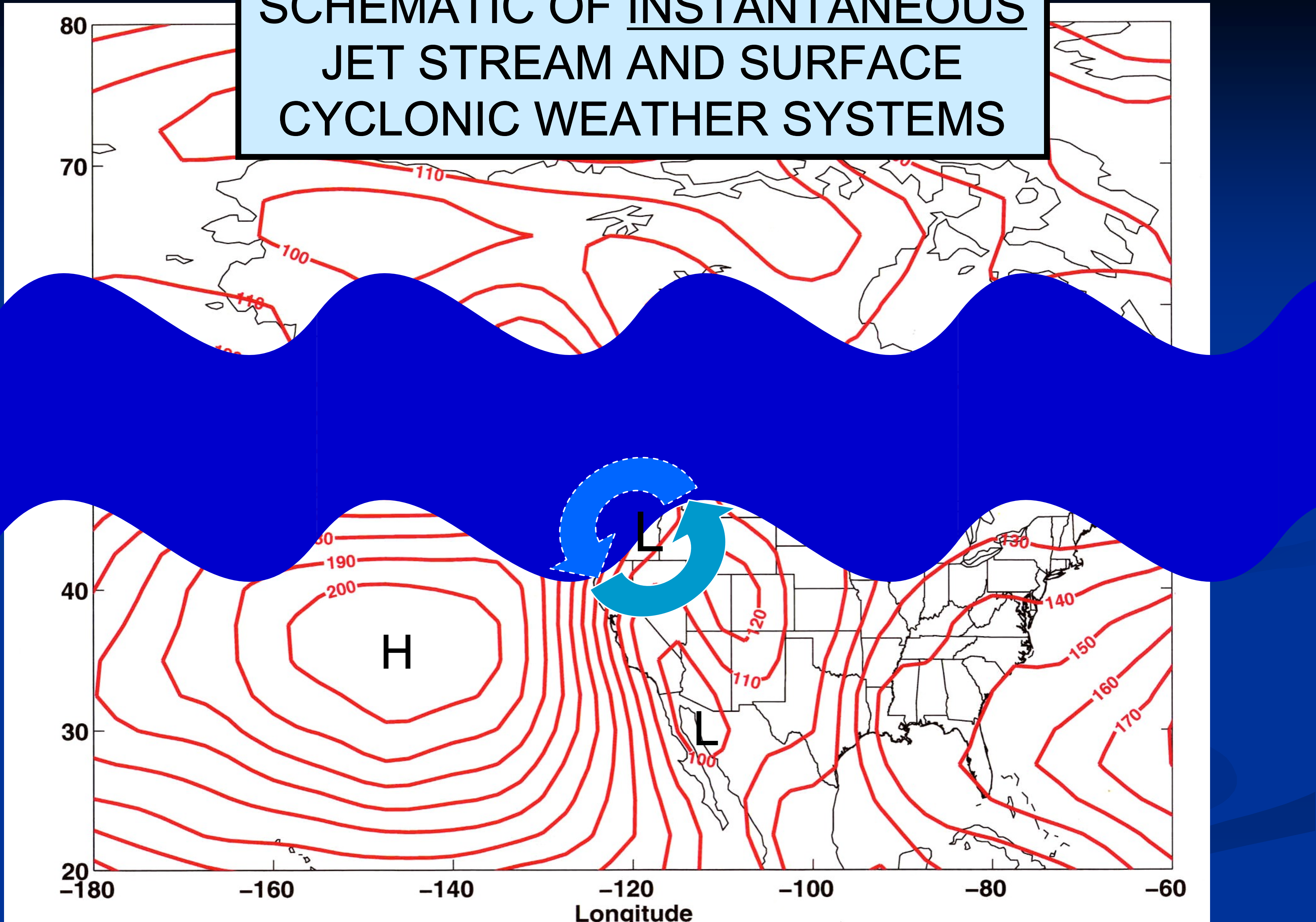
PISCO



ATMOSPHERIC SURFACE PRESSURE
Height of 1000 mb surface (m)
Average: May-August 2001
AVERAGE JET STREAM
N. PACIFIC HIGH
H
THERMAL LOW
L
Latitude
Longitude
80
70
60
50
40
30
20
−180
−160
−140
−120
−100
−80
−60
120
110
100
90
190
200
150

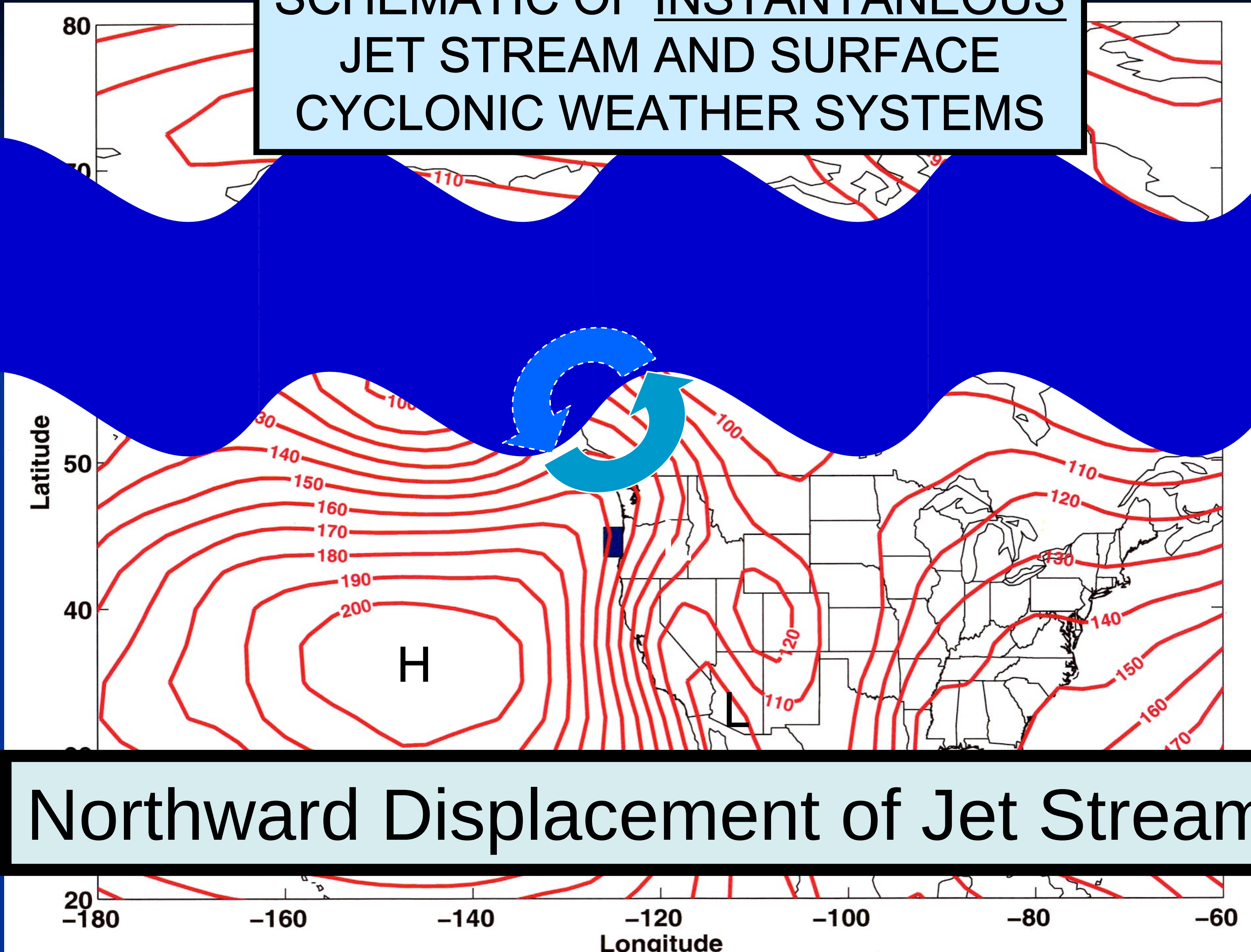
Bane (UNC)

SCHEMATIC OF INSTANTANEOUS JET STREAM AND SURFACE CYCLONIC WEATHER SYSTEMS



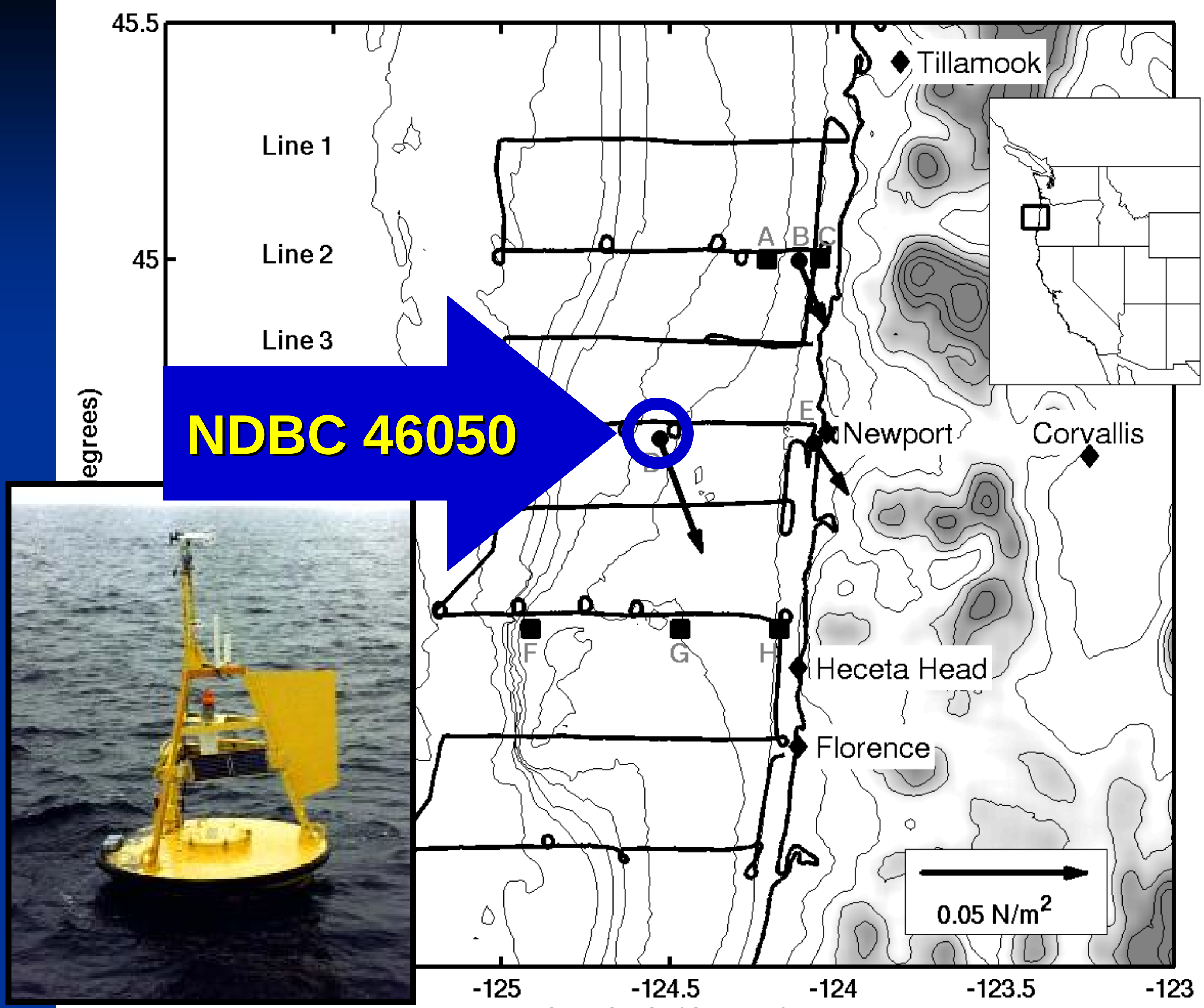
Bane (UNC)

SCHEMATIC OF INSTANTANEOUS JET STREAM AND SURFACE CYCLONIC WEATHER SYSTEMS



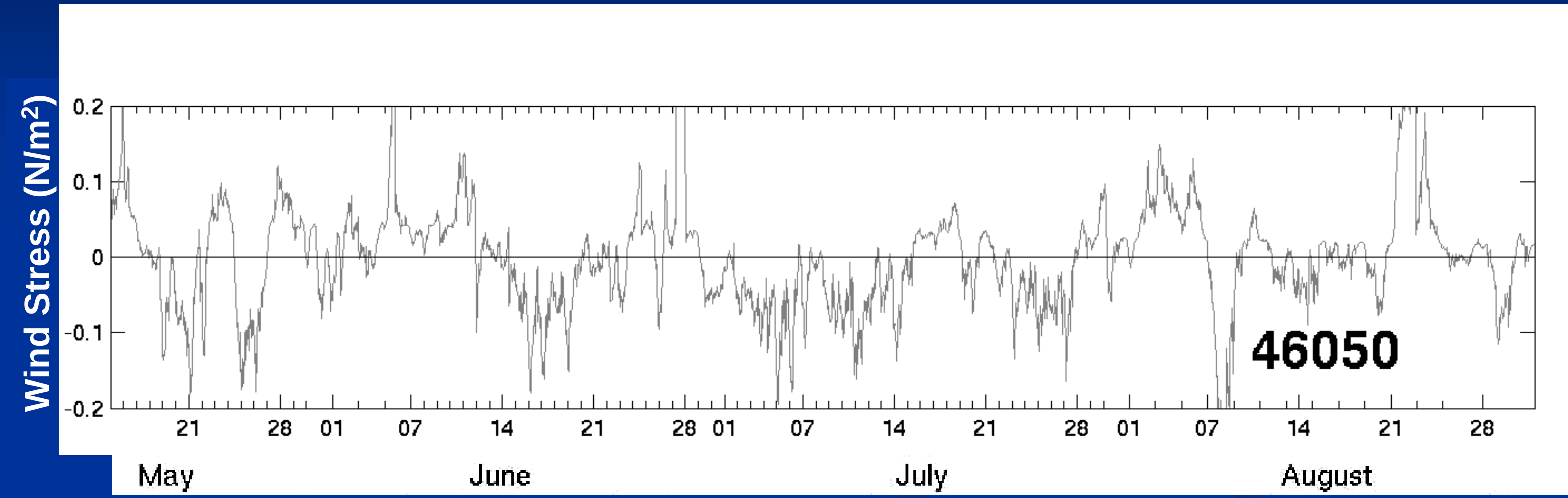
Northward Displacement of Jet Stream

Bane (UNC)



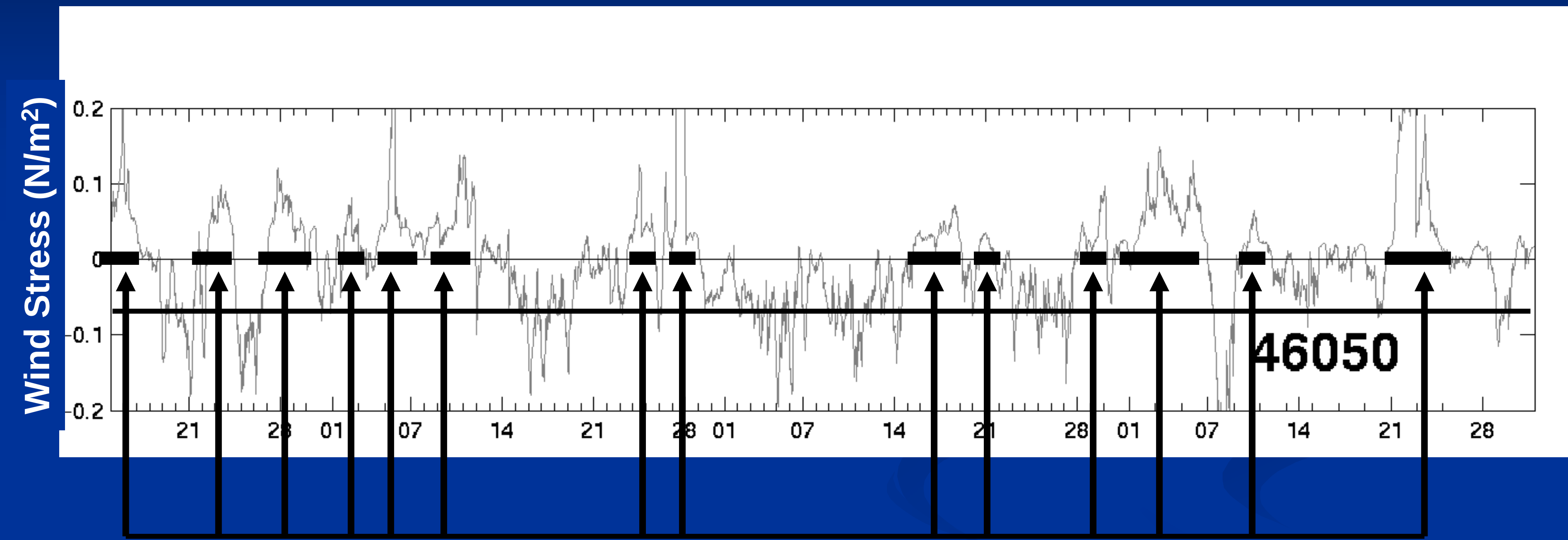
NDBC 46050
45.5
45
Line 1
Line 2
Line 3
A
B
C
E
Tillamook
Newport
Corvallis
F
G
H
Heceta Head
Florence
0.05 N/m²
-125
-124.5
-124
-123.5
-123
Longitude (degrees)

NORTHWARD WIND STRESS



Bane et al. (2005)

NORTHWARD WIND STRESS



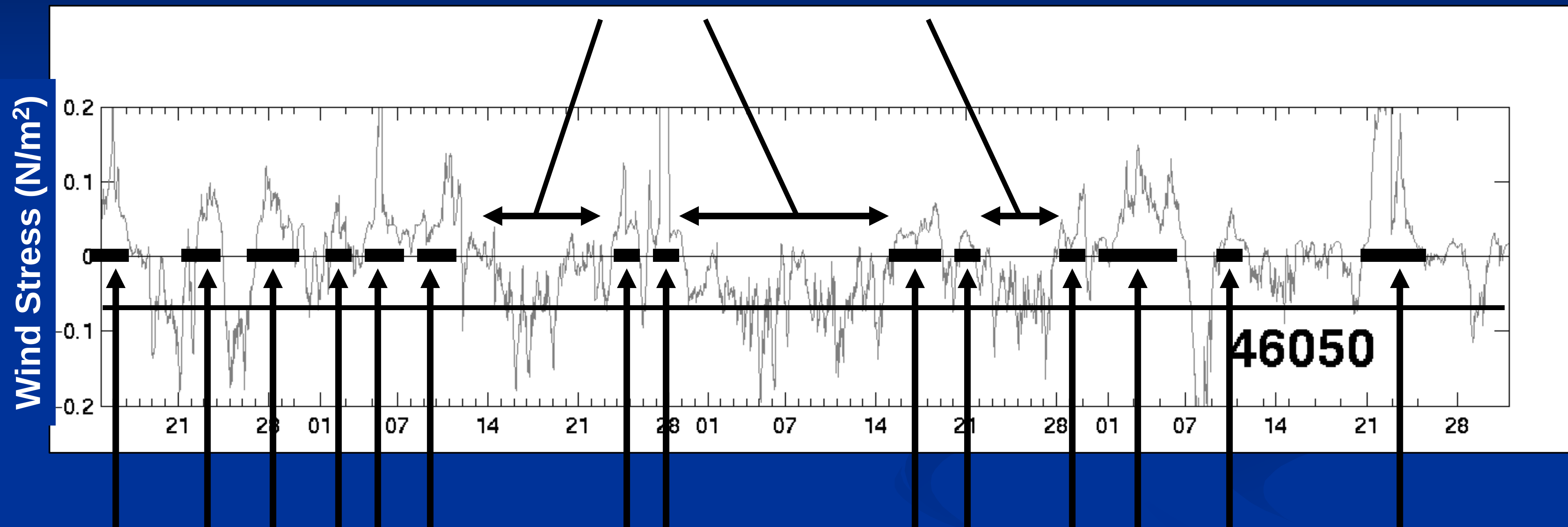
Passing Extratropical Cyclones

3- to 7-day periods of Northward Winds

Bane et al. (2005)

NORTHWARD WIND STRESS

Longer Periods of Persistent Southward Winds

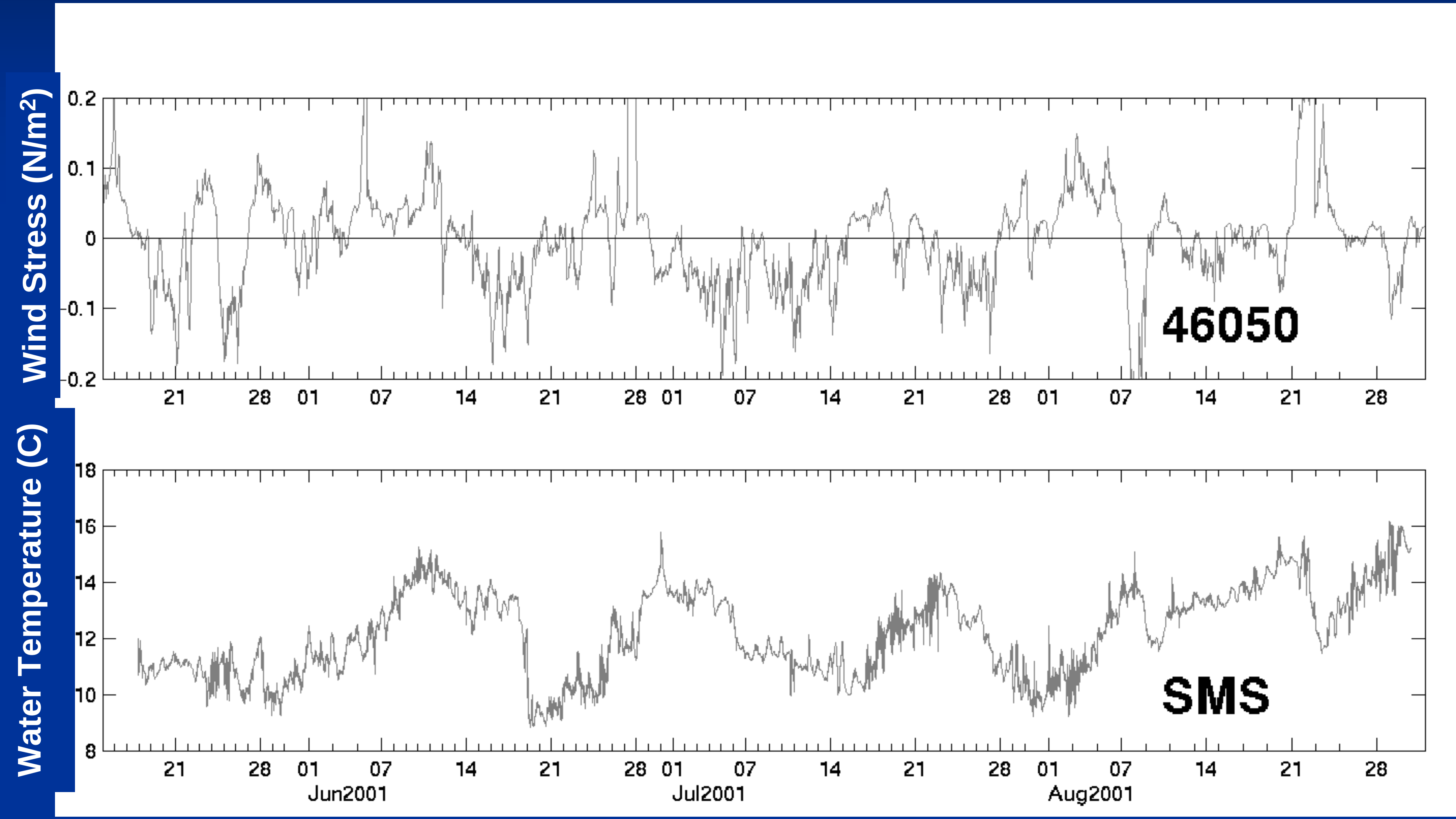


Passing Extratropical Cyclones

3- to 7-day periods of Northward Winds

Bane et al. (2005)

NORTHWARD WIND STRESS
NEAR-SURFACE WATER TEMP

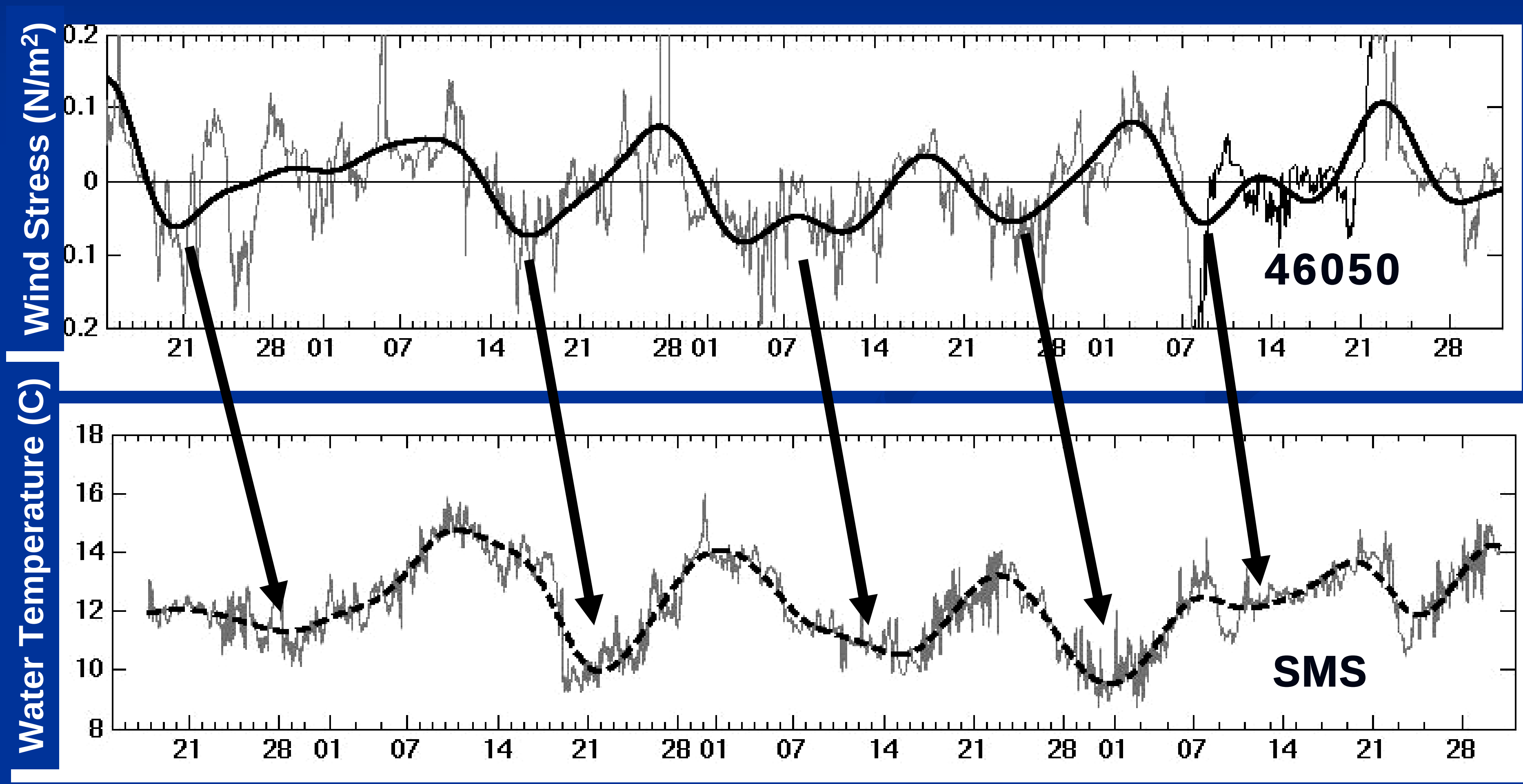


Bane et al. (2005)

NORTHWARD WIND STRESS

NEAR-SURFACE WATER TEMP

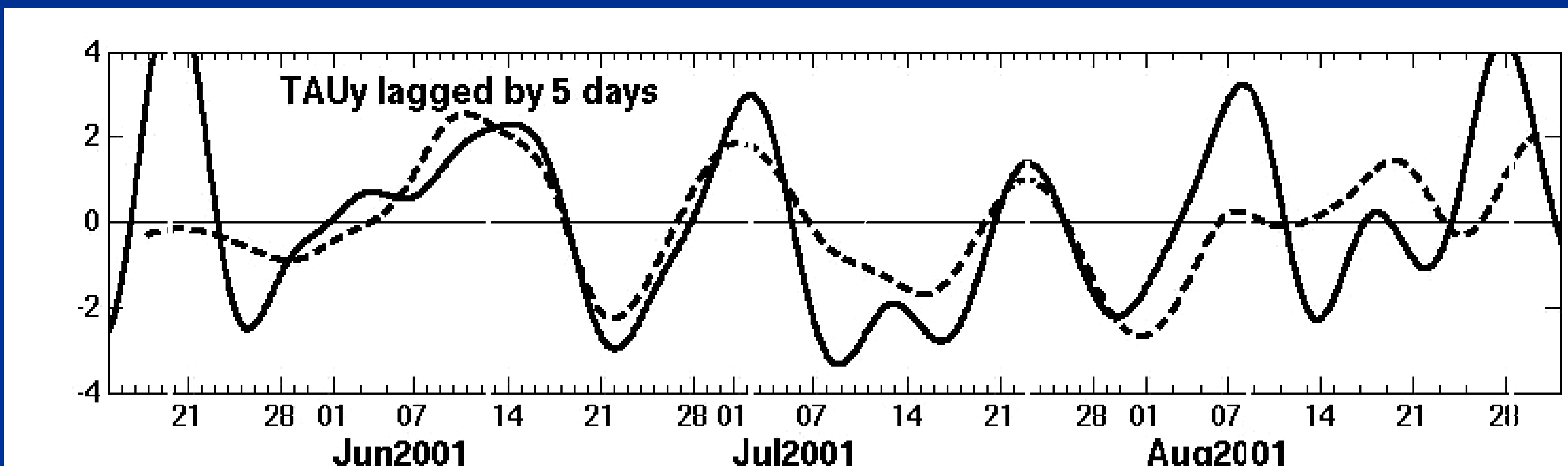
8-DAY LOW-PASS FILTERED



Bane et al. (2005)

NORTHWARD WIND STRESS
NEAR-SURFACE WATER TEMP

8-DAY LOW-PASS FILTERED



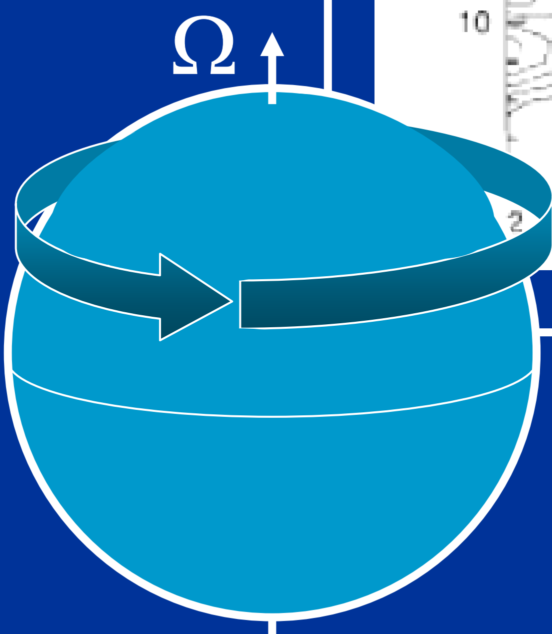
23 days **19 days** **21 days** **17 days** **19 days**

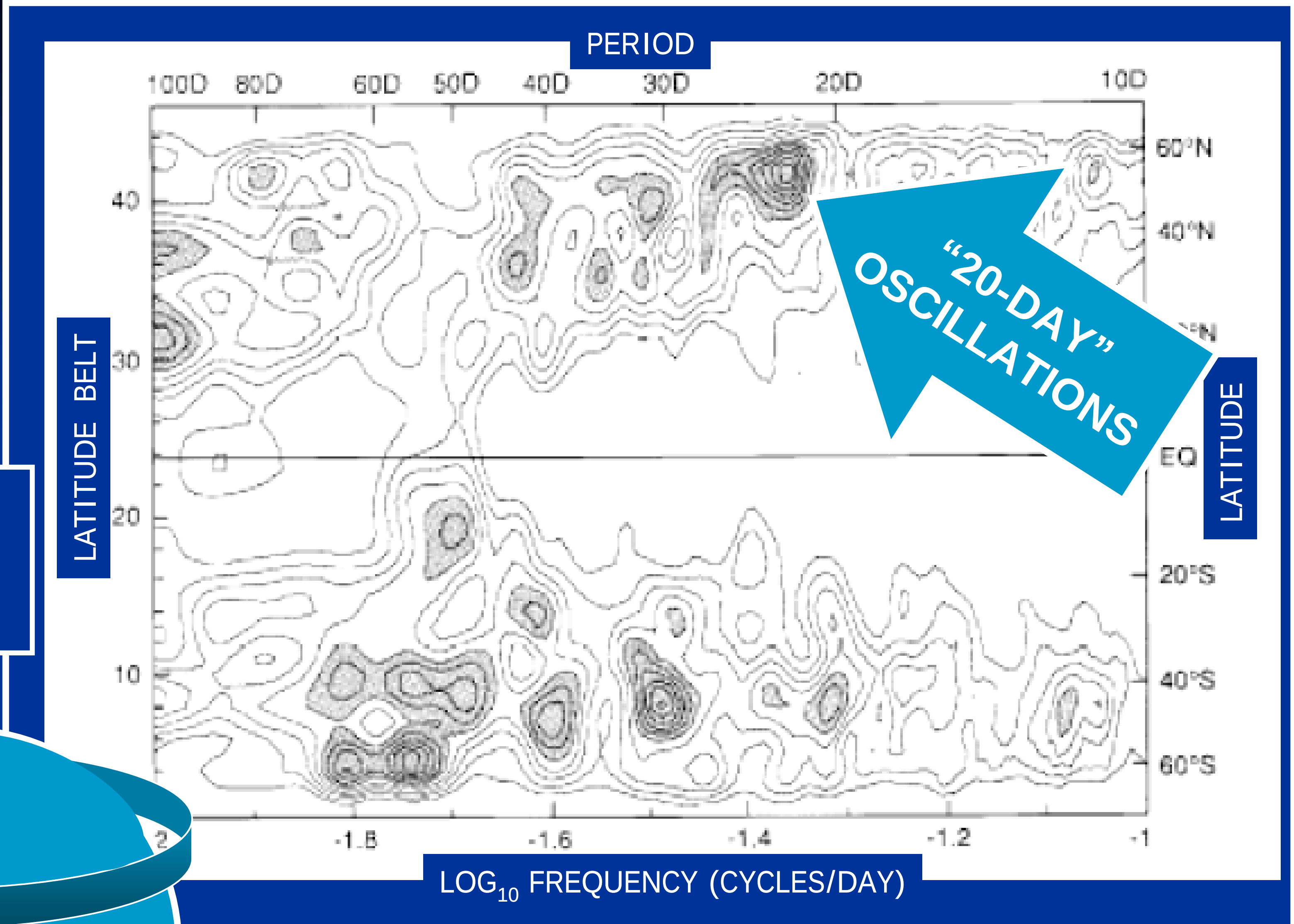
R = 0.54, Significant at 95%

SERIES OF "20-DAY" OSCILLATIONS

Bane et al. (2005)

Atmospheric Angular Momentum

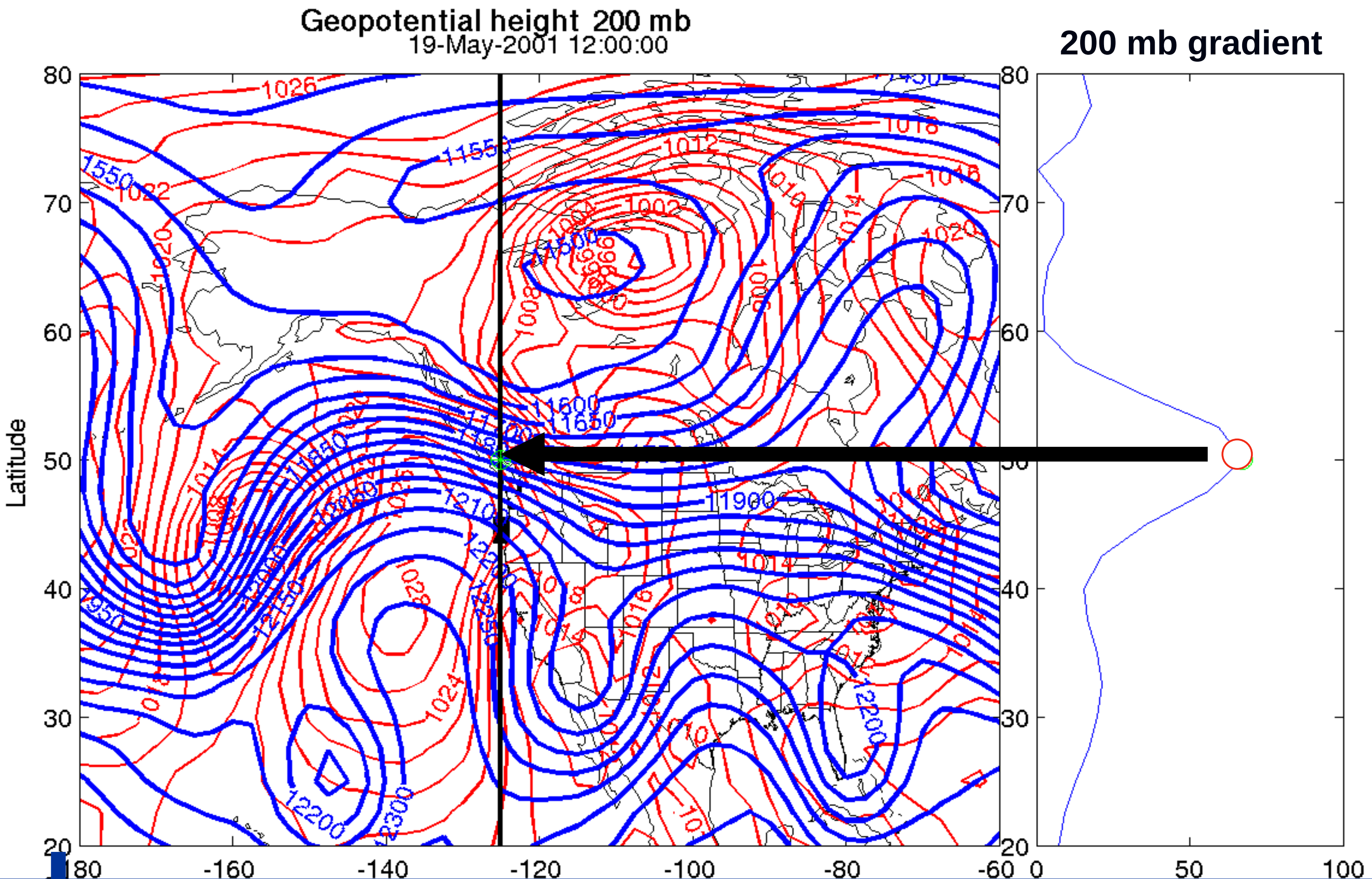


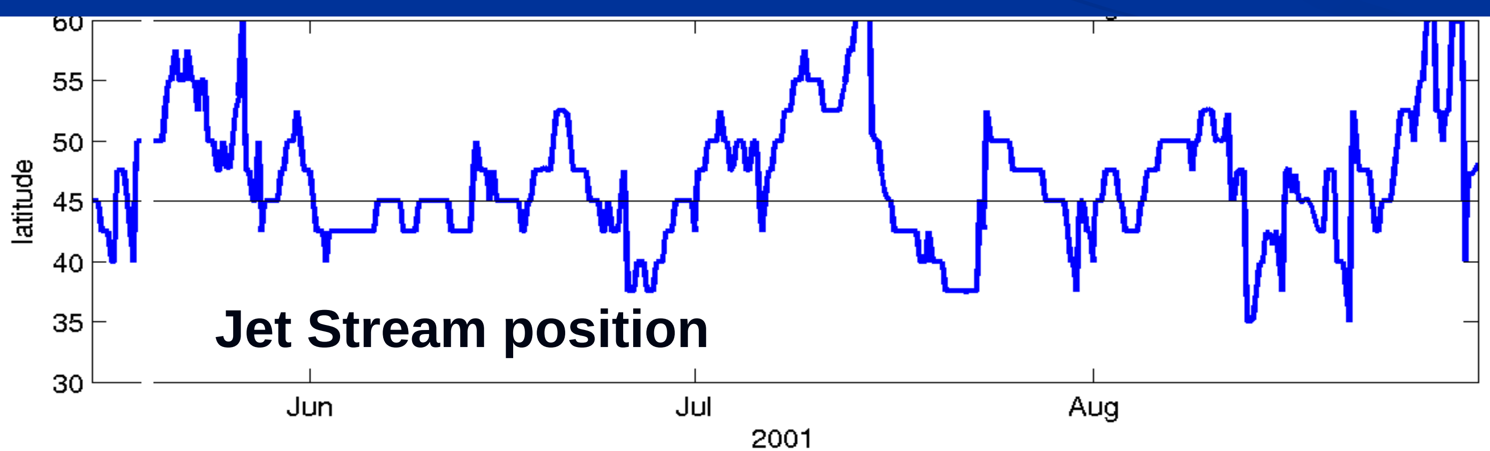


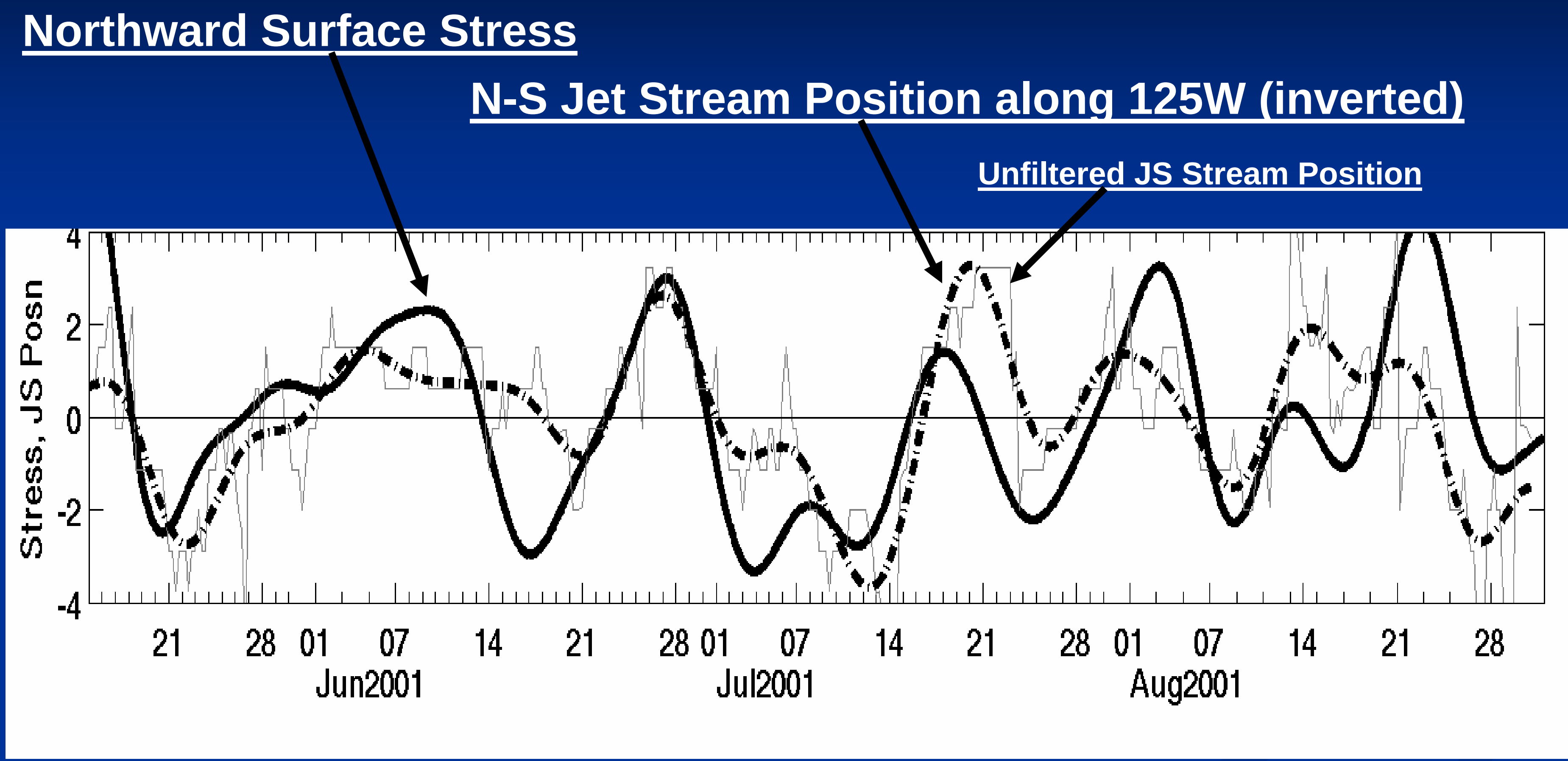
Observed AAM Spectrum

Variance has been computed in each of 46 equal-area belts
[From *Dickey et al.*, 1991]

Bane (UNC)


Geopotential height 200 mb
19-May-2001 12:00:00
200 mb gradient
Latitude


Jet Stream position
latitude
Jun
Jul
Aug
2001



R = 0.61, Significant at 95%

Bane et al. (2005)

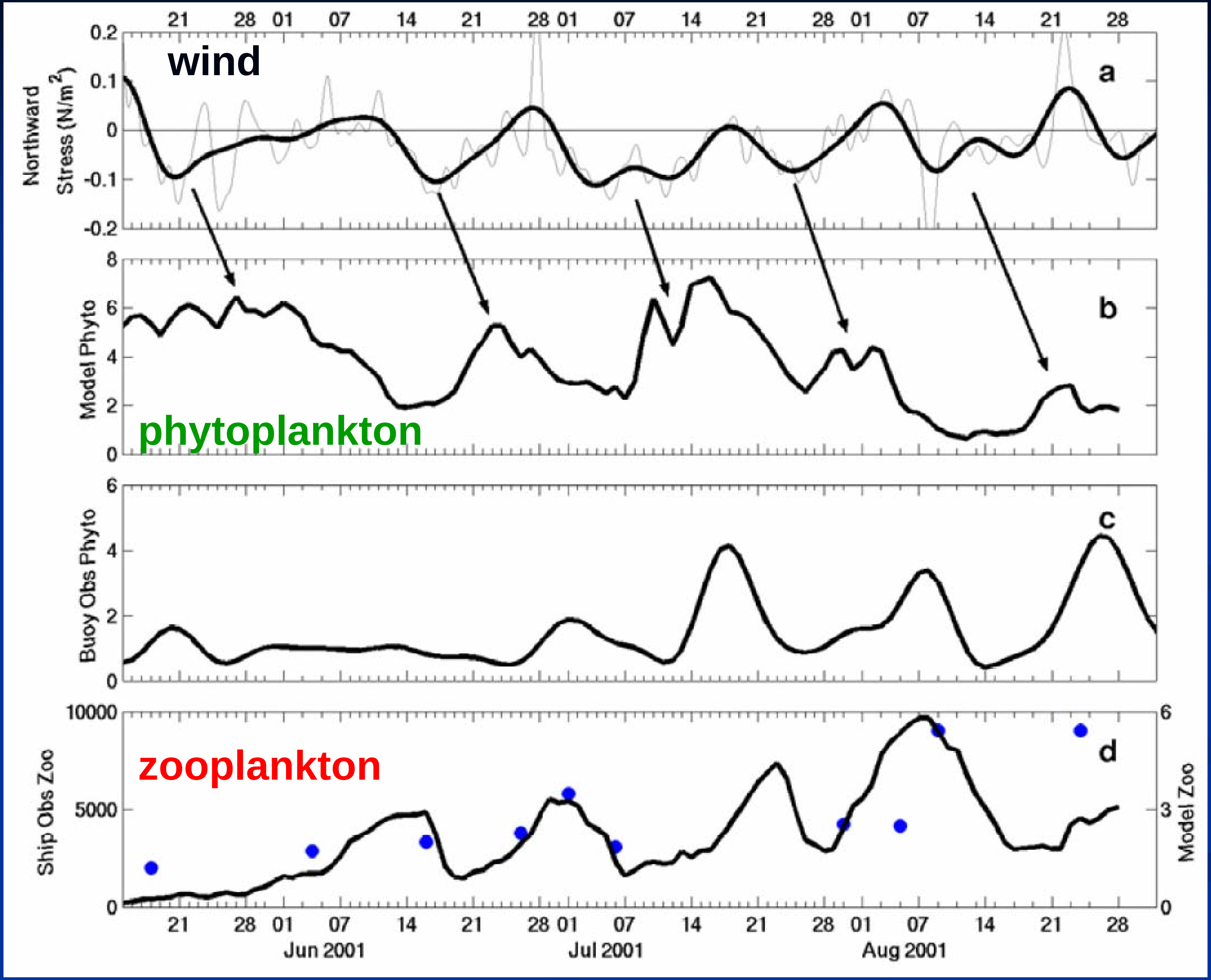
Now what about the biology?

Wind Stress

Model Phytoplankton

Observed Phyto

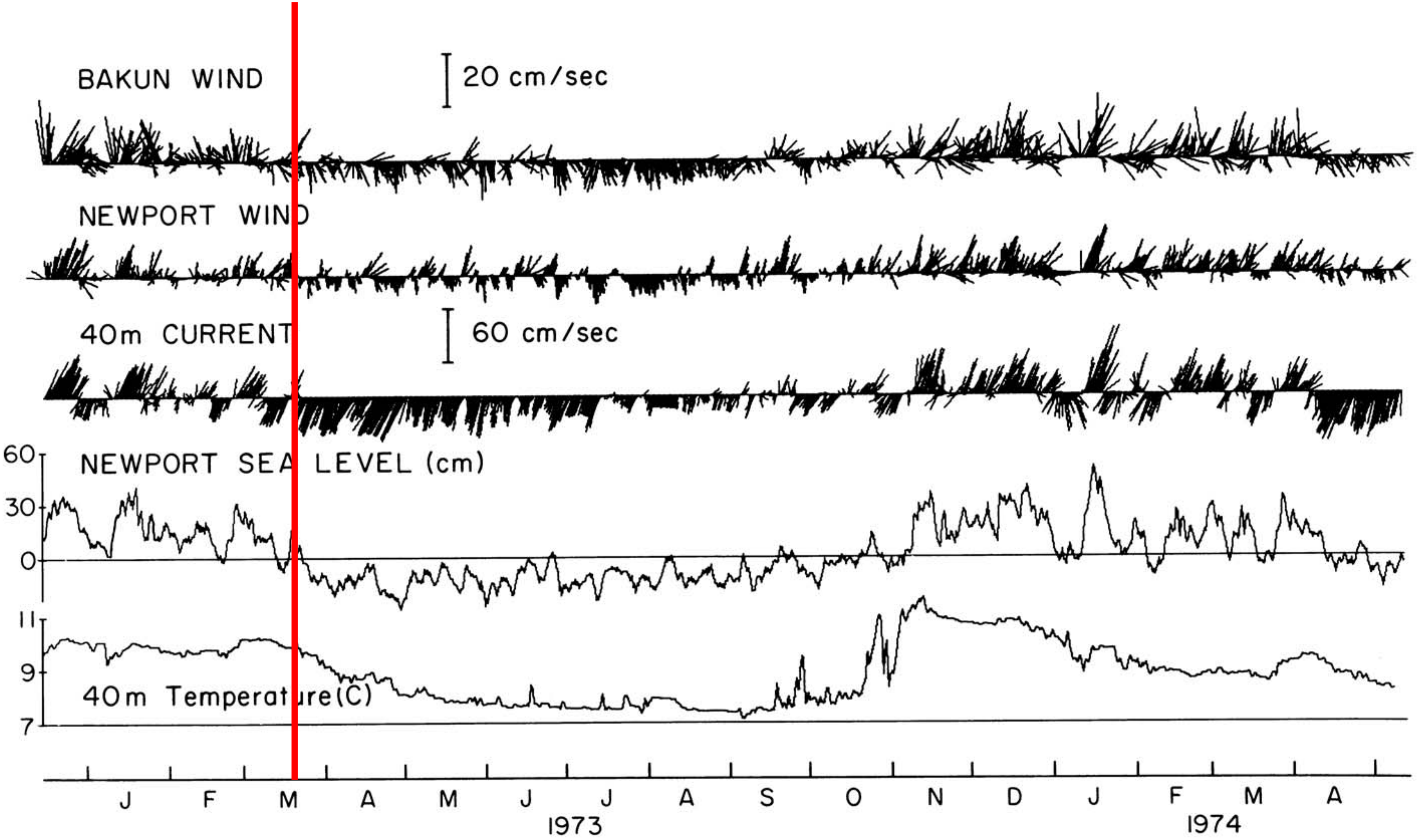
Observed Zooplankton



Model Zooplankton

Bane et al. (2006)

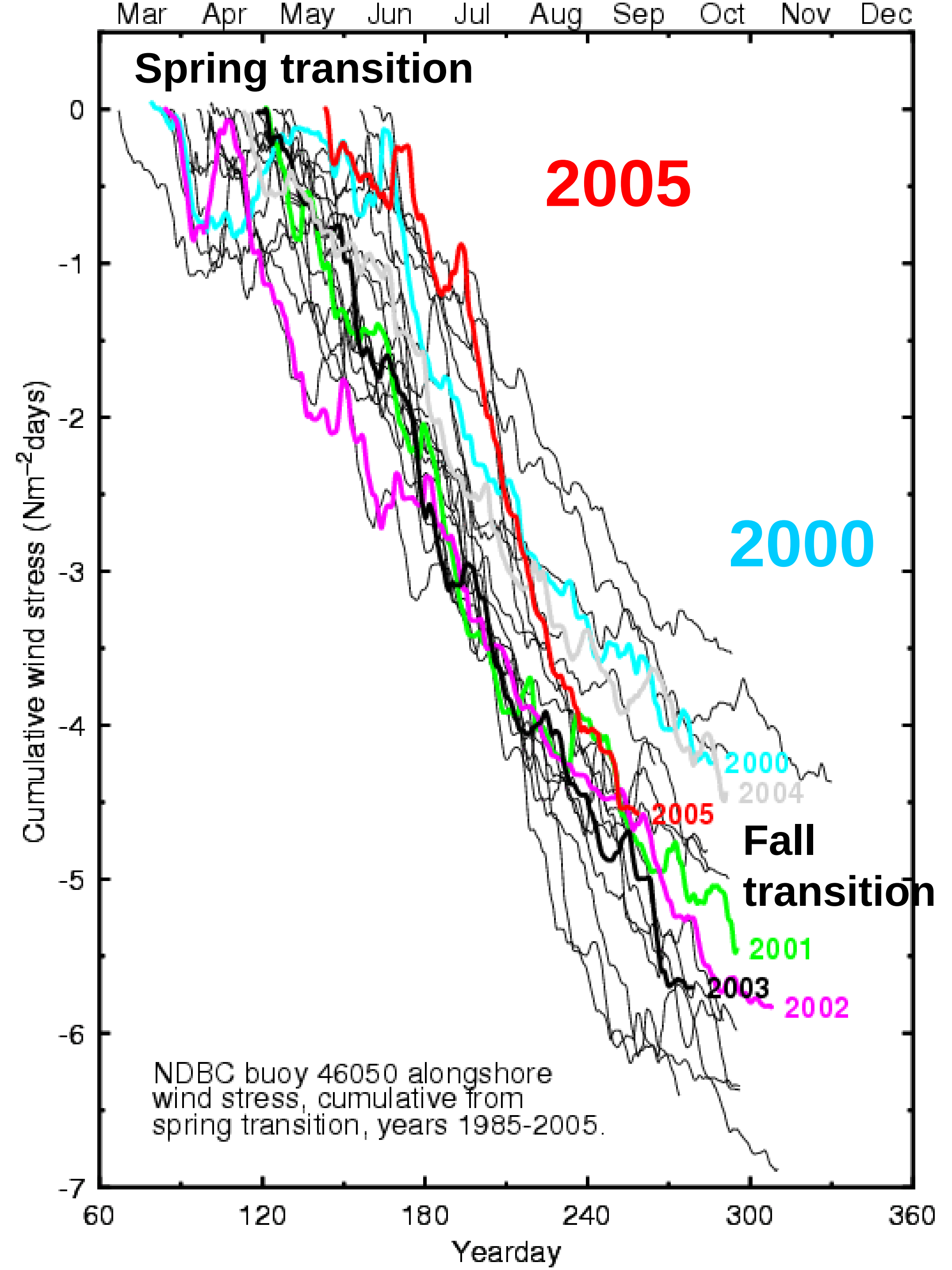
Spring Transition



Huyer and Smith (1978)

Interannual variability in wind stress

Cumulative wind stress since Spring Transition

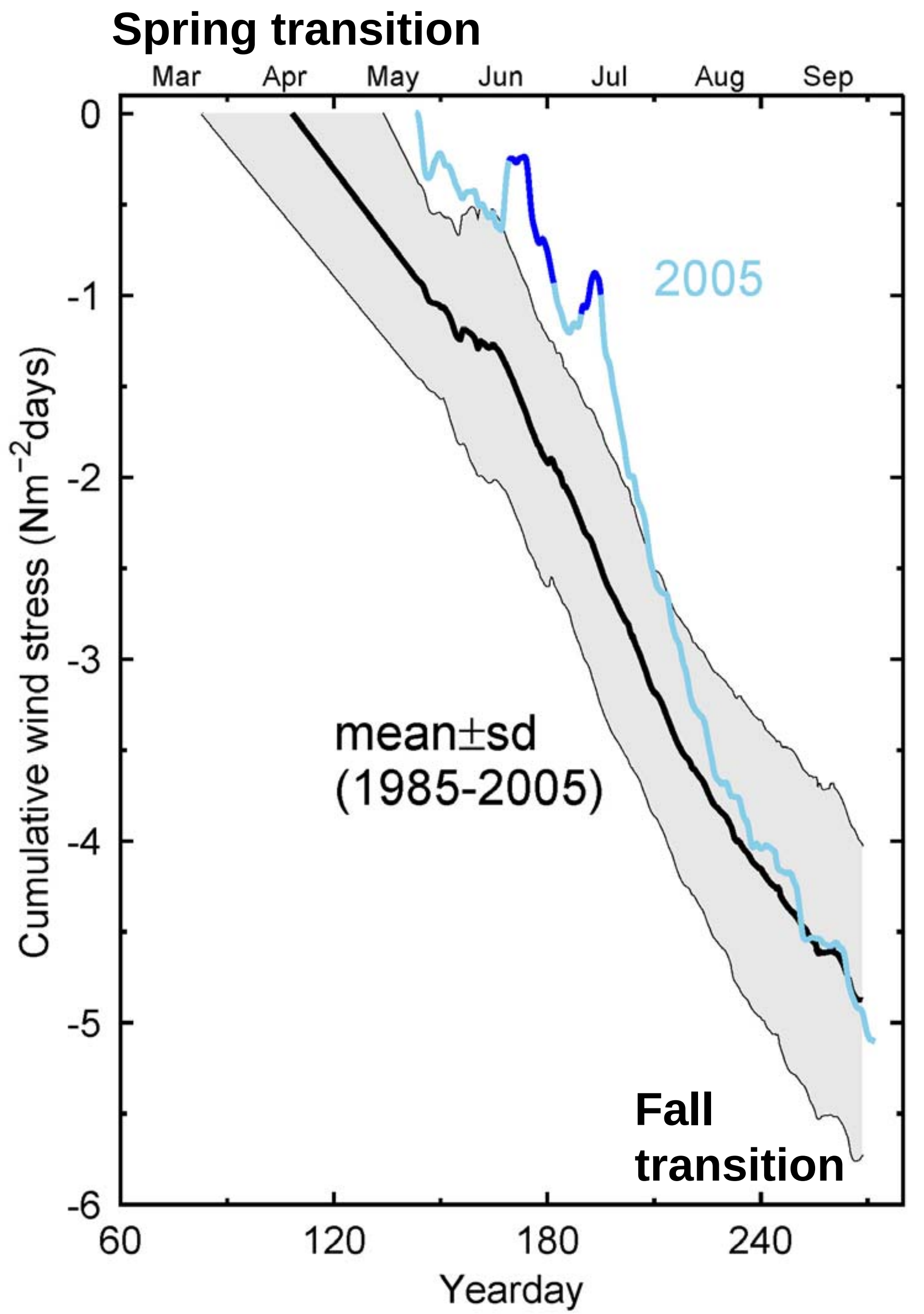


Equatorward, Upwelling favorable

Barth/Pierce (OSU)

Interannual variability in wind stress

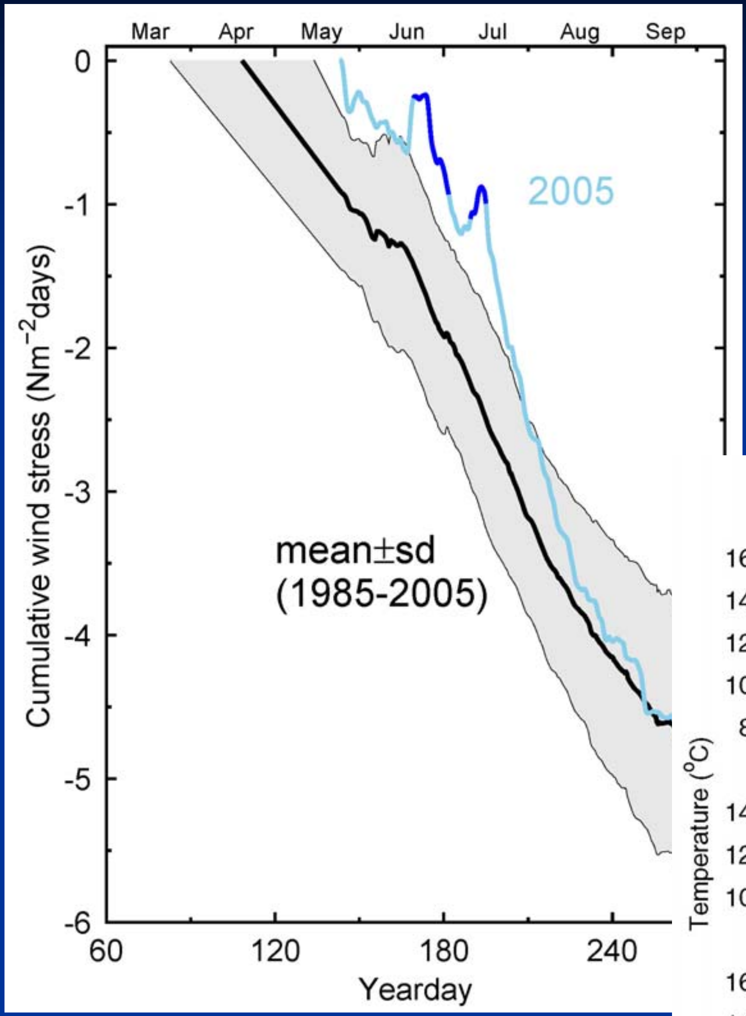
Cumulative wind stress since Spring Transition



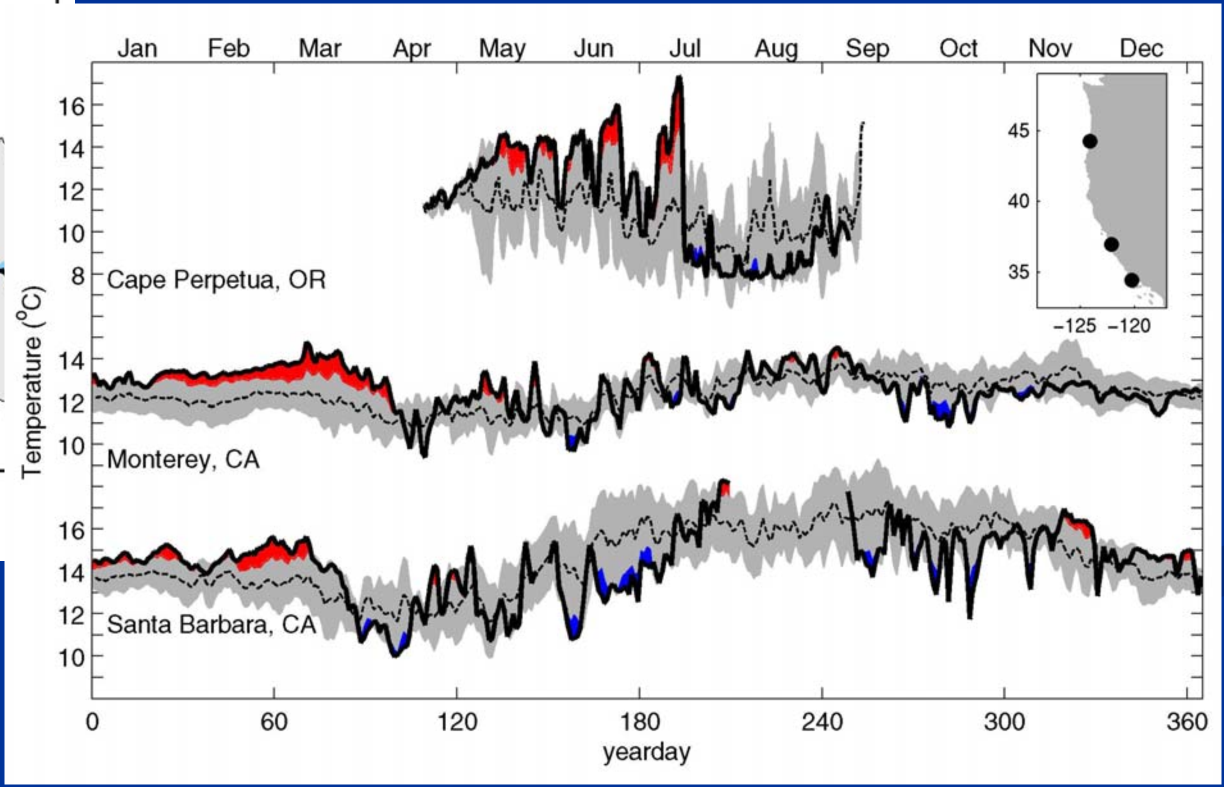
Equatorward, Upwelling favorable

Barth et al. (2006)

late, weak upwelling in 2005



led to warm ocean temperatures



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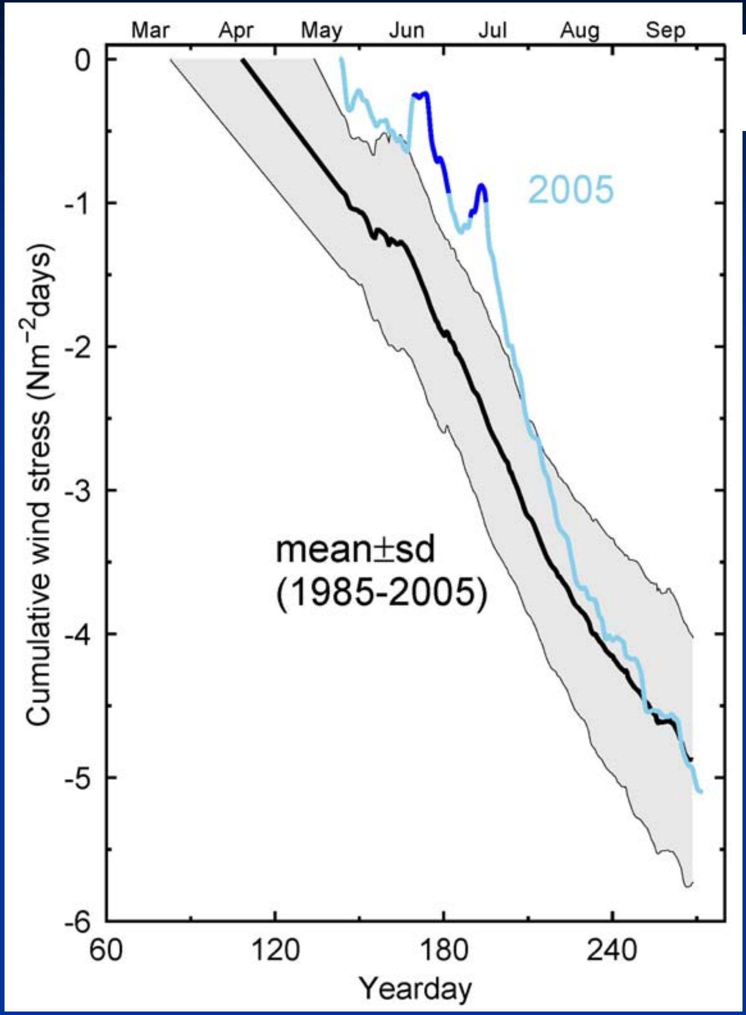
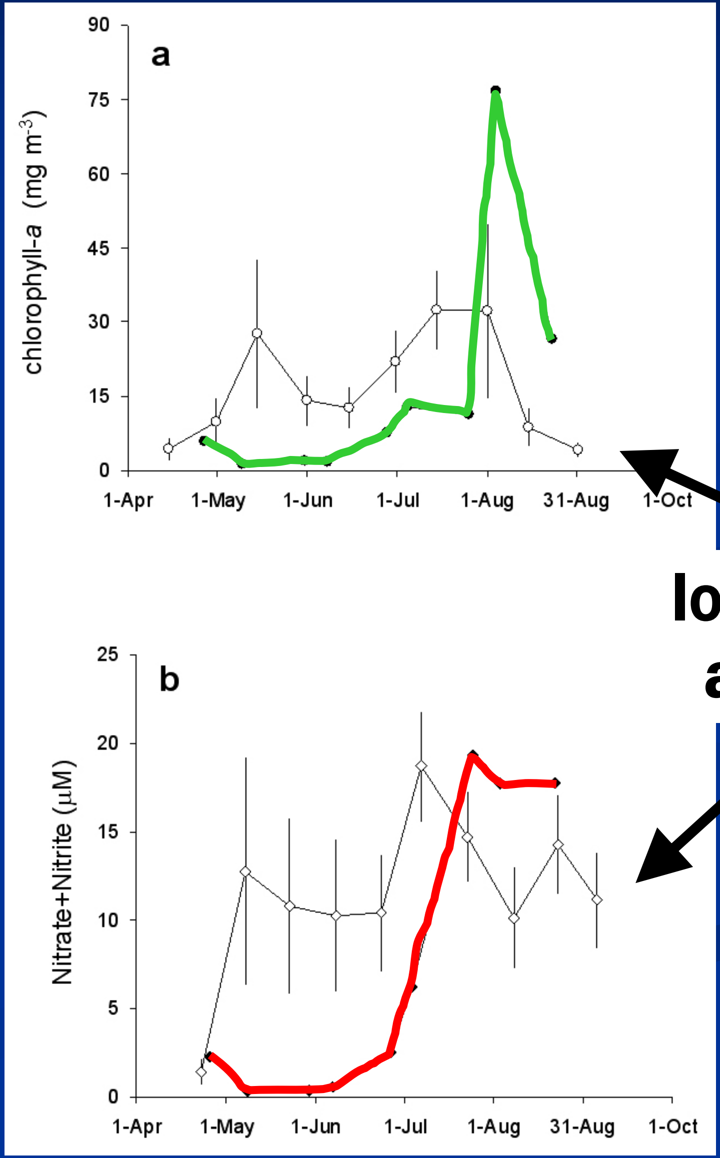
Barth et al. (2006)

late, weak upwelling in 2005



led to low nutrients and chlorophyll



long-term average

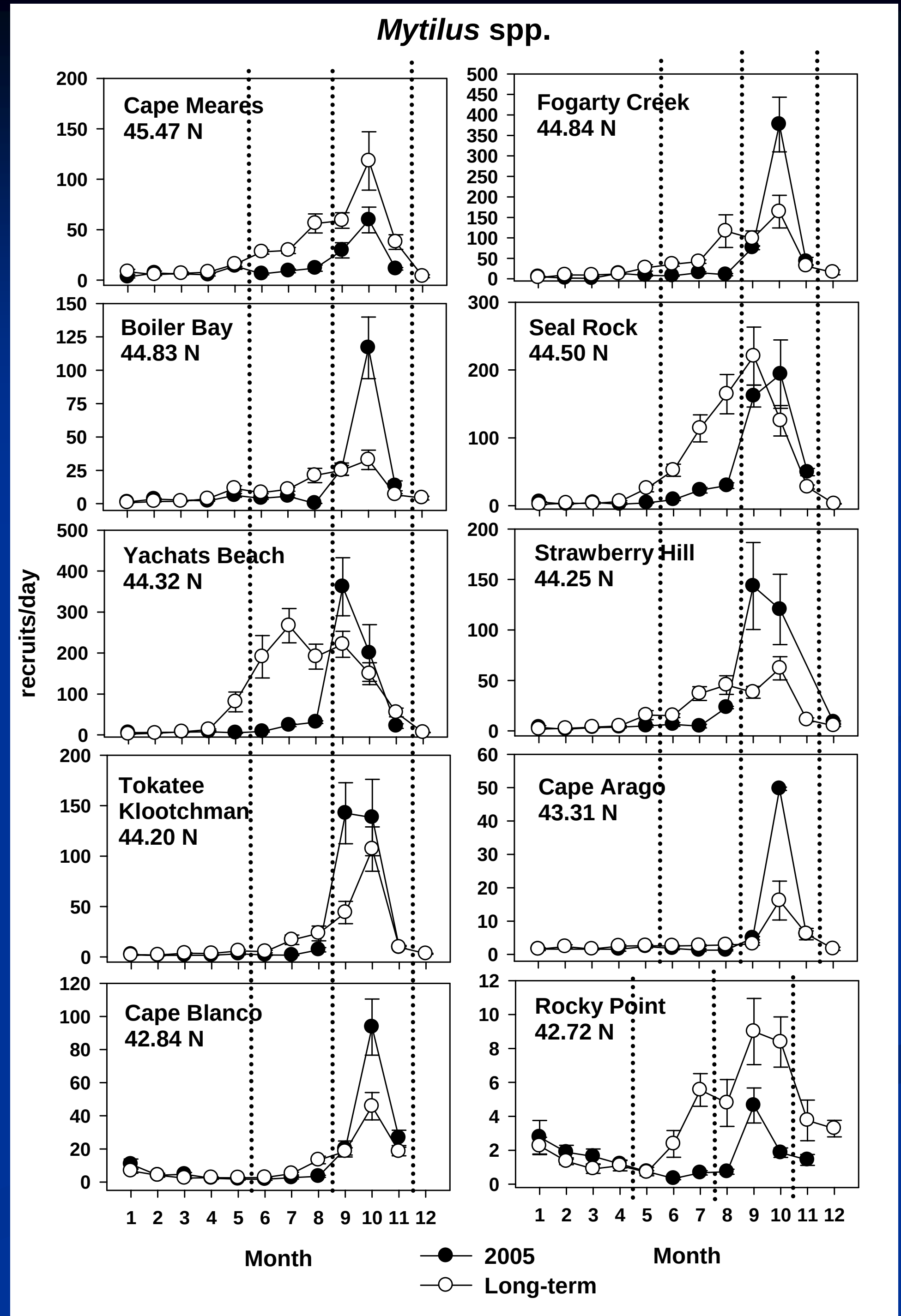
PISCO

Barth et al. (2006)

and unprecedented low recruitment !

mussels (*Mytilus* spp.)

2005
Long-term



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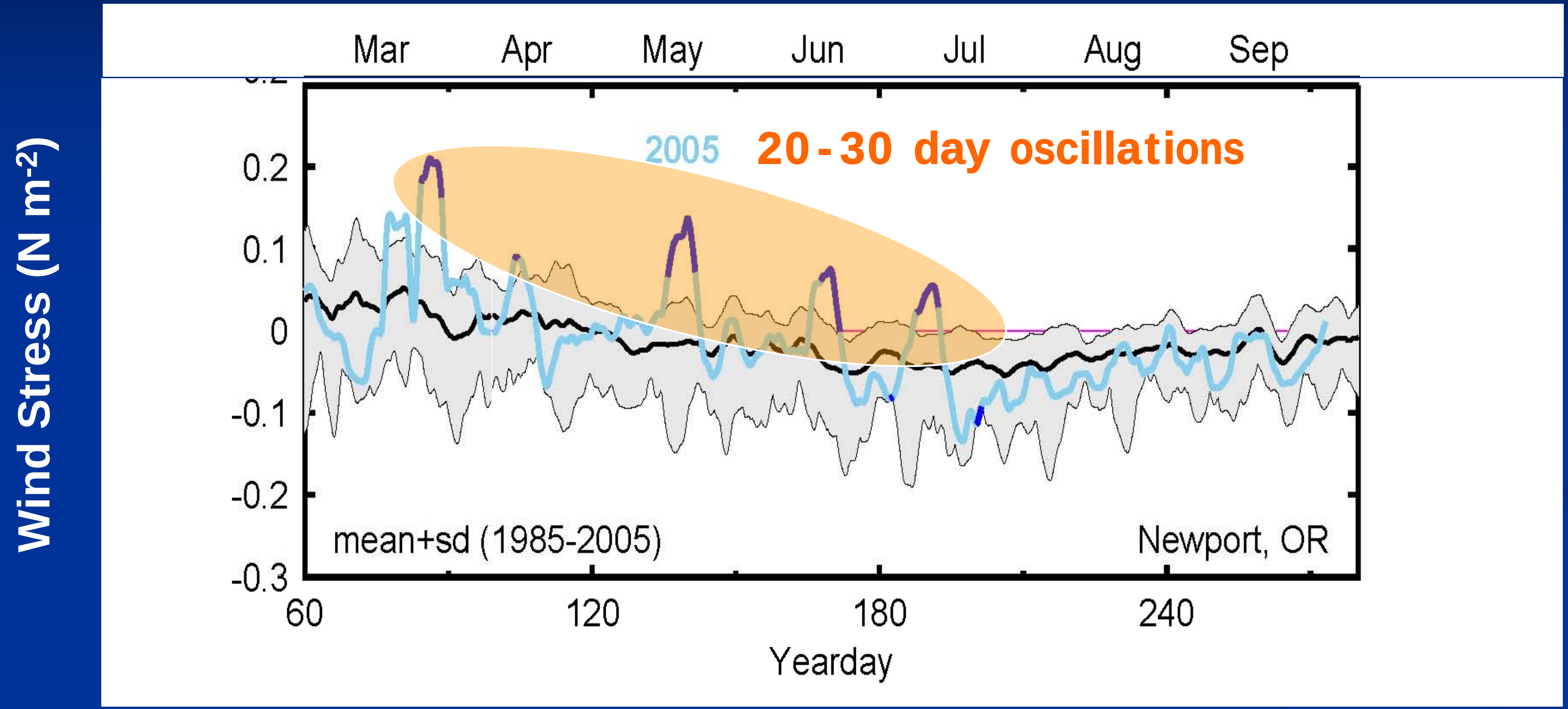
Barth et al. (2006)

The culprit? Strong intraseasonal wind oscillations and an anomalously southern Jet Stream location



44.6N = Oregon

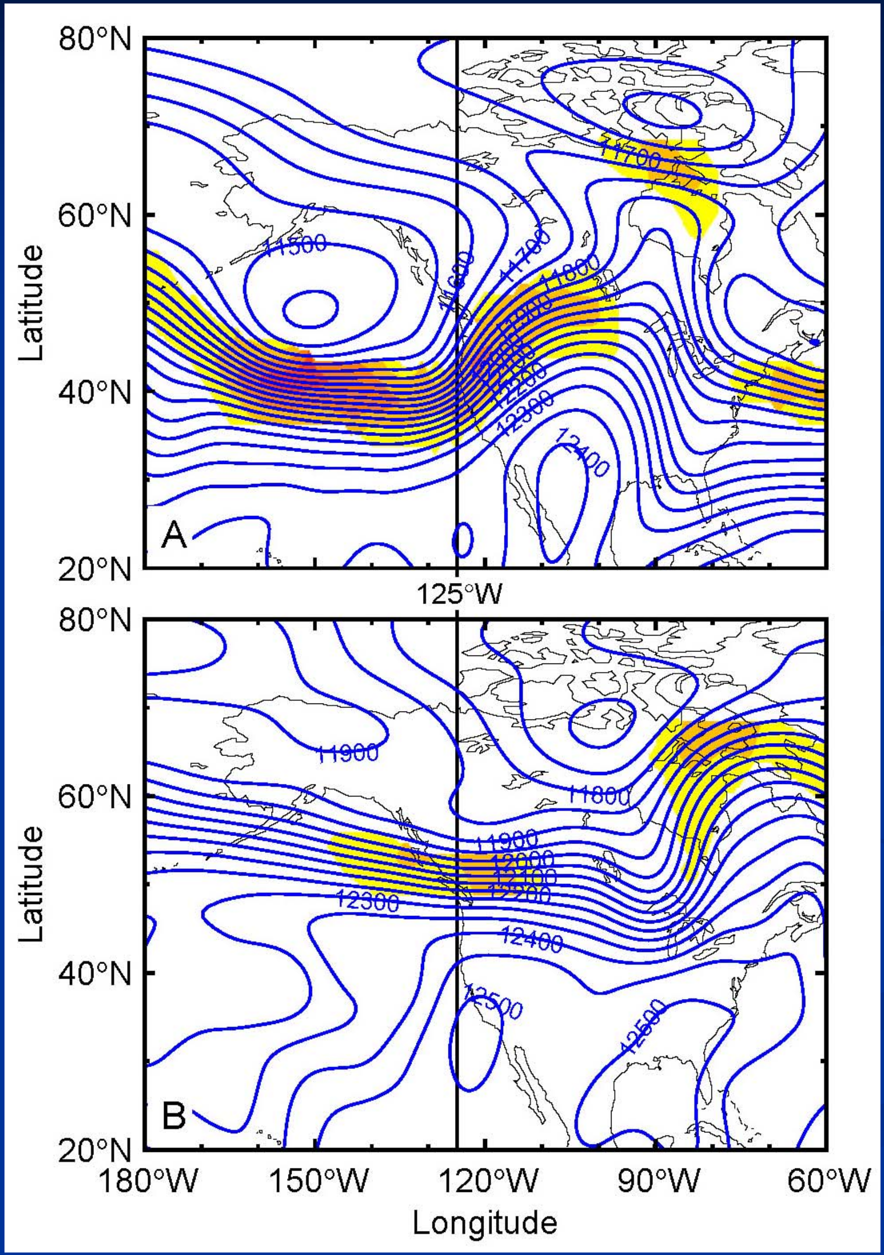
Barth et al. (2006)

The culprit? Strong intraseasonal wind oscillations and an anomalously southern Jet Stream location

Jet Stream Position

May 2005

July 2005



Barth et al. (2006)

Summary

- 20-day intraseasonal oscillations in wind stress of central Oregon correlate with 20-day Jet Stream (JS) position fluctuations
- Upper-ocean temperature, phytoplankton and zooplankton follow 20-day wind stress oscillations with a several-day lag
- Late spring transition in 2005: caused by southern Jet Stream position and intraseasonal oscillations
- Warm, nutrient-poor water nearshore during spring
- Depressed primary production & sessile invertebrates recruitment (reduced zooplankton, fish, seabirds too)
- How is this related to climate variability?
- Presence and importance of ISOs in the Northwest Pacific?