Santa Barbara Coastal LTER
Field Trip Briefing Booklet

Prepared for the National Science Foundation Site Review Team

October 29 & 30, 2009
Santa Barbara, CA

SBC LTER FIELD TRIP SCHEDULE

Thursday October 29, 2009
8am – 4 pm

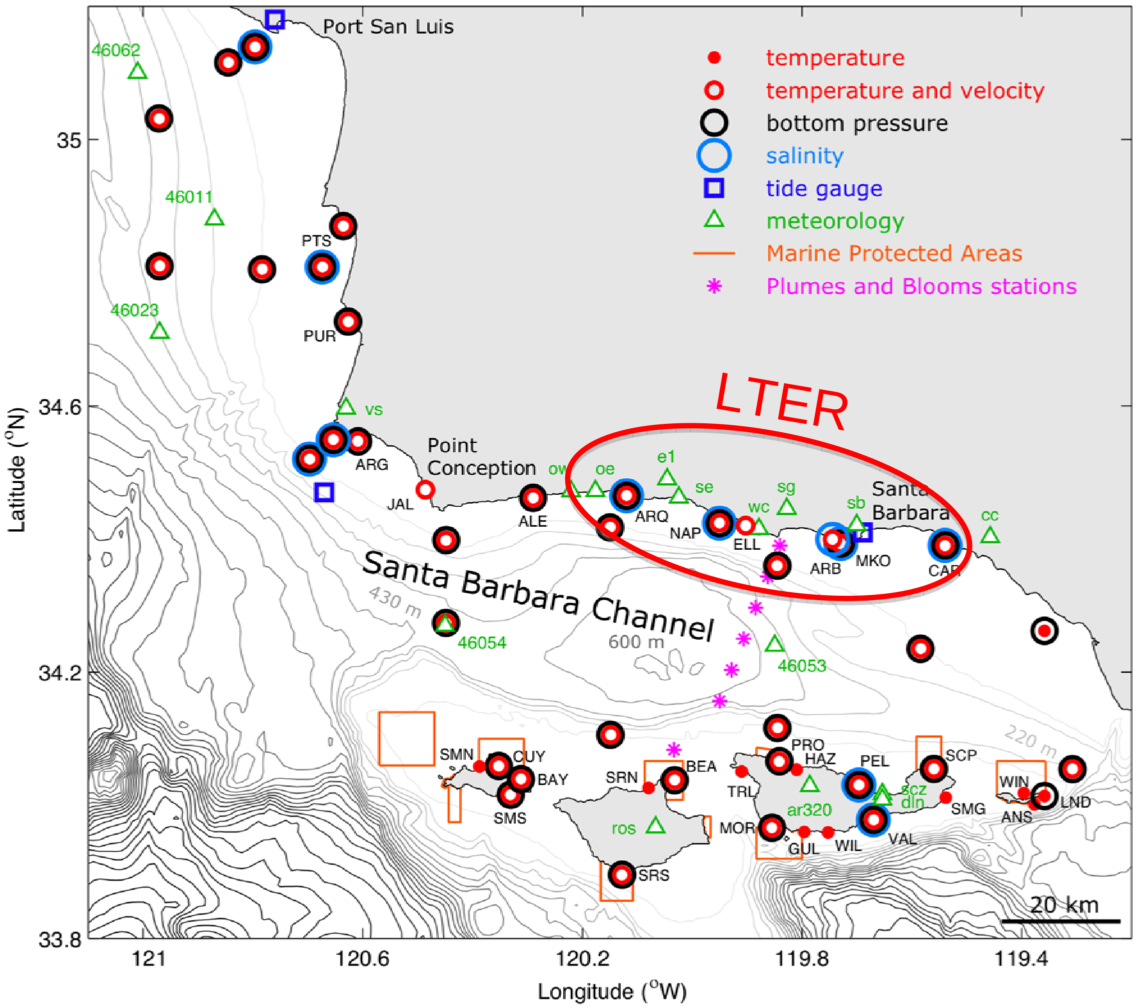
Location	TOPIC	SPEAKER
SB Harbor	Introduction to the SBC LTER	Dan Reed
Mohawk Reef	Coastal Oceanography	Melanie Fewings
	Giant kelp Net Primary Production	Andy Rassweiler
	Rates of Dissolved Organic Carbon Release by Giant Kelp	Elisa Halewood
	Interactions among Primary Producers in Giant Kelp Forests	Bob Miller
	Long-term Studies of Kelp Forest Dynamics	Shannon Harrer
	Plumes & Blooms - Ocean Color Variability in Case II Ocean	Dave Siegel
transit	SBC LTER Education and Outreach: Using Today's Science to Teach Tomorrow's Scientists	Scott Simon
Carpinteria Reef	Offshore Production and Transport of C & N to Kelp Forests	Libe Washburn
	CALobster Collaborative Fisheries Research	Matt Kay
	Remote Assessment of Giant Kelp Production and Dynamics	Dick Zimmerman
	State Changes in Reef Communities	Sally Holbrook
	Particulate Organic Matter in Coastal Ecosystems: Composition and Use by Suspension Feeders	Mark Page
	Overview of SB Watersheds	John Melack
Leadbetter Beach	LUNCH	
	Kelp Forest Subsidies to Sandy Beach Ecosystems	Jenny Dugan
	Ecological History of Coastal Santa Barbara	Jenny Dugan
Rocky Nook	Hydrological Modeling of Stream Discharge	Ed Beighley
	Modeling Effects of Urban Connectivity on Water Balance in Mission Creek	Catherine Shields
	Does productivity drive diversity or vice versa? Testing the multivariate productivity-diversity hypothesis in streams	Brad Cardinale
Rattlesnake Canyon	Stream Discharge Measurement and Hydrochemical Sampling	Blair Goodridge
	Fire, Fish, Flood, and Land Use Effects on Streams	Scott Cooper
	Santa Barbara Burning	Josh Schimel

Physical Oceanography and Biochemical Ocean Monitoring

Melanie Fewings, Libe Washburn, and Mark Brzezinski

We collect **long-term time series** data to **characterize physical and biochemical processes** such as transport of sediments, freshwater, and nutrients from land; coastal upwelling; internal tides; surface wave forcing; and along-shelf flow forced by wind and pressure gradients. We study these abiotic mechanisms as **drivers of kelp forest ecosystem processes** via their effects on transport of nutrients, spores, and larvae.

Unique and Comprehensive Physical, Optical, and Biochemical Ocean Data



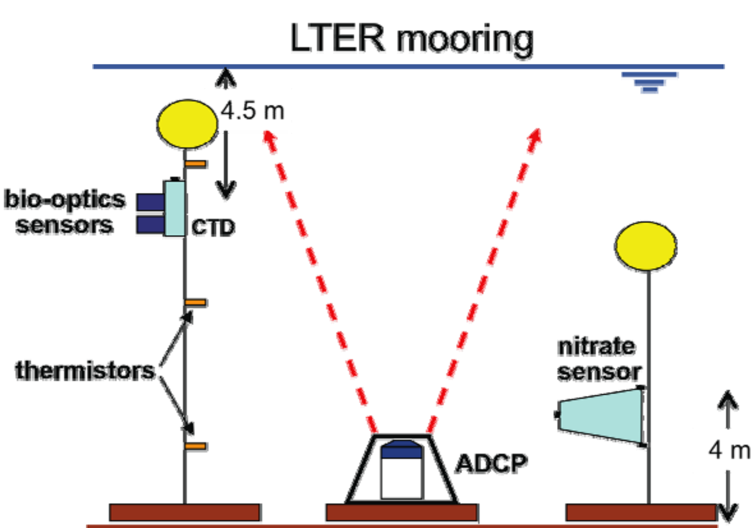
Moored Time Series (at left)
- Current velocity
- Temperature
- Surface and bottom irradiance
- Bottom pressure
- Surface wave height and period

Sampling by Small Boat
- Salinity and temperature profiles
- Bottle samples for nutrients, chlorophyll, organic matter

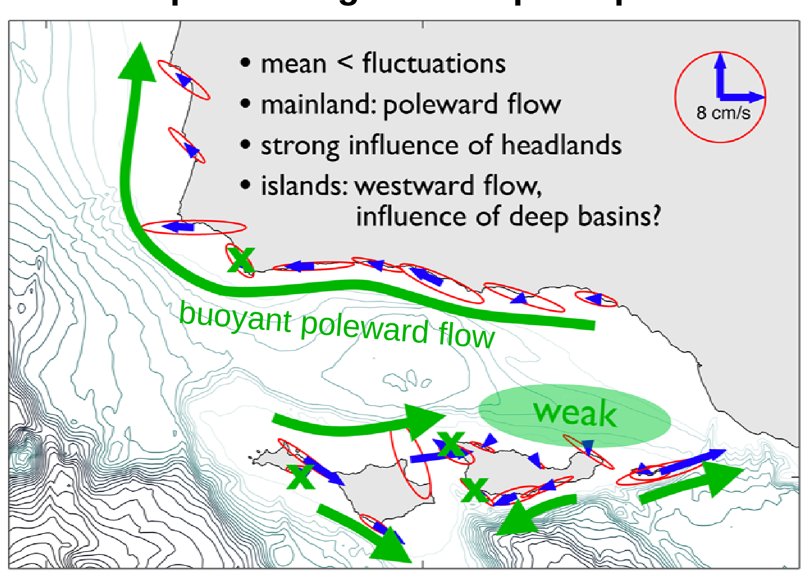
Event-Response Sampling
- for storm runoff

Focused Campaigns
- stream water dispersal

Real-Time Sensor Networks
- Pier sampling (temp, salinity, etc)
- HF radar for surface currents



Mean depth-average flow & principal axes



Giant Kelp Net Primary Production

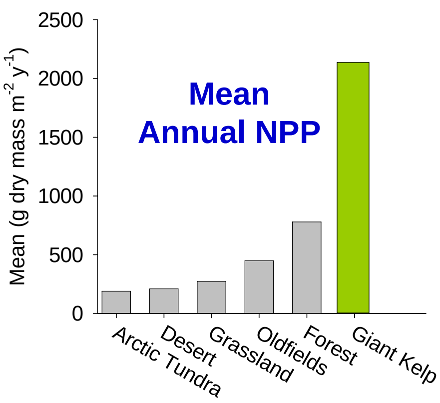
Andrew Rassweiler, Dan Reed and Katie Arkema

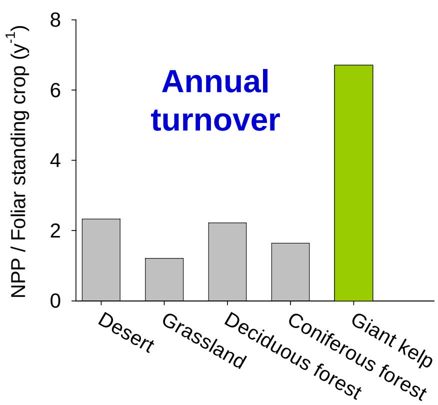
Our long–term investigations are aimed at determining patterns of NPP by giant kelp under different climatic and oceanographic conditions. Data obtained from intensive measurements at 3 sites have revealed the environmental drivers of temporal variation in NPP. They also validate less intensive methods for predicting kelp biomass and NPP across broader regional scales.

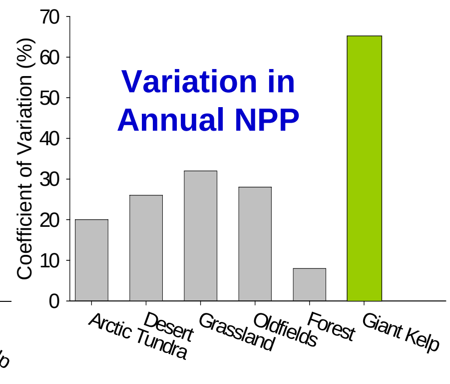
To estimate giant kelp NPP we

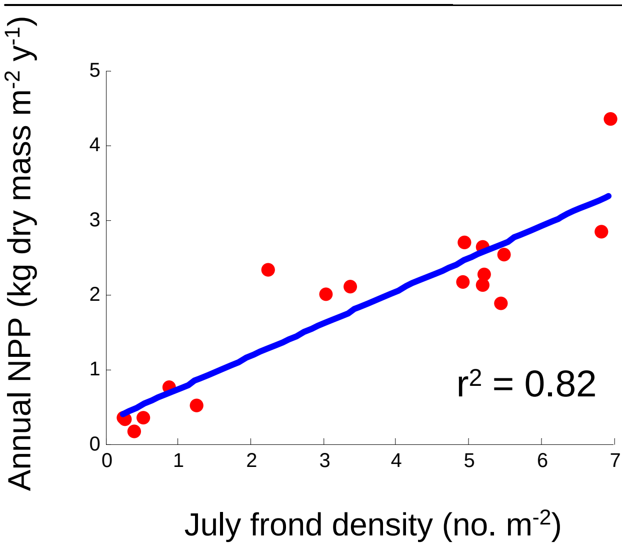
- Measure biomass monthly at 3 sites.
- Estimate loss rates over a month from observed loss of tagged plants and fronds.
- Calculate the growth rate and NPP that explain the change in biomass, given the loss rates

Patterns in NPP and growth relative to other ecosystems









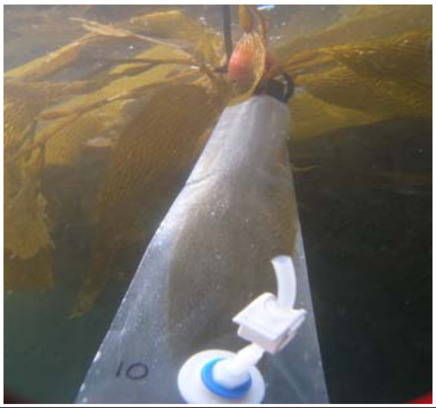
Broader implications

- Results lead to predictions about the role of disturbance as a driver of kelp NPP
- We can extend our analyses to a regional scale using summer frond density as a proxy for NPP
- But we have not observed a full range of conditions; Will our current results hold in a strong El Nino?

Rates of Dissolved Organic Carbon (DOC) release by Giant Kelp

Elisa Halewood, Shannon Harrer, Clint Nelson, Dan Reed and Craig Carlson

Our long-term estimates of Net Primary Production (NPP) by *Macrocystis pyrifera* are based on allometric relationships that do not account for the loss of organic carbon in the dissolved organic phase. Here we aimed to determine rates of DOC release by kelp fronds, and to include this loss term in estimates of NPP.

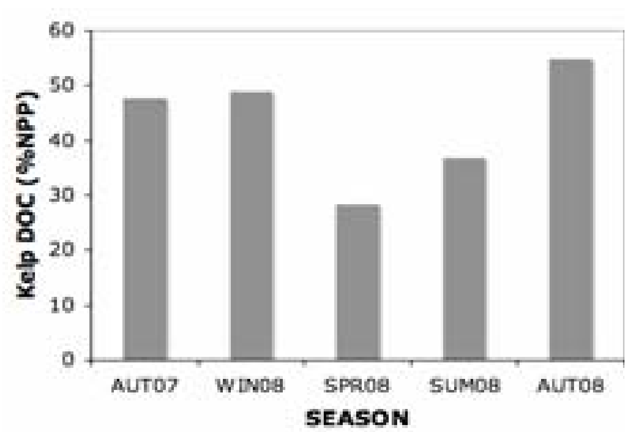


I. Methods

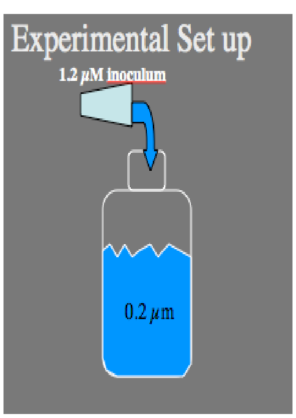
- *In situ* incubation experiments were done at Mohawk Kelp Forest seasonally by sleeving kelp blades with polyethylene bags for ~3 hours during mid day. DOC was measured at T_0 and T_f.
- DOC release rates were incorporated with seasonal NPP measurements from the long term data set.

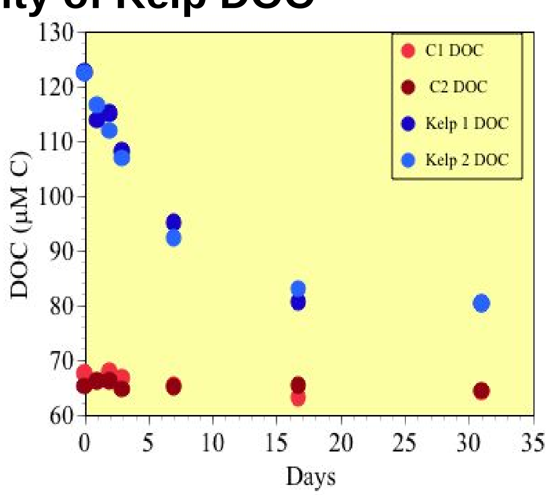
II. Results

The contribution of DOC to giant kelp NPP varied considerably throughout the study, but on average accounted for 43% of production indicating DOC is a significant component of NPP by *Macrocystis*.



III. Bioavailability of Kelp DOC





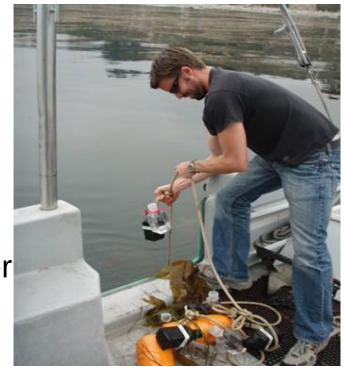
- A large fraction of kelp DOC is remineralized by the microbial community in the forest, but a portion remains unused and potentially available for export from the reef ecosystem.
- Understanding production and fate of *Macrocystis* DOC has greater implications for carbon cycling within the nearshore ecosystem.

Interactions Among 1º Producers in Giant Kelp Forests

Robert Miller, Dan Reed, and Mark Brzezinski

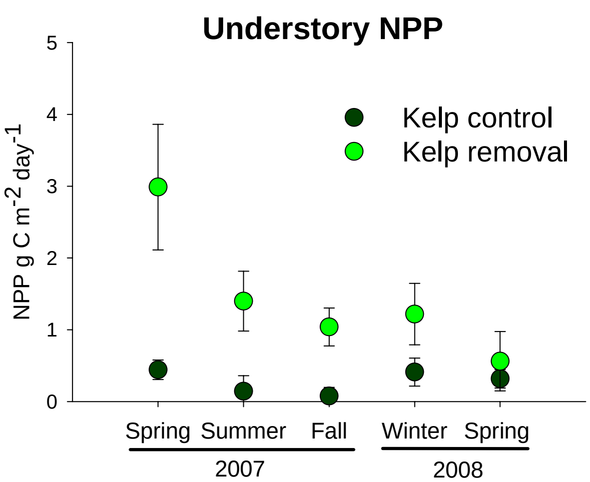
We removed giant kelp from a plot at Mohawk Reef and compared rates of primary production by understory macroalgae and phytoplankton to those within an intact kelp forest to determine the extent to which NPP by the kelp forest ecosystem is altered by changes in the abundance of giant kelp.

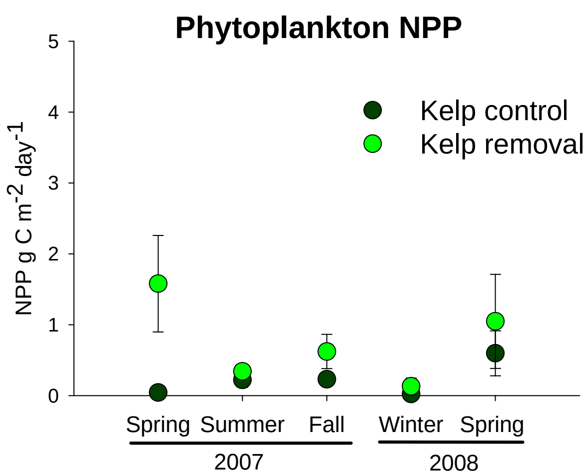
- NPP by understory algae was measured *in situ* as changes in dissolved O_2 in closed chambers.
- Incubations were done in the light and dark over the course of a day during daylight hours



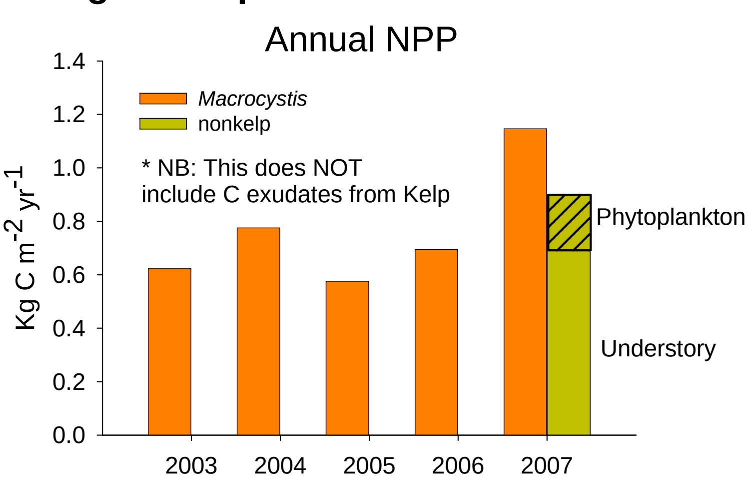
- Phytoplankton NPP was measured in light and dark bottles at 5 depths using ^{13}C bicarbonate tracer incubations.
- Incubations began in the morning and lasted 24 hours

Kelp suppresses understory macroalgal NPP more than phytoplankton NPP





NPP by understory macroalgae and phytoplankton contribute significantly to ecosystem NPP following the loss of giant kelp due to disturbance



Long-Term Studies of Kelp Forest Dynamics

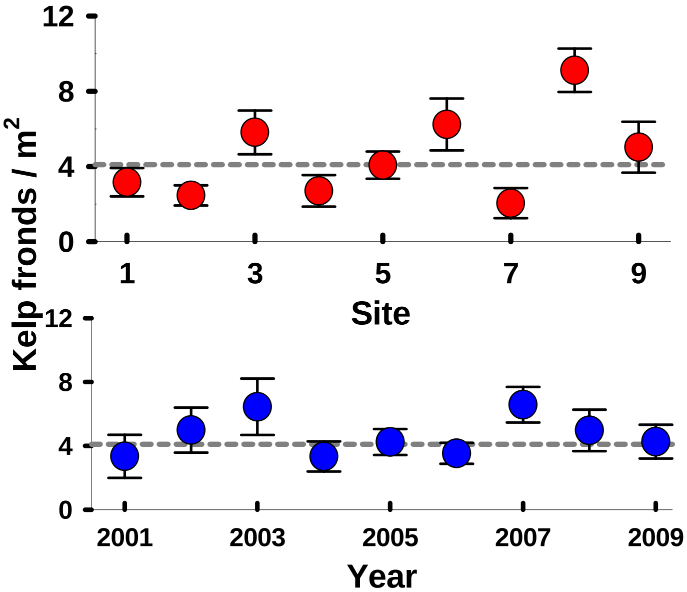
Shannon Harrer, Sally Holbrook and Dan Reed

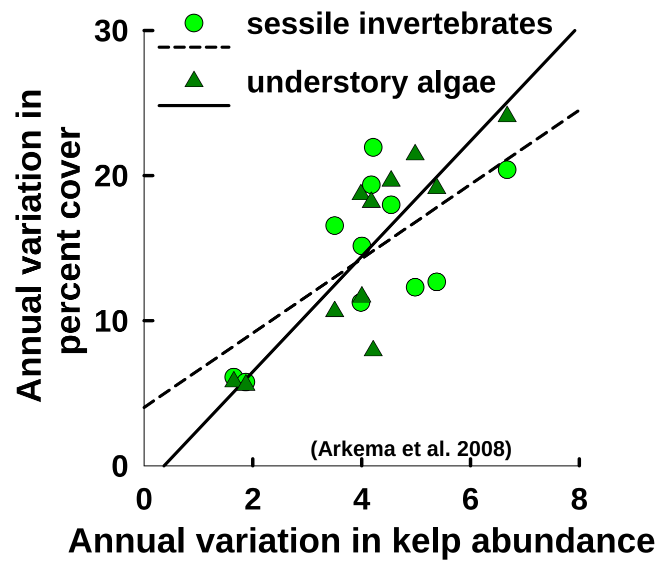
Annual data on kelp forest community structure collected over the long-term provide information on population dynamics and species change and offer correlative insights into their underlying drivers. A recently initiated long-term experiment is providing a mechanistic understanding of ecosystem responses to increased frequency of kelp loss that may arise from climate change.

Data on the abundance of ~ 250 species of algae, invertebrates and fish are collected annually in summer in permanent plots at 9 mainland and 2 island reef sites.

Physical parameters recorded at each site include reef topography, substrate type, bottom temperature and swell profile.

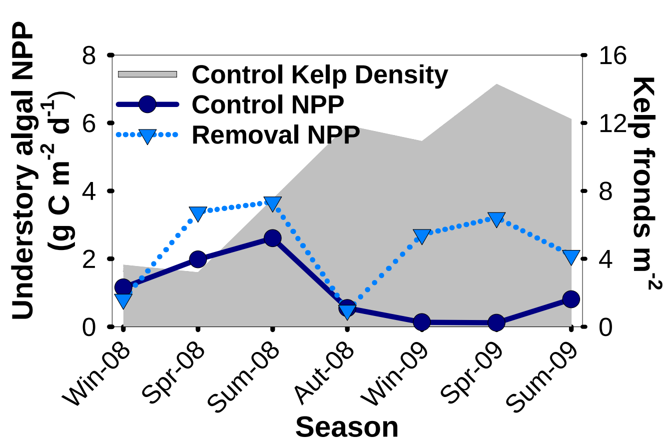
Kelp forest communities vary greatly in space and time.





Drivers of community dynamics.

- Long-term kelp removal experiment initiated in January 2008 at 4 sites that display different dynamics.
- Purpose is to understand short and long term consequences of annual kelp loss on kelp forest structure and function.
- Species abundance & rates of biological processes measured 2x per season

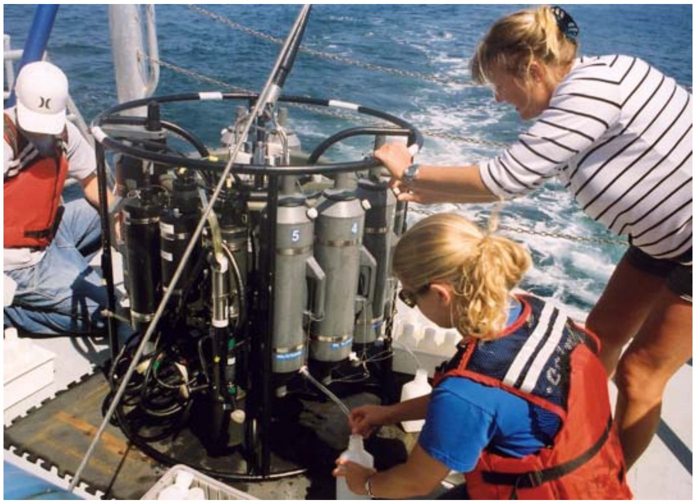


Plumes & Blooms - Ocean Color Variability in Case II Ocean

David Siegel & Stéphane Maritorena

Plumes & Blooms (PnB) focuses on the understanding ocean color variability in highly variable coastal environment with the goal of improving coastal satellite ocean color observations. PnB makes monthly cross-channel surveys and collaborates with the SBC-LTER on studies of oceanographic variability, phytoplankton community structure, HABs, inorganic/organic carbon cycle dynamics, etc. PnB is funded by NASA.

Monthly Sampling of Optical, Physical & Biogeochemical Parameters



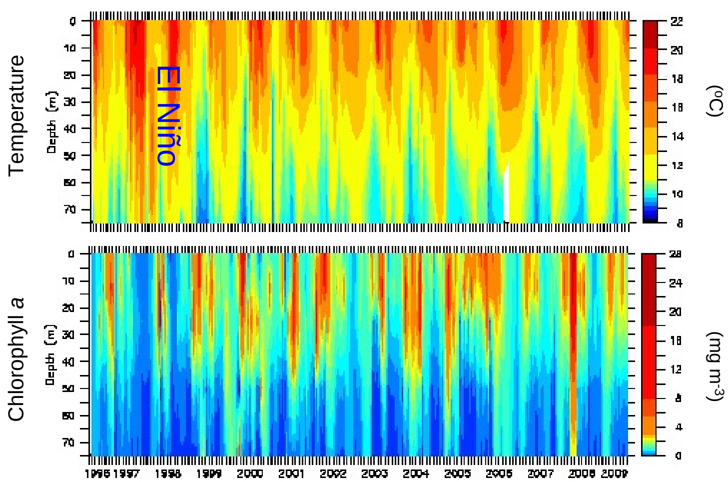
Monthly 7 station transect on NOAA R/V Shearwater

In situ Profile Parameters Sampled

- Ocean color spectra (profiling radiometer)
- Total absorption & scattering spectra (AC-9)
- Backscatter spectra (Hydroscat)
- Particle size spectra (LISST-900)
- Salinity, temperature, depth

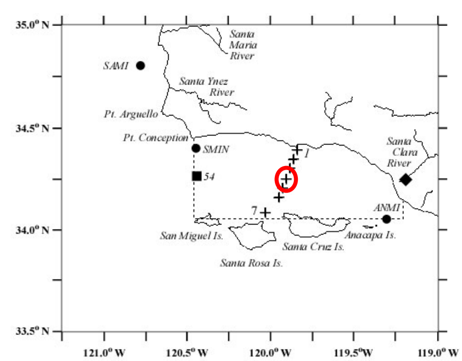
Bottle sample Parameters Sampled

- Phytoplankton, dissolved organic & detrital absorption spectra (spectrophotometry)
- Nutrients (NO_3, PO_4, SiO_4)
- Phytoplankton pigments
- Dissolved inorganic & organic carbon
- Particulate silica (biogenic & lithogenic)

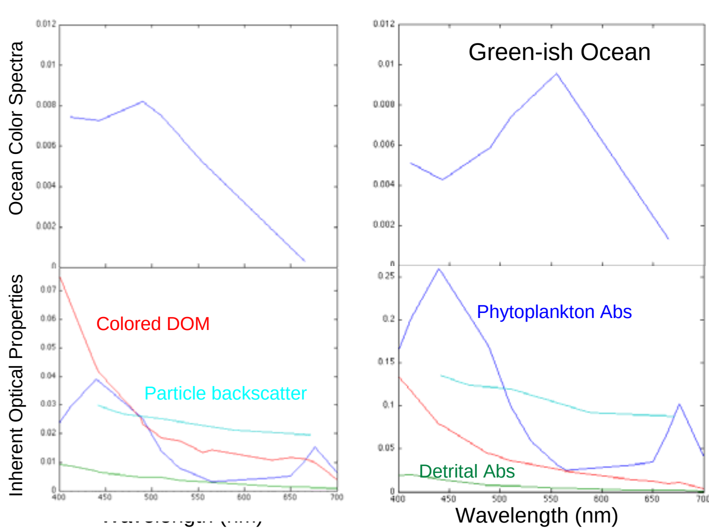


PnB Time Series Observations

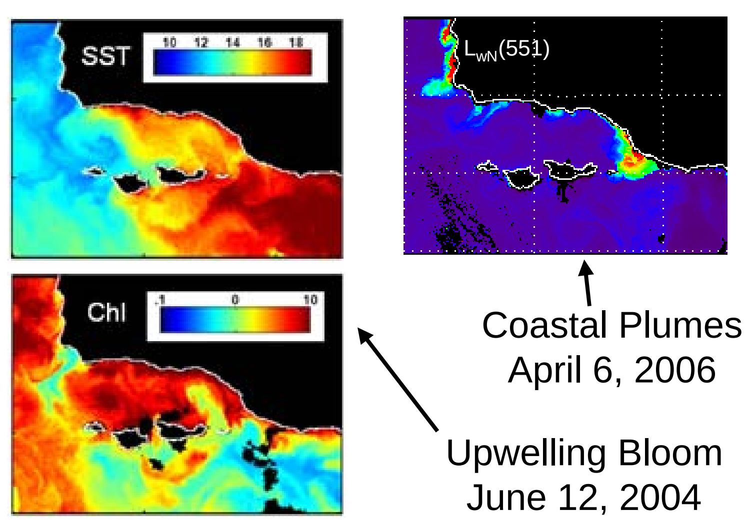
Time-depth contours at PnB Station 4



Ocean Color Spectral Observations



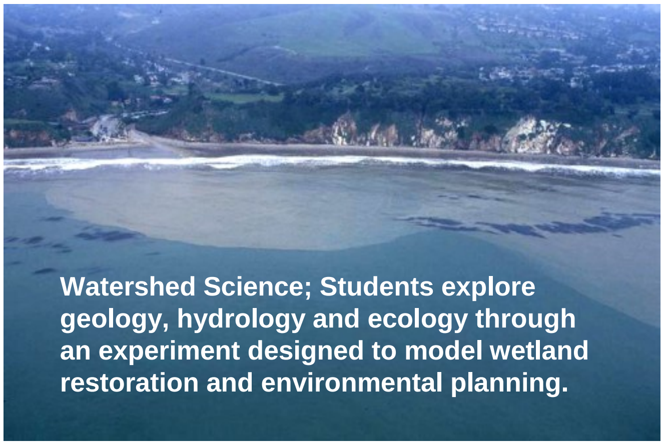
Satellite Observations



SBC LTER Education and Outreach: Using Today's Science to Teach Tomorrow’s Scientists

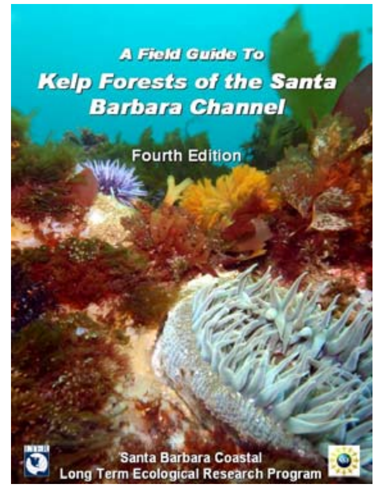
Scott E. Simon

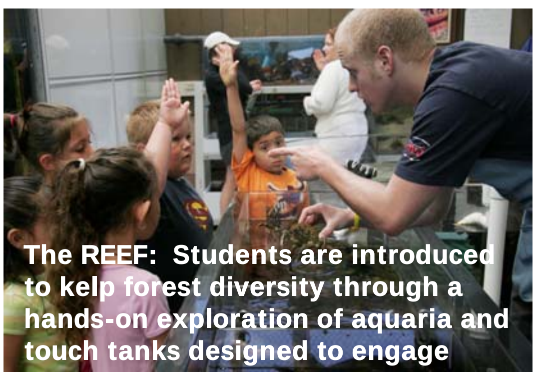
SBC’s Schoolyard LTER (SLTER) program is organized around a theme of kelp forest and watershed ecology. This approach allows for an integrated and interdisciplinary program that includes K-12 students, K-12 teachers, undergraduate and graduate students.



Watershed Science; Students explore geology, hydrology and ecology through an experiment designed to model wetland restoration and environmental planning.

SLTER Lessons: Lead by undergraduates, graduate students, staff and faculty working with the SBC LTER. Undergraduates are trained at the REEF using the SBC Field Guide to Kelp Forests of the Santa Barbara Channel

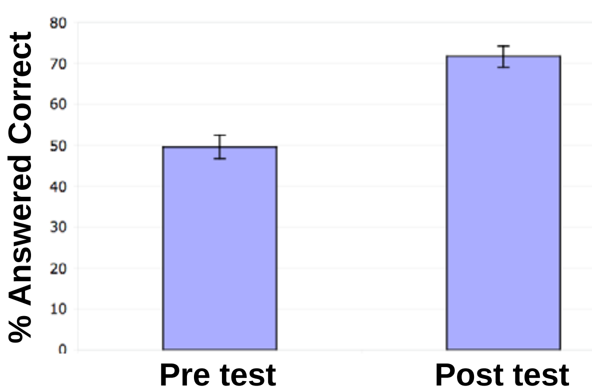




The REEF: Students are introduced to kelp forest diversity through a hands-on exploration of aquaria and touch tanks designed to engage

Floating Lab: Through the Floating Lab, students explore the Santa Barbara Channel. Cruises visit SBC LTER monitoring sites. Once anchored, students engage in 6 education stations.

Mean scores on pre and post tests



Science Education Research: A network approach. Utilizing site-specific science education, SBC is working with LTER sites in Colorado (SGS), Michigan (KBS) and Baltimore (BES) in science education research to develop environmental literacy principles as part of the NSF Math and Science Partnership (MSP). Graph at left shows results from preliminary watershed-based assessment developed by KBS and used as part of SBC SLTER.

Partners and Programs
American Association of University Women-Tech Trek (2009)
UCSB Office of Academic Preparation-Pathways (2008)
Los Angeles Conservation Corp-Clean & Green (2005-06)

Offshore Production and Transport of C & N to Kelp Forests

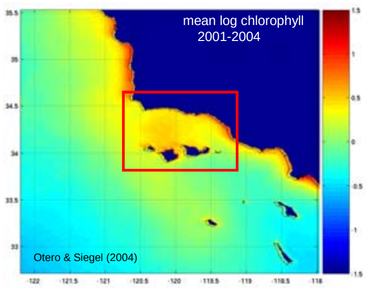
Libe Washburn, Mark Brzezinski, Chris Gotschalk, & Nick Dellaripa

Research Questions:

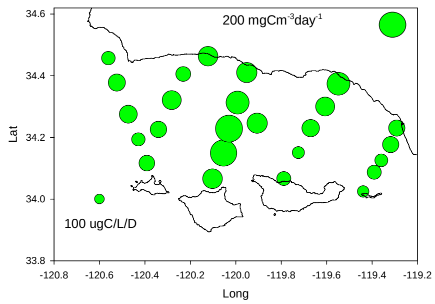
What are the rates and spatial patterns of phytoplankton primary productivity (PP) in the Santa Barbara Channel?

How do these rates & patterns change due to variable forcing by upwelling, nutrient advection, and other environmental drivers?

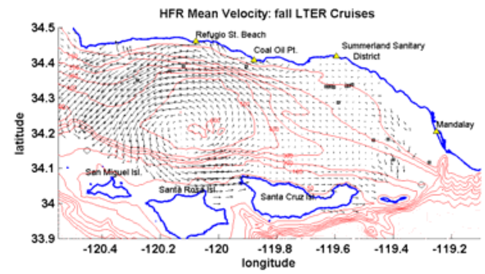
Chlorophyll climatology



Mean Productivity



Mean Circulation

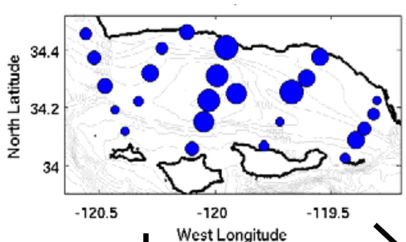


Approach & data

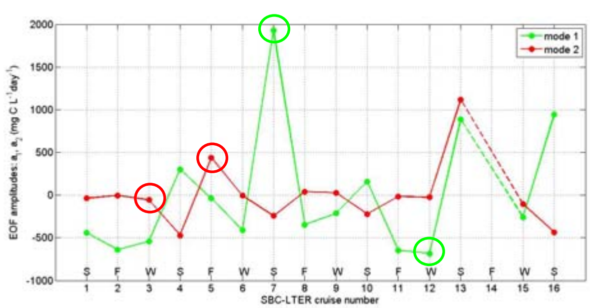
- describe patterns of PP & ocean conditions during 16 cruises, 2001-2006
- measurements: CTD, towed surveys, discrete samples, currents from ADCPs, HF radar

Productivity well described by 2 of 25 modes (81%of variance):

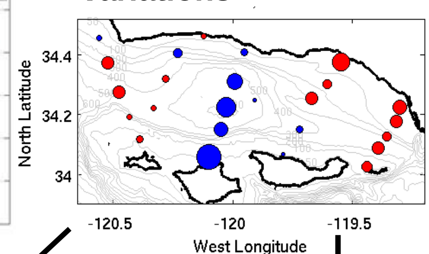
Mode 1: seasonal productivity (64%) variations



Time variations of modes 1 & 2



Mode 2: eddy-driven productivity (17%) variations

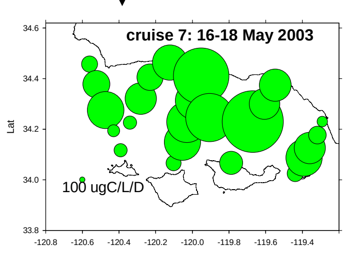


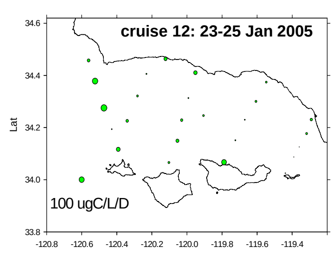
strong mode 1

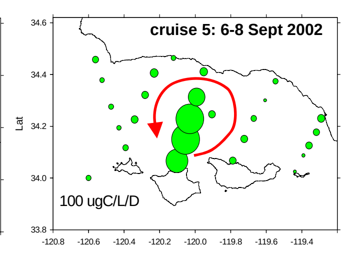
weak mode 1

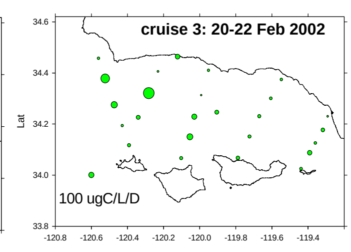
strong mode 2

weak mode 2









Future research will examine:

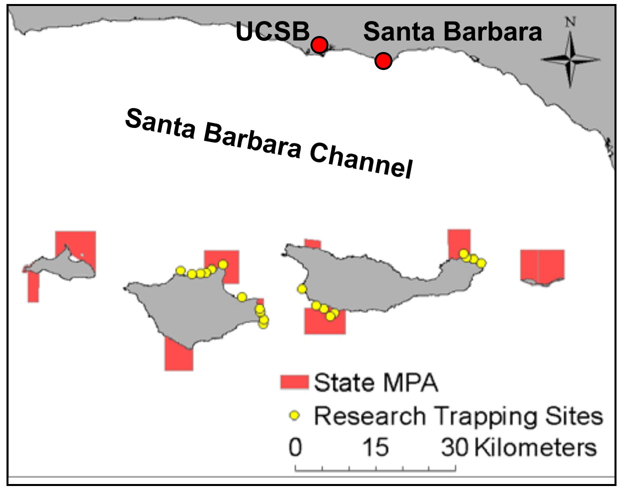
- transport between areas of offshore production and kelp forests
- eddy dynamics and production

CALobster Collaborative Fisheries Research

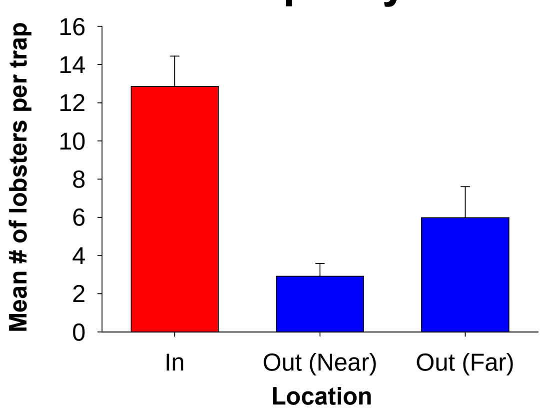
Matt Kay, Carla Guenther, and Hunter Lenihan

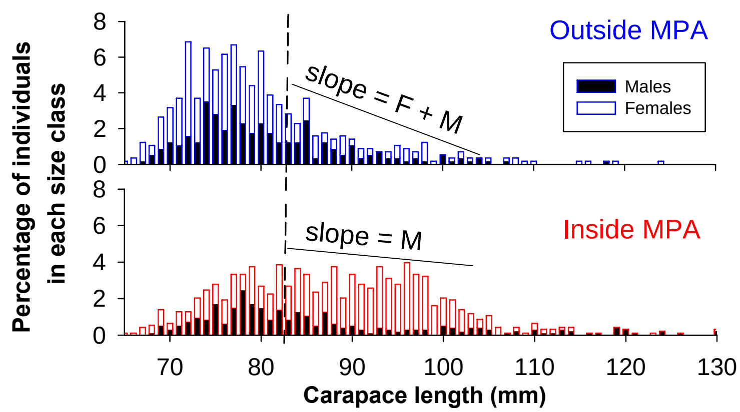
CALobster is a collaboration between commercial fishermen and UCSB biologists with State Fish & Game oversight. Our mission is to foster lobster sustainability via **collaborative data collection**, improved **resource and policy assessment**, and understanding **socio-economic dynamics.**

Collaborative data collection

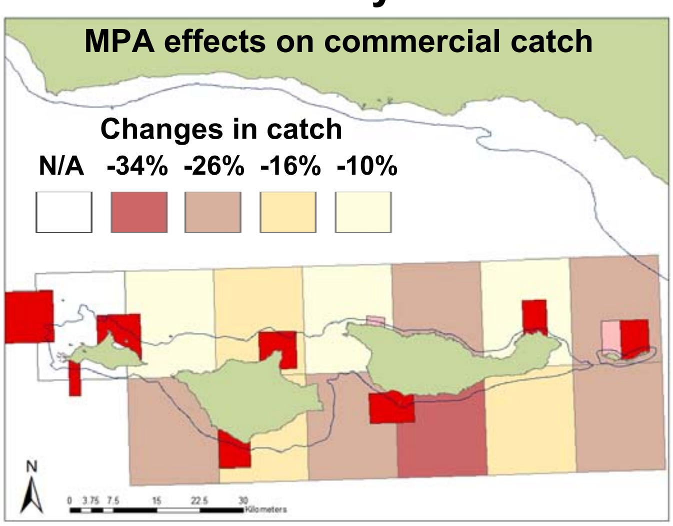


Resource and policy assessment





Socio-economic dynamics



MPA impacts and fleet demographics

Individual Catch	**-30%**
Seasonal Revenues	**-10%**
Effort Changes	
Fishermen	**-8%**
Days Fished/ Fisherman	**No Δ**
Traps/ Fisherman	**No Δ**
Trap Pulls/ Day	**+10%**
Operating Costs (per pull)	**+50%**
Mean % Household Income (70)	**No Δ**
Mean Age (52)	**No Δ**

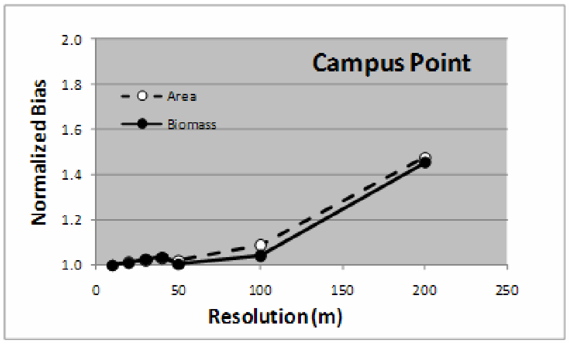
Remote Assessment of Giant Kelp Production and Dynamics

Richard Zimmerman & David Siegel

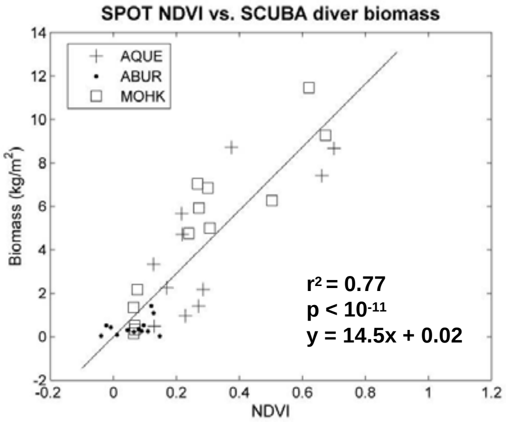
With co-funding from NASA, we are using a combination of **high-resolution remote sensing** of giant kelp cover, **calibrations with diver collected data** on kelp biomass and production and **bio-optical modeling** of kelp productivity to synthesize the ecological processes driving giant kelp dynamics at local and regional scales

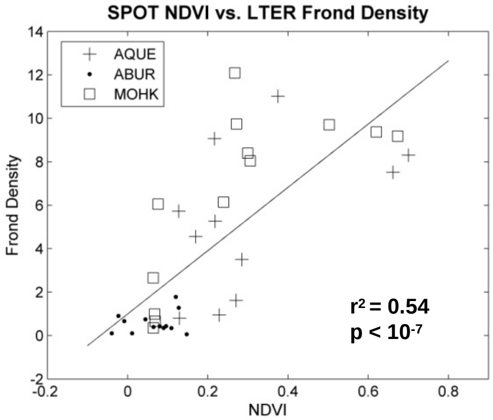
Quantitative remote sensing of kelp forest canopies using NDVI

- SPOT 10 m satellite imagery (2004-2008)
- Landsat 30 m satellite imagery (1984-present)
- SAMSON 3 m aerial imagery (March 2006)
- NDVI retrievals depend on resolution



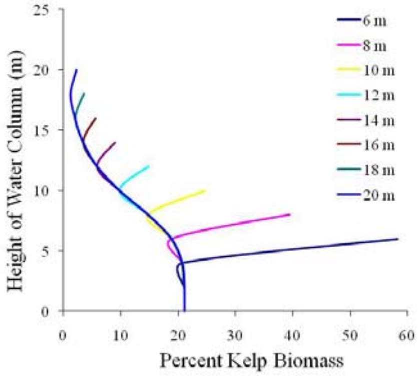
Calibrations with in situ data confirm the utility of NDVI

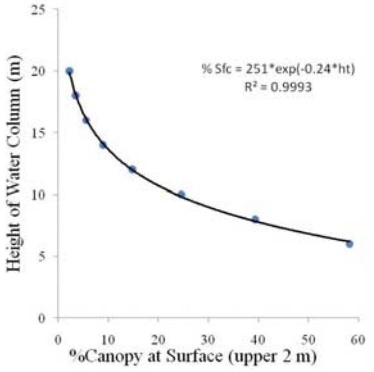


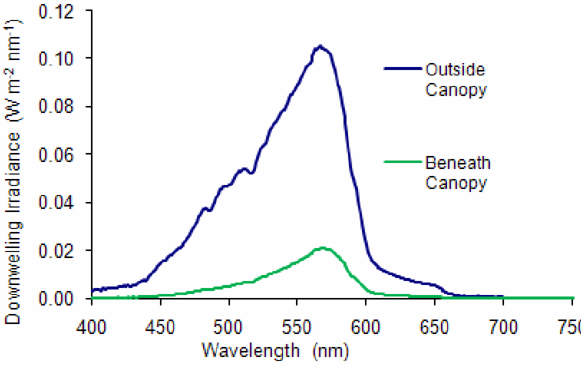


Strong relationships between the satellite measured Normalized Difference Vegetation Index (NDVI) and *in situ* measurements of biomass and frond density enable the remote estimation of regional biomass and frond density

Bio-optical modeling of giant kelp canopies predicts submarine light distribution and productivity of benthic macrophytes



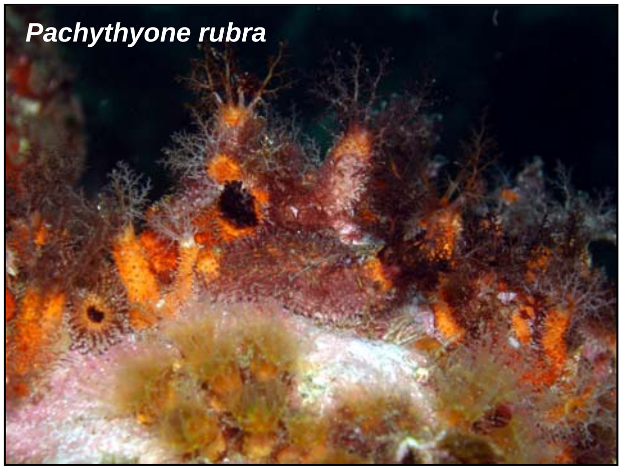


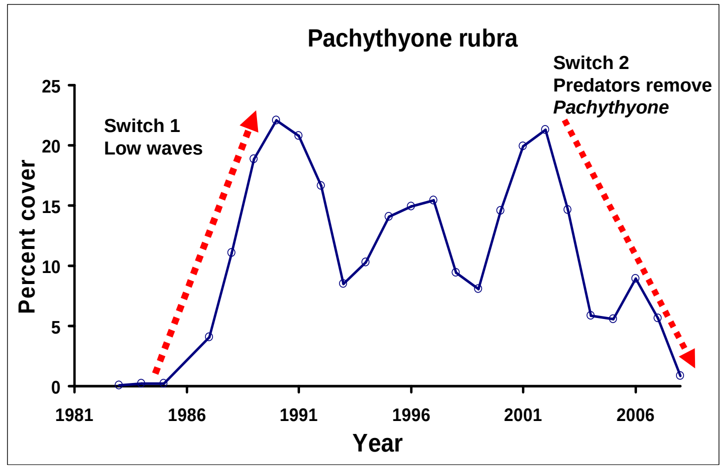


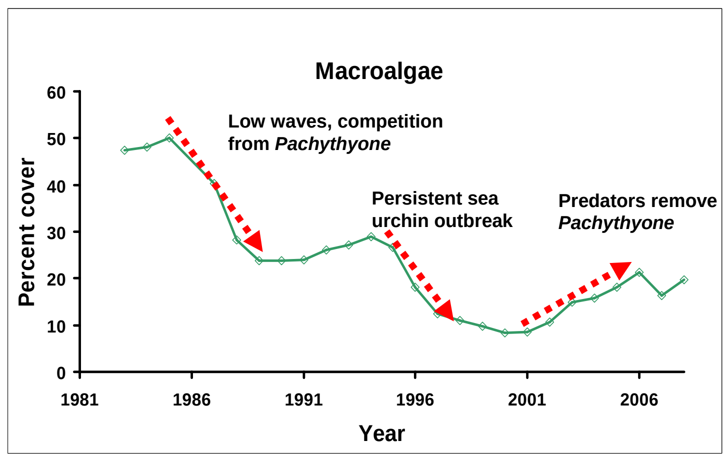
State Changes in Reef Communities

Sally Holbrook, Andy Rassweiler and Russ Schmitt

Temperate reef systems are characterized by abrupt shifts between distinct community states. We explored state shifts between autotrophs (macroalgae) and heterotrophs (the filter feeding sea cucumber *Pachythyone rubra*), the dominant space holders during the past 26 years. We focused on the causes of - and factors maintaining - shifts in this system using times series data, field experiments and modeling.

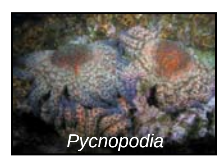






Causes of – and Factors Maintaining – the State Shifts

- Space competition between macroalgae & *Pachythyone* mediated by wave disturbance
- Initial switch: sustained low wave regime, *Pachythyone* became established & outcompeted algae
- Shift maintained by consumption of algal spores by *Pachythyone*
- Subsequent decline in algae due to persistent but patchy outbreak of sea urchins
- Switch from *Pachythyone* dominance caused by invasion of its predator (*Pycnopodia*)
- *Pachythyone* removal resulted in increase in algal abundance in non-urchin barren areas



Conclusions

- Observed series of state shifts were caused & maintained by different mechanisms
- Only long-term studies can resolve the complexity of state shifts in natural communities
- Expect additional abrupt transitions in response to press & pulse environmental drivers

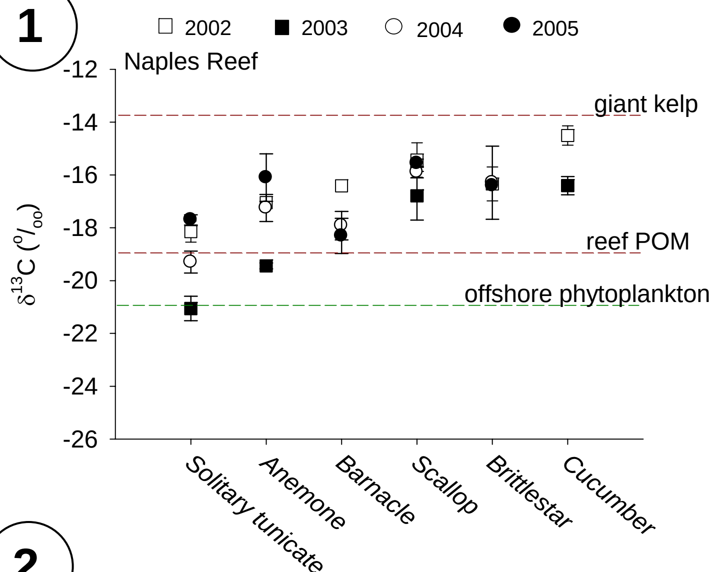
Particulate Organic Matter in Coastal Ecosystems: Composition and Use by Suspension Feeders

Mark Page and Bob Miller

Kelp forest suspension feeders-important benthic consumers

Kelps a detrital food source?- evaluation using stable isotopes

1



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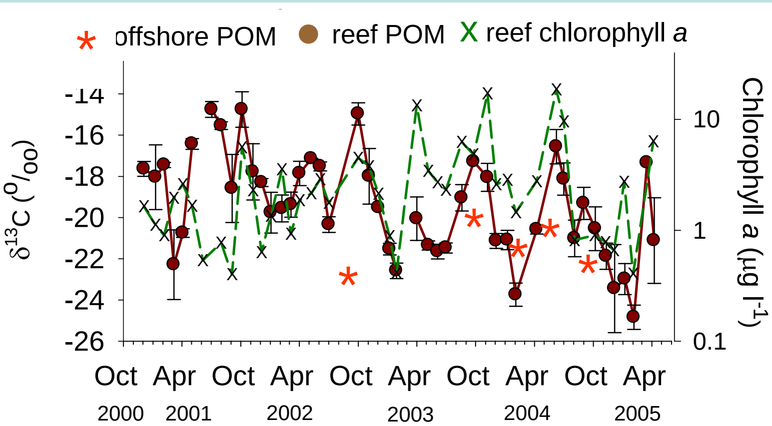
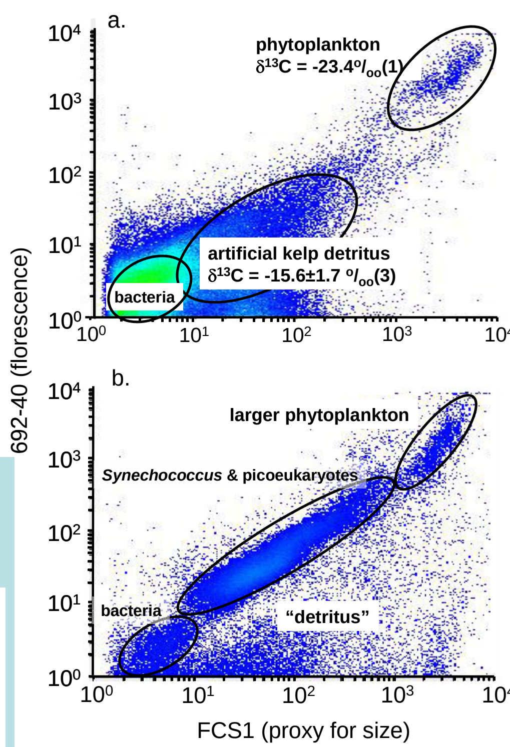
Uncertainty in isotope end-member value for reef phytoplankton.



Page et al. 2008 MEPS 360:47-62

3

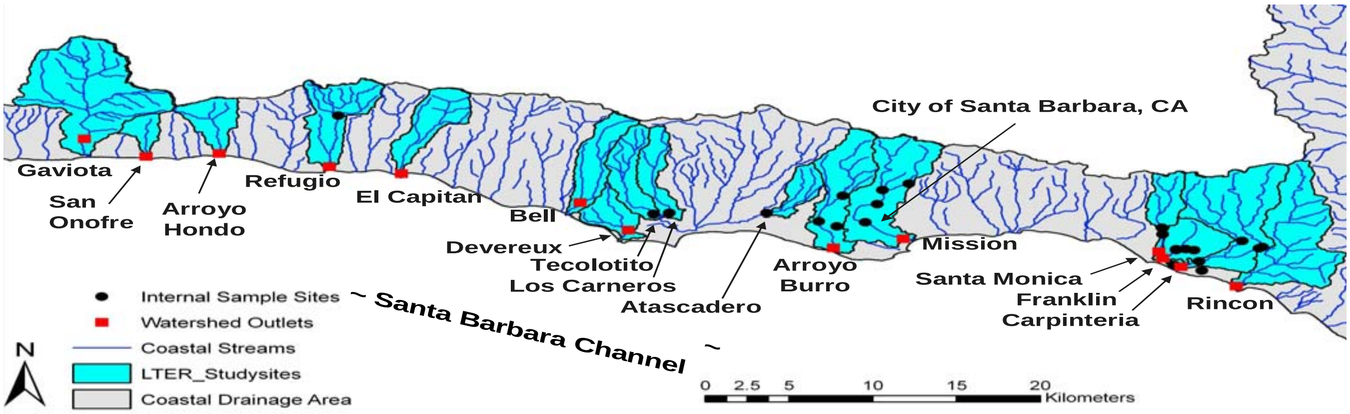
New approaches needed



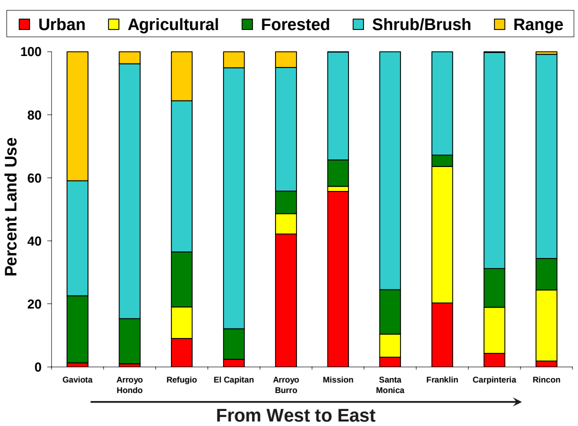
Proposed use of flow cytometry to obtain "clean" phytoplankton end-member value (s).

Overview of Coastal Catchments

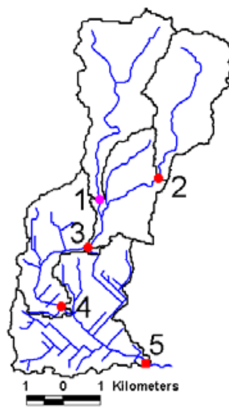
John Melack



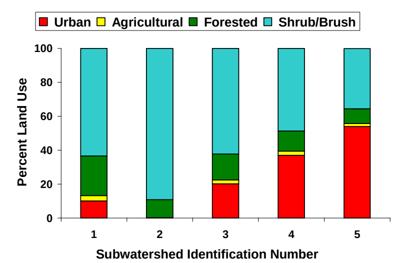
Land use among catchments



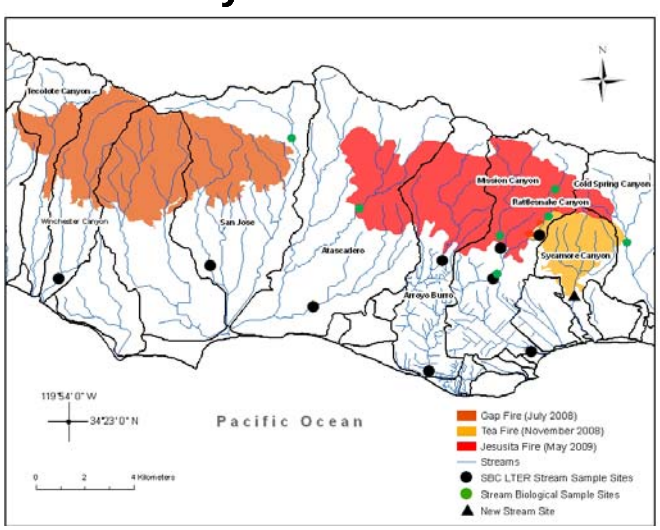
Sub-Watershed Scale…



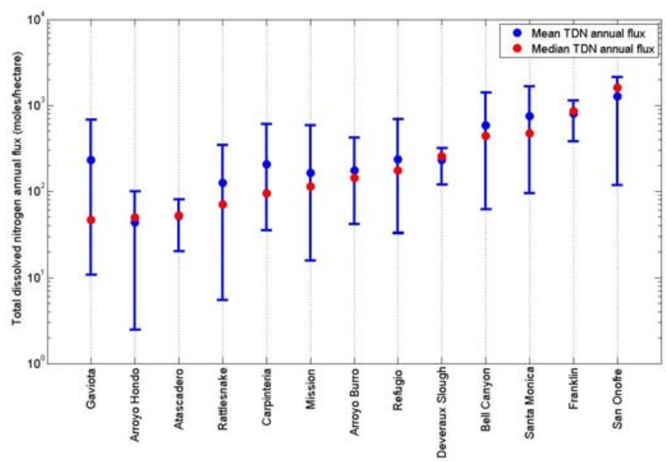
ID	Area (km^2)	Elev (m)	Slope (%)	Relief (m)	Impervious (%)
1	7.2	710	46	1031	2
2	5.7	761	43	875	0
3	16.9	620	40	1080	6
4	21.8	503	33	1105	11
5	30.0	382	26	1150	16



Recently burned areas



Total dissolved N export



Kelp Forest Subsidies to Sandy Beach Ecosystems

Jenny Dugan, Mark Page and Dave Hubbard

Subsidized food webs

- Giant kelp and other macroalgae
- Phytoplankton

High shorebird use

- > 26 species
- Annual means to 127 birds km^{-1}
- Threatened and declining species

Wrack-associated species

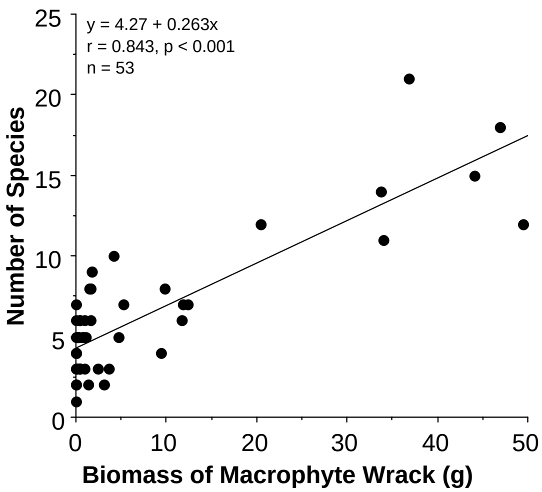
~40% of species

Shorebirds

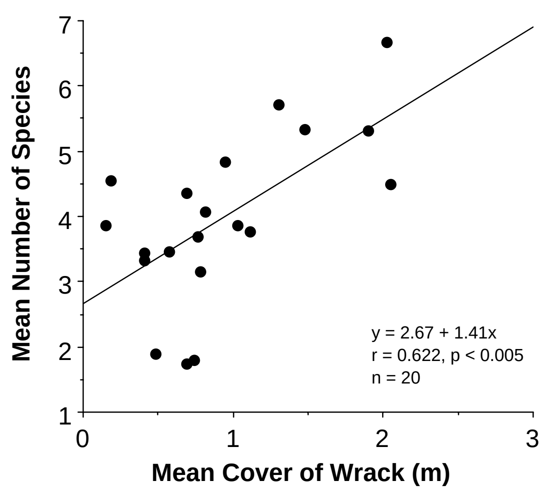
Prey on all invertebrates

Strong responses to kelp subsidies at all trophic levels

Invertebrates



Shorebirds



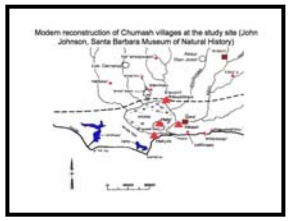
Subsidies from kelp forests support ecosystem functions & services

Coastal Dynamics in a Historical Context

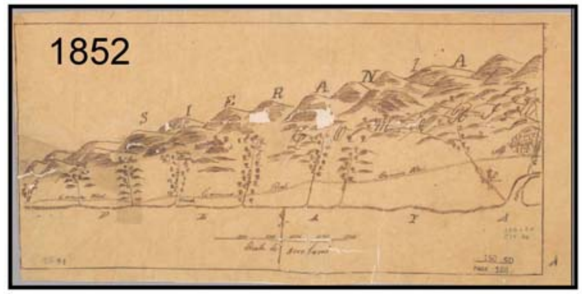
Anita Guerrini and Jenny Dugan

Coastal dynamics and human history are closely linked. Interpretation of early records requires integration of diverse sources of evidence. A section of SBC's coast was used as a case study.

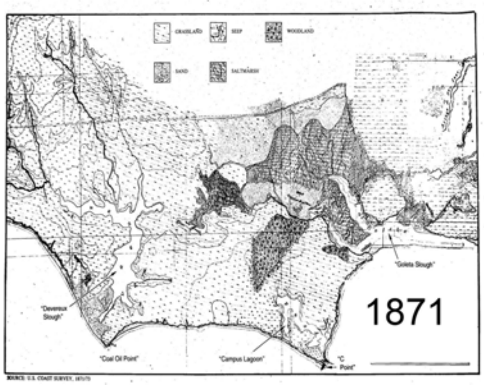
Marine terrace fossils suggest a shallow muddy bay ~40,000 ybp.



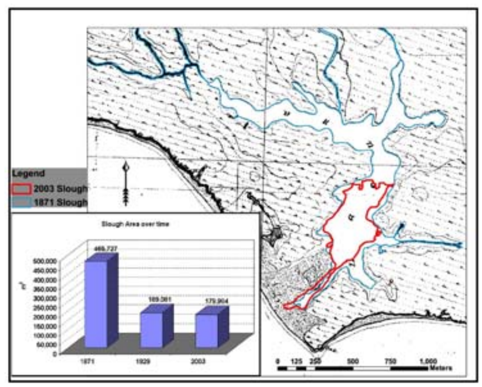
Artifacts & dating indicate continuous human use for at least 8500 years



Early visual records, such as this spanish land grant *diseño* (1852), contain little information on vegetation or landscape. Textual sources are needed to interpret.



By the first US coastal survey (1871) grasslands dominate after >8 decades of livestock grazing initiated in Mission Period (1786).



The slough lost 60% of the 1871 area by 1929. The mouth moved ~180 m west between 1929 and 2005.

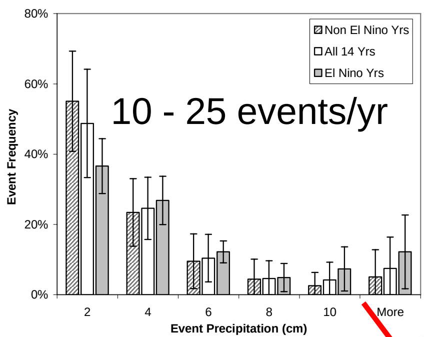
Agriculture and oil development important by the 1920's. F. Clements used dunes for adaptation experiments. Development intensifies by 1950's.

High variability in beach widths, beach rotations and intense bluff erosion associated with ENSO events. Strong effects of coastal squeeze from SLR on bluffs and beaches expected.

Hydrological Modeling of Stream Discharge

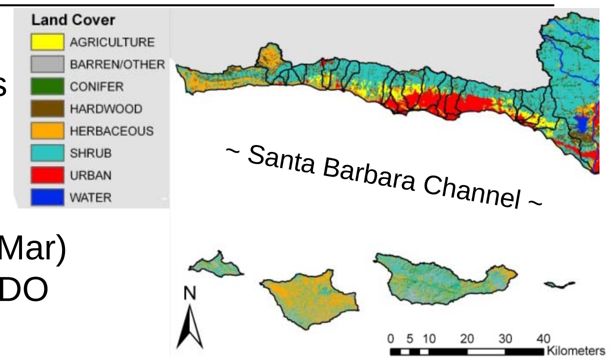
Ed Beighley, John Melack and Blair Goodridge

Hydrologic modeling for SBC-LTER provides: (1) terrestrial export of water and constituents to kelp forests for entire study region (i.e., fills in gaps from in-situ measurements), and (2) understanding on how potential climate and landuse variations can impact terrestrial export to the kelp forests.

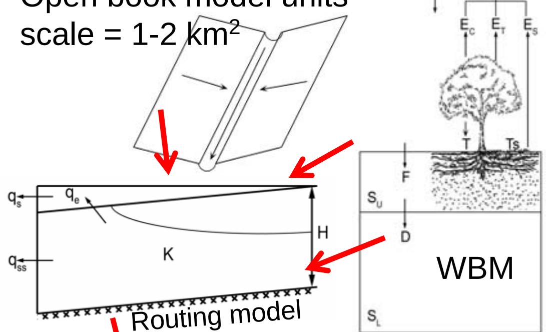


Watersheds

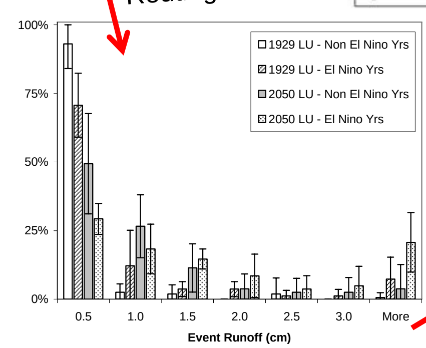
- varied land cover types
- steep slopes
- orographic rainfall
  (50 vs. 85 cm)
- seasonal rainfall (Dec-Mar)
- sensitive to ENSO & PDO



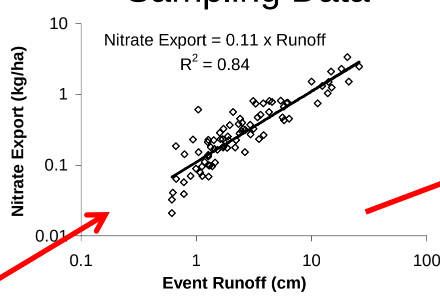
Open book model units scale = 1-2 km^2

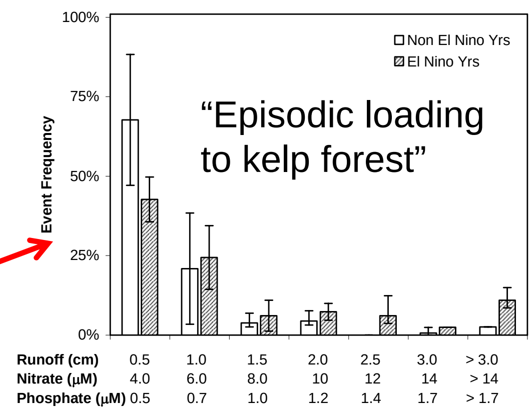


- Hydrologic variability is high (up to >90% of annual runoff in 1-2 events)
- Difficult to simulate initial conditions for storms early or late in wet season (high Q:P ratio variability)
- Sensitive to both climate and landuse variations



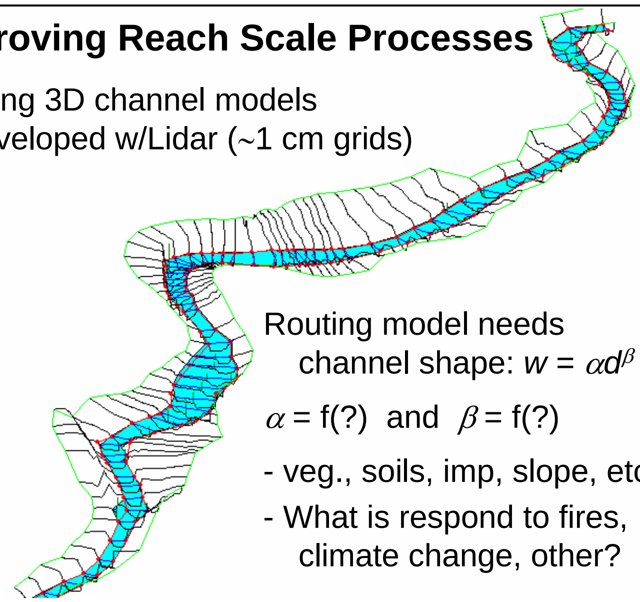
"Sampling Data"





Improving Reach Scale Processes

using 3D channel models developed w/Lidar (~1 cm grids)



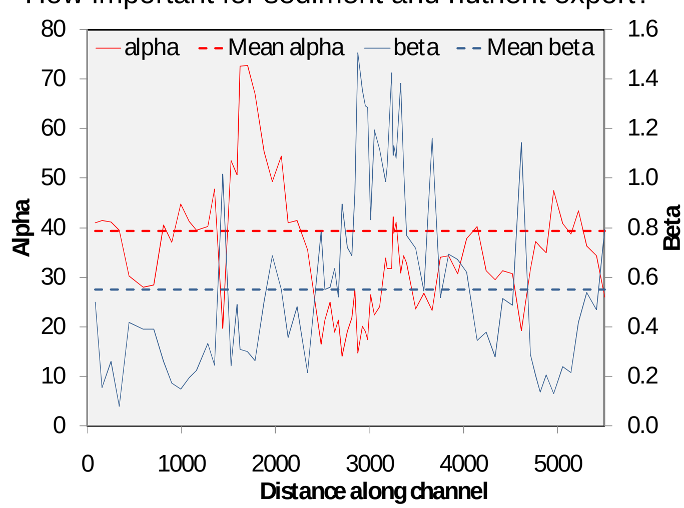
Routing model needs channel shape: $w = \alpha d^{\beta}$

α = f(?) and β = f(?)

- veg., soils, imp, slope, etc.
- What is respond to fires, climate change, other?

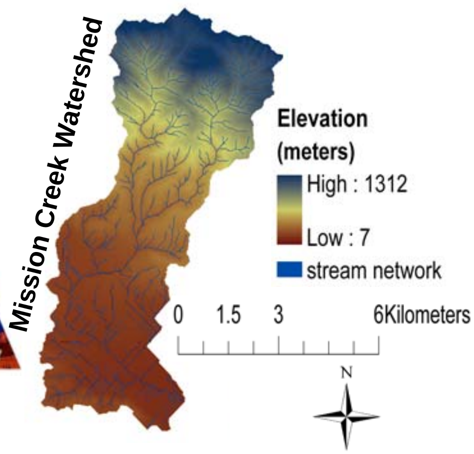
Spatial variability in channel shape:

How important for sediment and nutrient export?



Modeling Effects of Urban Connectivity on Water Balance in Mission Creek

Catherine Shields, Christina Tague, Ed Beighley



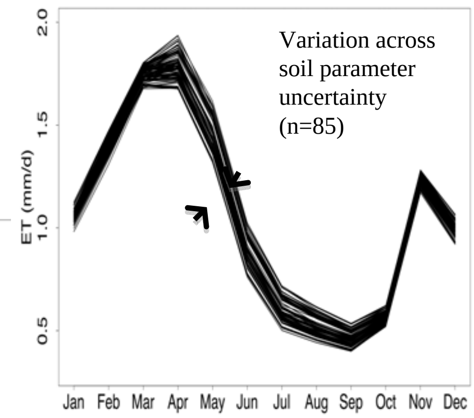
Hydrologic model calibration and uncertainty analysis

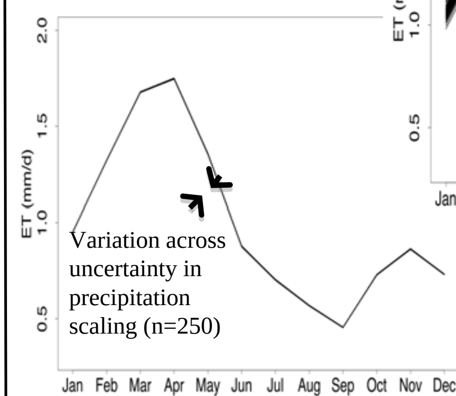
Goal: Prediction of streamflow and spatial patterns of vegetation water use for historic conditions and climate/land use change

First, quantification of model sensitivity to uncertainty is needed to understand predictive limitations of model and guide future data collection

How do model estimates of ET and streamflow vary in response to uncertainty in:

- Calibrated soil parameters
- Spatial scaling of precipitation
- Fog-induced temperature change
- Outdoor water use



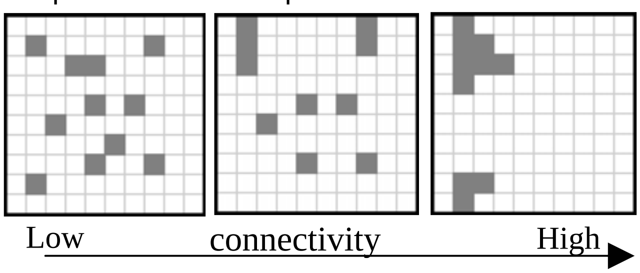


Model output was found to be most sensitive to uncertainty in soil parameters.

Minor seasonal sensitivities to fog-induced temperature changes and outdoor water use were also observed

Quantifying the connectivity effect

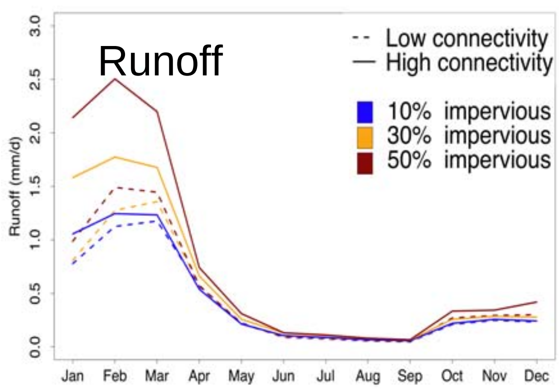
- Impervious surface increases a major driver of urbanization response
- Connectivity of impervious surfaces may be as important as total impervious surface area

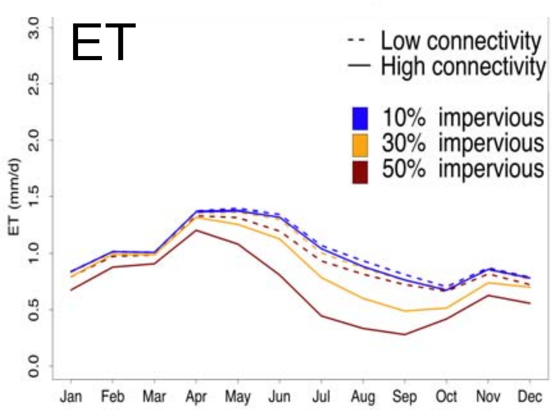


Patches may have the same impervious surface area but varying connectivity

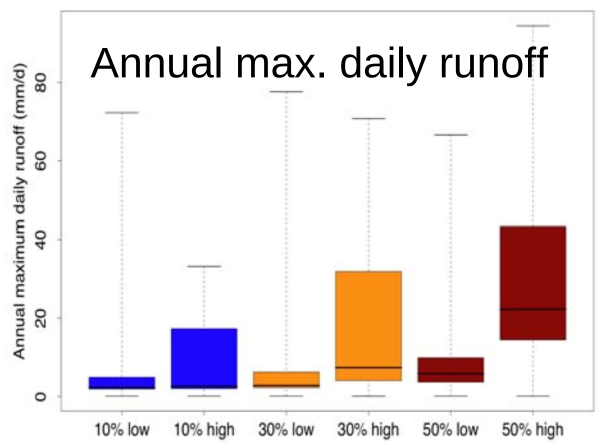
- How does connectivity affect urban water balance?
- How can we incorporate the connectivity effect into an ecohydrologic model?

Effect of impervious surface connectivity for a small urban patch





Changes in connectivity have a greater effect on water balance than total impervious surface area. As impervious surface increases, connectivity effect becomes more pronounced. Effects on streamflow occur primarily during rainy winter season, while effects on ET are seen primarily in spring and summer. With high connectivity, maximum runoff is highly variable from year to year and is greater than in the low connectivity scenario.



Next steps

- Use remote sensing and GIS data to estimate impervious surface connectivity for Mission Creek
- Assimilate this information into RHESSys model
- Use model to explore watershed response to changes in urban design, climate

Does productivity drive diversity or vice versa? Testing the multivariate productivity-diversity hypothesis in streams

Bradley Cardinale

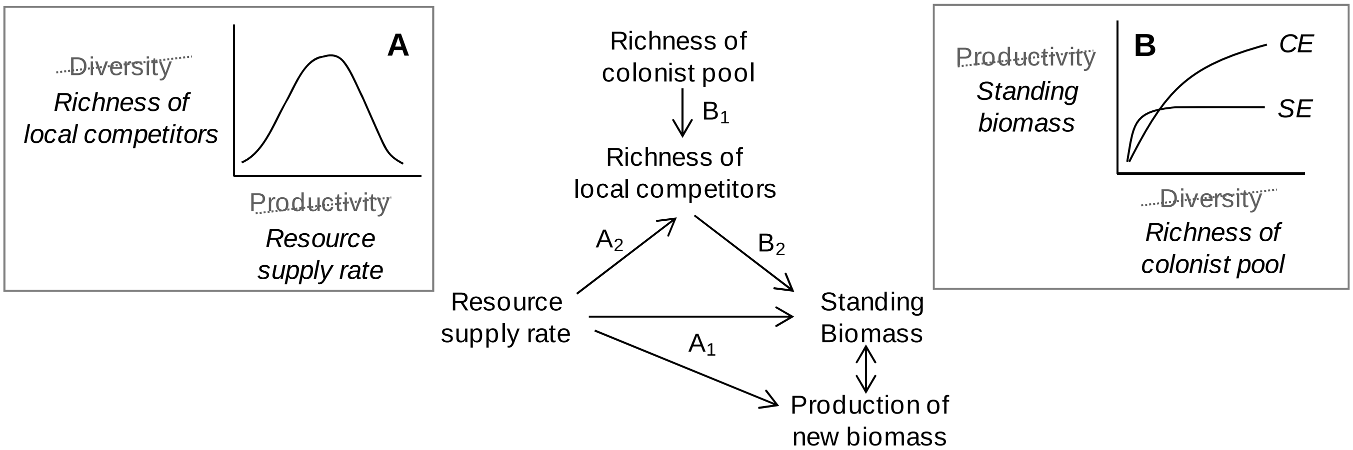


Fig 1. The Multivariate Productivity-Diversity hypothesis illustrates one way the historical perspective that productivity-drives-diversity (panel A) might be merged with the more recent perspective that diversity-drives-productivity (panel B). The historical perspective has focused primarily on how the supply rate of limited resources influence the richness of local competitors. Richness is often highest at intermediate supply rates due to trade-offs in species abilities to compete and dominate at low vs. high supply. In contrast, the recent perspective focuses more on how richness of a colonist pool influences standing biomass of local competitors. Here, biomass can saturate with increasing richness due to selection effects (SE) ,or increase monotonically due to complementary resource use (CE). We propose that these mechanistically distinct relationships are connected by a broader set of pathways (middle).

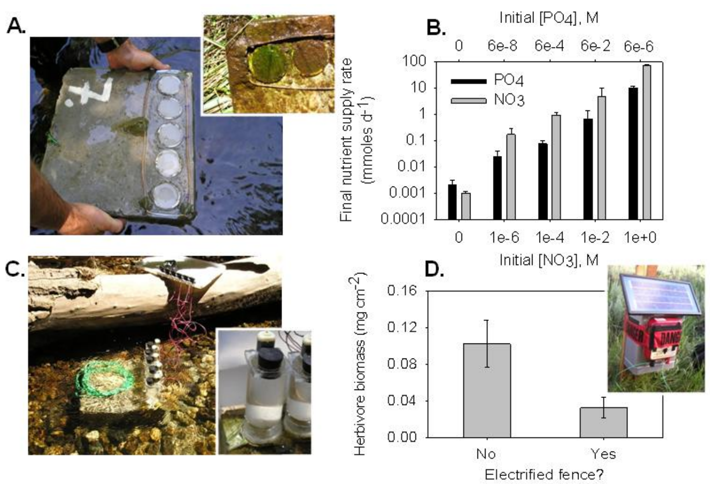


Fig 2. A) Nutrient diffusing substrates. Inset shows algae after 45-d of growth during a 2006 pilot study. B) Final rates of nutrient release after 45-days as a function of initial N/P in nutrient patches . C) Metabolism chambers used to measure GPP on nutrient patches. D) Herbivore densities on substrates that were/were not electrified in 5 streams.

Fig 3. The environmentally controlled flume facility at UCSB houses 120 independently re-circulating stream channels where temperature, flow and light are all standardized. Each unit is fitted with an air-tight lid and a port for an O_2 probe that allows 1° production to be estimated by gas exchange. A variety of algal species have been grown successfully in these flumes. The inset shows just one example of the filamentous alga *Stigeocloneum* growing in the 300-cm^2 working section of the channel.

Stream Discharge Measurement and Hydrochemical Sampling

John Melack and Blair Goodridge

(1) A pressure transducer (PT) is secured within a perforated pipe, which is fixed to an immovable object within the stream channel (i.e. boulder, concrete bridge) (Figure 1). The PT logs absolute pressure (ft) and temperature (C) at 5 minute intervals. A barometric pressure transducer logging at the same frequency is used to derive water level (stage) at each 5 minute interval:

absolute pressure – atmospheric pressure = water pressure (stage)

Figure 1. Pressure transducer (top) and perforated pipe in stream (bottom)

(2) Stream channel morphology survey data is used to model stream hydraulics at sampling locations where PTs are located (Figure 2), generating a rating curve (stage-discharge relation) for each sample site.

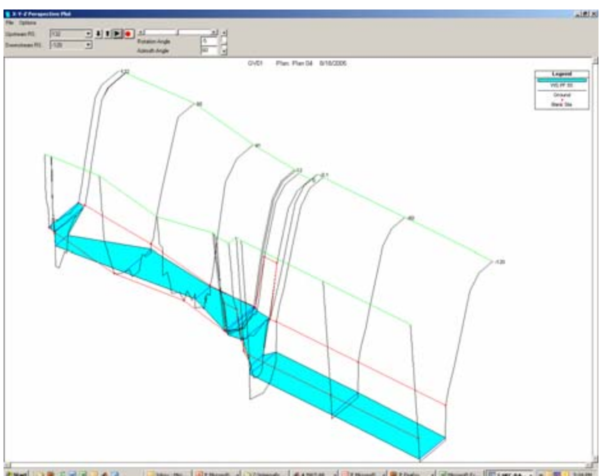


Figure 2. Stream channel morphology and water surface profile for Gaviota Creek (GV01)

(3) Continuous 5-minute stage data is then converted to a 5-munite discharge value using the rating curve. Discharge time-series can then be constructed for each sampling station (Figure 3).

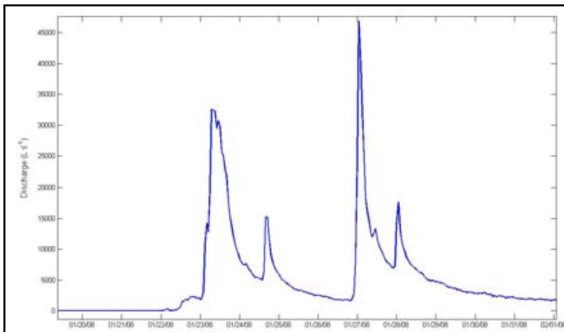


Figure 3. Example of discharge time series

(4) ISCO automated water samplers (Figure 4) are used to collect storm event hydrochemical samples at sample sites (Figure 5). Due to flashy nature of local hydrology, samples are collected hourly on the rising limb, and every 2-4 hours on the falling limb of the hydrograph

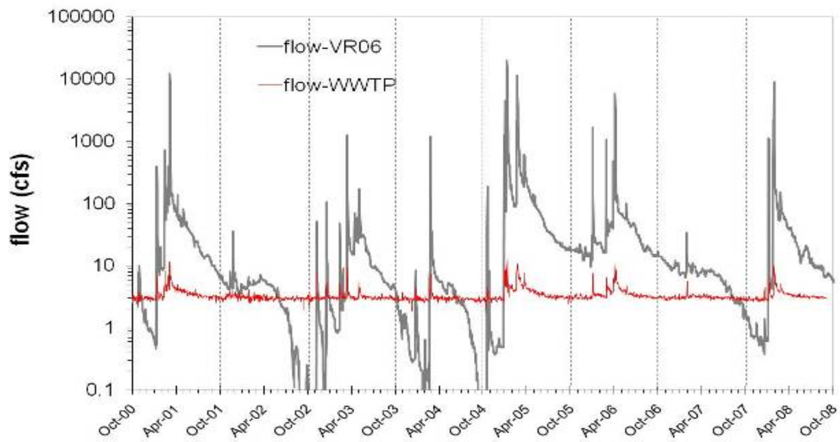
Figure 4. ISCO 6712C automated water sampler

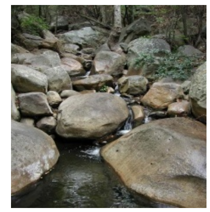
Figure 5. Stream sampling site (Gaviota Creek – GV01)

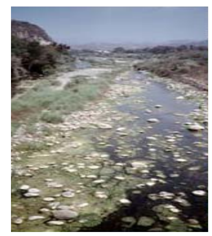
Fire, Fish, Flood, and Land Use Effects on Streams

S. Cooper, D. Bennett, J. Brinkman, L. Busse, T. Dudley, T. Even, K. Klose, C. Nelson, S. Sadro, J. Simpson, S. Wiseman

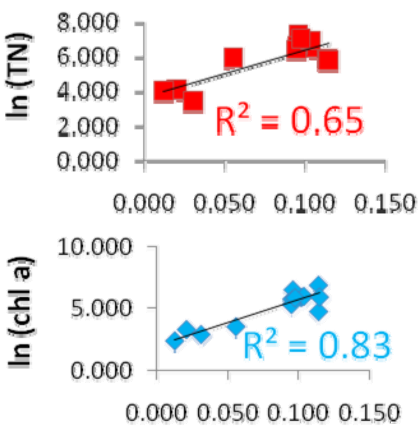
Large interannual and seasonal variation in discharge



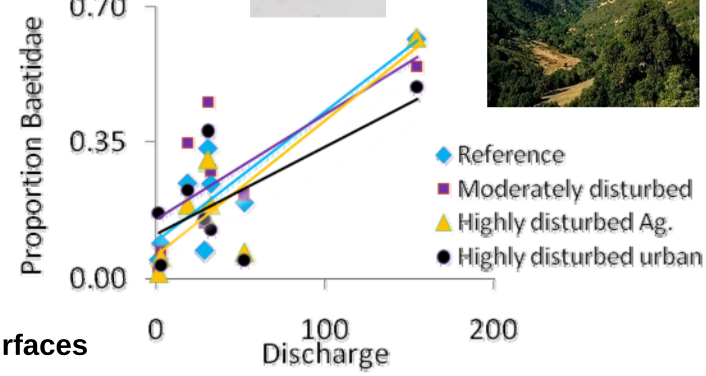


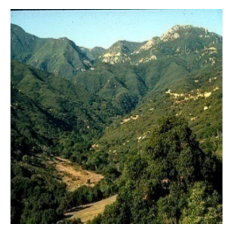


Against a background of land use changes and fire histories

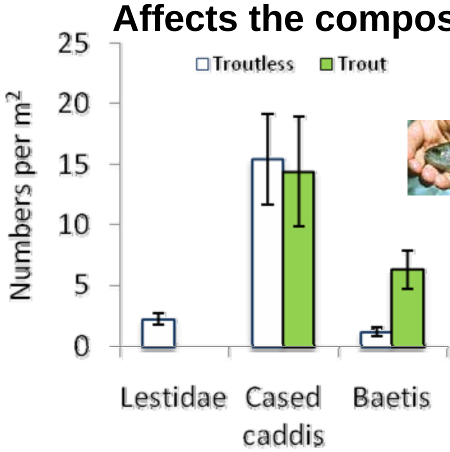


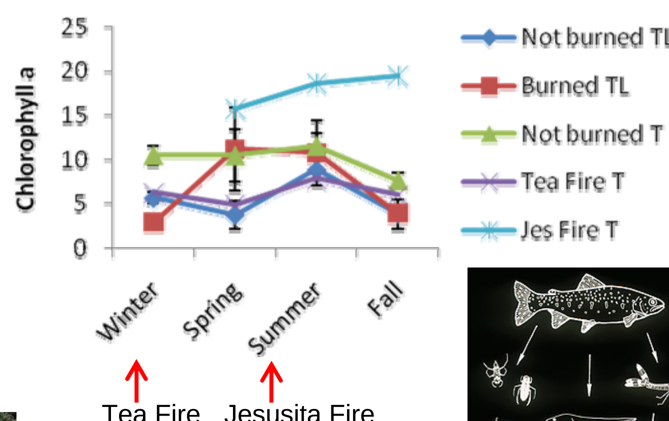
Proportion Impervious Surfaces

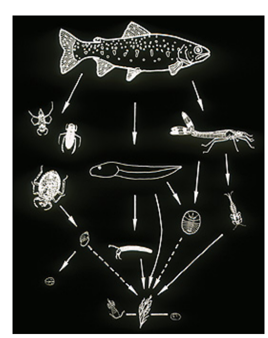




Affects the composition and interactions of biological communities

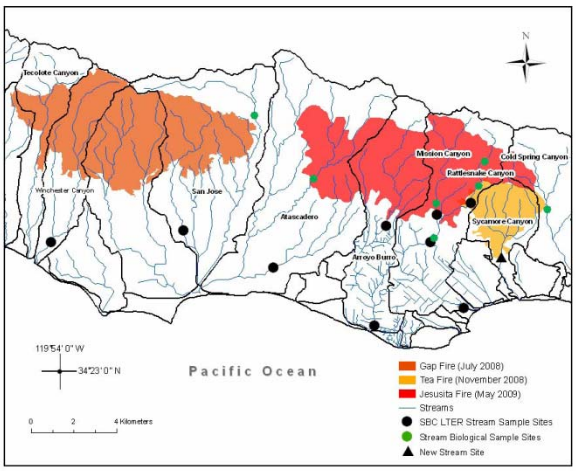






Santa Barbara Burning

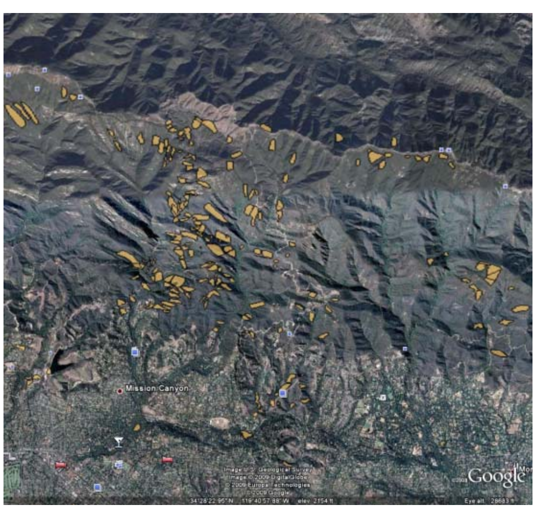
Josh Schimel, Bodo Bookhagen, Scott Cooper, Carla D'Antonio, Bill Freudenburg, John Melack, Dar Roberts, Christina Tague, and others



Gap Fire: July 2008
Tea Fire: November 2008
Jesusita Fire: May 2009

In the last two years most of the chaparral above Santa Barbara has burned.

What do we need to do to understand how large scale fire affects transport of nutrients, sediment, and possibly organisms, into coastal waters?



Coordinate onto existing mapping of vegetation.

On a sub-set of analyzed plots, measure:

- Soil nutrient dynamics (mineralization cores)
- Vegetation recovery (Field plots, remote sensing)
- Erosion (Lidar)
- Nutrient & sediment delivery to streams (water samples)
- Changes in stream biota (stream biota surveys)
- Impacts on coastal communities (isotope tracing)
- Human responses (surveys and policy change)
- Hydro-chemical modeling (RHESSys)

Pending Proposals:
NSF Rapid proposal
NASA Research in Earth Science