Santa Barbara Coastal (SBC)

The mission of the Santa Barbara Coastal LTER (SBC LTER) is to understand the linkages among ecosystems at the land-ocean margin through interdisciplinary research, education and outreach. Our principal study area is the Santa Barbara Channel and the coastal watersheds that drain into it, and our focal ecosystem is giant kelp forests, which occur on shallow rocky reefs at the interface of the land-sea margin in temperate regions throughout the world. The focus of SBC LTER research is on developing a predictive understanding of the structural and functional responses of giant kelp forest ecosystems to environmental forcing from the land and the sea. The amount of nutrients and organic matter delivered to the kelp forest from land and the surrounding ocean varies in response to short- and long-term changes in drivers such as climate, ocean conditions and land use. Variation in the supply of these commodities interacts with physical disturbance to influence the abundance and species composition of the forest inhabitants and the ecological services that they provide.

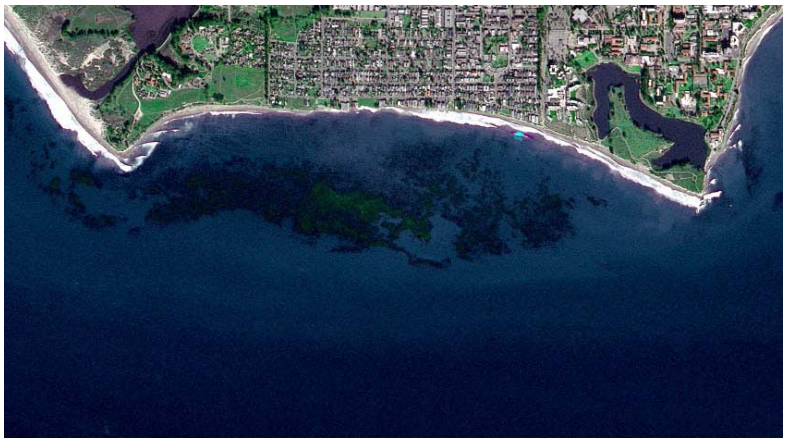
Site characteristics. SBC LTER encompasses the coastal region of Santa Barbara, California, USA (34.42 N, 119.95 W). It is bounded by the steep east-west trending Santa Ynez Mountains to the north and the Northern Channel Islands archipelago to the south. Point Conception, where the coast of California shifts to an east-west orientation, forms the western boundary and the Santa Clara River marks its eastern edge. The site lies on the active boundary of the Pacific Oceanic Plate and the North American Continental Plate. High levels of tectonic activity have created dramatic elevational gradients in both the terrestrial and the underwater landscapes of the site. The Santa Barbara Channel includes some of the deepest ocean basins known on the continental shelf of the US along with remarkable submarine canyons and escarpments.
As in many temperate regions throughout the world, shallow rocky reefs in the Santa Barbara Channel are dominated by giant kelp forests. Giant kelp, *Macrocystis pyrifera,* is the world's largest and fastest growing submarine plant. The rapid growth and high turnover of giant kelp result in very high rates of primary production making giant kelp forests one of the most productive systems on earth. The characteristic three-dimensional structure of giant kelp, coupled with its extremely high productivity, enable kelp forests to provide food and habitat for a rich diversity of algae, invertebrates, fishes, birds and marine mammals, many of which are ecologically and economically important. Giant kelp itself is of great commercial value, with thousands of tons harvested annually in California.

The spiral growing tip of a giant kelp (*Macrocystis pyrifera*) frond

Santa Barbara is characterized by a Mediterranean climate with mild, moist winters and moderately warm, generally rainless summers. Average high temperatures range from 11° C in December and January to 19° C in August and the vast majority of rainfall occurs between December and March. Annual precipitation in the region averages 430 mm, but varies greatly among years ranging from less than 180 to more than 1100 mm in the past 150 years. Peak rainfall years are often associated with El Nino Southern Oscillation (ENSO) events, which produce striking physical and biological responses in the Santa Barbara Channel. Terrestrial

runoff and the associated transport of sediments, nutrients, and organic matter to the ocean increase dramatically because of elevated precipitation. Sea surface temperatures increase, sea level rises, and offshore nutrient levels decline as the thermocline deepens. Large-scale patterns of ocean circulation also change dramatically, and storm disturbance from waves is often extreme. These ENSO conditions dramatically influence the growth, standing crop and production of giant kelp and the organisms that associate with it. Not surprisingly, giant kelp forests in SBC LTER are very dynamic and their standing crop, size structure and aerial extent vary dramatically over time.

Research focus. A major focus of SBC research is on the importance of bottom-up processes and allochthonous inputs to giant kelp forests. Although there is increasing concern about the impacts of human activities on coastal watersheds and nearshore marine environments, there have been few long-term studies of the linkages among the coastal ocean, shallow nearshore reefs, and terrestrial habitats. SBC LTER is helping to fill this gap by studying the effects of oceanic and coastal watershed influences on kelp forests in the Santa Barbara Channel. Integrative measurements, experiments, and modeling are used to examine questions and test hypotheses pertaining to giant kelp forests that relate to the transport and processing of organic and inorganic materials, patterns and control of primary production, disturbance and population dynamics of key species, species interactions, trophic structure, and food web dynamics. Interdisciplinary studies coordinated among more than twenty investigators are designed to determine the effects of land use patterns on the distribution and movement of nutrients, sediments, and organic matter across landscapes, their transport and modification by streams and estuaries, and the effects of stream outflows and coastal ocean processes (e.g., upwelling, currents, waves, and water column productivity) on population, community, and ecosystem level processes in giant kelp forests. Education and training are tightly integrated into all aspects of our research through SBC's Schoolyard (K-12 students and teachers), undergraduate, graduate and postdoctoral training programs. A major goal of our Schoolyard and public outreach programs is to instill a strong appreciation for stewardship of coastal land and marine habitats and to connect local environmental issues with basic principles of science education for a lifetime of learning.



SPOT image of the Santa Barbara coast near UC Santa Barbara showing kelp forests in shallow water. © CNES 2006, Distributed by Terra Image USA, LLC and SPOT IMAGE