

Overview of site-specific research
questions at the 8 coastal/marine sites
in the U.S. LTER network

Russ Schmitt
Moorea Coral Reef LTER

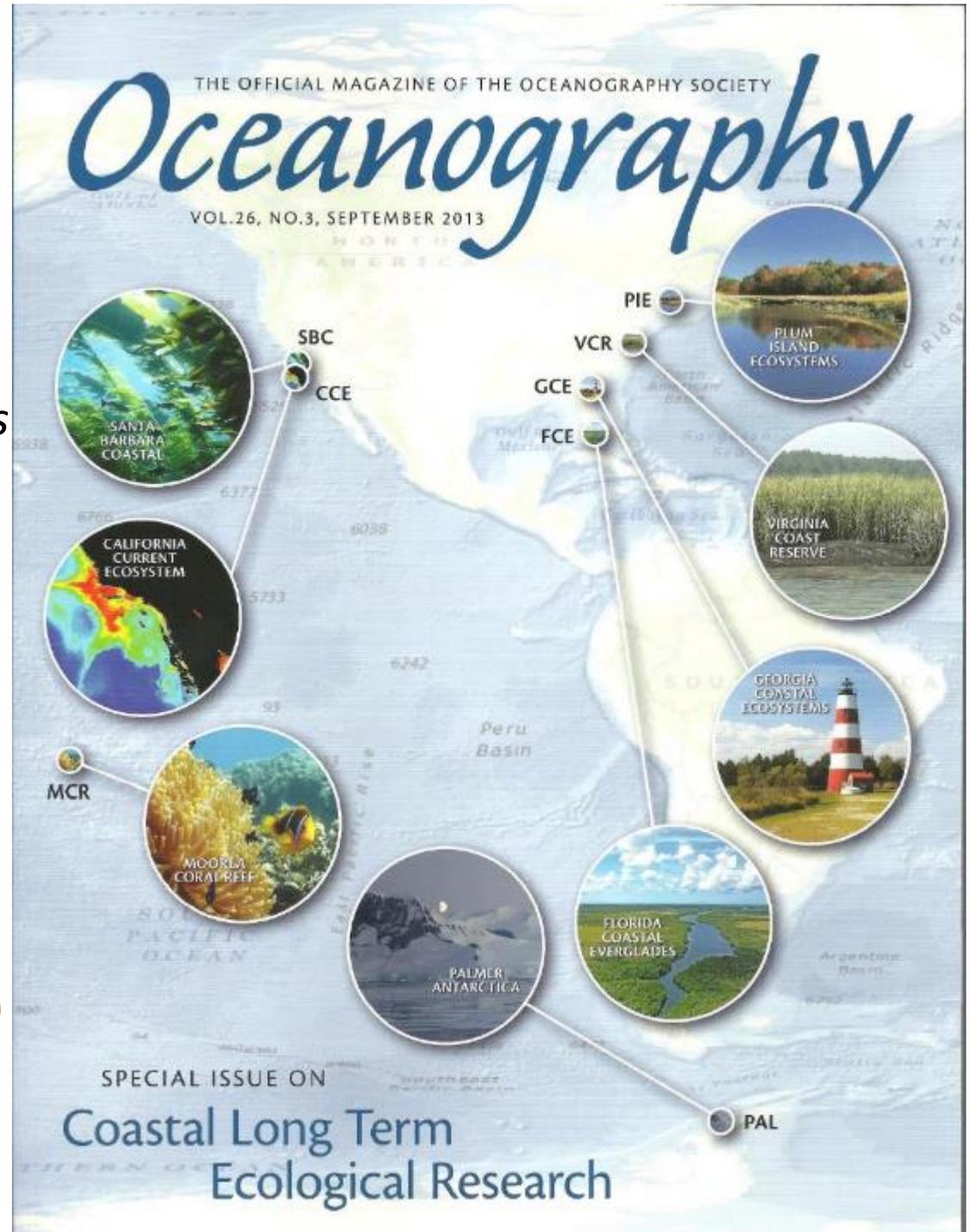
Coastal / Marine Sites in the US LTER Network

Russell J. Schmitt, UC Santa Barbara

- *8 of the current LTER sites focus on coastal marine ecosystems*
- *Diverse set of coastal / marine biomes & research themes*
- *Oceanography 2013, vol 26(3) dedicated to the long-term research at these 8 sites*



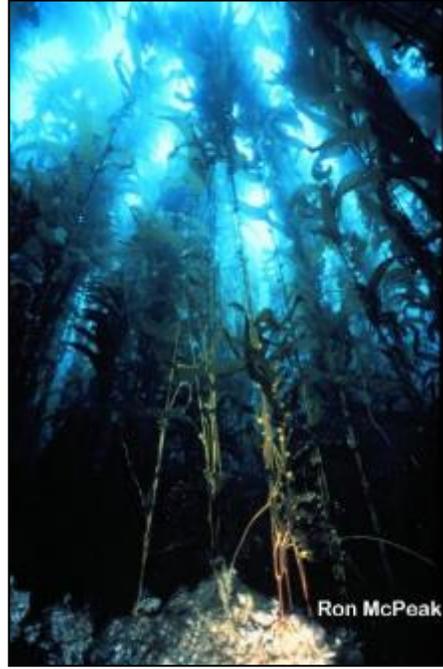
The Long Term Ecological Research Network



The principal biome at 4 coastal LTER sites is a benthic and/or pelagic marine ecosystem



Moorea Coral
Reef (MCR)



Santa Barbara
Coastal (SBC)



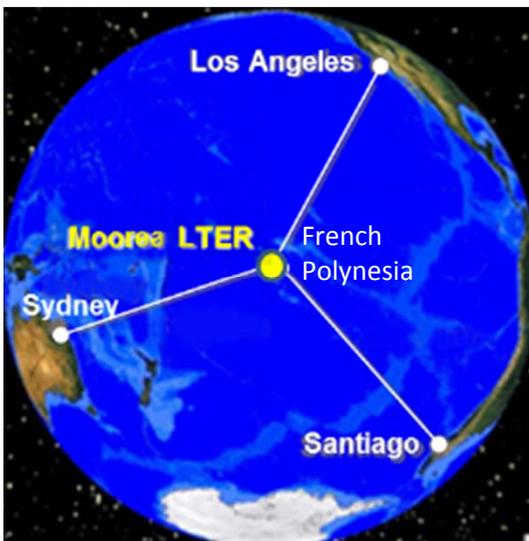
California Current
Ecosystem (CCE)



Palmer Station
(PAL)

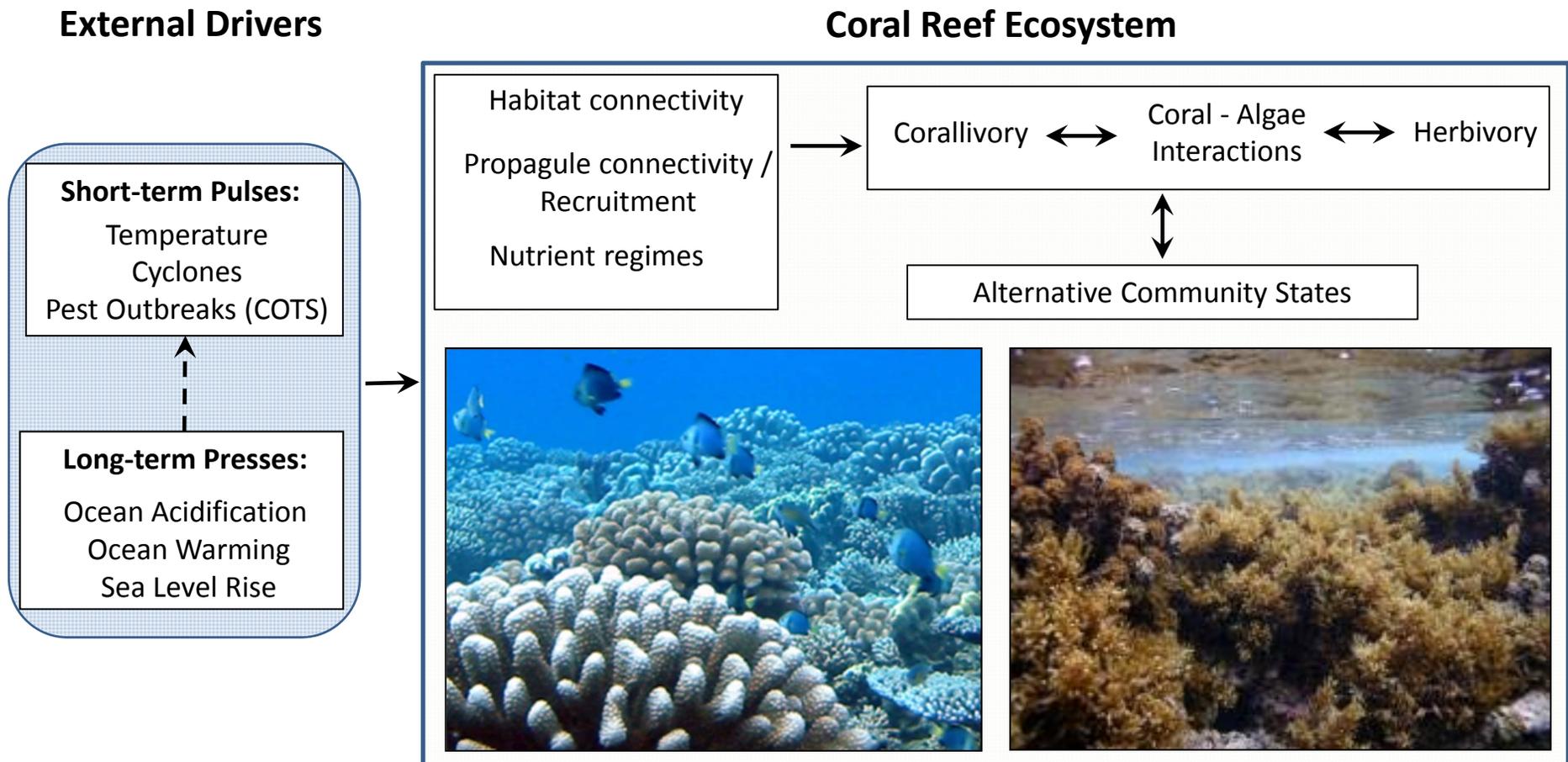


Understanding how disturbance & long-term change shape the nature of coral reef ecosystems



Moorea Coral Reef (MCR) LTER Central Research Questions

- *What processes & attributes enhance or weaken the ecological resilience of contemporary coral reef ecosystems? (State change dynamics & consequences)*
- *How will changing environmental drivers alter community composition, ecosystem functioning & resilience of reefs in the future?*

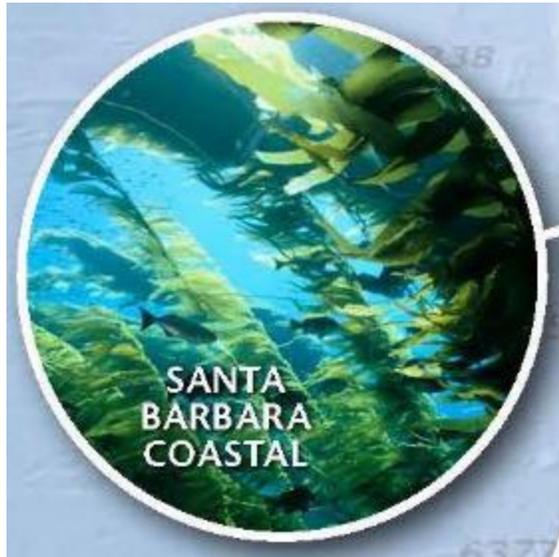


Santa Barbara Coastal (SBC) LTER Est. 2000



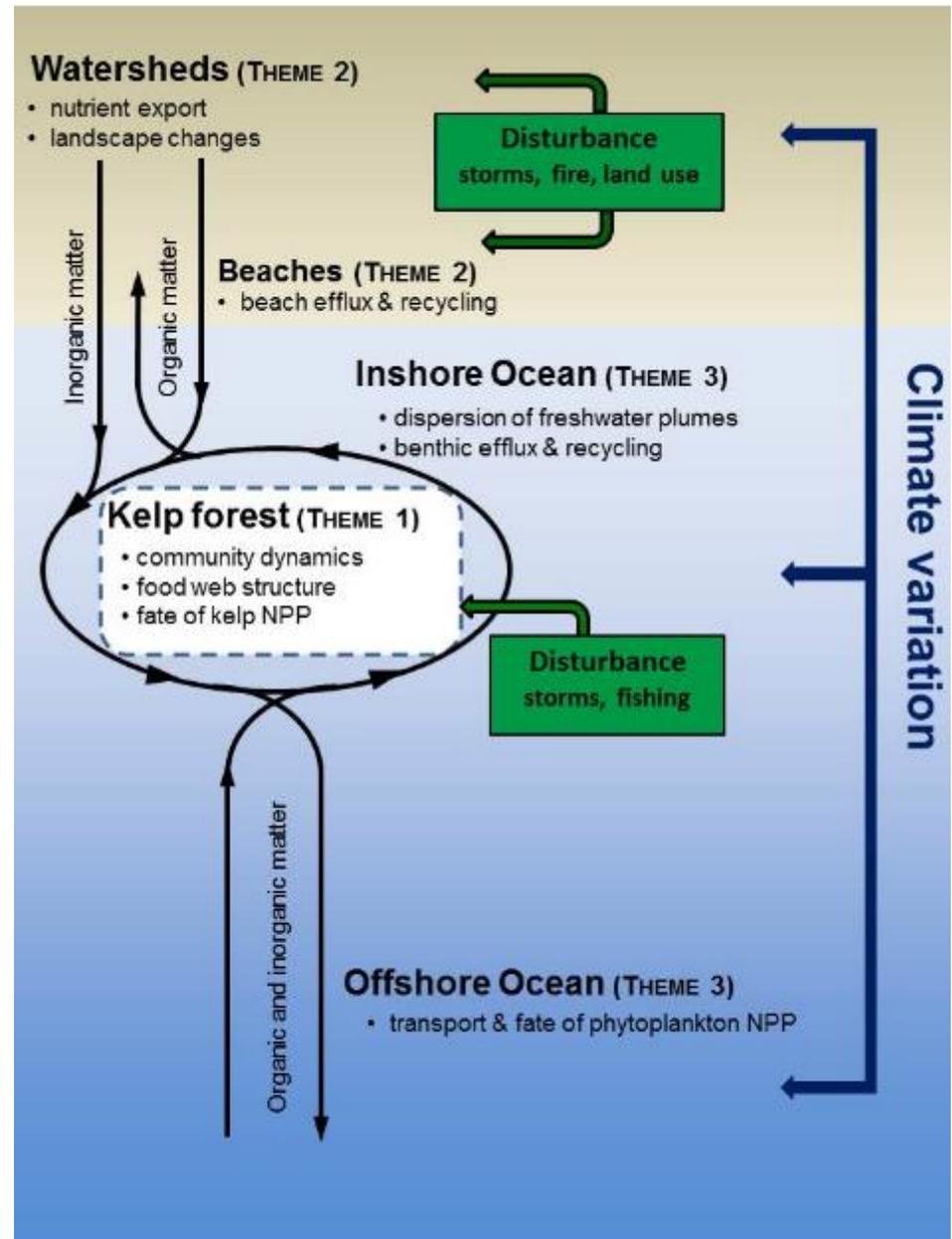
Understanding ecosystem connectivity at the land-ocean margin

Santa Barbara Coastal (SBC) LTER



Overarching Question

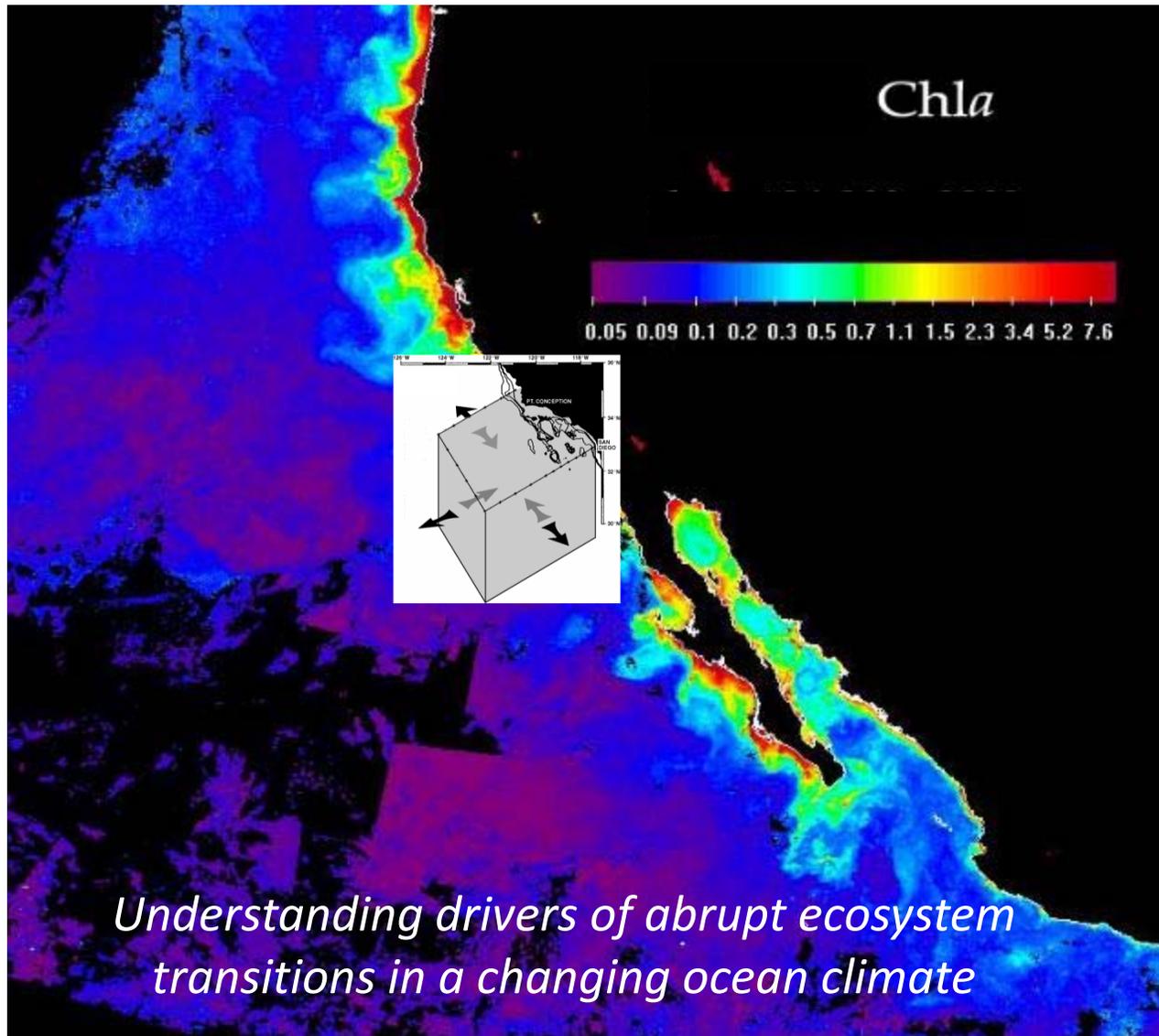
How are the structure and function of kelp forests and their material exchange with adjacent land and ocean ecosystems altered by disturbance and climate?



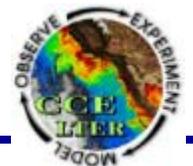
California Current Ecosystem (CCE) LTER

Est. 2004

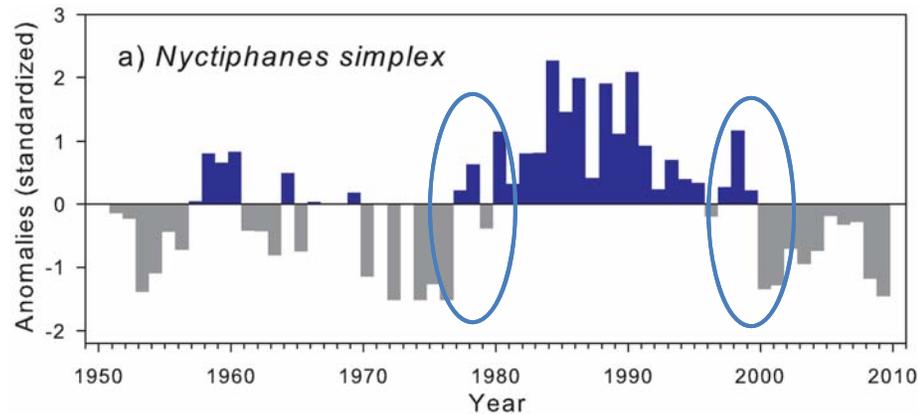
Principal biome: Coastal upwelling zone



M. Kahru
SIO



Mechanisms Underlying Ecosystem Transitions

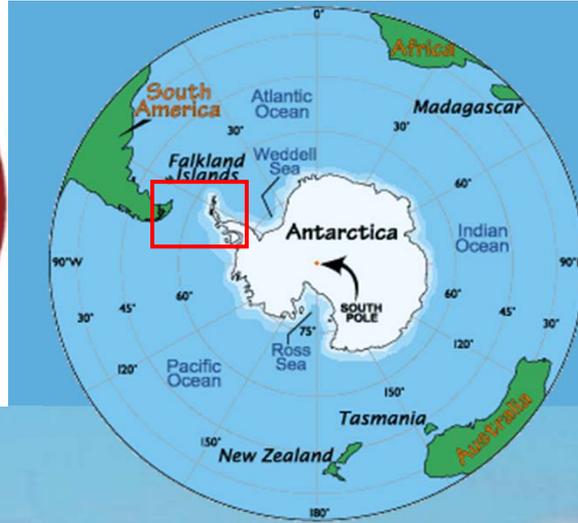
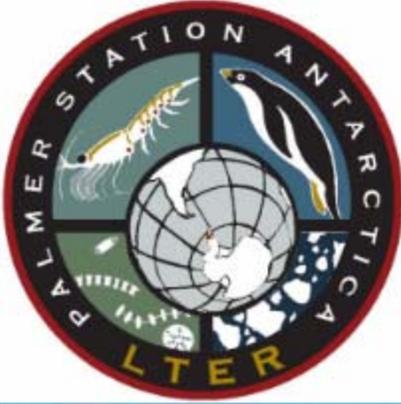


Nyctiphanes simplex

Hypothesized mechanisms:

- Sustained, anomalous **alongshore advection** of different assemblages
- **In situ food web changes** in response to altered stratification and nutrient supply
- Changes in **cross-shore transport** and loss/retention of organisms
- Altered **predation pressure**





PALMER ANTARCTICA LTER Est. 1990

Principal biome: Polar marine pelagic

Understanding drivers of primary production & food web dynamics

Focus on mechanisms coupling climate variability, sea ice, marine ecosystem dynamics and biogeochemistry



Research Themes and questions, 2014-20:

Long-term change and ecosystem transitions. What is the sensitivity or resilience of the ecosystem to external perturbations as a function of the ecosystem state?

Lateral connections and vertical stratification. What are the effects of lateral transports (connectivity: sea ice, glacial meltwater, offshore heat and nutrients, iron) on local stratification and productivity and how do they drive changes in the ecosystem?

Top-down controls and shifting baselines. Is the ecosystem responding to this large-scale change in top-down control resulting from the recovery of whales from human predation?

Foodweb structure and biogeochemical processes. How do temporal and spatial variations in foodweb structure influence carbon and nutrient cycling, export, and storage?

Photo: Natasja van Gestel

The principal biome at the remaining 4 coastal LTER sites is an estuarine ecosystem on a protected coast or embayment



Plum Island Ecosystems (PIE)



Virginia Coast Reserve (VCR)



Georgia Coastal Ecosystem (GCE)

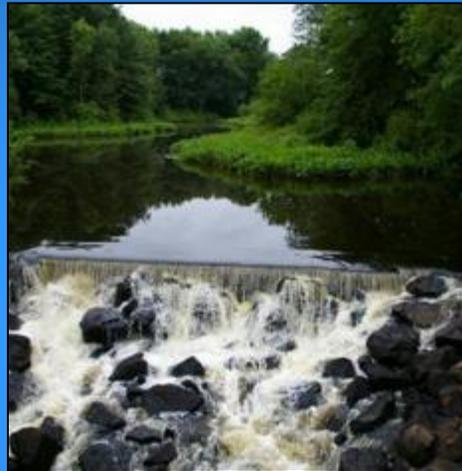
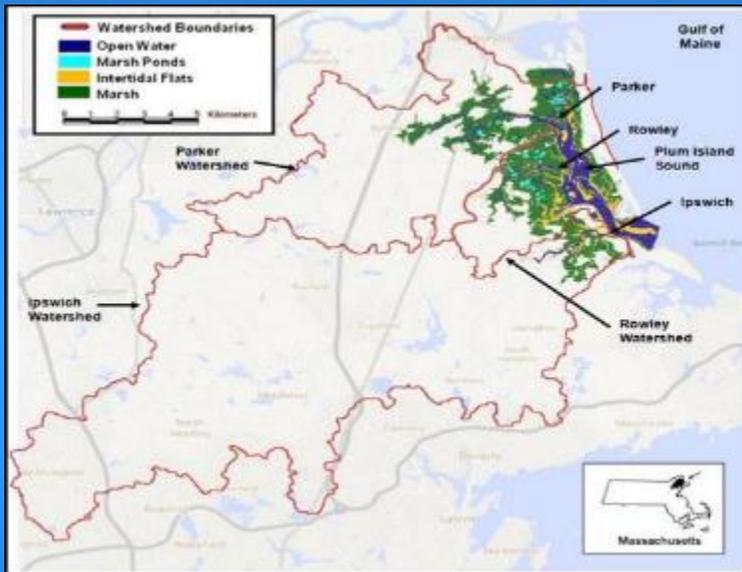


Florida Coastal Everglades (FCE)

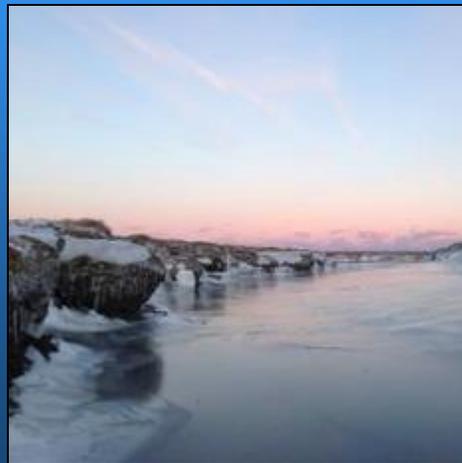
Plum Island Ecosystems (PIE) LTER Est. 1998

Principal biome: Coastal estuary (cold water Acadian Province)

Understanding ecosystem & community responses of estuarine ecosystems to changing environmental drivers

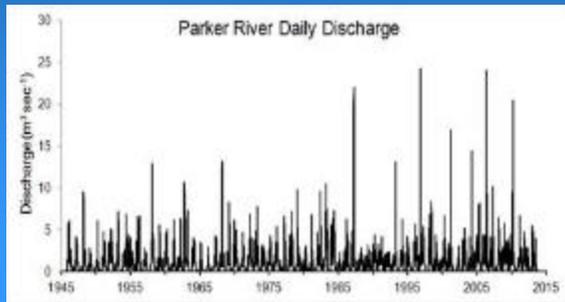


A linked land-water system: studies include the watersheds, fresh, brackish and salt water marshes, estuaries, bays and tidal flats.



How will trophic structure & productivity respond to changes in organic matter, nutrient loading & hydrodynamics caused by climate, land use & sea level?

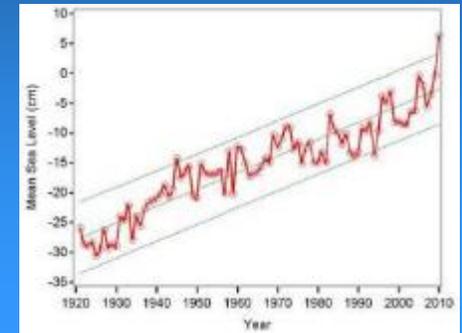
Climate



Human activities



Sea Level



Current Foci Include:



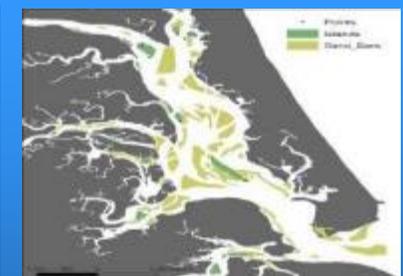
Flows and transformations of C, N, P, and S in areas with different geomorphology



Physical changes in marsh-creek structure



Changes in river flows, N and C export with urbanization and beaver ponds



Hydrodynamic and geomorphic controls on the distribution and abundance of organisms

Virginia Coast Reserve (VCR) LTER Est. 1987

Principal biome: Coastal barrier island complex (salt marsh, lagoon, barrier island)

Understanding how long-term change and disturbance control the dynamic nature of coastal barrier landscapes



(1) Mainland marsh



(2b) Back-barrier & lagoon marshes



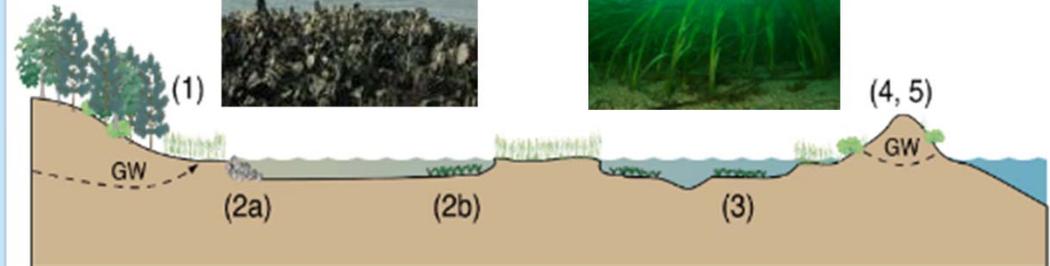
(4,5) Island geomorphology & vegetation



(2a) Oyster reef



(3) Seagrass meadow



Climate Press: Sea level rise, temperature, precipitation, [CO₂]

Climate Pulse: Storms

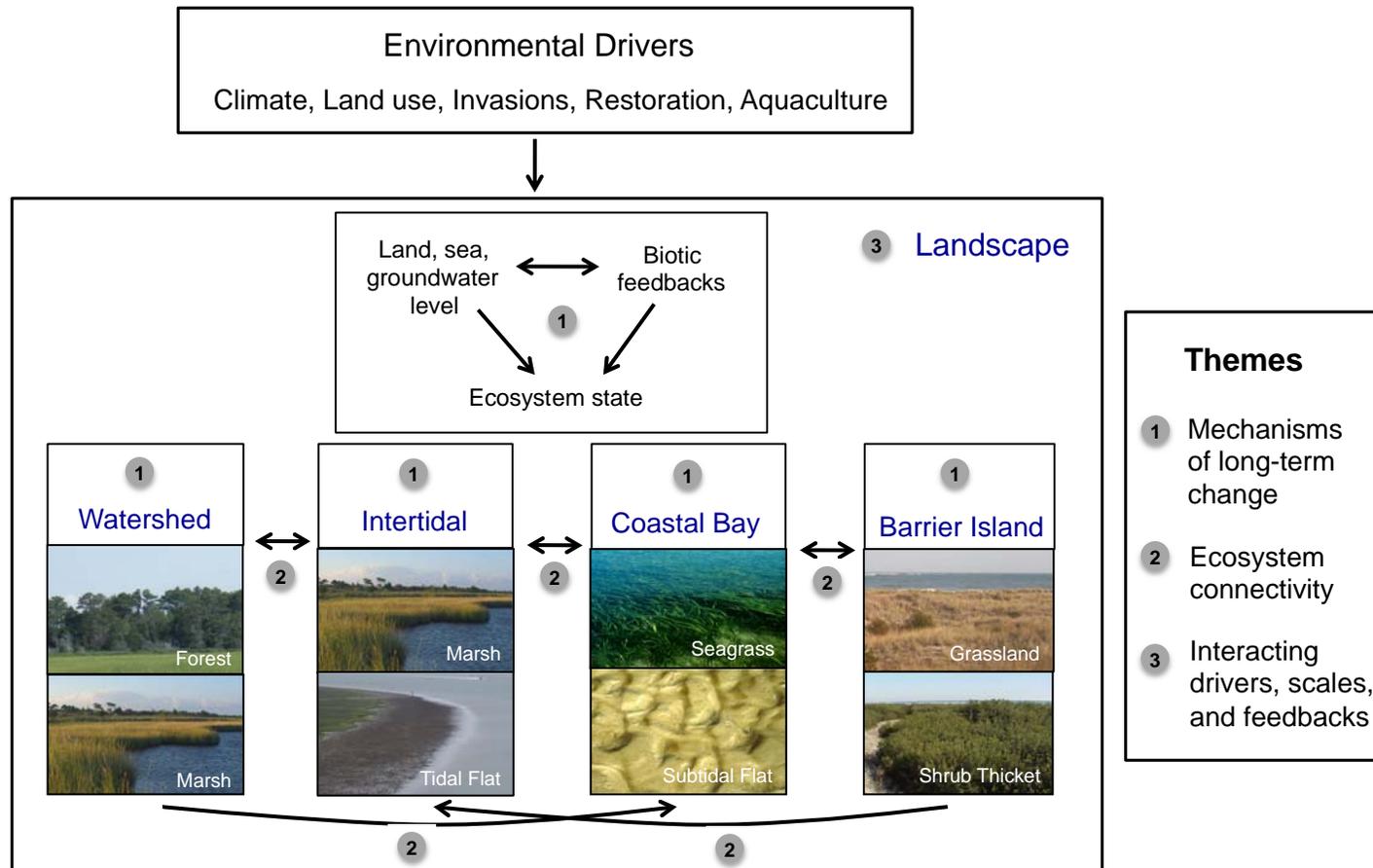
Regional Press:
Land use change, atmospheric deposition, poultry farms, aquaculture

Regional Pulse: Invasions

VCR LTER

Hypothesis, conceptual framework and themes

Ecosystem changes on the coastal barrier landscape in response to long-term drivers are primarily the result of complex non-linear dynamics based on the existence of alternative stable states and threshold responses.



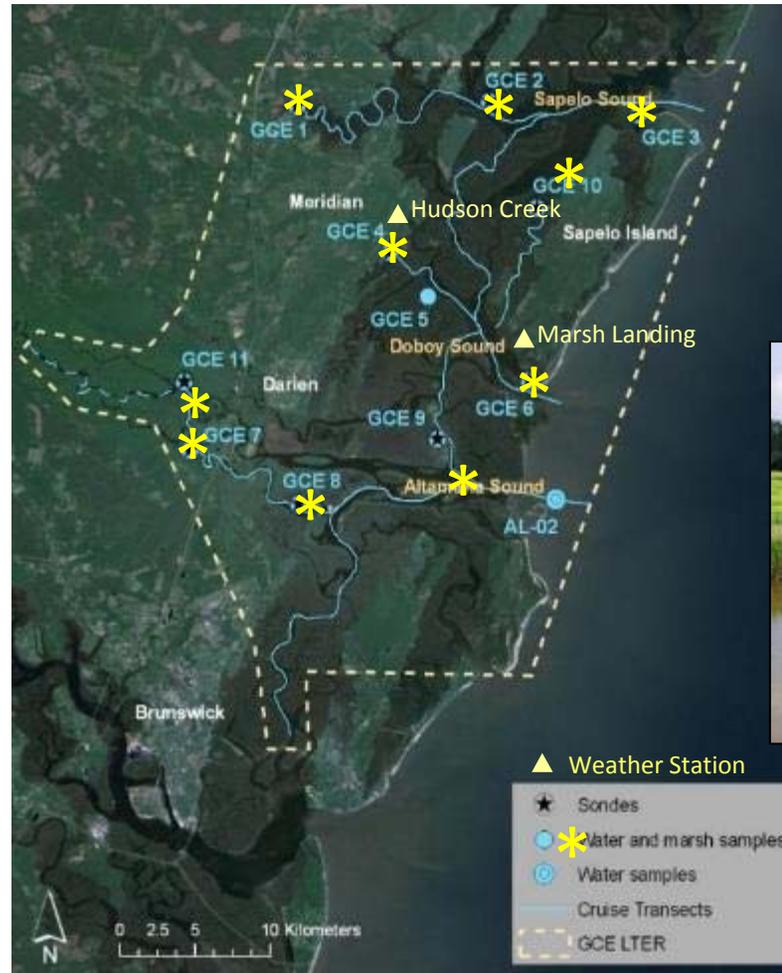


Georgia Coastal Ecosystems LTER

Est. 2000

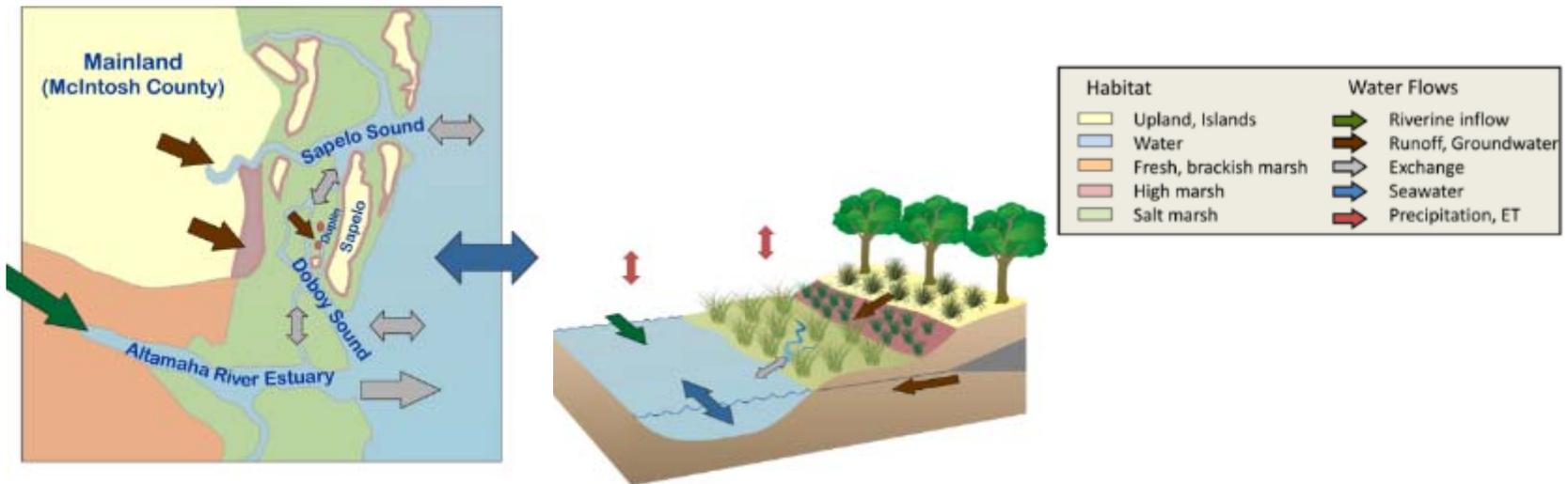
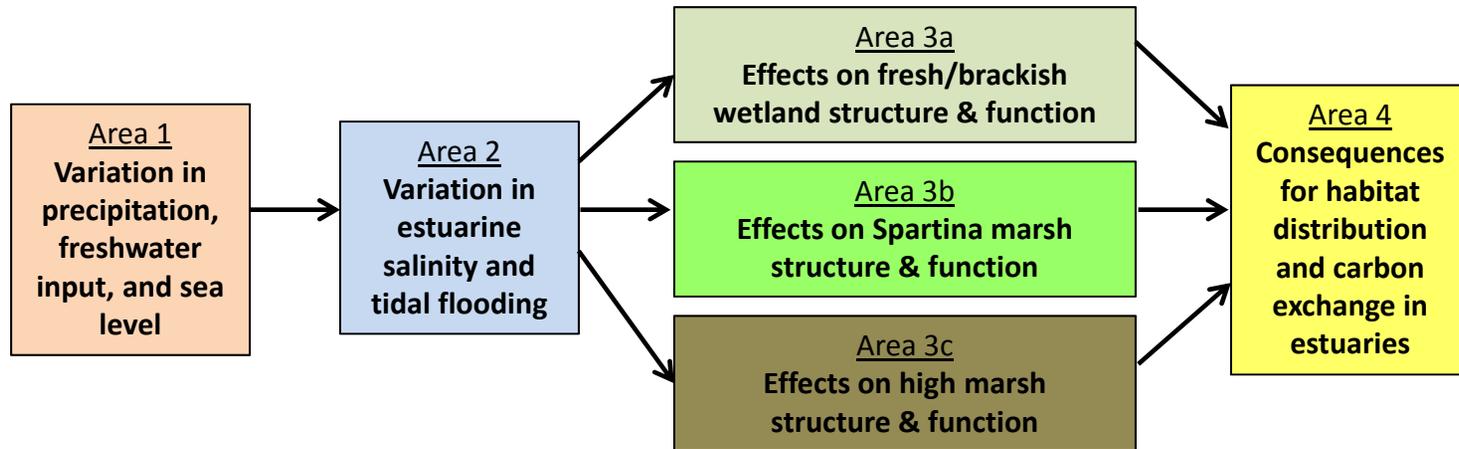


Principal biome: Coastal barrier island / marsh complex



Understanding how salinity regimes affect community structure & ecosystem processes

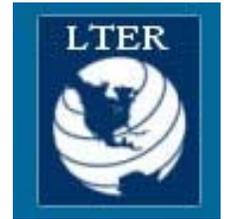
GCE Focus: How does variation in salinity and inundation affect coastal ecosystems?





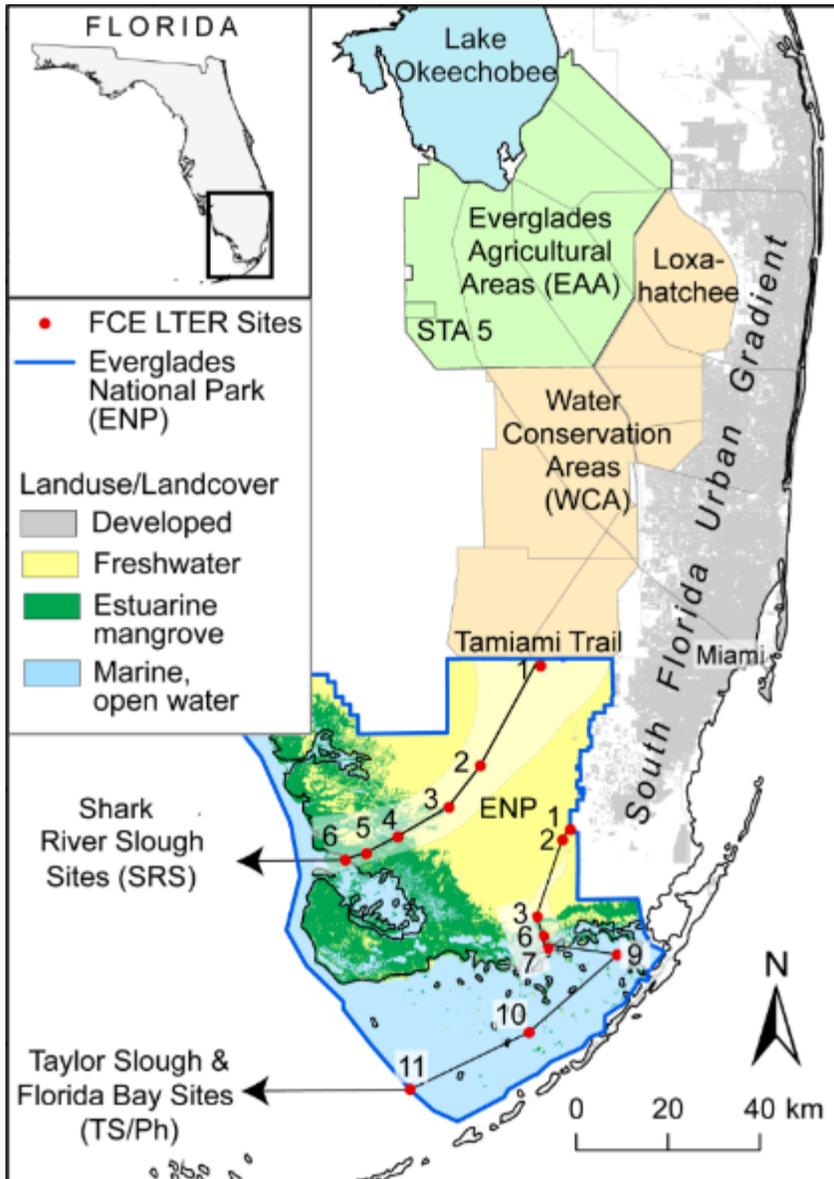
Florida Coastal Everglades (FCE) LTER

Est. 2000



Principal biome: Freshwater marsh – estuarine mangroves

Exploring long-term ecological dynamics in a sensitive coastal ecotone



Shark River Slough (SRS)



Freshwater Slough



Oligohaline Ecotone



Gulf of Mexico

Taylor Slough (TS/Ph)



Freshwater Slough

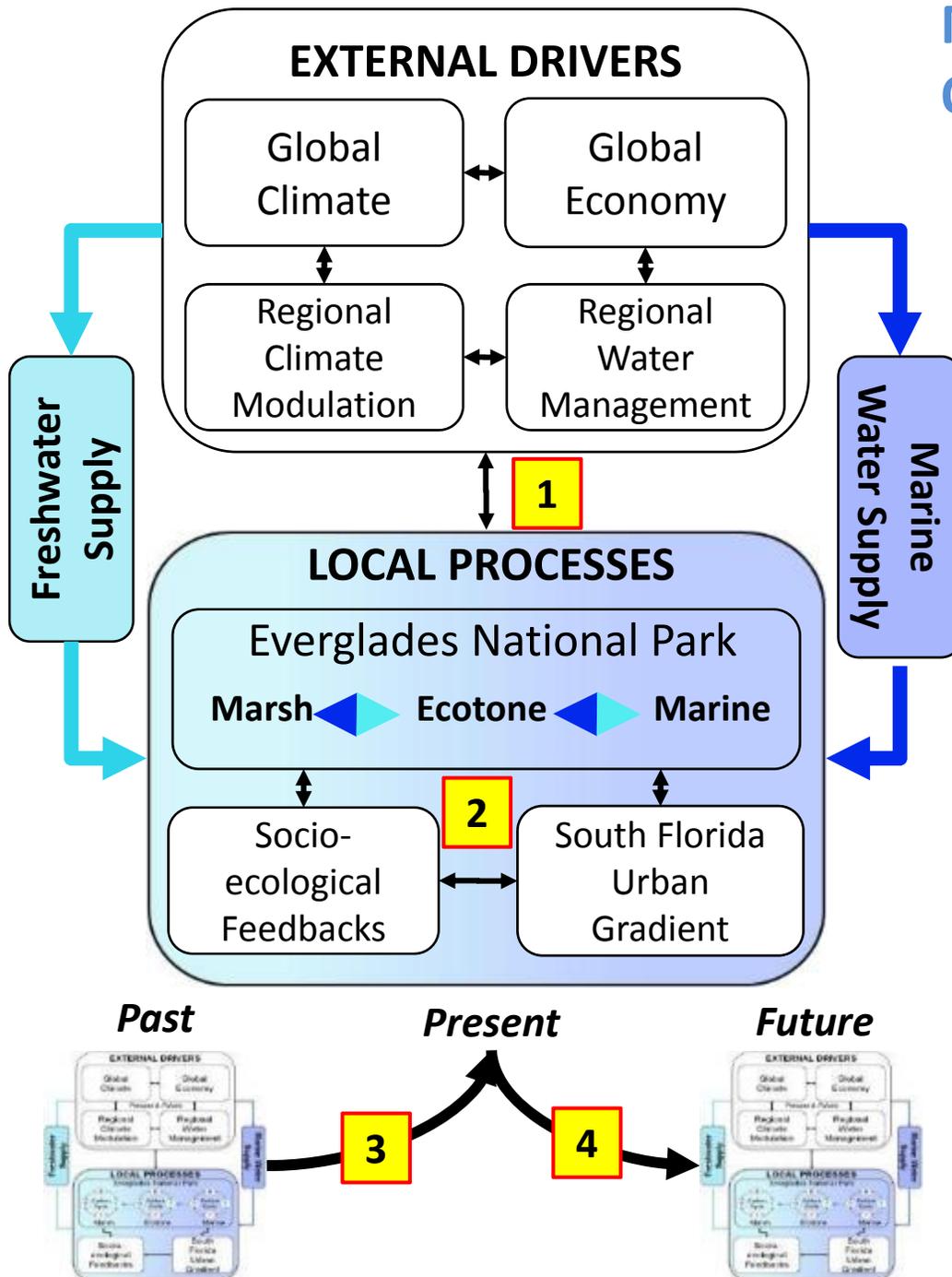


Oligohaline Ecotone



Florida Bay

MULTI-SCALED SOCIO-ECOLOGY OF THE EVERGLADES



How does climate change (**SLR**) interact with freshwater allocation decisions (**RESTORATION**) to control:

- 1 **Hydrologic conditions**
- 2 **Carbon balance** in the oligohaline ecotone?
- 3 Do **legacies of disturbance** influence vulnerability?
- 4 What are possible **futures** for the FCE under contrasting SLR and freshwater flow scenarios?

Expanding the US Network of Coastal Ocean Ecosystem LTERs?

For more information on LTER sites:
<http://lternet.edu>



The Long Term Ecological Research Network



The cover of the journal "Oceanography" is displayed, featuring a map of the United States and the Atlantic Ocean. The title "Oceanography" is written in a large, blue, cursive font at the top. Below the title, it says "THE OFFICIAL MAGAZINE OF THE OCEANOGRAPHY SOCIETY" and "VOL. 26, NO. 1, 2013". The cover is decorated with several circular callouts, each containing a photograph of a different LTER site and its name: "SANTA BARBARA COASTAL" (under CCE), "CALIFORNIA COASTAL ECOSYSTEM", "MOOREA CORAL REEF" (under MCR), "PLUM ISLAND ECOSYSTEM", "VIRGINIA COAST RESERVE", "GEORGIA COASTAL ECOSYSTEMS", "FLORIDA COASTAL EVERGLADES", and "PALMER ANTARCTICA" (under PAL). Two blue circles with white text "New Marine Site?" are positioned above the map, connected by lines to the CCE and GCE/FCE sites. At the bottom of the cover, it reads "SPECIAL ISSUE ON Coastal Long Term Ecological Research".