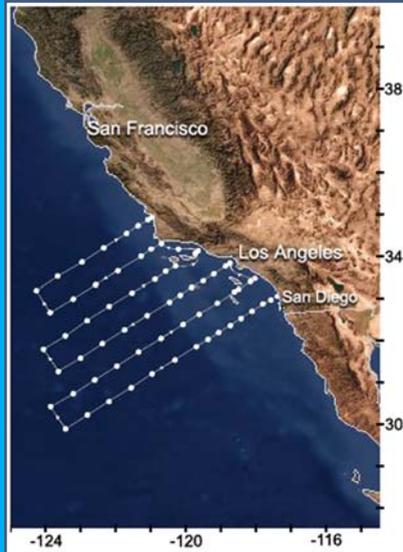


# California Current Ecosystem Long Term Ecological Research

The California Current Ecosystem (CCE) Long Term Ecological Research (LTER) site is an interdisciplinary group of scientists, students, and educators that is working to understand and communicate the effects of long term climate variability on the California Current pelagic ecosystem. The CCE site became part of the U.S. National Science Foundation-supported Long-Term Ecological Research network in 2004. CCE is based at the Scripps Institution of Oceanography/University of California, San Diego, but currently includes partners at four other institutions (Duke University, Georgia Institute of Technology, Point Reyes Bird Observatory Conservation Science, and the Southwest Fisheries Science Center/National Marine Fisheries Service). The CCE site welcomes scientific collaborations with visitors and researchers located elsewhere.

CCE research also is integrated with Education programs for local schools and Outreach efforts to convey research findings to a broader public audience.



For more information  
please contact:

<http://ccelter.sio.ucsd.edu>

California Current Ecosystem LTER site  
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La Jolla, CA 92093-0218  
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For more information about the LTER Network, see:  
<http://www.lternet.edu>

Merged  
SeaWiifs/MODIS-Aqua  
satellite ocean color  
image illustrating  
elevated  
phytoplankton  
concentrations along  
the U.S. west coast  
and Baja California  
that are characteristic  
of coastal upwelling.  
(Phytoplankton  
biomass ranges from  
red [high] to magenta  
[low]). Black in the  
offshore indicates  
clouds. Data from  
NASA, image  
produced by M.  
Kahru, Scripps  
Institution of  
Oceanography.

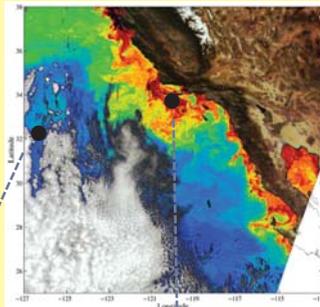
## California Current Ecosystem

LTER Long Term  
Ecological  
Research

The California Current Ecosystem (CCE) research site is a coastal upwelling biome, as found along the eastern margins of all major ocean basins. These are among the most productive ecosystems in the world ocean. The California Current system is of particular interest because it sustains active fisheries for a variety of finfish and marine invertebrates, influences weather patterns and the hydrologic cycle of much of the western United States, and plays a vital role in the economy of myriad coastal communities.

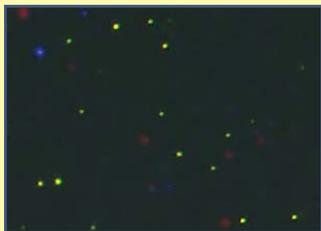
The CCE LTER site is investigating nonlinear transitions between different states of the California Current coastal pelagic ecosystem, with particular attention to the effects of a long-term warming trend, the Pacific Decadal Oscillation, and El Niño. The objectives are to understand how these and other processes alter the structure and dynamics of this plankton-based ecosystem.

**Spatial differences provide a clue about long-term change:** We use the spatial variability within the California Current to project how the planktonic ecosystem might change in response to climate variations over the long term. For example, the primary producers at the base of the food web may become increasingly dominated by tiny picoplankton cells rather than larger diatom cells.



GLI satellite ocean color image off of Southern California (red = high concentrations of phytoplankton chlorophyll a, blue = low concentrations, white = clouds, brown = land mass). Image courtesy of JAXA and the GLI science team.

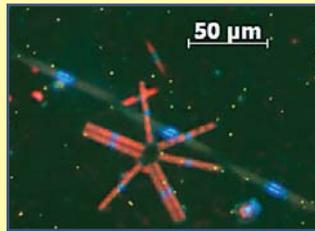
**Picoplankton-dominated**



Epifluorescence microscope images of plankton samples (green = protein, red = chlorophyll a, blue = DNA, orange = phycoerythrin). Photo: M. Landry.

Offshore: phytoplankton are primarily tiny photosynthetic bacteria ("picoplankton")

**Diatom-dominated**



Nearshore: large diatoms dominate the phytoplankton

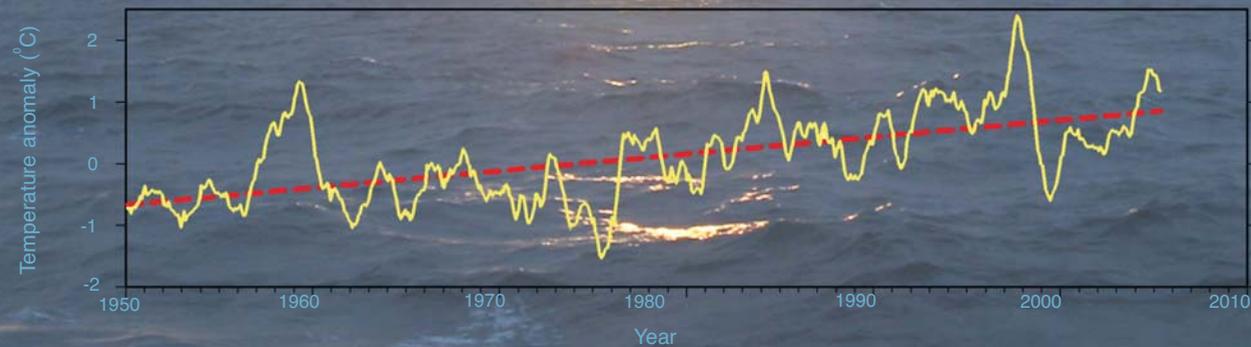
# The California Current Ecosystem LTER

site focuses on the planktonic food web.

Researchers seek to understand how climate variability, both natural and anthropogenic, alters this key ocean upwelling ecosystem.

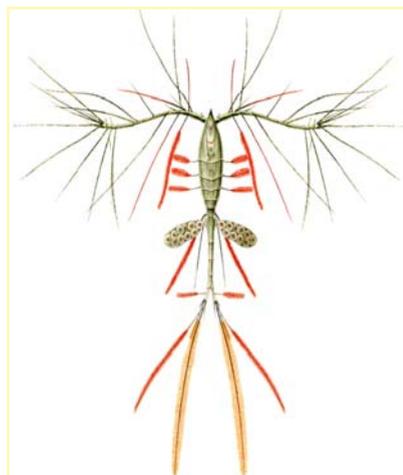
The California Current System is a dynamic ocean environment that varies from year-to-year as well as decade-to-decade. Scientists in the CCE LTER site are working to understand how natural sources of ocean

variability interact with anthropogenically-induced changes in the ocean ecosystem. The overall goal is to develop an understanding of how ocean productivity and biodiversity may change in the future.



Scripps pier temperature shows a progressive increase in ocean temperature, in addition to the effects of El Niño and multi-decadal variations.

## Central Research Questions



planktonic copepod

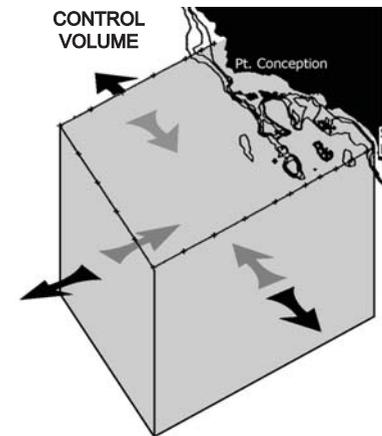
- What are the mechanisms leading to different ecosystem states in a coastal pelagic ecosystem?

- What is the interplay between changing ocean climate, community structure, and ecosystem function?

**Mathematical Modeling** is an integral part of this research. Models help test our level of understanding and eventually make ecosystem forecasts. CCE scientists are developing different types of models, including:

- Bio-physical models that couple interactions in the pelagic food web to computer simulations of 4-D ocean circulation
- Nonlinear time-series models
- Control volume property fluxes

Representing the ocean environment as a 'control volume' helps to understand fluxes of nutrients and organisms into and out of the boundaries of the study site.



Long-term measurements, together with experiments and numerical ocean models, permit researchers to go beyond simple correlations to understand the complex nonlinear dynamics underlying ecosystem variability.

CCE measurement programs include:

- Four augmented CalCOFI cruises each year, on a regular grid of 66 sampling stations
- Experimental process cruises, to assess key biological rates and interactions
- Satellite remote sensing
- Benthic time series measurements
- Nearshore measurements from the Scripps pier and Dana Point (in cooperation with the Ocean Institute)
- *Spray* ocean glider surveys



**Student research** is an integral part of the CCE LTER site. There are opportunities for students to pursue their PhD research and for undergraduates to participate in research experiences at CCE.

**CCE's Education and Outreach** fosters partnerships that bridge research science and formal/informal learning environments. An outreach coordinator promotes inquiry-based science and encourages community involvement.



**Information Management:**

The CCE LTER team is building an information management system as part of an informatics environment that serves as a digital hub for the site.

Please visit: <http://cclter.sio.ucsd.edu>