Latitudinal Differences in Chlorophyll Variability in the California Current

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Study Domain
California Current System

Seasonal cycle in wind forcing
- summer = upwelling favorable
- upwelling of nutrient-rich cold water
- elevated shelf phytoplankton concentrations

Strong interannual variability
Both: a function of LATITUDE
DATA

**surface chlorophyll**: SeaWiFS satellite data
- 6 year time series (Sept 1997 – Aug 2003)
- 23°N (tip of Baja) to 55°N (BC shelf)
- 4km resolution, daily data (gaps due to clouds)
- monthly composite images

**wind forcing**: NOAA Upwelling Indices:
- offshore Ekman transport
- specific latitude coastal sites

**alongshore transport**: TOPEX/JASON altimeter data
- (here) Sept 1997 – April 2003
- displacements over 90 day periods
- bin-averaged over latitudinal sections of coast
Climatological Seasonal Cycles

Monthly composites
Climatological Seasonal Cycles

EOF decomposition (of 12 month climatology)

MODE 1

Variance = 44.4%

MODE 2

Variance = 22.8%
Climatological Seasonal Cycles

Extract mean [chl] from 100km coastal region,
At each LATITUDE

SHELF seasonal cycle
Seasonal Cycles: details
latitudinal differences in cross-shelf structure & timing
Climatological Seasonal Cycles
comparison: wind and chlorophyll amplitudes and phase (of maximum)

chlorophyll
wind (offshore Ekman transport)
(from SCAT data)
Seasonal Cycles → Interannual Variability (6 years, 97-03)

Extract 100km coastal means

[Image: Map showing seasonal cycles and interannual variability with color-coded data for 1997 to 2003]
Interannual Variability

MONTH Composite 100km Cross Shelf Mean

MONTH Anomalies 100km Cross Shelf Mean

100km coastal mean

ANOMALIES
Cross-shelf patterns of anomalies

1997-98

2001-02
Interannual Variability
EOF decomposition (of 72 month series)

MODE 1
Variance = 21%

MODE 2+3
Variance = 17%

examine anomalies in the time series
Interannual Variability
EOF time series ANOMALIES

MODE 1

Original EOF timeseries

ANOMALIES
Interannual Variability

Specific latitudes: Cross-shelf structure & wind forcing

Vancouver Isl. 49.26 N
CROSS-SHELF PIGMENT DISTRIBUTION
(μg/l SeaWiFS Pigment)

Upwelling Anomalies

PFEL Upwelling Anomaly Time Series (1997-2003), 24 N
Interannual Variability
Altimeter Data: Alongshore displacements

42-53N
35-40N
23-30N

Seasonal Mean Transport and Cumulative Transport 42-53N
Seasonal Mean Transport and Cumulative Transport 35-40N
Seasonal Mean Transport and Cumulative Transport 23-30N

Actual Transport km

Seasonal Anomalies and Cumulative Anomalies 42-53N
Seasonal Anomalies and Cumulative Anomalies 35-40N
Seasonal Anomalies and Cumulative Anomalies 23-30N

Anomalies Transport km

Time series
Cumulative series
Interannual Variability

Anomaly fields: late 2002
Summary: Chlorophyll Latitudinal Variability in the California Current

Satellite Data: recent missions provide synoptic time series over large latitudinal ranges enabling robust comparisons

- SeaWiFS Instrument: stable (and calibrated well) enough to allow robust interannual comparisons

- Seasonal Cycles:
  - latitudinal phasing,
  - earliest max at lower latitudes,
  - in phase with wind forcing
  - max amplitude at highest latitudes (over widest shelf)

- Interannual Variability:
  - max negative anomalies 1997-98 (El Nino)
    - largest over Pacific NW (in this data set)
  - max positive anomalies in 2001-2002
    - not clearly related to wind,
    - more to southward advection

Thank you