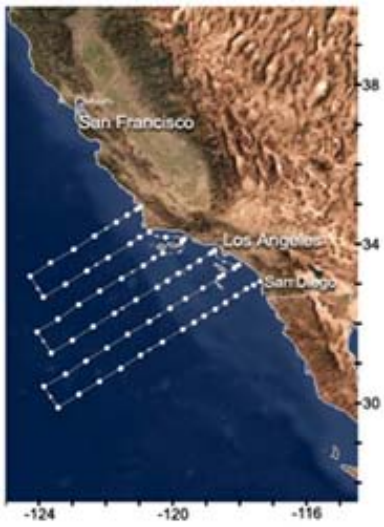
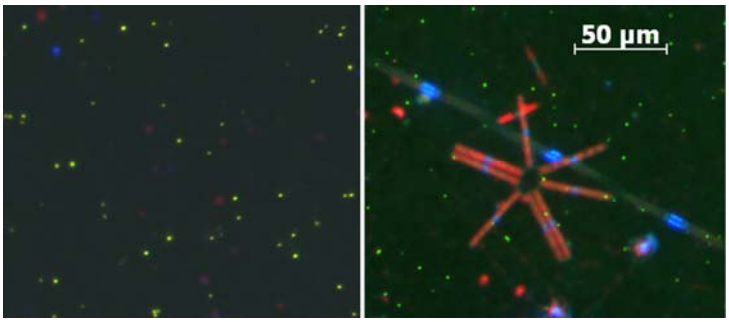
California Current Ecosystem (CCE)

The pelagic ocean California Current Ecosystem (CCE) LTER site was established in 2004 to understand the processes that govern this dynamic coastal upwelling ecosystem. The California Current System is part of the great clockwise circulation pattern of the North Pacific Ocean. It travels off the productive shores of California, Oregon, and Washington, sustaining active fisheries for a variety of finfish and shellfish and providing essential habitat for many invertebrates, marine mammals, seabirds, and kelp forests. It also modifies weather patterns and the hydrologic cycle of much of the western United States and plays a vital role in the economy of numerous coastal communities. Over 55 years of climate and ecosystem variations within the CCE site have been identified by the *California Cooperative Oceanic Fisheries Investigations* (CalCOFI) program. These include interannual fluctuations dominated by El Niño, longer-term variations represented by the Pacific Decadal Oscillation (PDO), and an ocean warming trend beginning in the 20th century. The CCE site seeks to understand how these multiple scales of climate forcing interact, and modify interactions between species, leading to altered structure and dynamics of the pelagic ecosystem. CCE researchers are particularly interested in the mechanisms leading to transitions between different ecosystem states. The overall goal of the CCE LTER is to develop an understanding of how ocean productivity and biodiversity may change in the future.



Site description and characteristics: The CCE LTER site encompasses 193,000 square kilometers of California coastal waters, extending from San Diego north to the major upwelling site at Pt. Conception and from the shoreline approximately 500 km offshore. The sampling grid builds on the transect lines of CalCOFI, currently consisting of six tracks extending from nearshore to offshore, along which shipboard observations are made quarterly at 66 stations. This region lies between ca. 30-35º N and 117-124º W. It is representative of the productive coastal upwelling biomes found along the eastern margins of all major ocean basins. The water column food web is markedly affected by physical ocean characteristics, and thus variations in upwelling, turbulent mixing, density stratification, and ocean circulation have important consequences for ocean communities. This linkage to the physical environment is particularly true for the planktonic organisms near the base of the food web. The CCE study site encompasses diverse planktonic communities, extending from upwelling-dominated plankton assemblages to stably stratified offshore assemblages typical of the subtropical gyres.

Allied measurement programs within the CCE site include satellite remote sensing, autonomous ocean gliders, seabird and mammal surveys, and nearshore measurements in the coastal zone. The CCE group is based at the Scripps Institution of Oceanography (SIO)/ University of California, San Diego, and includes partners at several other institutions (Duke University, Georgia Institute of Technology, Monterey Bay Aquarium Research Institute, Point Reyes Bird Observatory Conservation Science, and the Southwest Fisheries Science Center/ National Marine Fisheries Service).



Epifluorescence microscope images of California Current phytoplankton. (L) *Synechococcus* and other picoplankton from stratified waters, (R) chain-forming diatoms from upwelled waters.

Research focus: The central research questions are 1) What are the mechanisms leading to different ecosystem states in a coastal pelagic ecosystem? and 2) What is the interplay between changing ocean climate, community structure and ecosystem dynamics? To address these questions, CCE scientists use an integrated research program with three primary elements:

1) **Experimental process studies** focus on changes in the planktonic food web in response to water column stratification;
2) **2) Time series studies** evaluate alternative hypotheses using space-resolving time series measurements, including high-frequency temporal measurements at nearshore locations, satellite remote sensing, ocean glider surveys, and an extensive quarterly shipboard measurement program;
3) **3) Mathematical modeling** helps to quantify the dynamics underlying the observations. These models provide a platform for hypothesis testing through numerical experiments, furnish a means for dynamic interpolation between observations in space and time, and help optimize the field program.

In addition, the **Information Management** and **Education and Outreach** components within the CCE site facilitate the exchange of research findings with other LTER partners, educators, policy makers, and the general public. The information management system contains multiple layers for data storage, access, and discovery. The education and outreach program teams up scientists, educators, and external partners in the "K through grey" community to communicate both the scientific process and understanding gained from this research.