Wind, circulation, and topographic effects on alongshore phytoplankton variability in the California Current

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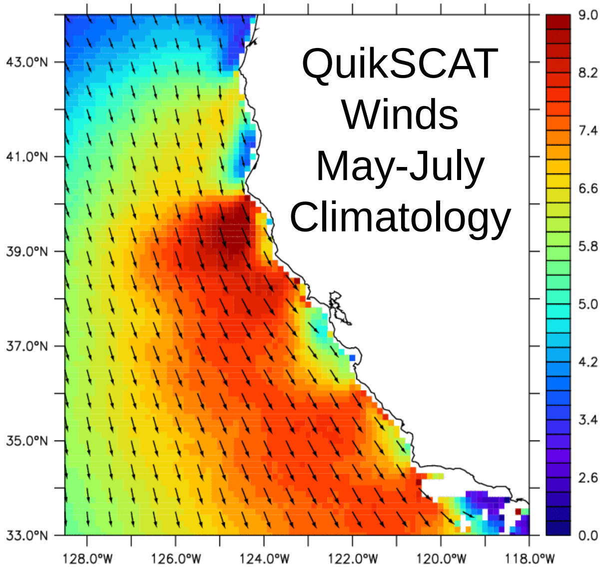
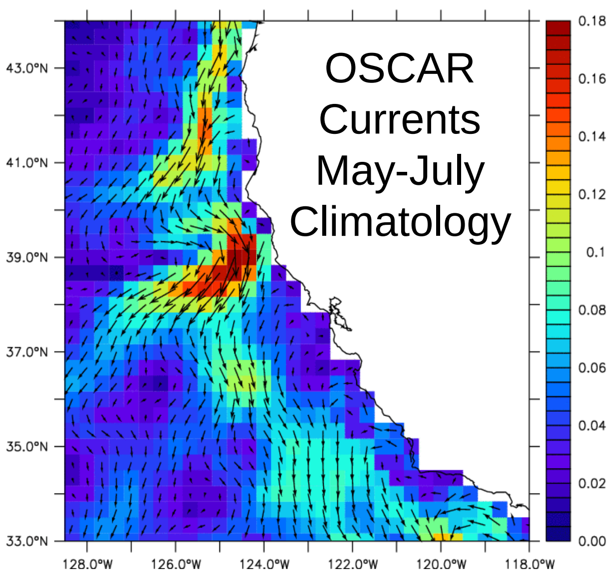
Alongshore Chlorophyll Variability in California Current





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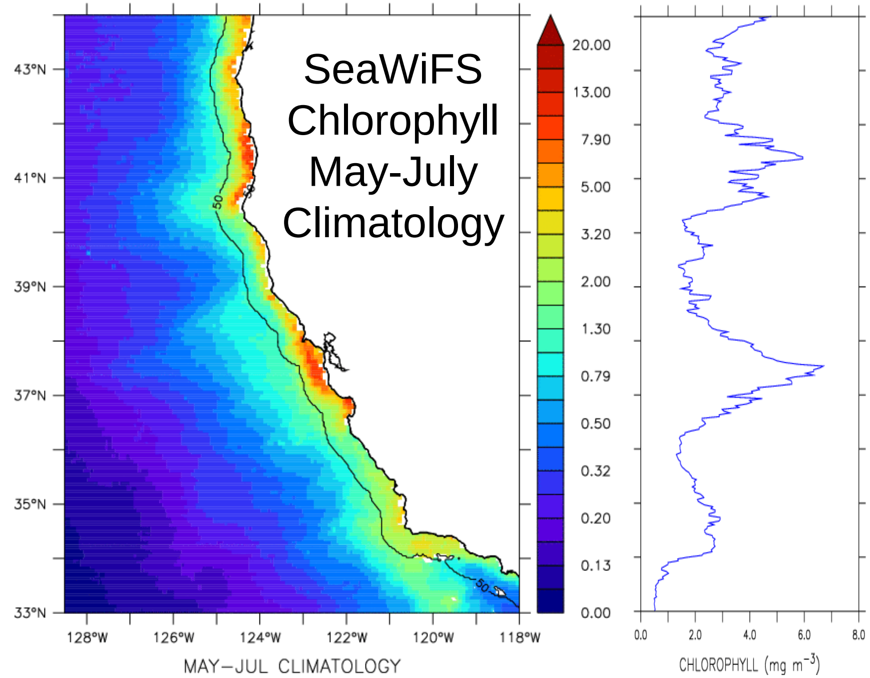
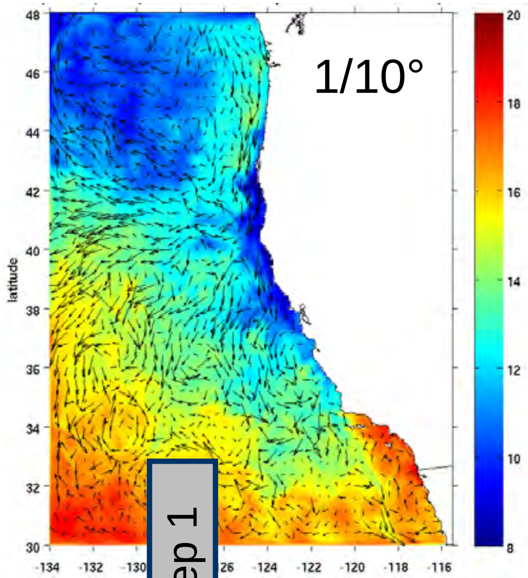


Question: How do alongshore variation in surface winds and coastal currents affect the distribution of phytoplankton biomass in the California Current?

Physical-Biogeochemical Model Configuration

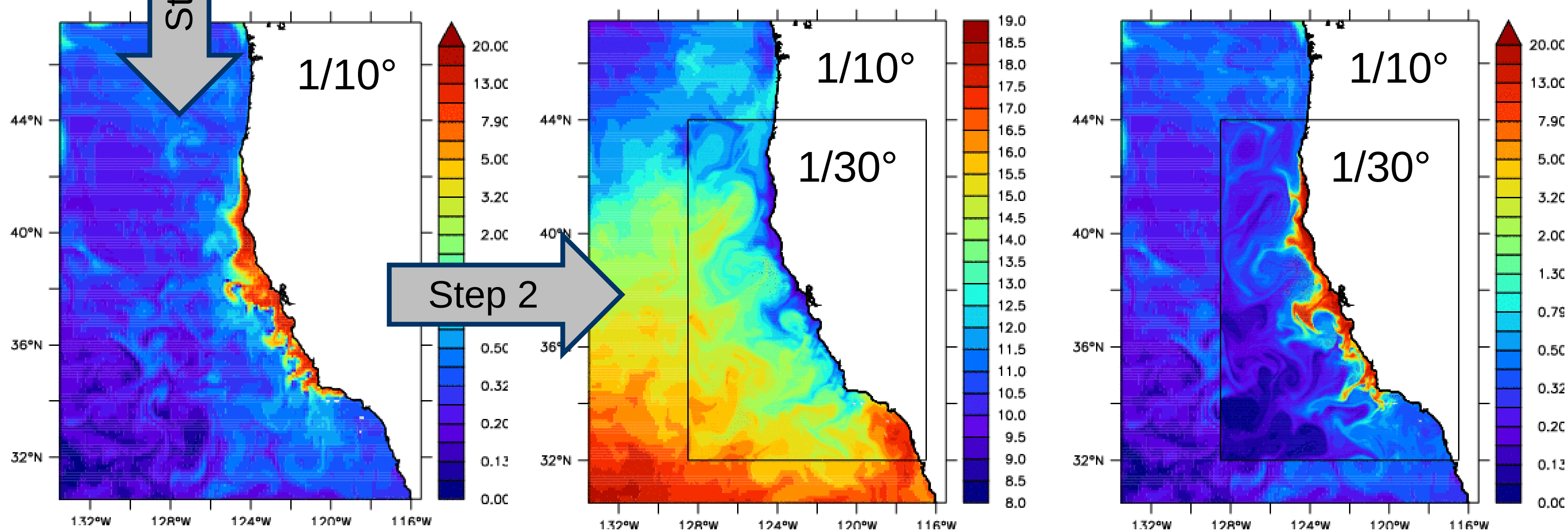


Ocean Circulation: ROMS (1/10° → 1/30°)

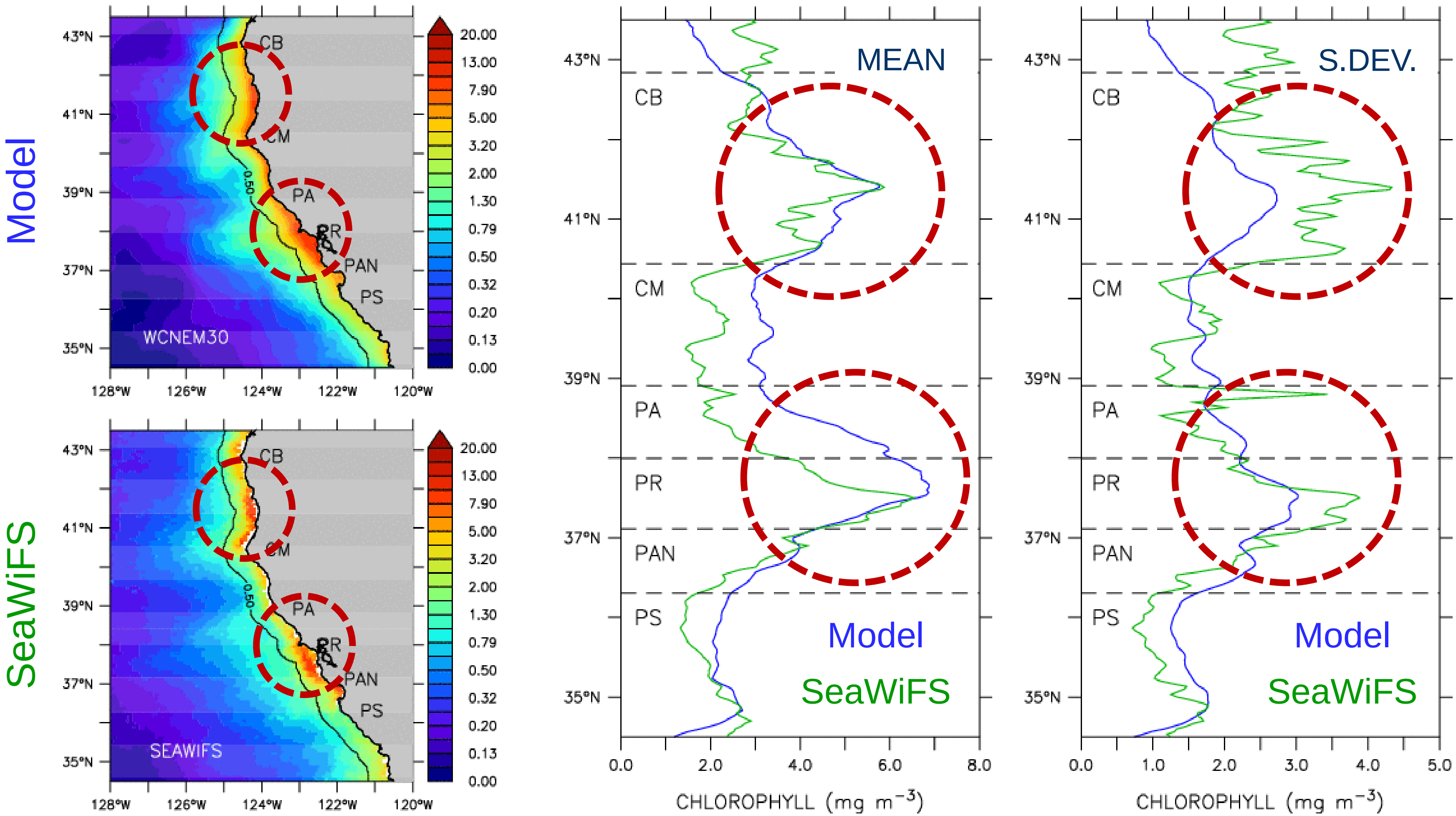
Biogeochemistry: NEMURO-UCSC (3N2P3Z)

Step 1: Offline NEMURO forced by data-assimilative reanalysis of CCS circulation at 1/10° for 1988-2010

Step 2: Nested coupled ROMS-NEMURO solution at 1/30° benefiting from physical data assimilation

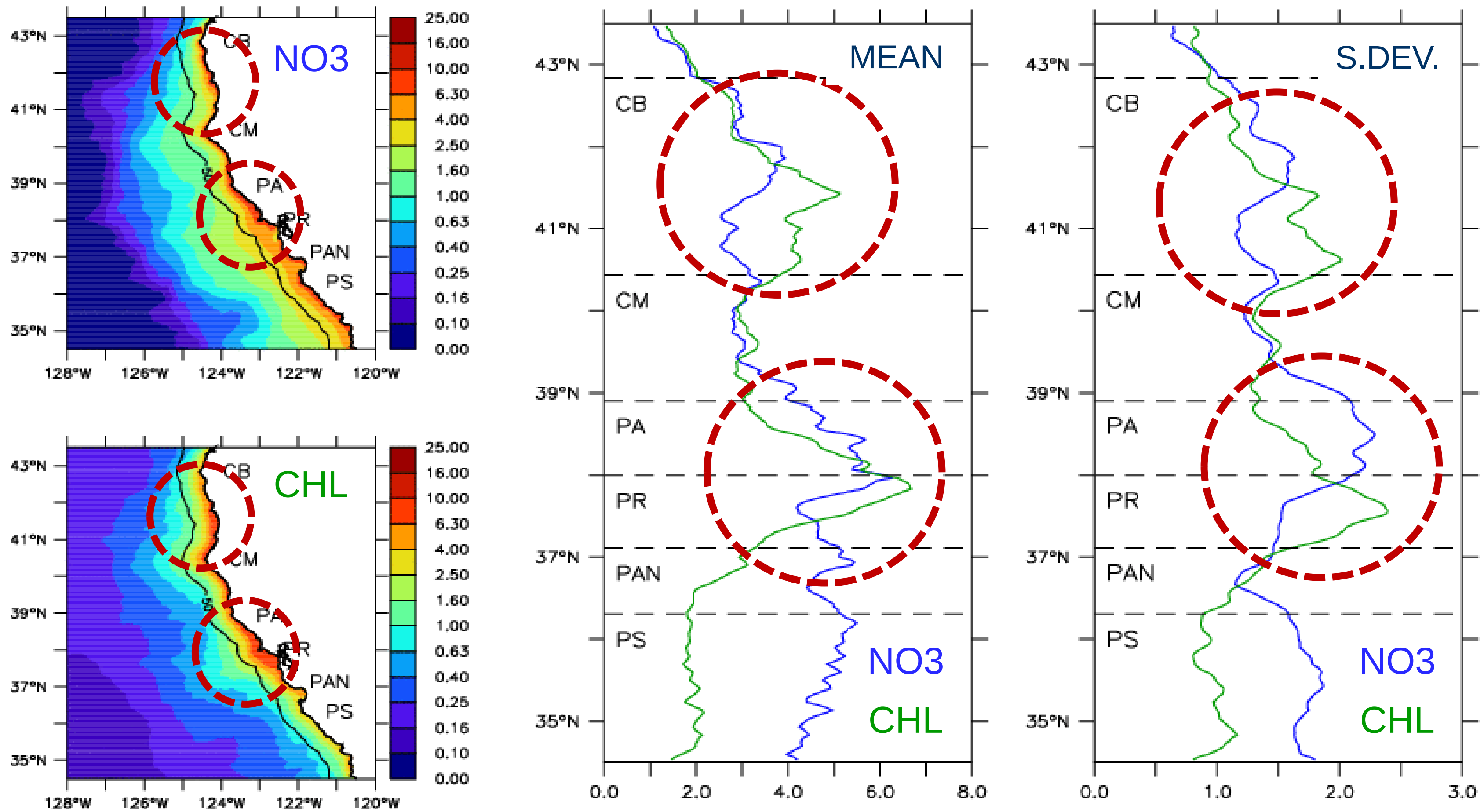


Chlorophyll Climatology for May-July



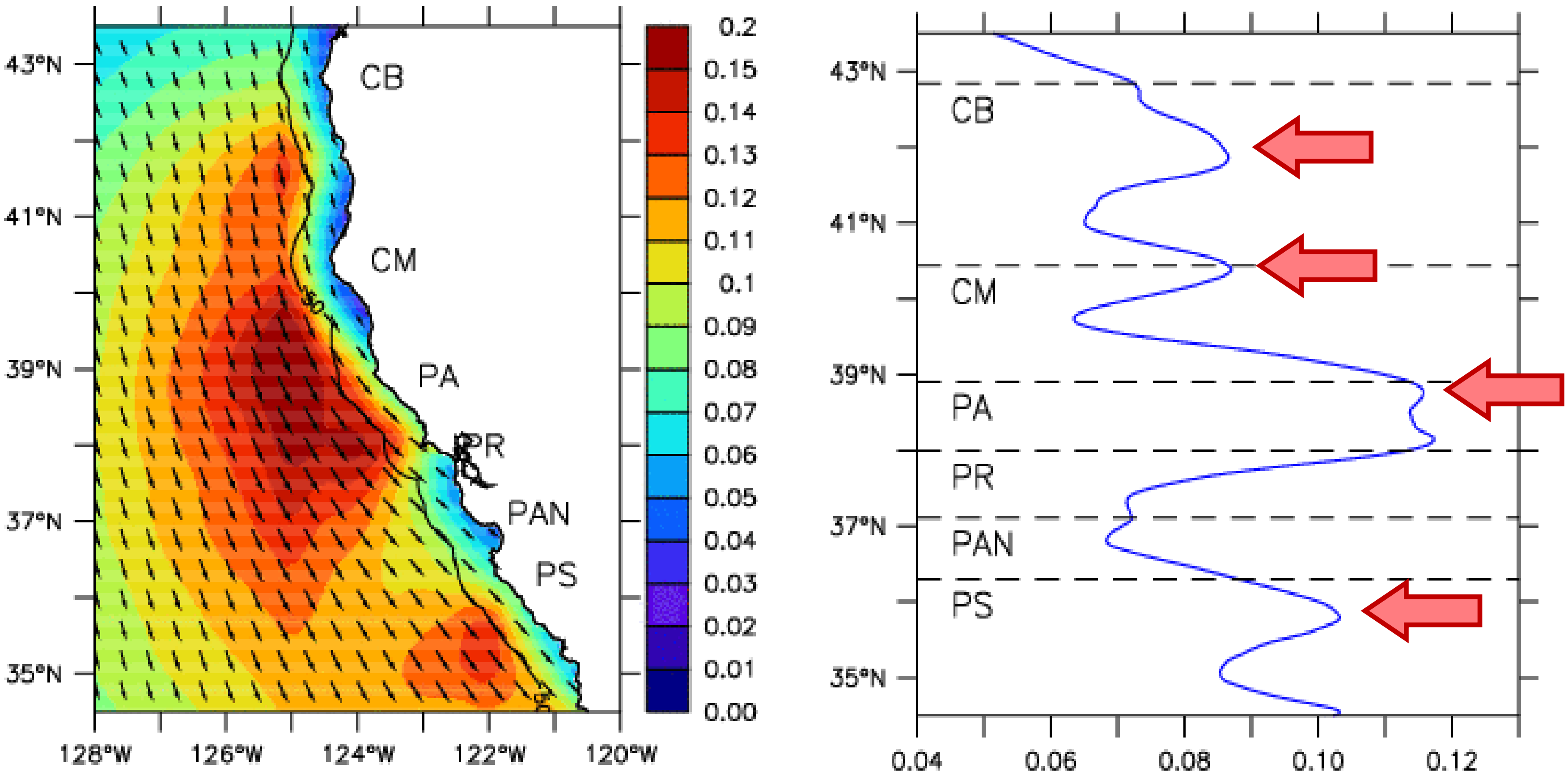
Model and observations consistently predict two alongshore regions of increase chlorophyll concentrations and variability.

Nitrate and Chlorophyll Climatology for May-July



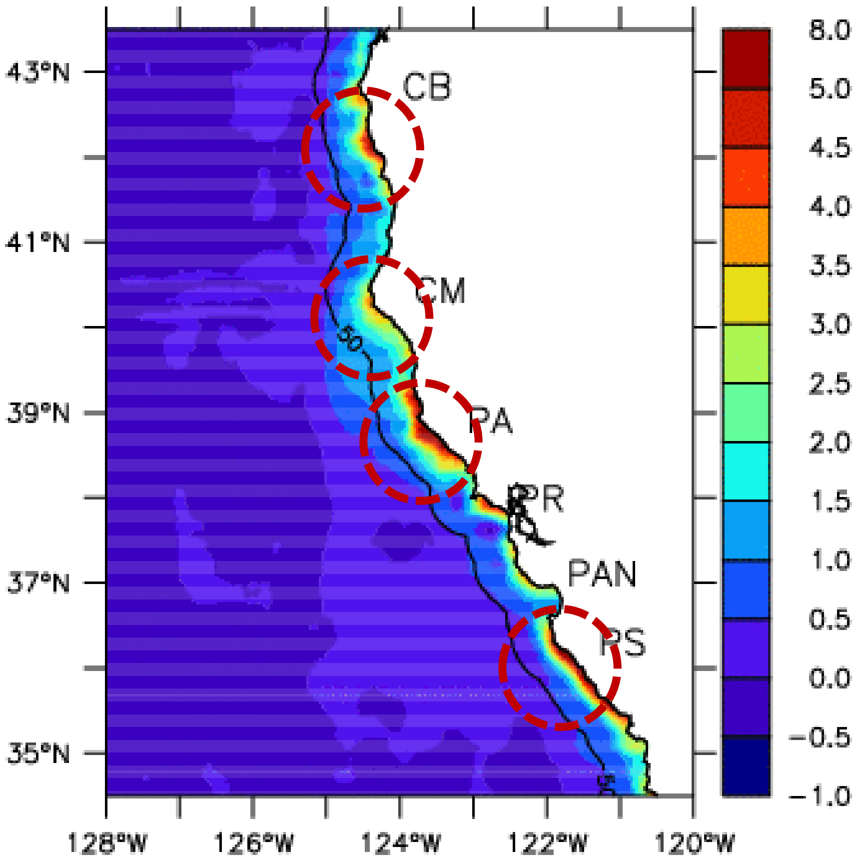
Simulated nearshore nitrate and chlorophyll concentrations exhibit similar alongshore peaks and variability.

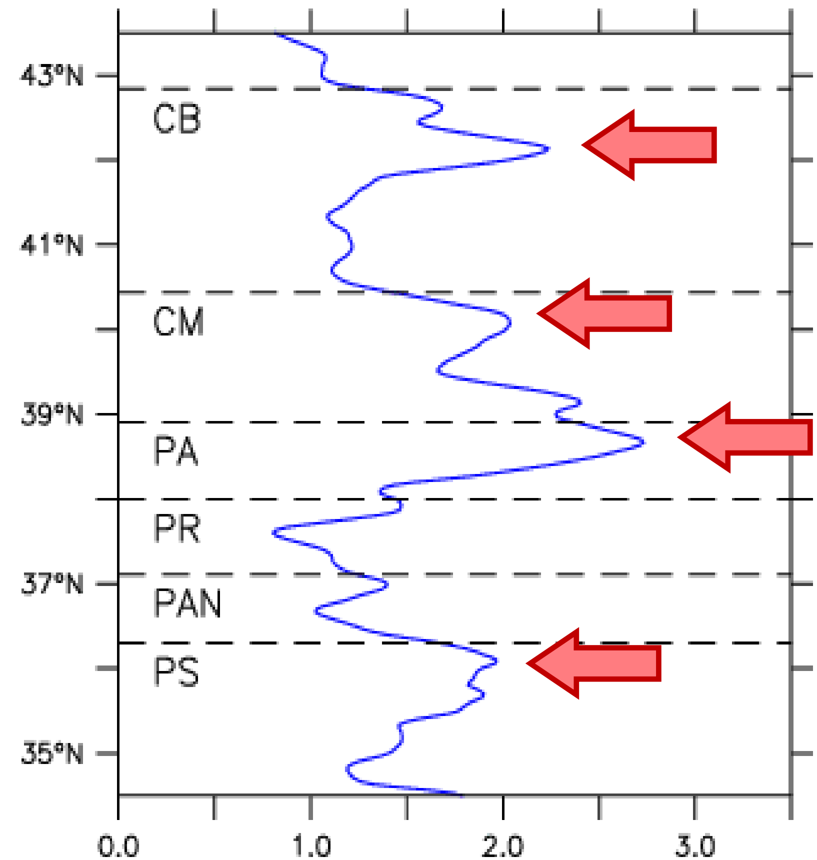
Wind Stress Climatology for May-July



Regions of locally enhanced nearshore surface wind stress downstream of major topographic features (expansion fans).

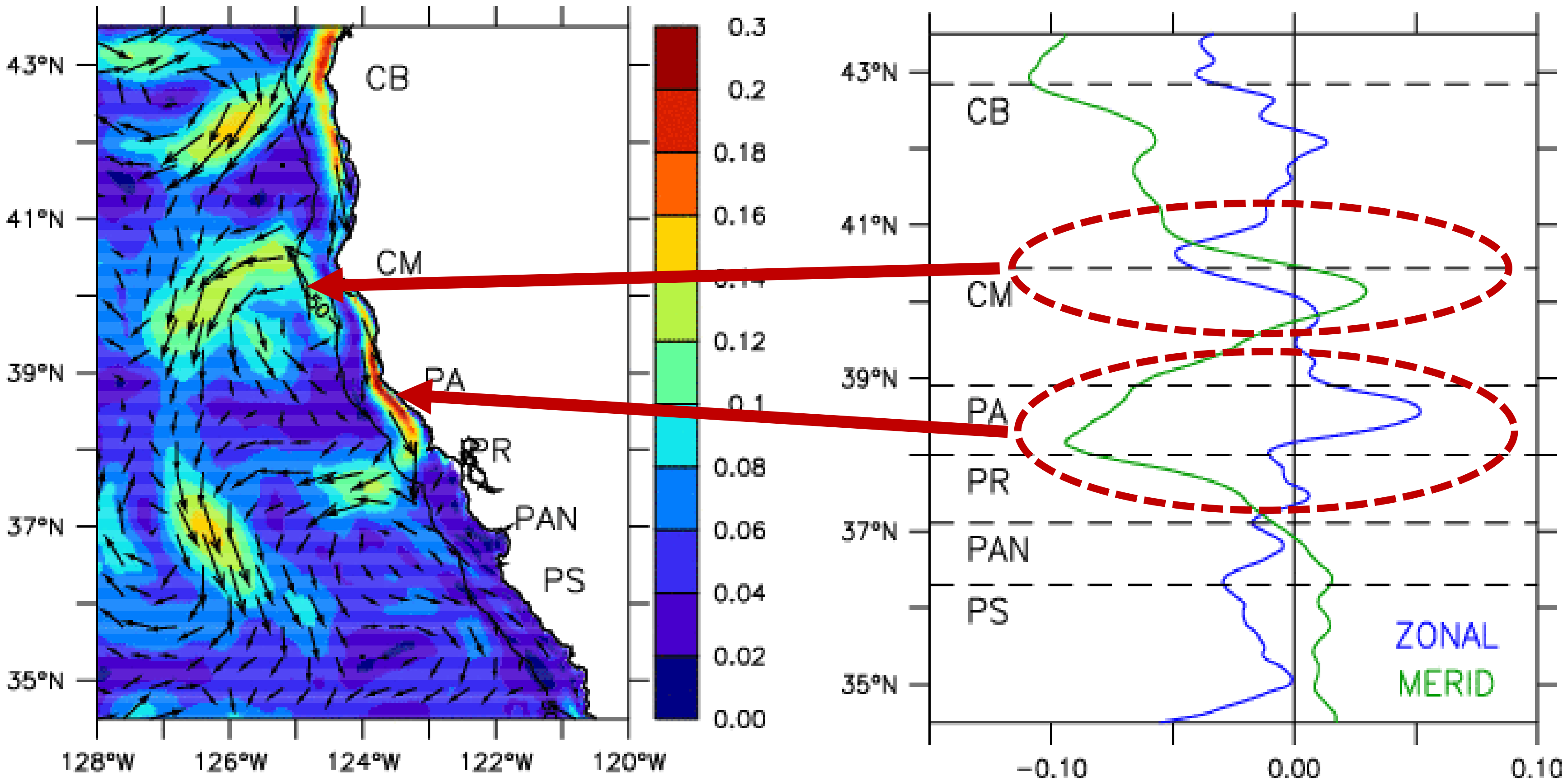
Vertical Velocity Climatology for May-July





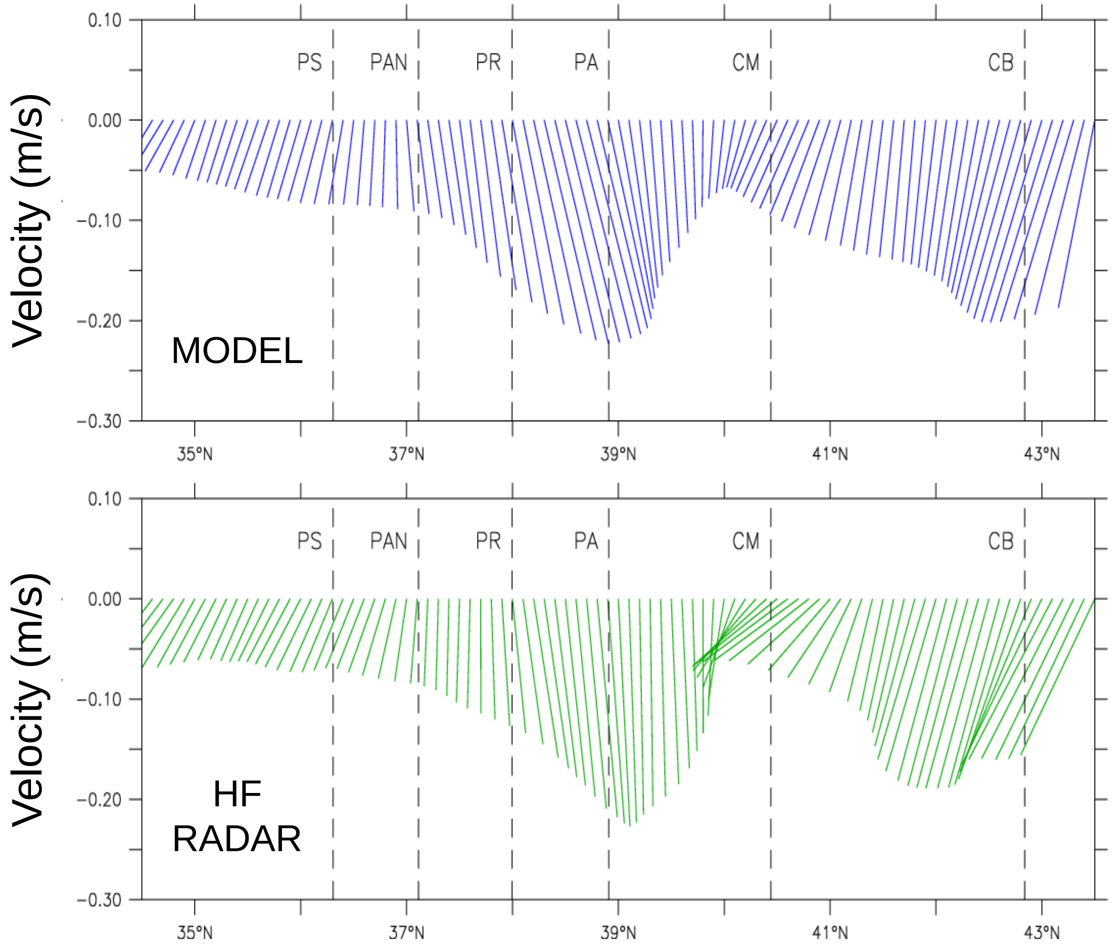
Regions of local upwelling intensification (enhanced vertical velocity nearshore) in the lee of major topographic features.

Horizontal Circulation Climatology for May-July

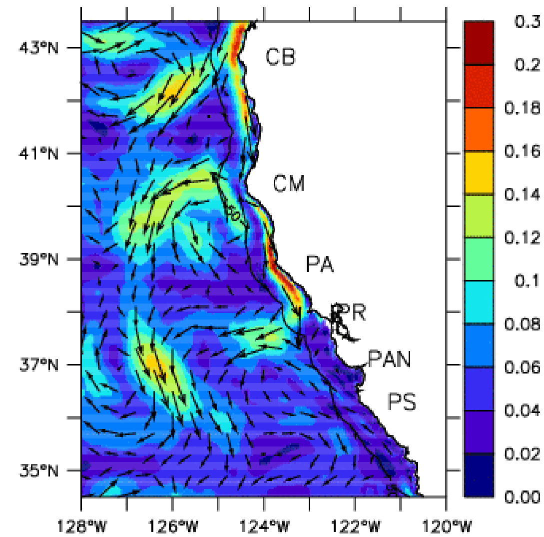


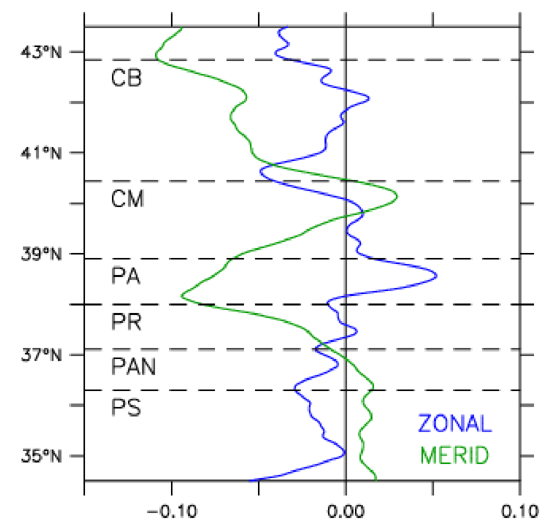
Alongshore variability in the coastal circulation leads to local regions of onshore retention and offshore export.

Nearshore Circulation Climatology for May-July



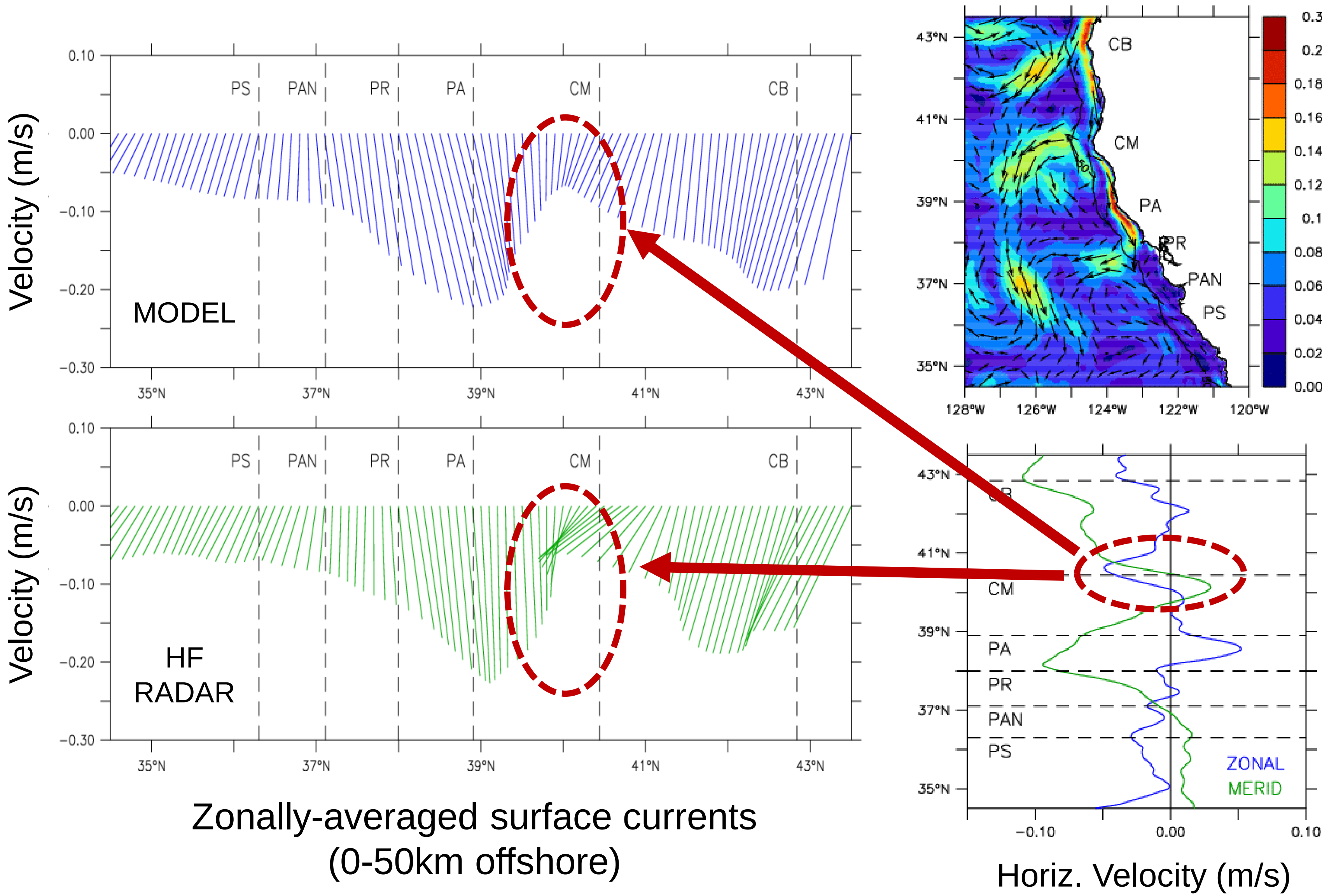
Zonally-averaged surface currents
(0-50km offshore)





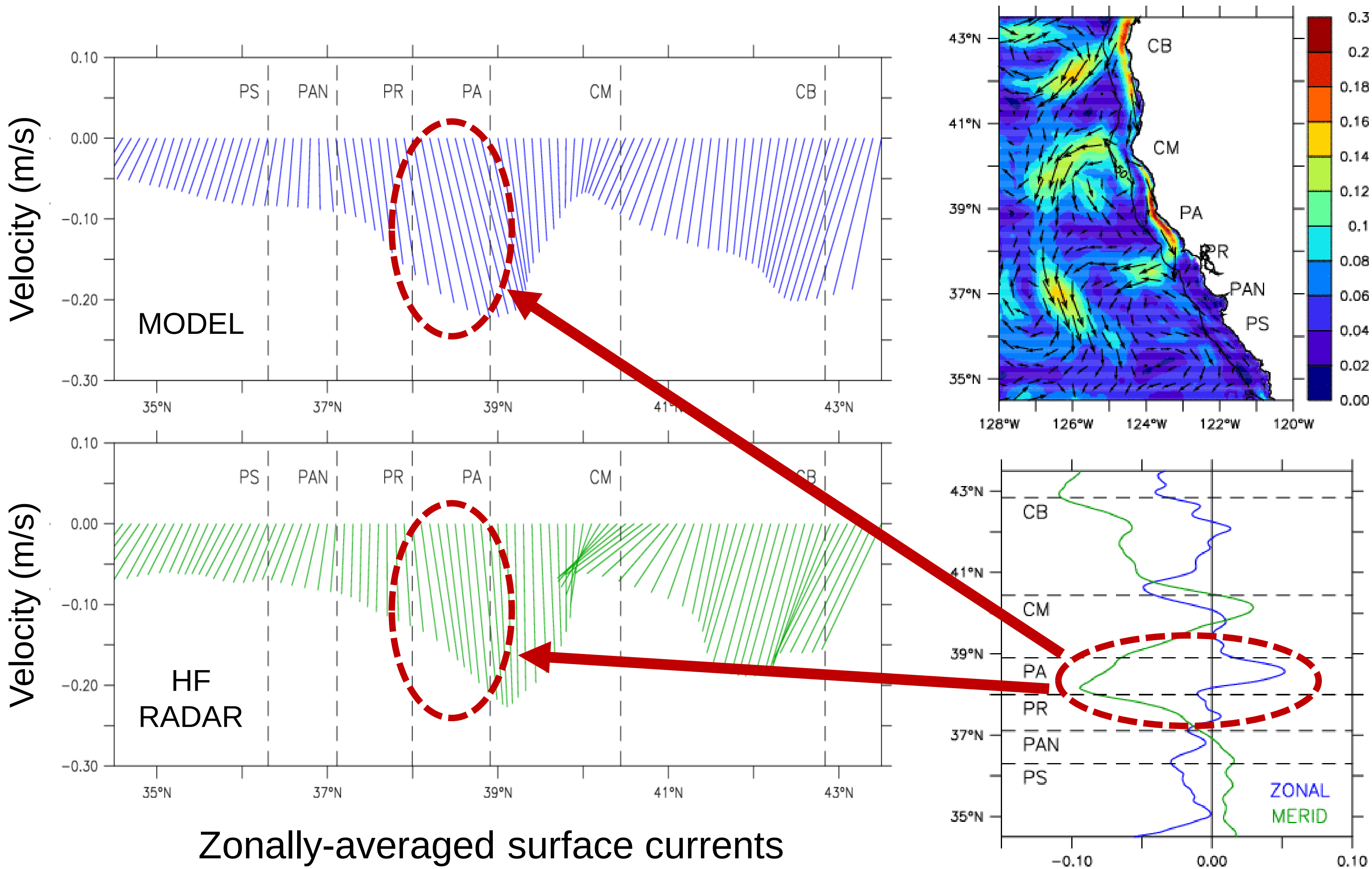
Horiz. Velocity (m/s)

Nearshore Circulation Climatology for May-July



Zonally-averaged surface currents (0-50km offshore)

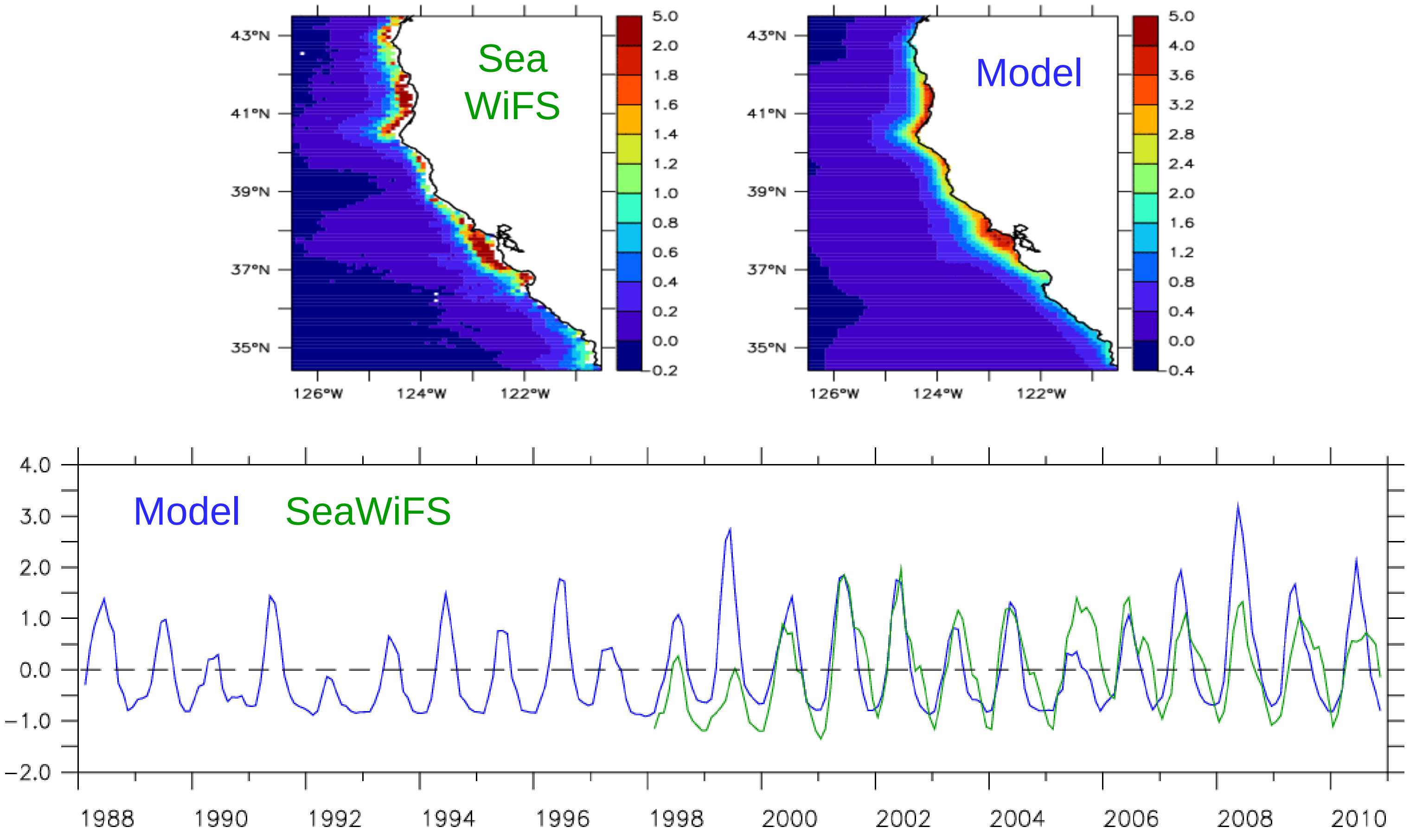
Nearshore Circulation Climatology for May-July



Zonally-averaged surface currents
(0-50km offshore)

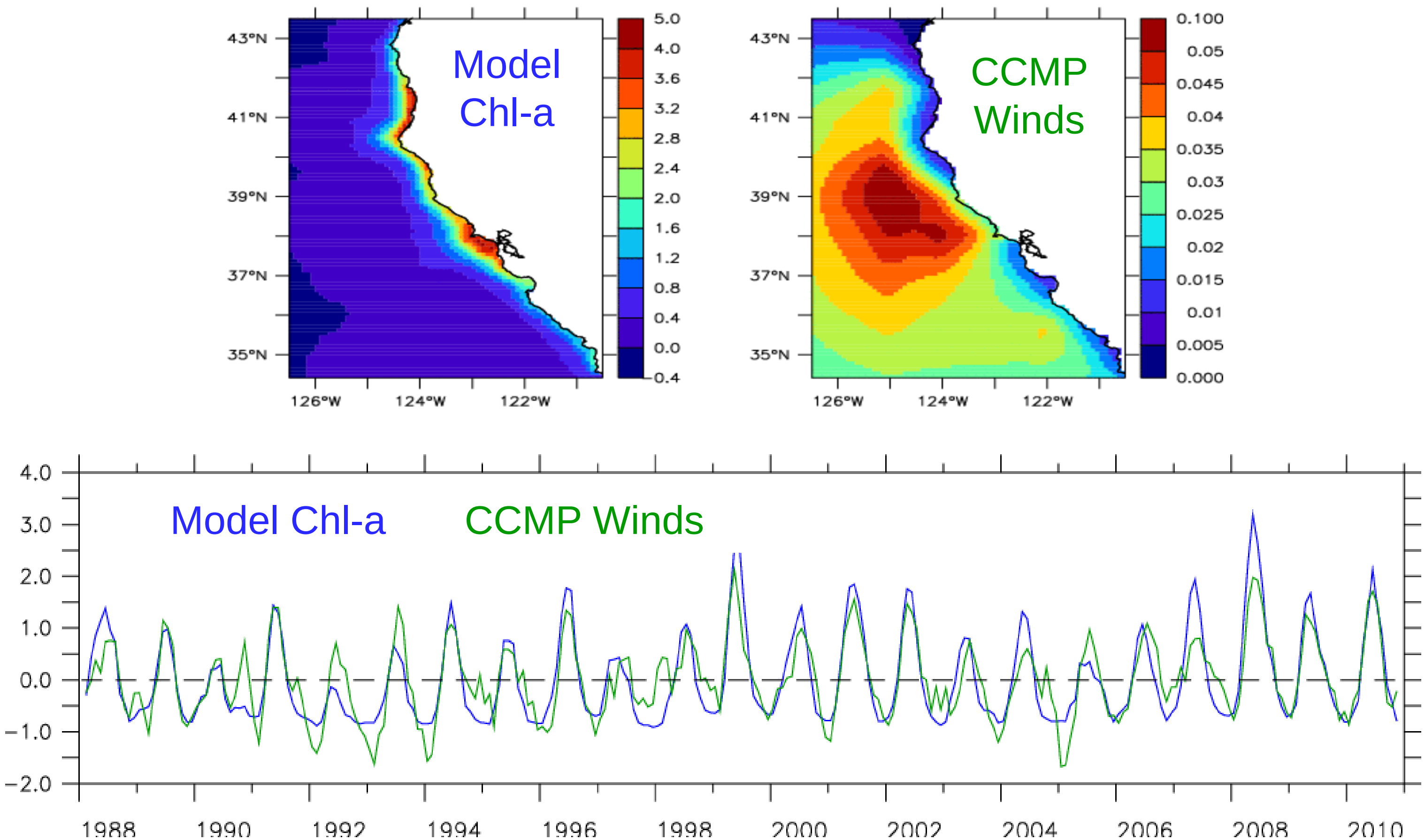
Horiz. Velocity (m/s)

Leading Mode of Interannual Chlorophyll Variability



Leading EOF mode for simulated and observed chlorophyll represents interannual variability of alongshore peaks.

Leading Mode of Interannual Wind Stress Variability



Most of the interannual variability in the alongshore chlorophyll peaks is explained by regional changes in surface wind stress.

Summary

- Alongshore variations in wind stress caused by coastal topography lead to enhanced upwelling in lee of capes.
- Alongshore variations in the coastal circulation lead to regions of enhanced nearshore retention and offshore export of upwelled nutrients.
- The interplay between alongshore variations in coastal circulation and wind stress leads to the formation of two distinct peaks of phytoplankton biomass downstream of Cape Blanco and Point Arena.
- Peak biomass location also exhibit higher interannual variability and trends than the surrounding shelf regions.