

# CalCOFI:

New opportunities & challenges

## SCCOOS

*Southern California Coastal Ocean Observing System  
PaCOOS relevant activities within SCCOOS*



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CALPOLY-SLO

UCSB

UCLA

JPL-NASA

CSLA

USC

SCCWRP

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SIO-UCSD

CICESE

UABC



[WWW.SCCOOS.ORG](http://WWW.SCCOOS.ORG)

*SCCOOS Observational Components funded via  
NOAA and State of California*

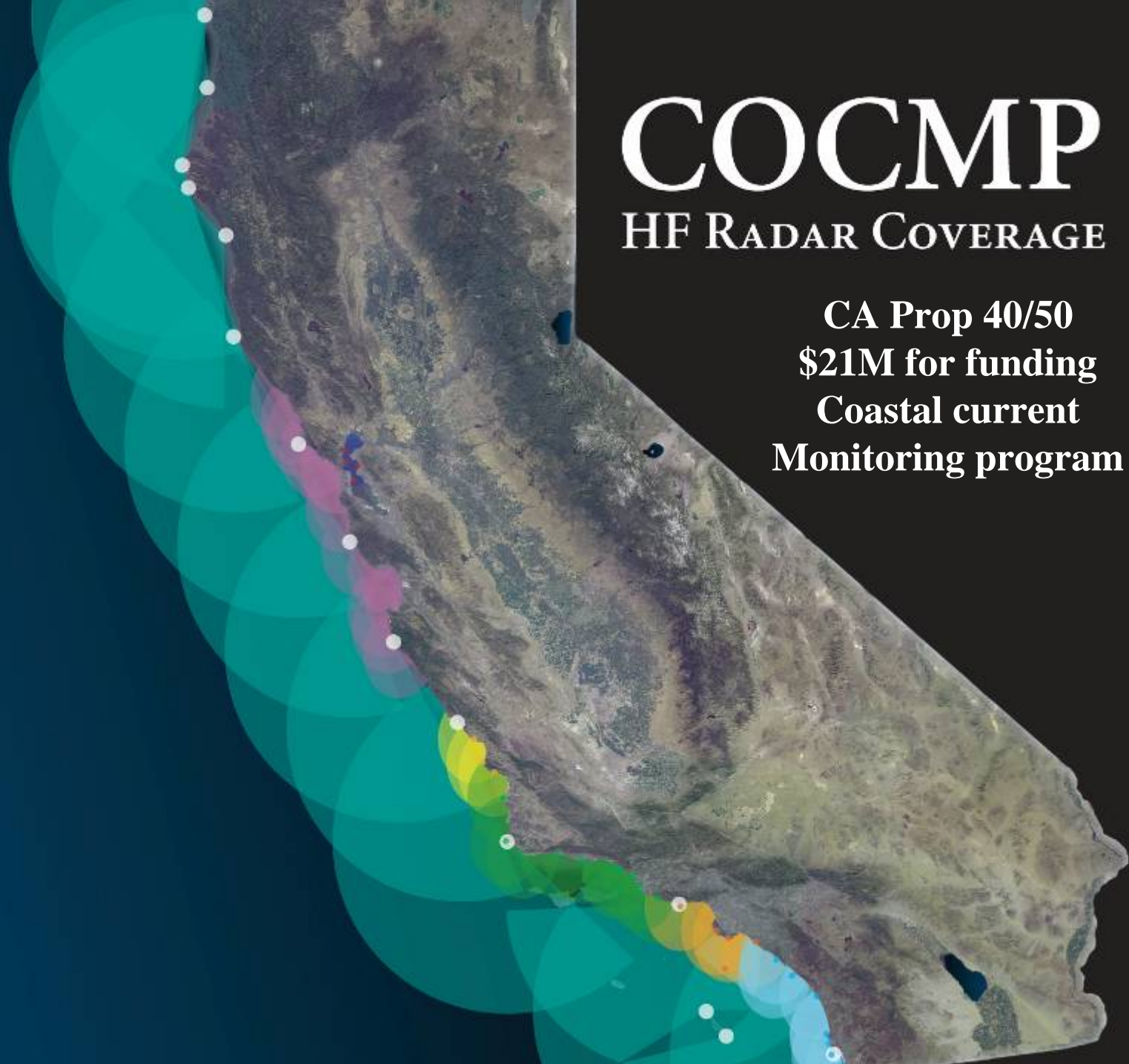
- *HF radar surface current mapping array*
- *Three oceanographic moorings at Santa Barbara, Santa Monica Bay, and San Diego*
- *Glider lines on CALCOFI lines off Dana Point, Point Conception and Monterey*
- *manual shore station program coupled with growing network of pier-based ocean sensors*
- *aggregated met stations – about 360 stations*
- *high resolution met nowcast/forecasts (winds/rain)*
- *shoreline water quality – 6 different health agencies*
- *hydrography data collected quarterly by EPA NPDES permit holders in the Bight*
- *bathymetry*
- *remote sensing*
- *nearshore augmentation of CALCOFI lines*
- *HABS species sampling*
- *Regional Ocean Modeling System*



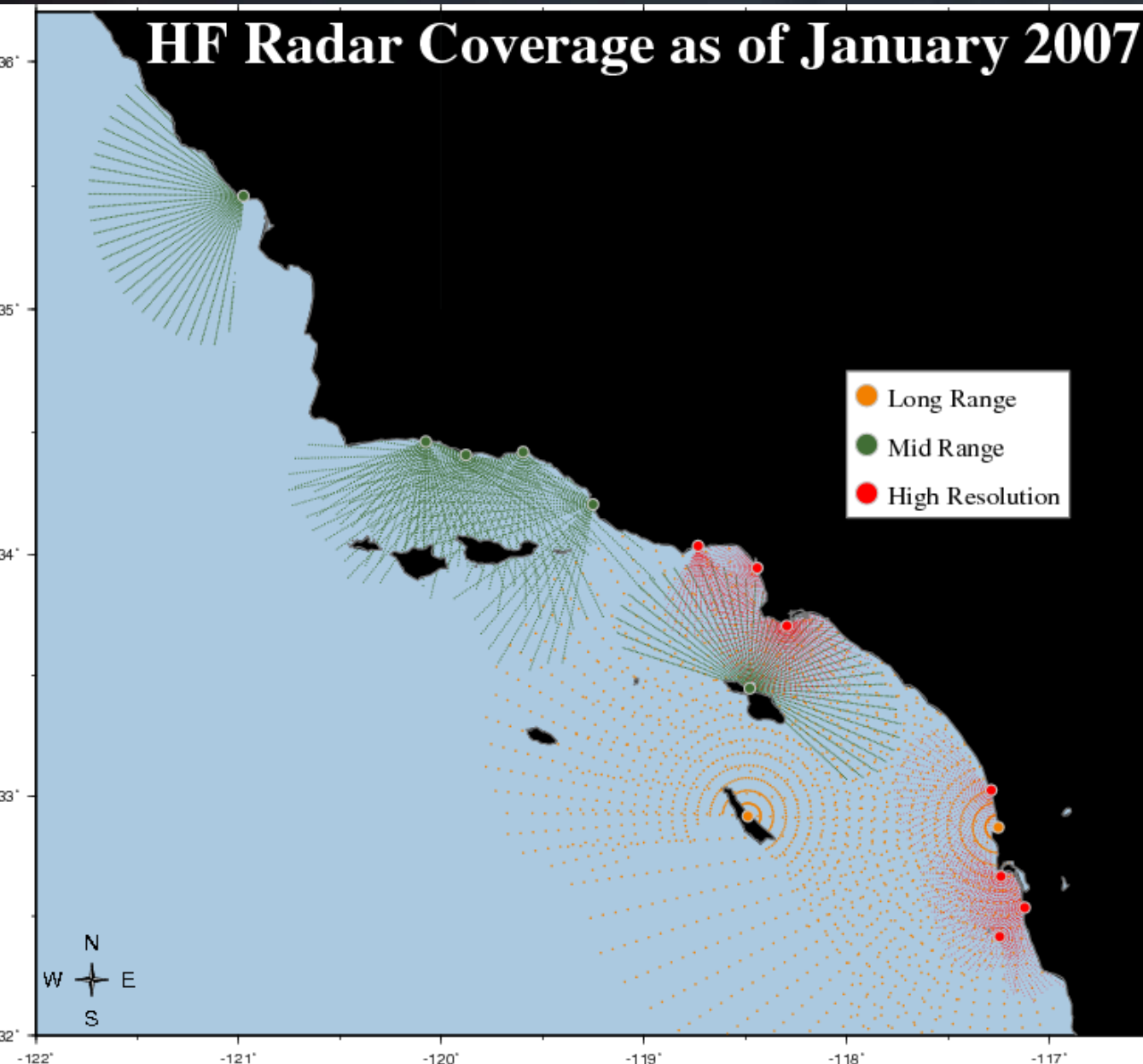
# COCMP

## HF RADAR COVERAGE

**CA Prop 40/50**  
**\$21M for funding**  
**Coastal current**  
**Monitoring program**



# HF Radar Coverage as of January 2007



● Long Range

● Mid Range

● High Resolution

## *SCCOOS - PaCOOS*

*•Biota/ecosystems, to date, has not been principal focus of national IOOS. Southern California has a large share of local issues that require coupled physical/biological observing efforts:*

- Areas of Special Biological Significance*
- Marine Protected Areas*
- powerplant cooling water*
- LNG warming water*
- land input impacts (stormwater / POTW)*
- HABs*
- salmon recovery efforts*

*SUGGESTED ACTION – engage west coast RAs into a coordinated climate observing system*



# southern california bight



Buoy



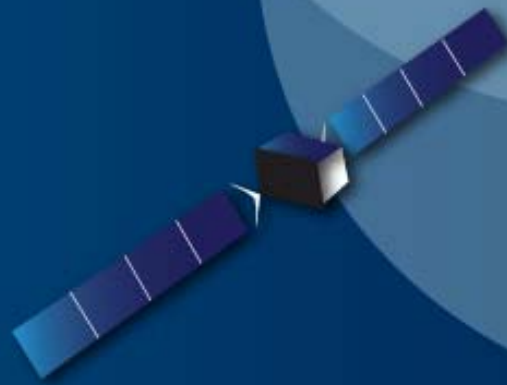
Mooring



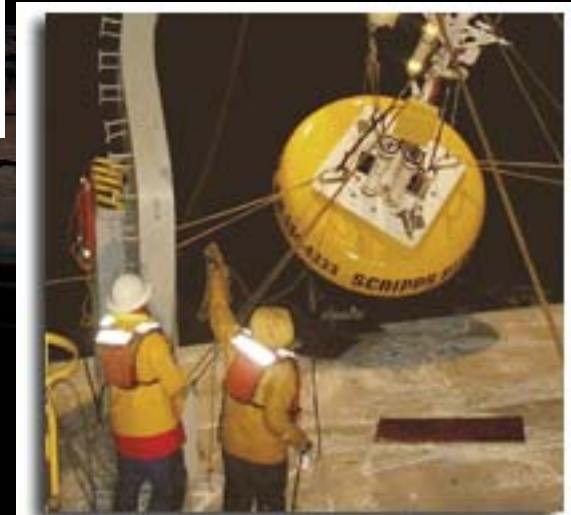
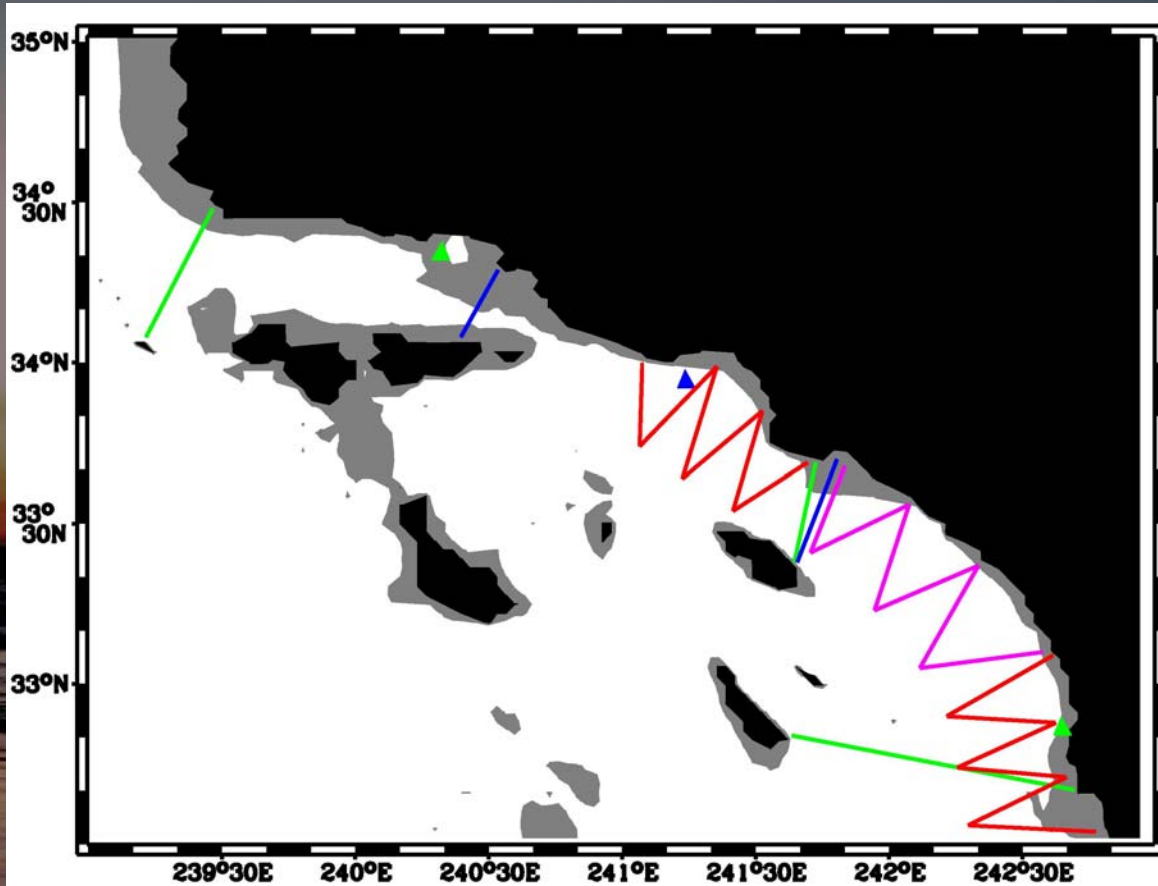
Glider Track



SCCOOS Shore Station

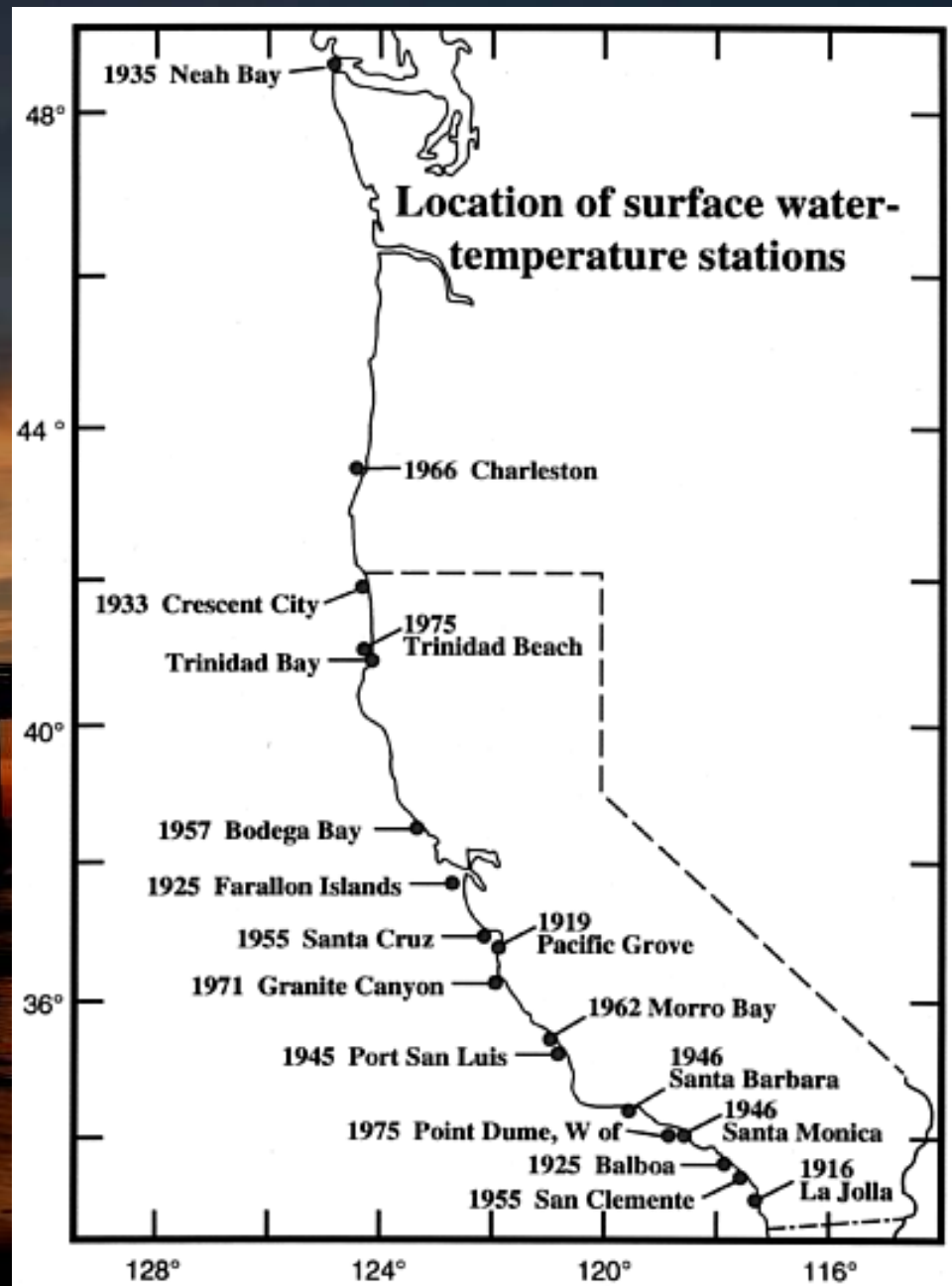


# SCCOOS FUNDED SUBSURFACE OBSERVATIONS



# California Shore Station Program

18 Stations – CA, OR, WA  
Volunteers  
Temperature  
Salinity  
Once-per-day





Click map to reset.

### Southern California Regions

- [Morro Bay](#)
- [Santa Barbara Channel](#)
- [Ventura County](#)
- [Los Angeles](#)
- [South Channel Islands](#)
- [Orange County](#)
- [North San Diego](#)
- [San Diego / Mexico](#)

### Available Products

- [Automated Shore Stations](#)
- [Manual Shore Stations](#)
- [Overview](#)
- [Neah Bay](#)
- [Charleston / Coos Bay](#)
- [Crescent City](#)
- [Trinidad Beach](#)
- [Trinidad Bay](#)
- [Bodega Bay](#)
- [SE Farallon Island](#)
- [Santa Cruz](#)
- [Pacific Grove](#)
- [Granite Canyon](#)
- [Morro Bay](#)
- [Port San Luis / Avila](#)
- [Santa Barbara](#)
- [Pt. Dume](#)
- [Santa Monica](#)
- [Newport Beach](#)
- [Santa Catalina Island](#)
- [San Clemente](#)
- [SIO Pier](#)

- [Bathymetry](#)
- [Moorings](#)
- [Satellite Imagery](#)
- [Shoreline Water Quality](#)
- [Surface Current Maps](#)
- [Surface Winds](#)
- [Wave Conditions \(CDIP\)](#)
- [Cast Data \(Ships & Gliders\)](#)

### Manual Shore Stations

#### SIO Pier Shore Station - seafloor

Personnel from Scripps Stephen Birch Aquarium-Museum take daily temperature and salinity samples from the end of the Scripps Pier at the sea surface and a depth of about 5 meters. The proximity of Scripps Pier to the deep waters at the head of La Jolla submarine canyon results in data quite representative of oceanic conditions.

**Latitude:** 32° 52.00' N  
**Longitude:** 117° 15.05' W

Operational since August 1916

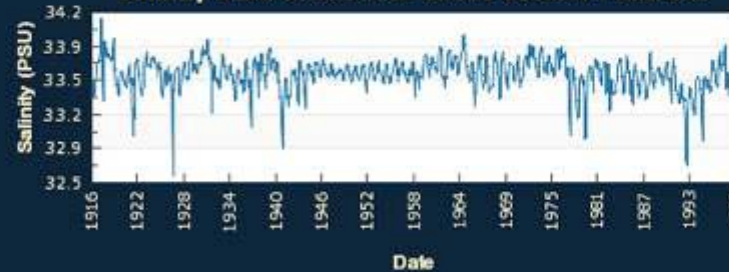
#### Measurements Taken

- [Surface](#)
- [Temperature](#)
- [Salinity](#)
- [Seafloor](#)
- [Temperature](#)
- [Salinity](#)

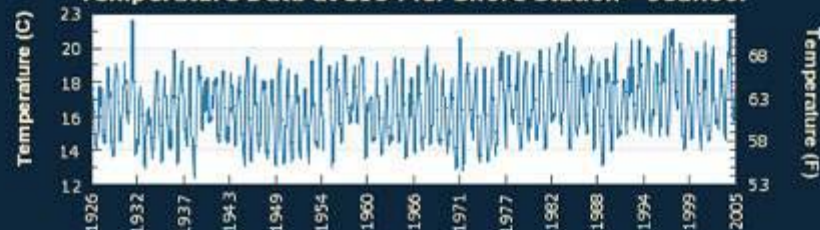
Temperature Data at SIO Pier Shore Station - surface



Salinity Data at SIO Pier Shore Station - surface

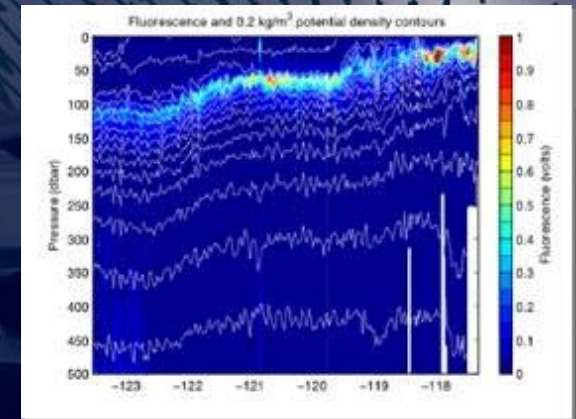
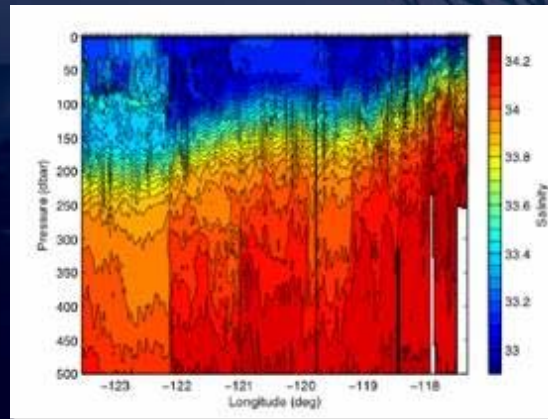
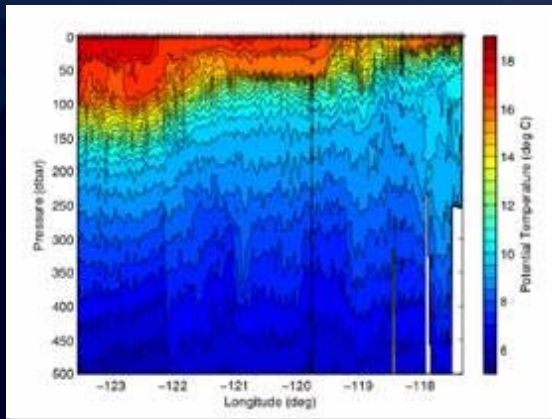
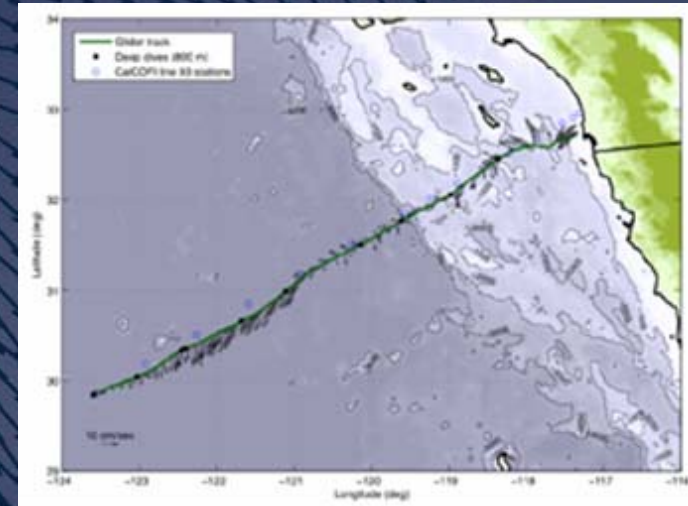


Temperature Data at SIO Pier Shore Station - seafloor



# SCCOOS Glider Operations

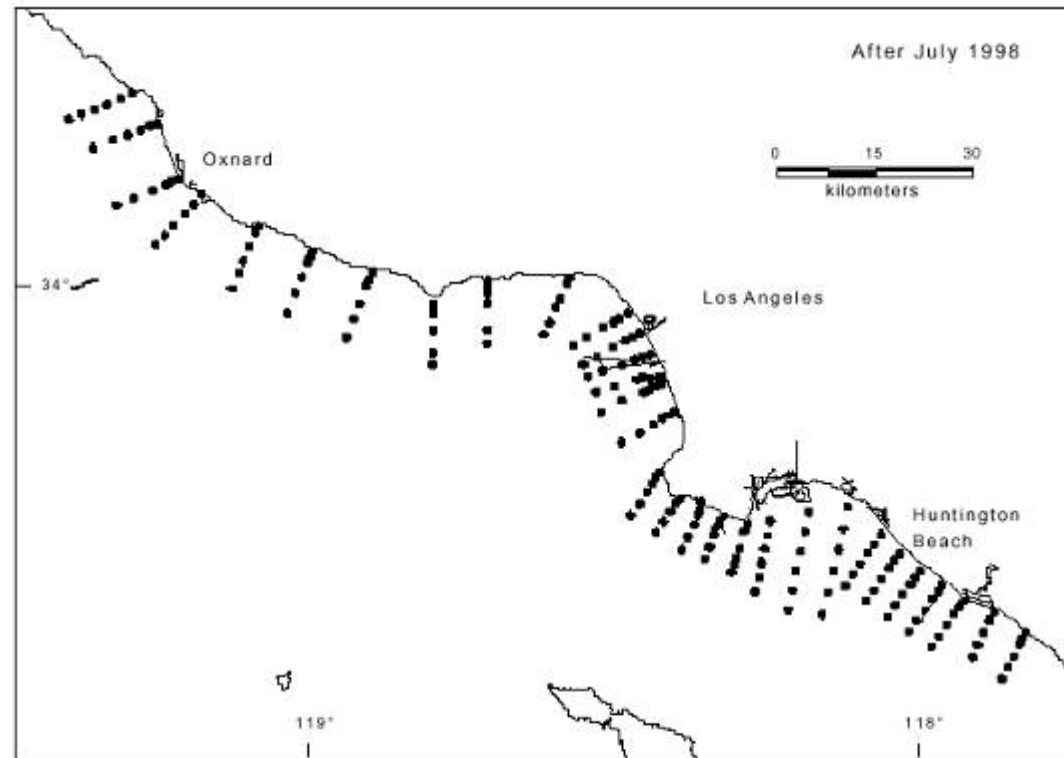
- Continuously monitors coastal velocity, temperature, salinity, and phytoplankton
- SCCOOS gliders are able to profile from the surface to 500m and back in 3 hours, while moving horizontally 3 km
- Example of successful deployment
  - 21 April 2005 offshore of La Jolla: completed ~ 700-km section 19 May (line 93)



*water properties show not only the large-scale structure typical of the region, but also meso- and fine-scale features that a glider can resolve continuously*

*~\$31M spent annually on marine monitoring programs by EPA NPDES permittees in the Southern California Bight (Schiff et al 2000)*

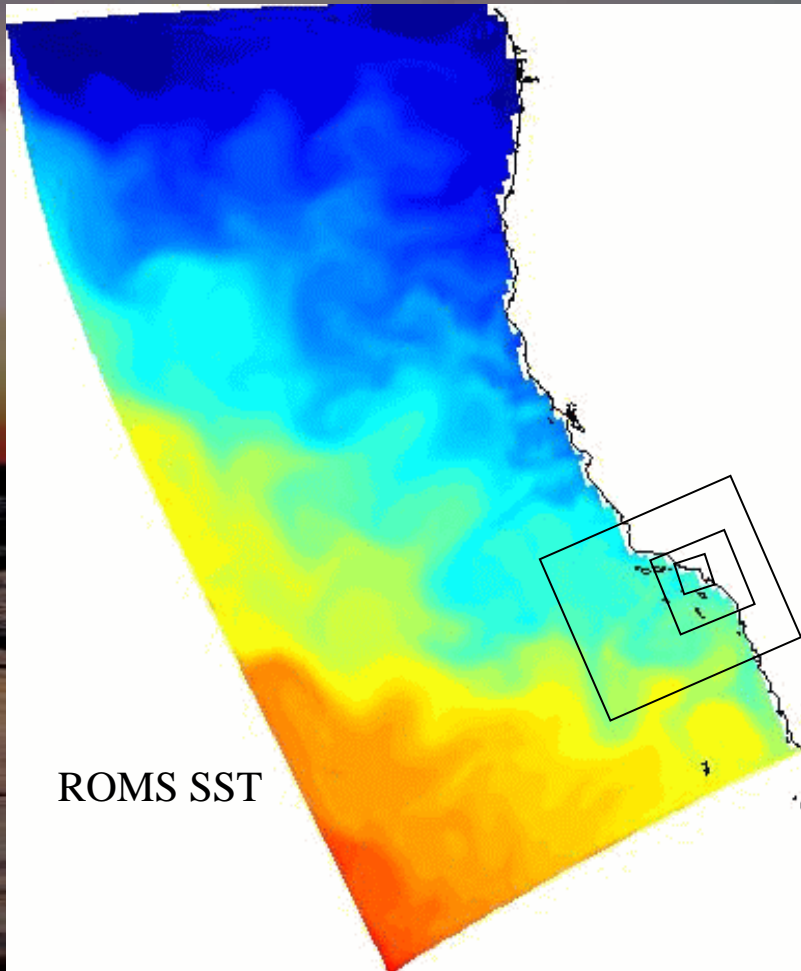
*Quarterly sampling stations maintained by agencies in Southern California*



**FIGURE V-1. Location of water quality stations before 1998, and after 1998 as part of the Central Bight Cooperative Program.**

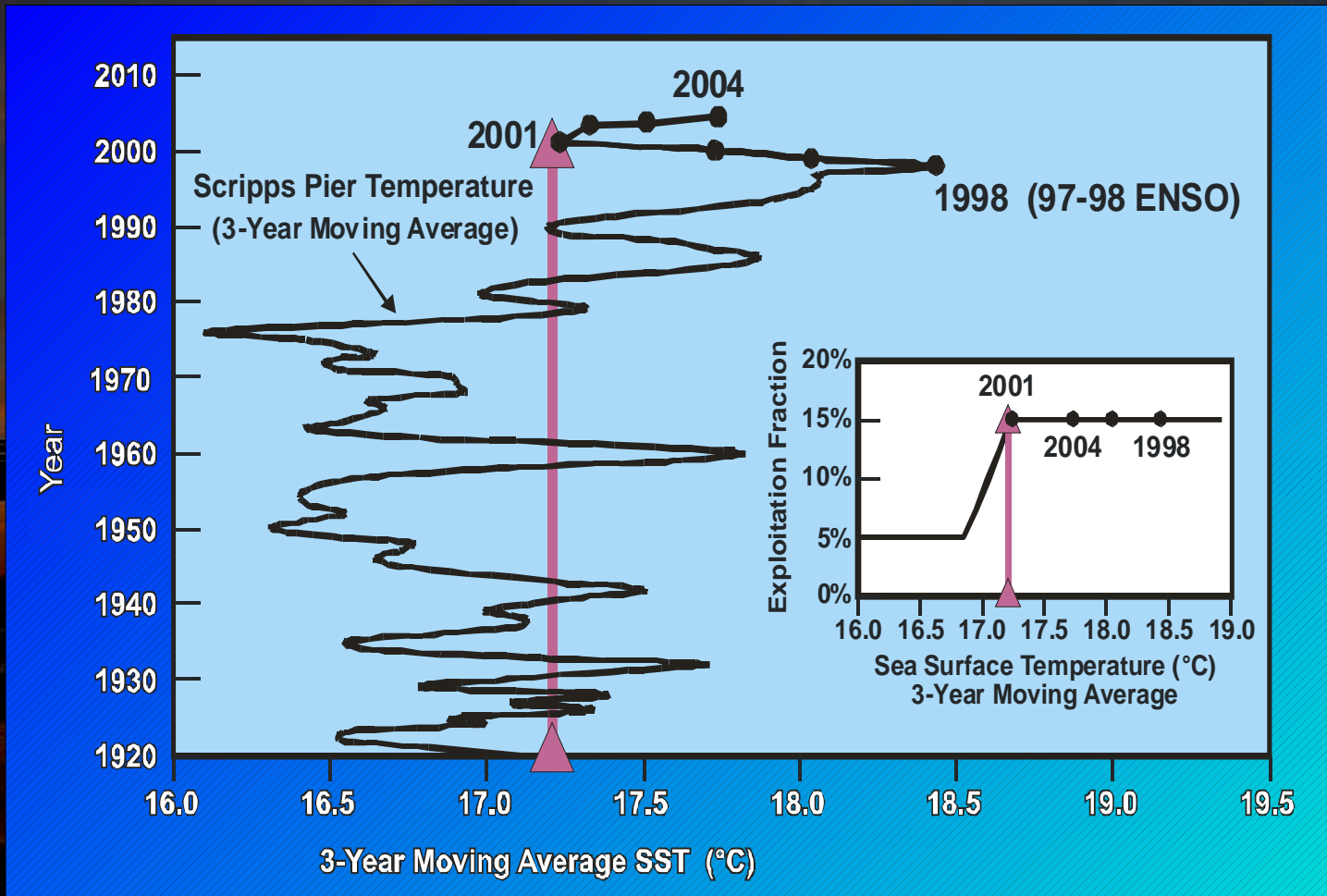


# 3D Modeling



- Regional Ocean Modeling System (ROMS)
  - US West Coast : 20km resolution
  - Intermediate : 6km resolution
  - SM Bay : 2km resolution
- JPL, UCLA, SCRIPPS

# Sardine is the only Federally Managed Stock With an Environmentally-based Harvest Policy



- 🐟 Policy linked to decadal variability in sardine productivity
- 🐟 If mean drops to 16.85°C, allocation drops to 5% of the harvestable biomass



# CalCOFI: new opportunities & challenges

MPA monitoring

California state fisheries assessment

New observing technologies

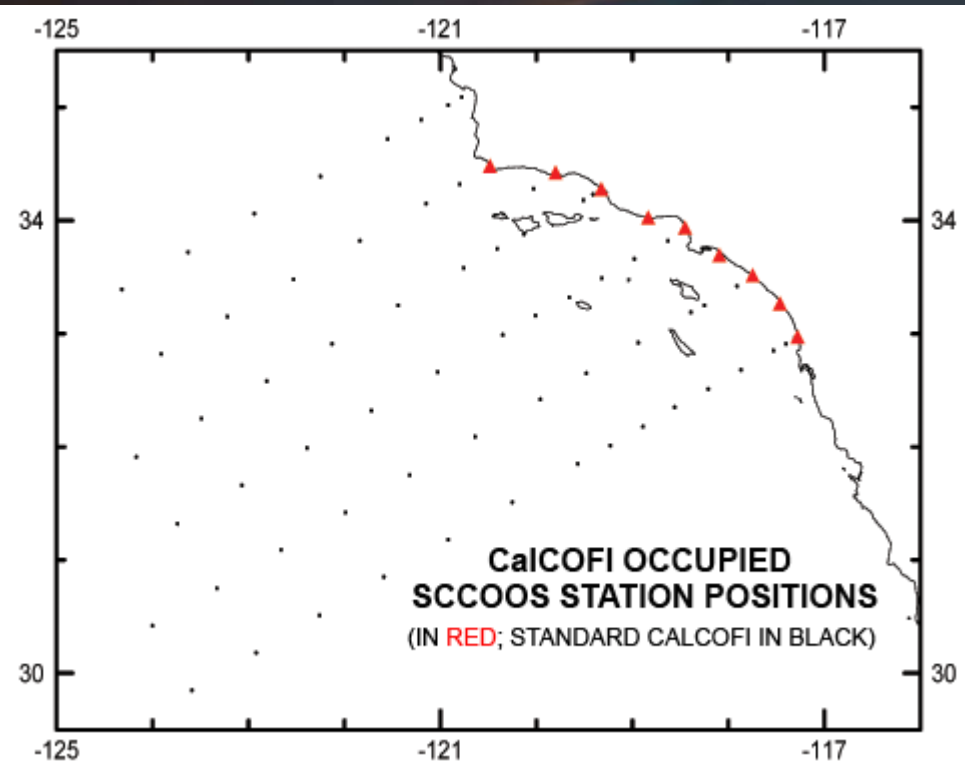
Improved database management  
across observing platforms

Fisheries oceanography, climate &  
ecosystem-based fishery management

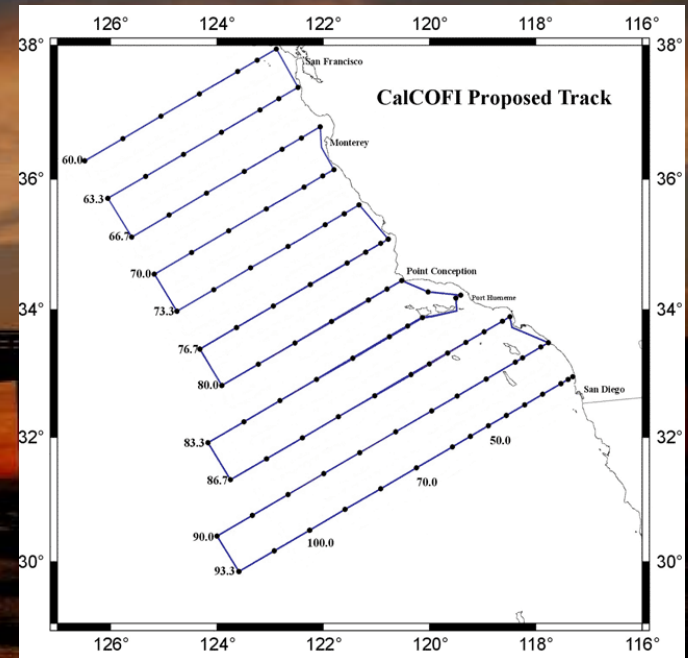
Expanded W coast sampling &  
integration



# Does CalCOFI have a role in MPA monitoring?



Should CalCOFI's expansion inshore (SCCOOS) continue N?



- Inshore communities are likely distinct
- A means to observe nearshore communities/larval production
- Monitor key state fisheries: squid, spiny lobster, urchins
- State funding



# ENSO & spiny lobster recruitment off Alta California

- Evidence from Martin Johnson from CalCOFI 1949-55 (!)
- Higher recruitment of juveniles (puerulus) during El Ninos: enhanced Davidson Current and advection from Baja

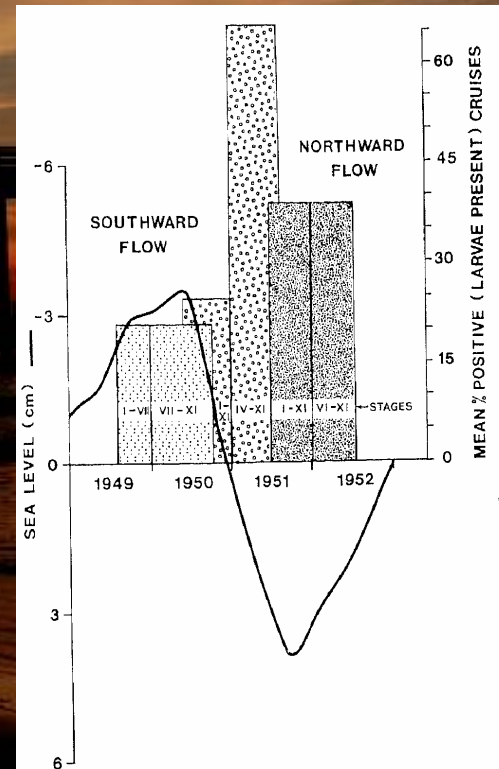
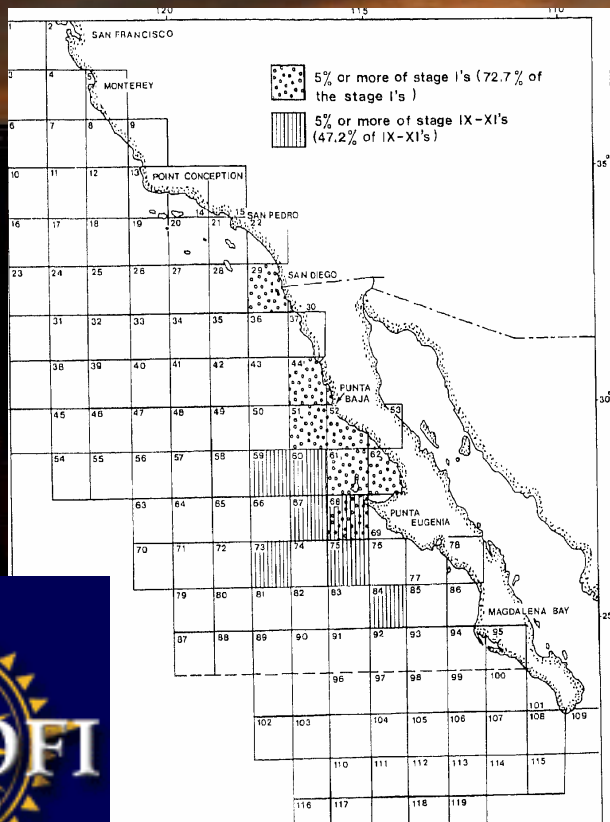


FIG. 5. Percent "positive" cruises (those cruises that captured *P. inter-raptus* phyllosome larvae; see Table 2) on the CalCOFI grid during 1949-52 inclusive compared with the steric height anomaly. Larval stages captured per temporal period are given.



(From Pringle 1986)

# Future CalCOFI directions

- Expand range of species to include key invertebrates
  - *Recruitment time series, environmental relations for market squid, spiny lobster*
    - Both exhibit ENSO response
    - Squid paralarvae now removed from CalCOFI neuston samples to 1981
    - Need fishery-independent time series to 1950 to assess long-term trends, responses to environmental change, e.g. what is the response to the regime shift of late 1970s?
  - *Improved management for key state fisheries (CDFG, OPC)*

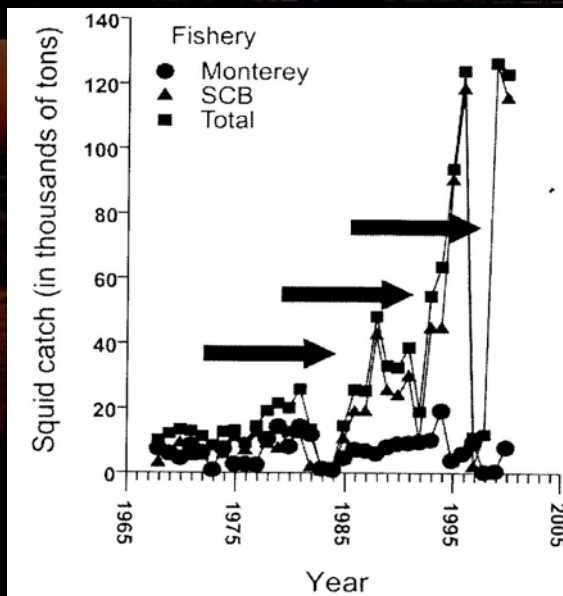


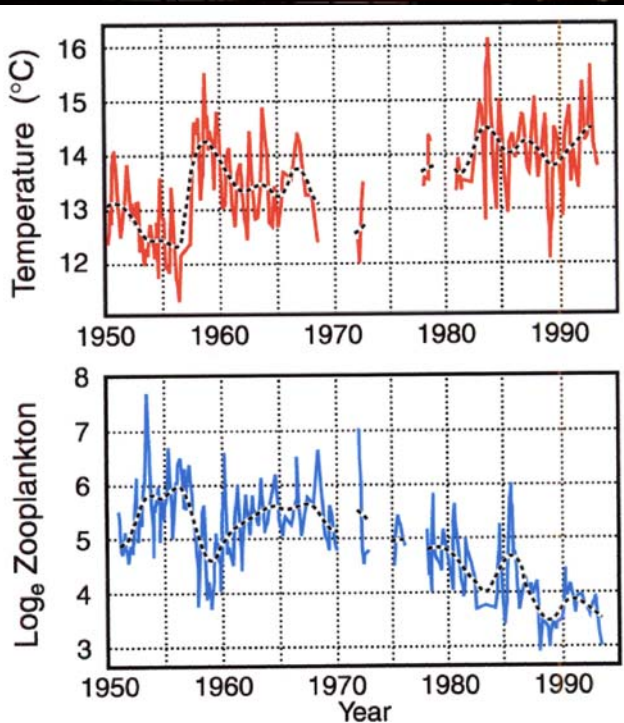
Figure 1. Plot of annual squid catch between 1965 and 2001 for Monterey (circles), Southern California Bight (triangles), and the total of both (squares). Arrows indicate fishery decline during El Niño periods followed by rapid recovery.



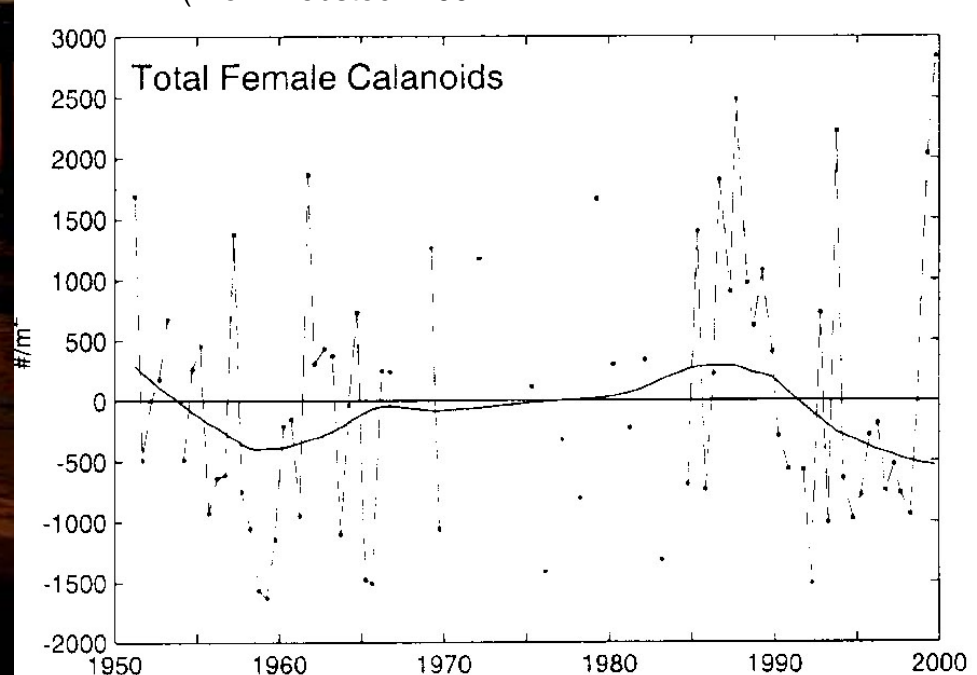
# Future CalCOFI directions

- Further analysis of existing samples & time series
  - *Zooplankton: DV too crude, species counts too difficult*
    - Image analysis (ZooScan, ZooImage, PlanktonJ): assess the biomass & size distribution of the zooplankton by major functional groups
    - Builds on Isaacs, Colebrook (1976) for 1955-59; Roemmich & McGowan; Ohman, Rebstock
    - Need to resolve the long-term trends and environmental relationships of the zooplankton in the California Current, relations to fish/invertebrate populations

(From Roemmich & McGowan 1995)



(From Rebstock 2002)



# Future CalCOFI directions

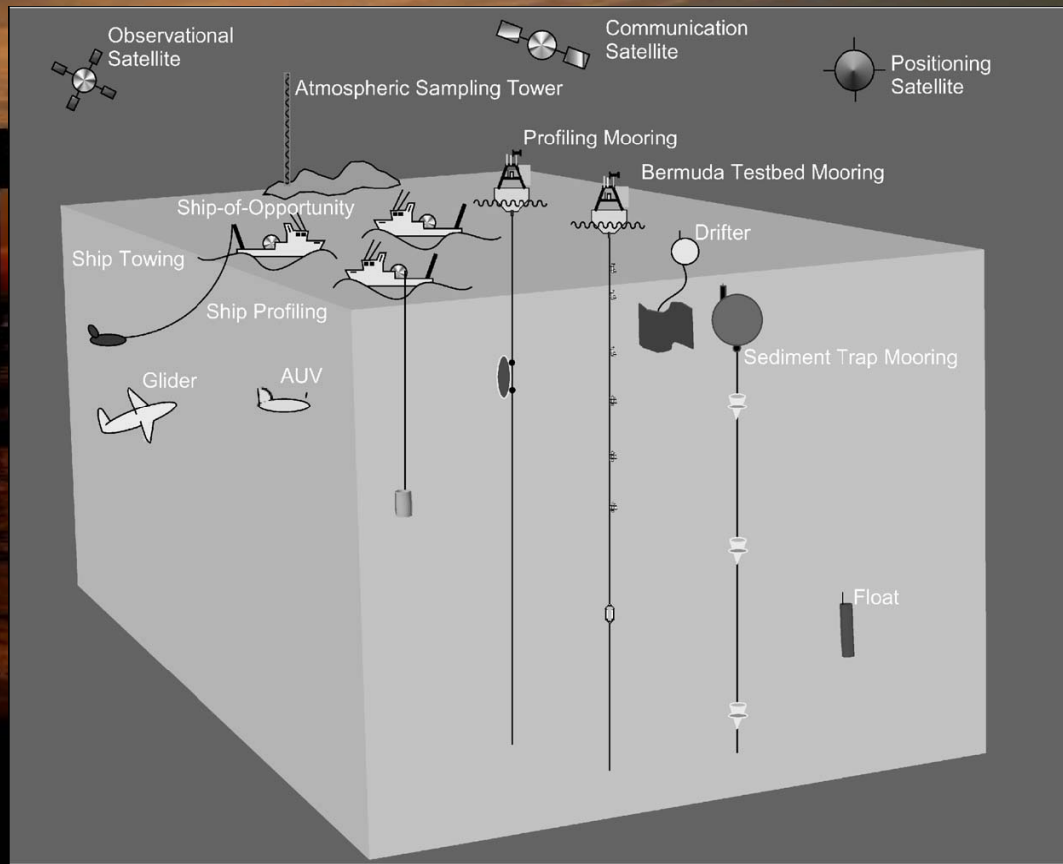
- Further analysis of existing samples & time series: Ichthyoplankton
  - ~400 taxa of fish larvae enumerated from CalCOFI samples
    - Comprehensive, detailed, highly complex data set
  - How has the biomass of fish assemblages changed within the California Current since 1950? (CalCOFI ichthyoplankton data used as a proxy for adult spawning stock biomass in combination with stock assessments)
  - Have the community and trophic structure and diversity of regional fish assemblages significantly changed over this period?
  - What are the implications of shifts in community and/or trophic structure for commercial and other key species of interest?
  - How has the fish community in the California Current responded to regime shifts, ENSO events, climate and zooplankton trends?
  - How can these potential shifts in assemblage and trophic structure and relationships with regional oceanography be incorporated within regional fisheries management?

(Sea Grant proposal)

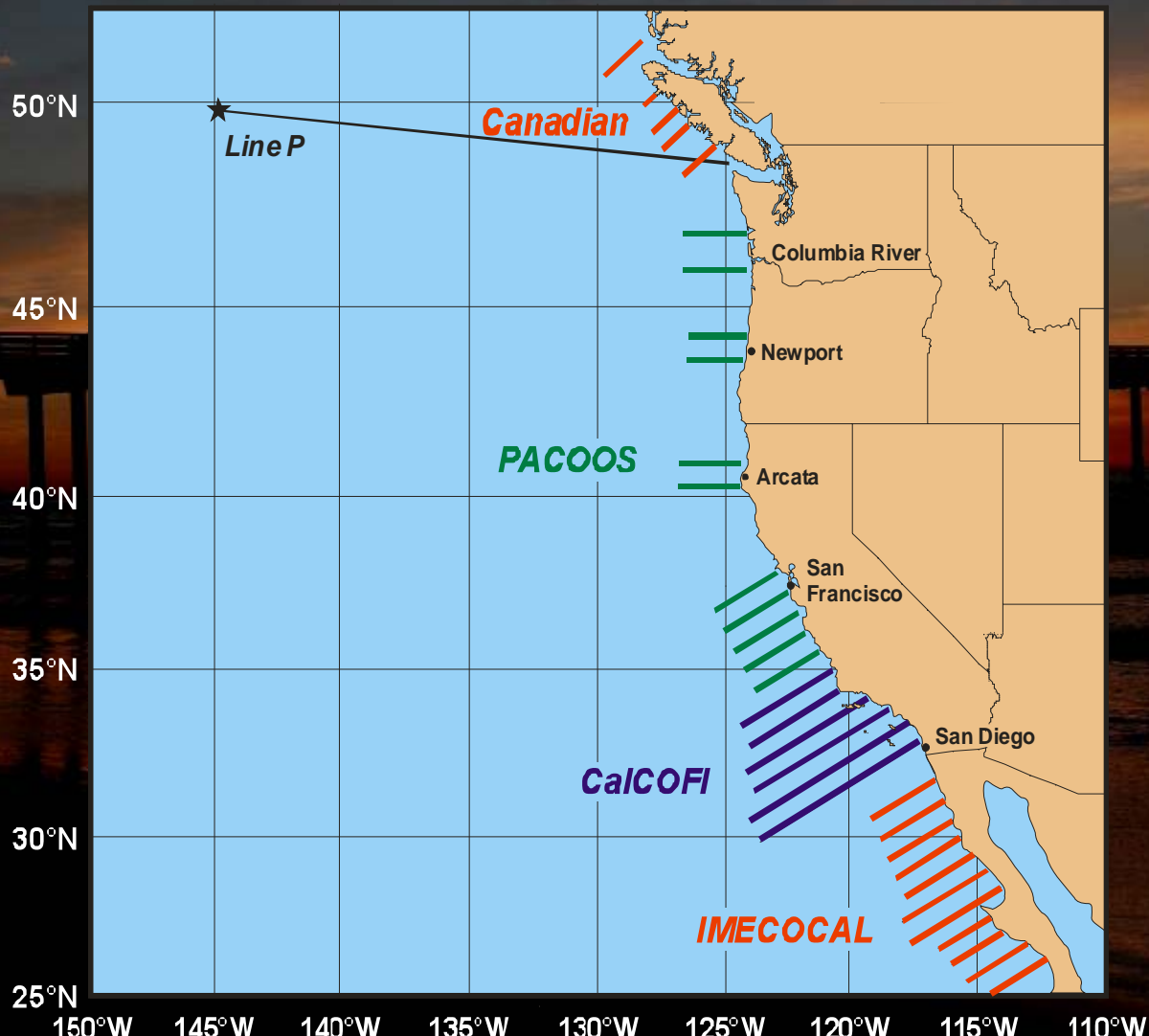


# Enhance sampling intensity in space & time

- Gliders (Davis, Ohman)
- MVP with LOPC between CalCOFI stations (Checkley, LTER)
- Moorings: ORION? Other?
- SOLOPC drifters? (Checkley)



# Integration with California Current-wide PaCOOS program



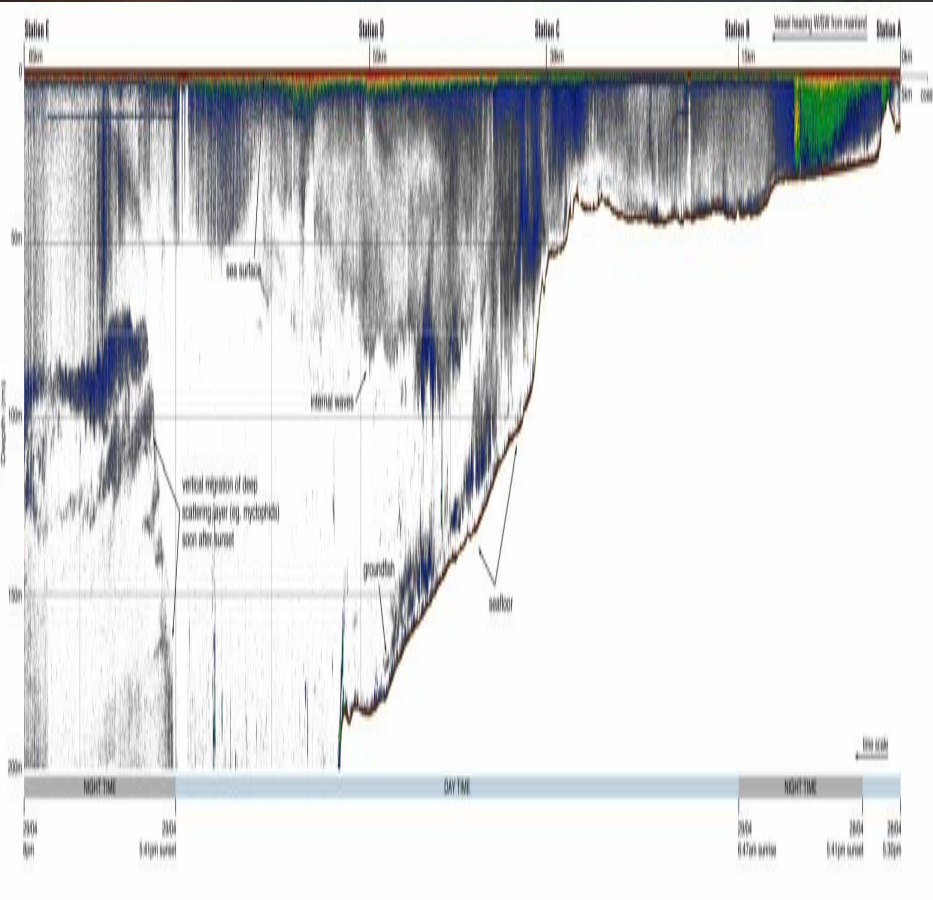
# Fisheries oceanography in the California Current

- What is the impact of pelagic fish predation in regulating plankton community structure?
  - *Pelagic fish biomass has varied by orders of magnitude*
  - *My PhD field study & model of anchovy feeding selectivity indicates it should be significant*
  - *Data available to test further models*
- What is the role of pelagic & meso-/bathypelagic fishes in the C flux to the deep ocean? Most net sampling has underestimated mesopelagic biomass by an order of magnitude
- What drives recruitment of dominant fishes in the CC? Late larval & juvenile life history stages appear critical. What is the role of eddies & other features/pelagic habitats on growth & survival? (Smith; NOAA proposal)
  - *Sampling in conjunction with CalCOFI*

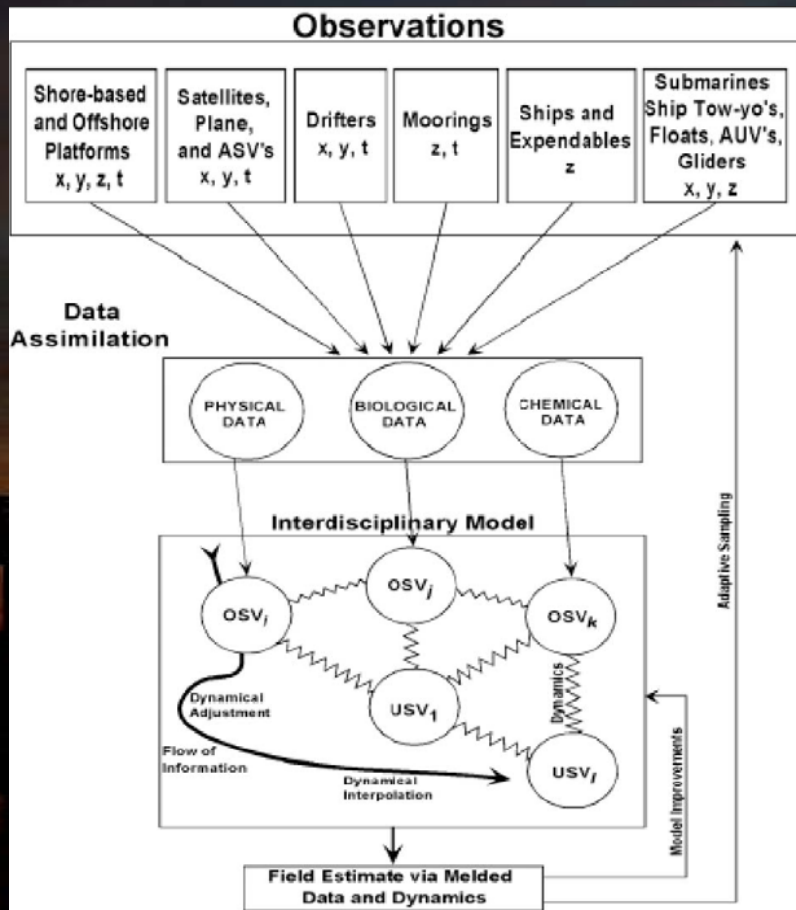


# Fisheries oceanography project requirements

- Calibrated multifrequency acoustics
- + quantitative trawl for sampling
  - + *ship time & collaborators (D Demer + .....*)



# The vision



## – Observations

- Modernized instrumentation (gliders, moorings, drifters, satellites + enhanced ship surveys)
- Full suite of relevant variables measured
- Ecosystem scale (California Current embedded in N Pacific system)
- Improved data management

## – Research

- Process-oriented research (rate parameters, assess critical processes) (LTER, fisheries oceanography)
- Time-series & spatial analyses of CalCOFI + augmented data (LTER, PaCOOS, SCCOOS, . . .)

## – Modelling & prediction

- 1- to 4-D models to test conceptual understanding, predict impacts of climate variability/change

## – Delivery to management

- Ecosystem-based fishery management: incorporate climate/ecosystem variability into management practices
- Input to adaptive management
- Design & monitoring of MPAs
- Manage impacts of climate change

*CalCOFI engaged in research, modelling & delivery, as well as ocean observation*



Thank you for your attention!

