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

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with contributions from:

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ATMOSPHERIC SURFACE PRESSURE
Height of 1000 mb surface (m)
Average: May-August 2001
SCHEMATIC OF INSTANTANEOUS JET STREAM AND SURFACE CYCLONIC WEATHER SYSTEMS
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Northward Displacement of Jet Stream
NORTHWARD WIND STRESS

Wind Stress (N/m²)

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

SERIES OF “20-DAY” OSCILLATIONS

Bane et al. (2005)
"20-DAY" OSCILLATIONS

Observed AAM Spectrum

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

Bane (UNC)

Atmospheric Angular Momentum
Geopotential height 200 mb
19-May-2001 12:00:00

200 mb gradient

Jet Stream position

Jet Stream position

Jun  Jul  Aug 2001
Northward Surface Stress

N-S Jet Stream Position along 125W (inverted)

Unfiltered JS Stream Position

R = 0.61, Significant at 95%

Bane et al. (2005)
Now what about the biology?

**Wind**: Stress (N/m²)

- Observed
- Model

**Phytoplankton**: Observed

**Zooplankton**: Model

Bane et al. (2006)
Spring Transition

Huyer and Smith (1978)
Interannual variability in wind stress

Cumulative wind stress since Spring Transition

Spring transition

Fall transition

Equatorward, Upwelling favorable

Barth/Pierce (OSU)

Interannual variability in wind stress

Cumulative wind stress since Spring Transition

Spring transition

Cumulative wind stress (Nm$^{-2}$days)

Fall transition

mean±sd (1985-2005)

Equatorward, Upwelling favorable

Barth et al. (2006)
late, weak upwelling in 2005 led to warm ocean temperatures

mean±sd (1985-2005)

PISCO

Barth et al. (2006)
late, weak upwelling in 2005 led to low nutrients and chlorophyll

Barth et al. (2006)
and unprecedented low recruitment!

mussels (*Mytilus* spp.)

PISCO

Barth et al. (2006)
The culprit? Strong intraseasonal wind oscillations and an anomalously southern Jet Stream location

Wind Stress (N m$^{-2}$)

Yearday

Mar Apr May Jun Jul Aug Sep

2005 20–30 day oscillations

mean+sd (1985-2005)

Newport, OR

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?